

TABLE OF CONTENTS

ABSTRACTS

American Dairy Science Association
American Society of Animal Science

Tuesday, July 8, 2008

POSTER PRESENTATIONS

Session	Abstract Numbers	Page
Animal Health: Mastitis	T1–T12	1
Breeding and Genetics I	T13–T37	5
Dairy Foods: Cheese I	T38–T59	14
Extension Education	T60–T70	21
Food Safety	T71–T76	25
Forages and Pastures I	T77–T98	27
Graduate Student Competition: ADSA Production Division		
Poster Competition	T99–T103	34
Meat Science and Muscle Biology	T104–T127	36
Nonruminant Nutrition: Feed Additives	T128–T168	44
Physiology and Endocrinology: Immune Function and Health	T169–T174	58
Physiology and Endocrinology: Nutritional and Metabolic Effects		
on Growth, Reproduction and Lactation	T175–T185	60
Physiology and Endocrinology: The Hypothalamic-Somatotrophic Axis	T186–T189	64
Ruminant Nutrition: Carbohydrates - Dairy	T190–T201	66
Ruminant Nutrition: Fats - Dairy	T202–T228	70
Ruminant Nutrition: Methods, Models and Other	T229–T267	79
Small Ruminant: Goats	T268–T286	92
Teaching/Undergraduate and Graduate Education: Teaching in the Animal Sciences	T287–T294	98

SYMPOSIA AND ORAL SESSIONS

Session	Abstract Numbers	Page
Animal Health I	1–3	101
Symposium: Beef Species: The Evolution of Beef Cattle Genetic Evaluation	4–7	103
Breeding and Genetics: Current Issues in Dairy Cattle Breeding	8–18	105
Dairy Foods: Dairy Food Chemistry and Microbiology	19–27	109
Symposium: ESS Program: Horse Genome Toolbox for Animal Science Applications	28–31	112
Symposium: Extension Education: Has the Land Grant College Left the Farm?	32–36	113
Symposium: Forages and Pastures: Fiber Fermentation: Influence of Supplemental Nonstructural Carbohydrates	37–39	115
Graduate Student Paper Competition: ADSA Dairy Foods	40–49	116
Graduate Student Paper Competition: ADSA Production Division	50–57	120
Graduate Student Paper Competition: ADSA Southern Branch	58–60	123

Symposium: Meat Science and Muscle Biology: Meat Quality:		
Regulation of Intramuscular Fat Deposition	61–65	124
Symposium: Nonruminant Nutrition: Mineral Absorption: What is Known?	66–69	126
Physiology and Endocrinology: Nutrition and Growth, Reproductive and Lactational Performance	70–78	128
Production, Management and the Environment: Measuring and Evaluating Environmental Stress	79–90	131
Ruminant Nutrition: Forages	91–98	136
Ruminant Nutrition: Minerals and Vitamins	99–109	139
ADSA-SAD (Student Affiliate Division) Undergraduate Competition:		
Dairy Foods	110–114	143
Animal Health II	115–117	145
Graduate Student Paper Competition: ADSA-ASAS Northeast Section	118–123	146
ADSA-SAD (Student Affiliate Division) Undergraduate Competition:		
Dairy Production	124–132	149
Symposium: Dairy Foods: Advances in Low Fat Cheese Research	133–141	152
Symposium: ADSA Southern Section Symposium: Responding to Hot Topics in Dairy Management	142–145	155
Symposium: ALPHARMA Beef Cattle Nutrition and Beef Species Joint Symposium: Producing Quality Beef in a Bio-Based Economy	146–151	157
Animal Health III	152–160	159
Symposium: ASAS Cell Biology: The Role of MicroRNA on Cell Function	161–163	162
Symposium: Bioethics: Value of Bioethics Leadership for Food Animal Agriculture	164–168	163
Symposium: Breeding and Genetics: Training of Future Animal Breeders	169–173	165
Companion Animals: Comparative Animal Biology	174–181	167
Forages and Pastures I	182–189	170
Nonruminant Nutrition: Mineral	190–199	173
Nonruminant Nutrition: Protein and Amino Acids	200–210	177
Ruminant Nutrition: Growing Youngstock, Calves and Heifers	211–221	181
Symposium: Ruminant Nutrition, and Production, Management & Environment Joint Symposium: Designing Field Studies to Evaluate Nutrition Effects on Production, Reproduction and Health of Dairy Cows	222–226	185
Symposium: Small Ruminant: The U.S. Goat Meat Industry and Recent Sheep and Goat Activities at the National Research Council of The National Academies	227–231	187
ADSA-SAD (Student Affiliate Division) Undergraduate Competition:		
Original Research	232–239	189

Wednesday, July 9, 2008

POSTER PRESENTATIONS

Session	Abstract Numbers	Page
Animal Health: Immunology	W1–W14	192
Beef Species	W15–W27	197
Breeding and Genetics II	W28–W57	202
Companion and Exotic Animal Biology	W58–W65	212
Dairy Foods: Milk, Dairy Food Chemistry and Microbiology	W66–W90	215

Forages and Pastures II	W91–W113	223
Nonruminant Nutrition: Carbohydrate and Lipids.	W114–W141	232
Physiology and Endocrinology: Gestation and Lactation Physiology.	W142–W149	241
Physiology and Endocrinology: Hormonal Control of the Estrous Cycle.	W150–W172	244
Production, Management and the Environment: Nutrient and Animal Management	W173–W194	252
Ruminant Nutrition: Management and Miscellaneous Additives - Dairy	W195–W233	260
Ruminant Nutrition: Proteins and Amino Acids - Beef, Sheep, and Miscellaneous Ruminants	W234–W243	272
Ruminant Nutrition: Rumen Fermentation and Miscellaneous Additives - Beef	W244–W280	276
Swine Species	W281–W302	289

SYMPOSIA AND ORAL SESSIONS

Session	Abstract Numbers	Page
Animal Behavior and Well-Being: Swine	240–245	297
Animal Health IV.	246–254	300
Symposium: Bioethics: How Do We Integrate Bioethics into Our Food Animal System?	255–259	303
Symposium: Breeding and Genetics: Genome Wide Selection.	260–263	305
Symposium: Food Safety: Assuring Food Safety in a Globalized Market	264–268	307
Symposium: Forages and Pastures: Forage-Based Systems for Beef and Dairy Cattle Production: Regional Challenges and Opportunities	269–273	309
Growth and Development: Historical Perspective and Future Direction	274–281	311
Horse Species I	282–289	314
Meat Science and Muscle Biology: Measuring and Manipulating Pork Quality	290–297	317
Nonruminant Nutrition: Past and Future of Nonruminant Nutrition	298–299	320
Symposium: Physiology and Endocrinology: Emerging Concepts on Dietary Components that Influence the Physiology and Endocrinology of Domestic Farm Animals	300–303	321
Production, Management and the Environment: Nutrient Management and the Environment	304–312	323
Production, Management and the Environment: Young Stock, Environment and Management	313–322	326
Ruminant Nutrition: Fats and Fatty Acids	323–333	330
Ruminant Nutrition: Rumen Fermentation and Microbiology	334–344	334
Small Ruminant: Goats and Sheep	345–351	338
Swine Species:	352–361	341
Symposium: Teaching/Undergraduate and Graduate Education: The Changing Student and Influence of Technology on Learning	362–367	345
Nonruminant Nutrition: Feed Additives I	368–371	347
Physiology and Endocrinology: Effects of Environment and Handling on Performance	372–376	349
Animal Behavior and Well-Being: Livestock: Swine and Sheep	377–384	351
Animal Health V	385–393	354
Symposium: ARPAS Symposium: Livestock Pharmaceuticals: The Past, The Present, The	395–397	357
Symposium: ASAS Graduate Student Symposium: Academia, Industry, Government, or None of the Above: Graduation is Coming, What Next?	398–402	358

Breeding and Genetics: Applications of Genomic Analysis	403–413	360
Symposium: Companion Animals: Perceptions and Implications of Companion Animals in Research and Teaching - Domestically and Globally	414–422	364
Symposium: Dairy Foods: Changes and Challenges of Probiotics in Dairy Products	423–427	367
Symposium: Extension Education: From 40 Acres and a Mule to Today: Historical Perspective of Extension Programming	428–433	369
Forages and Pastures II	434–440	371
Horse Species II	441–448	374
Lactation Biology I	449–457	377
Meat Science and Muscle Biology: Beef Quality	458–465	380
Symposium: Nonruminant Nutrition: Oxidative Stress and the Use of Antioxidants for Nonruminant Animals	466–469	383
Physiology and Endocrinology: The Physiology of Gestation and the Post-partum Interval	470–480	385
Production, Management and the Environment: Disease, Management and Environment	481–487	389
Symposium: Ruminant Nutrition: Glycerin as a Feed for Ruminants	488–492	392
Small Ruminant: Sheep	493–500	394
Teaching/Undergraduate and Graduate Education: Teaching in the Animal Sciences	501–508	397

Thursday, July 10, 2008

POSTER PRESENTATIONS

Session	Abstract Numbers	Page
Animal Behavior and Well-Being: Methodology	TH1–TH4	400
Animal Health: General	TH5–TH15	402
Contemporary and Emerging Issues	TH16–TH17	406
Dairy Foods: Dairy Products and Processing I	TH18–TH34	407
Forages and Pastures III	TH35–TH57	413
Growth and Development: Nonruminant Species	TH58–TH64	421
Growth and Development: Ruminant Species	TH65–TH82	424
Horse Species	TH83–TH99	430
International Animal Agriculture	TH100–TH102	436
Lactation Biology	TH103–TH118	437
Nonruminant Nutrition: Mineral	TH119–TH130	442
Nonruminant Nutrition: Protein and Amino Acids	TH131–TH160	446
Physiology and Endocrinology: Physiology of Heat Stress	TH161–TH165	455
Physiology and Endocrinology: Poultry and Swine Physiology	TH166–TH171	457
Physiology and Endocrinology: Spermatozoa, In Vitro Fertilization, and Embryo Transfer	TH172–TH185	459
Production, Management and the Environment: Calf, Young Stock and Stress Management	TH186–TH208	464
Ruminant Nutrition: Fats and Carbohydrates - Beef, Sheep, Miscellaneous Ruminants	TH209–TH232	472
Ruminant Nutrition: Minerals and Vitamins - Dairy	TH233–TH246	480

Ruminant Nutrition: Proteins and Amino Acids - Dairy	TH247–TH272.....	485
Small Ruminant: Sheep	TH273–TH294.....	495

SYMPOSIA AND ORAL SESSIONS

Session	Abstract Numbers	Page
Dairy Foods: Dairy Products and Processing II.....	509–517	502
Symposium: Animal Behavior and Well-Being: Animal Welfare Standards - Who Decides and How?.....	518–520	505
Breeding and Genetics: Computational Issues in Genomic Analysis	521–528	506
Breeding and Genetics: Current Issues in Swine Breeding	529–536	509
Dairy Foods: Cheese II	537–541	512
Food Safety Centennial Presentations	542–543	514
Forages and Pastures: Centennial Presentations	544–545	515
Horse Species III	546–551	516
Lactation Biology III	552–555	518
Symposium: Meat Science and Muscle Biology: Postmortem Changes in Myofibrillar Protein and the Associated Contribution to Meat Quality.....	556–560	520
Nonruminant Nutrition: Distillers Grains for Swine	561–565	522
Physiology and Endocrinology: Enhancing Reproductive Efficiency.....	566–571	524
Physiology and Endocrinology: Health and Immunology.....	572–578	526
Ruminant Nutrition: Carbohydrate Byproducts - Dairy	579–585	529
Ruminant Nutrition: Nitrogen Sources and Utilization	586–593	532
Symposium: Swine Species: Intestinal Barrier Function.....	594–596	535
Forages and Pastures III.....	597–600	536
Symposium: ADSA Production Division Symposium: Dairy Replacement Heifers: Cost Effective Strategies from Weaning to Calving	601–604	538
Animal Health VI.....	605–610	540
Breeding and Genetics: Breeding for Milk Quality and Test-Day Model Applications	611–621	542
Breeding and Genetics: Current Issues in Beef Cattle Breeding	622–630	546
Symposium: Companion Animals: Exotic Animal Nutrition	631–637	549
Symposium: Contemporary and Emerging Issues: Healthfulness of Dairy and Meat Products	638–641	552
Symposium: Dairy Foods: Emerging Non-Thermal Food Processing Technologies - Their Potential in Dairy Systems.....	642–649	553
Extension Education: All Species	650–659	556
Growth and Development: General Topics	660–671	560
Symposium: International Animal Agriculture: Welfare in Animal Production, from Science to Practice	672–676	564
Lactation Biology III	677–687	566
Meat Science and Muscle Biology: Meat Science Research: Past, Present, and Future	688–692	570
Nonruminant Nutrition: Energy Utilization.....	693–704	572
Nonruminant Nutrition: Feed Additives II.....	705–712	576
Physiology and Endocrinology: Synchronization of Estrus in Cattle	713–723	579
Ruminant Nutrition: Protein and Amino Acids - Beef.....	724–733	583
Ruminant Nutrition: Rumen Fermentation Modifiers	734–745	587

Friday, July 11, 2008

SYMPOSIA AND ORAL SESSIONS

Session	Abstract Numbers	Page
Animal Behavior and Well-Being: Beef and Cattle	746–756	592
Breeding and Genetics: Dairy, Sheep & Goat - Crossbreeding, Inbreeding and Breed Conservation	757–766	596
Symposium: Growth and Development: The Molecular Basis for Feed Efficiency	767–771	600
Nonruminant Nutrition: Protein and Feed Additives	772–781	602
Symposium: Nonruminant Nutrition: Energy Systems and Alternative Energy Ingredients for Swine	782–787	606
Ruminant Nutrition: Acidosis, DCAD and Acid-Base Metabolism	788–794	608
Ruminant Nutrition: Energy and Carbohydrate Byproducts - Beef	795–804	611
Symposium: Triennial Lactation Symposium joint with Lactation Biology: 9th ASAS-EAAP International Workshop on the Biology of Lactation in Farm Animals	805–811	614
Ruminant Nutrition: Feeding Behavior, Chewing and Digestibility	812–817	617
Symposium: Triennial Lactation Symposium joint with Lactation Biology: 9th ASAS-EAAP International Workshop on the Biology of Lactation in Farm Animals	818–823	619
Author Index		621
Key Word Index		639

ABSTRACTS
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Tuesday, July 8, 2008
POSTER PRESENTATIONS

Animal Health: Mastitis

T1 Dairy herd size and herd expansion are related to dairy cow mortality in Southeastern US dairy herds. G. W. Rogers¹, J. B. Cooper*¹, and J. S. Clay², ¹*The University of Tennessee, Knoxville*, ²*Dairy Records Management Systems, Raleigh, NC*.

Lactation records from dairy herds in 9 Southeastern states processed through DRMS were utilized to determine the relationship between dairy cow mortality and herd size and between mortality and herd expansion. Data analyzed were from herds with a minimum of 10 years of continuous recording between 1982 and 2005. Binary mortality traits (1=CAR code 6 indicating lactation ending in death versus 0=all other CAR codes) were developed separately for 1816 Holstein herds (2,292,630 lactations) and 268 Jersey herds (282,123 lactations) for lactations 1, 2 and 3 or later. Binary traits were analyzed using a logistic regression model including herd, year of calving, season of calving, age at calving and herd expansion [(maximum average herd size for 4 consecutive years)/(average herd size for first 4 years), as %] or herd size or both herd expansion and herd size. Herd size for Holsteins was categorized as: <100, 100 to 200, 200 to 400, 400 to 700 and >700 cows. Herd size for Jersey herds was categorized as: <100, 100 to 200 and >200 cows. Smaller herd size was associated with lower mortality risk except Holstein herd sizes of 200 to 700 had higher mortality risk than herds with >700 cows. Four herd expansion categories were constructed for Holsteins: <30%, 30 to 200%, 200 to 350% and >350%. In Holstein herds, herd expansion <30% had significantly higher mortality risk than herds that expanded >350%; herds with expansion from 30 to 350% tended to have higher mortality risk than herds expanding >350%. Jersey herd expansion categories were <30%, 30 to 200% and >200%. Jersey herd expansion <200% was associated with lower mortality risk compared with expansion >200%. Intermediate-scale expansion was associated with increased risk of mortality in Holstein herds (compared to >350%) but decreased risk of mortality in Jersey herds (compared to >200%). Including herd size and herd expansion in the model resulted in a more dramatic impact of Holstein herd expansion on mortality with expansion >350% favorably associated with mortality.

Key Words: Dairy Cow Mortality, Herd Size, Herd Expansion

T2 Genetic polymorphism of lactoferrin gene and association with mastitis in Holstein cows. J. B. Cheng¹, J. Q. Wang*¹, D. P. Bu¹, G. L. Liu¹, C. G. Zhang^{1,2}, X. L. Dong^{1,2}, H. Y. Wei¹, L. Y. Zhou¹, and K. L. Liu¹, ¹*State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China*, ²*College of Animal Science and Technology of Yangzhou University, Yangzhou, China*.

Whether lactoferrin (LF) is a candidate genetic marker for mastitis resistance needs to be studied. In this study, by using the method of sequencing to detect the polymorphisms, we found 6 SNPs in a region of 602bp promoter from 128 dairy cows. In the -241bp and -190bp, there were a T to C mutation and a G to A mutation, and those mutations were first discovered. The others mutations were in -28 bp (A/C), +33 bp (C/G) -131bp (T/C) and -156 bp (A/G), respectively. Analysis of association between the genotypes of LF gene and SCS that reflects mastitis traits was carried out with GLM procedure using the SAS software, and the lactation number and lactation month of cow were also be taken into consideration. Statistical results indicated that SCS was significantly correlated with the month of lactation ($r = 0.222$, Spearman correlation test; $P < 0.05$), and with no strong relationships to the LF genotype and lactation number ($P > 0.05$). Yet, the level of SCS tended to be higher as the lactation number increased. The month of lactation could strongly affect the level of SCS in the milk ($P < 0.05$). In the test group cows, the SCS level increased significantly ($P < 0.01$) from month 1, values of 1.707 to a peak of 3.592 on month 4. A dramatic decline of SCS occurred from month 5 to the month 6 with the value of 2.506, followed by an increase from month 7 to the month 9 ($P < 0.05$). The genotypes and diplotypes all did not have significant effect on SCS. Whether LF gene could be used as a genetic marker of mastitis resistance needs further studies to validate. Acknowledgement: Research funded by Ministry of Science and Technology (2006BAD12B03).

Key Words: Genetic Polymorphism, Lactoferrin, Mastitis

T3 Photonic plasmid stability of transformed *Salmonella typhimurium* using Stanford Photonic imaging and three plasmid types.

K. Moulton^{*1}, P. Ryan¹, D. Moore¹, S. Laird¹, J. Curbelo¹, D. Lay², and S. Willard¹, ¹Mississippi State University, Mississippi State, ²USDA-ARS, Livestock Behavior Research Unit, West Lafayette, IN.

Acquiring a highly stable photonic plasmid in transformed *Salmonella typhimurium* for use in biophotonic studies of bacterial tracking *in vivo* is critical to experimental paradigm development. The objective of this study was to determine the stability of transformed *Salmonella typhimurium* (*S. typh-lux*) using three different plasmids and their respective photonic properties. *S. typh-lux* isolates (porcine) were electroporated with either pCGLS-1, pAK1-lux or pXEN-1 plasmids. *S. typh-lux* was then grown over a 24 h period in LB broth or LB broth (10 ml) plus ampicillin (AMP; 50 µg/ml) and placed in an incubated shaker (37° C). After 24 h, inoculums were placed into a black 96-well plate for imaging (100 µl; n = 8 replicates). Photonic imaging was conducted for 5 sec and emissions quantified (RLU/sec). Inoculums were plated on Brilliant Green agar plates (with and without AMP), colony numbers counted (CFU) and plates imaged for the ratio of non-emitting to emitting colonies. Inoculums were sub-cultured daily from d 0 to 10 with and without AMP selection to determine photonic stability over time for the three plasmids. In the presence of AMP, *S. typh-lux* with the pCGLS-1, pAK1-lux and pXEN-1 plasmids remained 100% emitting over the entire 10-d study. Photon emitters of *S. typh-lux* with pCGLS-1, pAK1-lux and pXEN-1 without AMP selection decreased over time ($P < 0.05$), representing only $11 \pm 1\%$, $35 \pm 1\%$ and $43 \pm 1\%$, respectively, of the bacterial population by d 10. Photonic emissions were positively correlated with bacterial concentration ($P < 0.05$) for pAK1lux, pCGLS-1 and pXEN-1 ($r = 0.96$, 0.98 and 0.82 , respectively). These data characterize the photon stability properties for *S. typh-lux* transformed with three different photon generating plasmids that may permit real-time *Salmonella* tracking using *in vivo* or *in situ* biophotonic paradigms. [USDA-ARS Biophotonics Initiative # 58-6402-3-0120].

Key Words: *Salmonella*, Biophotonics, Plasmid

T4 Seasonal variation of mortality rate in dairy cows of the Po Valley (Italy). A retrospective study from 2001 to 2006. A. Vitali¹, L. Bertocchi², N. Lacetera^{*1}, U. Bernabucci¹, A. Cuteri¹, M. Guerini³, and A. Nardone¹, ¹Dipartimento di Produzioni Animali, Viterbo, Italy, ²Istituto Zooprofilattico Sperimentale Lombardia-Emilia Romagna, Brescia, Italy, ³Osservatorio Epidemiologico Veterinario Regione Lombardia, Brescia, Italy.

The present study is aimed to analyze seasonal variations of mortality rate in dairy cows. The analysis was carried out in years 2001-2006 and in the geographic area comprised between 44°- 46°.15' latitude north and 8°.30'- 12°.30' longitude east, known as the area of the Po Valley including the regions Lombardia and Emilia Romagna, Italy. This area is characterized by a subcontinental-temperate climate and a high density of dairy herds (approximately 900,000 dairy cows in 45,000 square kilometres). Data were extracted from the Italian Bovine Spongiform Encephalopathy (BSE) database, which provided data of daily mortality of cows older than 24 months. Data on cow populations were provided by the Italian National Institute of Statistics. The standardized mortality ratio (SMR) for each season and for each year was calculated by the ratio of observed and expected deaths (OD and ED, respectively). The ED for each of the 6 years considered in the study were calculated by the product between annual mortality rate and the population of the area, stratified by 4 age classes. Under the hypothesis of Poisson distribu-

tion, a 95% confidence interval (CI) was calculated for the SMR and its value was considered statistically significant if the value 1 was outside the confidence range. For all years and regions, the analysis of SMR showed that during summer season the OD was significantly higher than the ED. In summer season OD overcame ED by values ranging from +21% (year 2005, Lombardia) to +60% (year 2003, Lombardia); the corresponding 95% CI were 1.17-1.24 and 1.57-1.64 for the years 2005 and 2003, respectively. Results reported herein indicate the relevance to develop appropriate strategies, including management, feeding, genetic selection and insurance plans, to limit economic losses associated with heat stress in dairy cows.

Key Words: Dairy Cows, Season, Mortality Rate

T5 Monitoring body temperature of postpartum dairy cows using an intravaginal device. R. R. Peters¹, B. Erez^{*1}, L. A. Bornt¹, F. Siewerdt¹, and M. E. Iager², ¹University of Maryland, College Park, ²Mid-Maryland Dairy Veterinarians, Hagerstown, MD.

The first objective of this research was to build a system to continuously monitor body temperature (BT) within vagina of postpartum cows with ability to transfer temperature data cow-side to a palm pilot. A Pfizer EAZI-BREED™ Controlled Internal Drug Release (CIDR®) Cattle Insert was modified to hold a data logger button that monitors BT and wired with electrical connections that could be accessed and connected to palm pilot near the vulva. A second objective of this research was to ascertain that system under study provides BT data similar to rectal temperature (RT). Cows (n=12) were vaginally fitted with a CIDR no earlier than 1 day postpartum. Ibuttons were programmed to record BT every 15 min. RT of these cows was taken twice daily at milking time in milking parlor for 10 days. BT and ambient temperature (AT) were collected from Jan to Feb, 2007. AT was from weather station 10 km away. In the initial statistical analysis, temperature data from CIDR and RT taken at similar times were compared. BT (degrees C) averaged 38.6 and 38.9 from ibutton mounted on a CIDR and rectal thermometer, respectively. Because AT and RT had a significant ($P < .0001$) positive correlation (.30) AT was included in regression model. AT did not significantly affect intravaginal temperature. Regression coefficient of RT over CIDR is $.71 \pm .04$. Correlation coefficient and r-square value between CIDR and rectal thermometer were $.75 \pm .05$ and $.56$, respectively. Regression coefficient ($.71 \pm .05$) indicates that ibutton overestimates BT when temperatures are minimal and underestimates BT when temperatures are maximal. A third objective was to determine efficiency of the CIDR in detecting BT over 39.4 C. With CIDR temperatures uncorrected for AT, CIDR found only 30% of temperatures exceeding 39.4 C. When temperature from CIDR was corrected for AT, threshold temperature of 39.4 C decreased to 39.2 C. With adjusted temperature of 39.2 C, efficiency for detecting fever increased to 65%.

Key Words: Body Temperature, Intravaginal Device, Postpartum Cow

T6 A data exchange format and national database for producer-recorded health event data from on-farm management software. J. B. Cole, D. J. Null^{*}, and L. R. Bacheller, USDA-ARS-BA-ANRI-AIPL, Beltsville, MD.

There is great interest in producing dairy cows that are healthy and remain in the herd longer. Direct and indirect costs associated with

disease represent a significant expense to producers, and selection for improved health may reduce these costs significantly. Genetic response to selection for improved health based upon breeding values from genetic evaluations of field-recorded traits has been well-documented. That genetic variation is not now being directly utilized for genetic improvement, and several challenges must be overcome before useful tools to this end can be provided. The Animal Improvement Programs Laboratory, in conjunction with industry partners and veterinary experts, has developed a data exchange format (Format 6) for the transfer of health and management data from on-farm record-keeping systems to a national database. A Format 6 record includes detailed cow identification, a health event code, an event date, and an optional detail field. This format can provide the necessary data for research into, and implementation of, genetic evaluations for economically-important health traits. Format 6 was designed to be easily extensible, as demonstrated by the addition of a locomotion score event to the specification in January, 2008. The database and editing systems were tested using 63,423 health events from 23,332 cows provided by Dairy Record Management Systems (Raleigh, NC). The most common disorders reported were mastitis (38%), metritis (16%), and other reproductive problems (15%). Primiparous cows accounted for 38% of records, and rates of occurrence differed by age for some disorders. For example, 61% of dystocia events were for first parity cows, while only 79% of the cows with milk fever were older cows. A total of 3920 individual events were flagged by the edits system, and the most common data errors were calving dates that did not match event dates for dystocia (26%) and calving dates with no matching test day data (72%). Format 6 records are stored in the national dairy database with cow test day data, and may provide valuable information for genetic improvement.

Key Words: Database, Genetics, Health

T7 Dexamethasone administration increased bovine lymphocyte clock gene expression *in vitro* and *in vivo*. S. S. Pozzo*, M. K. Rankin, and T. F. Gressley, *University of Delaware, Newark*.

Regulation of circadian rhythms in the brain and peripheral tissues occurs via differential expression of clock genes in response to signals including hormonal profiles. Two experiments were conducted to explore the impact of administration of the synthetic glucocorticoid dexamethasone (dex) on clock gene expression in bovine lymphocytes. In the first experiment, lymphocytes were isolated from 5 Holstein cows and treated *in vitro* with 0 or 1.5 nM dex. The 1.5 nM dex dose suppressed *in vitro* lymphocyte proliferation by approximately 50%. Lymphocyte RNA was harvested after 0, 4, 8, 12, 16, 20 and 24h. Quantitative real-time RT-PCR was used to determine mRNA expression of 8 clock genes (*Bmal1*, *Clock*, *Per1*, *Per2*, *CK1ε*, *Cry1*, *Cry2* and *Rev-erba*) relative to housekeeping genes *RPS9* and β -*actin*. Expression of *Per1* and *Per2* were affected by time ($P < 0.01$), with peak expression found for both at 4h. *Per1* expression was up-regulated 67% in response to 1.5 nM dex ($P < 0.01$). In the second experiment, 6 Holstein steers averaging 225 kg were injected with either saline or dex (0.1 mg/kg BW) followed by the opposite treatment 1 wk later. Lymphocytes were harvested from blood sampled 0, 4, 8, 12, 16, 20 and 24h following treatment, and PCR was conducted as described for the first experiment. Dex increased expression of *Bmal1* 53% ($P = 0.06$), *Per1* 70% ($P < 0.01$), *Per2* 32% ($P = 0.09$), *CK1ε* 23% ($P = 0.07$) and *Cry1* 47% ($P < 0.01$). Time effects were found for *Clock* ($P < 0.01$) and *Cry1* ($P = 0.09$), peaking at 12 and 16h respectively. Interactions between treatment and time were found for *Per2* ($P = 0.06$), *CK1ε* ($P < 0.01$) and *Cry2* ($P = 0.03$). Relative to the

saline treatment, dex increased *Per2* expression 8, 12 and 16h after treatment ($P < 0.05$), *CK1ε* expression 8, 16 and 24h after treatment ($P < 0.05$), and *Cry2* expression 12 and 24h after treatment ($P < 0.05$). Our research demonstrates that dex alters bovine lymphocyte clock gene expression patterns both *in vitro* and *in vivo*. Changes in circadian rhythms may be important in regulating response of the bovine immune system to glucocorticoids.

Key Words: Clock Genes, Lymphocytes, Dexamethasone

T8 Negative energy balance (NEB) alters neutrophil (PMN) gene expression in response to a *Streptococcus uberis* (*S. uberis*) mastitis challenge in lactating dairy cows. K. M. Moyes*, J. K. Drackley, D. E. Morin, R. E. Everts, H. A. Lewin, and J. J. Loor, *University of Illinois, Urbana*.

Our objectives were to compare gene expression profiles in PMN during a *S. uberis* mastitis challenge between lactating cows subjected to feed restriction to induce NEB (n=2) and cows fed ad libitum to maintain positive energy balance (PEB; n=5). All cows had composite SCC <200,000 cells/mL prior to the study, and milk from all quarters was bacteriologically negative. NEB cows were feed-restricted to 60% of calculated NE_L requirements for 7 d, whereas PEB cows were fed the same diet for ad libitum intake. After 5 d of feed restriction, one rear mammary quarter of each cow was inoculated with 5,000 cfu of *S. uberis* (strain O140J). Blood PMN were isolated before inoculation and pooled within level of energy balance (NEB and PEB). PMN also were isolated at 12 and 20 h post-inoculation and pooled within cow (i.e., 12 plus 20 h), and then cows were pooled within level of energy balance. A 13,257 oligonucleotide (70-mers) array was used for transcript profiling. Cy3- and Cy5 labelled cDNA from PMN and a reference standard were used for hybridizations (8 microarrays total). Genes with > 2.0-fold change in expression were considered significantly different. In PMN before inoculation, NEB resulted in 76 down-regulated genes by >2.0-fold versus PEB cows. Genes up-regulated by NEB (n=29) were involved in protein metabolism (*USP21* and *FSCN1*); down-regulated genes (n=47) were involved in antigen presentation (*HLA-DXA1*) and elongation of fatty acids (*ELOVL6*). During infection, 175 genes were differentially expressed in NEB versus PEB cows. Genes up-regulated by NEB (n=103) included *OAS1* and *SERTINB4*, which are involved in the immune response. Genes involved in protein metabolism (*PTPRK* and *DPYSL3*), oxidative stress (*GSTA2*), and immune response (*MAP4K4/NIK*) were down-regulated (n=72) in NEB versus PEB cows during infection. Energy balance alters gene expression profiles in blood PMN from cows, both before and during mastitis challenge.

Key Words: Genomics, Energy Balance, Neutrophil

T9 Comparison of minimum inhibitory concentrations of *Staphylococcus aureus* obtained from clinical and subclinical cases of mastitis. L. Oliveira*¹, P. Ruegg¹, H. Langoni², and M. D. Apparao¹, ¹*University of Wisconsin, Madison*, ²*FMVZ - UNESP, Botucatu, SP, Brazil*.

The objective was to compare minimum inhibitory concentrations (MIC) of selected antimicrobials for *Staphylococcus aureus* isolated from clinical and subclinical mastitis. Duplicate aseptic milk samples were collected from all quarters of cows (n = 381) on commercial

dairy herds, with somatic cell counts (SCC) that exceeded 200,000 cell/ml. Additional duplicate quarter milk samples were obtained from cows identified with clinical mastitis. Pathogens were identified using laboratory procedures as defined by the NMC (1999). Minimum inhibitory concentrations were determined for 12 antimicrobial agents using broth microdilution with a custom extended dilution range (Trek Diagnostics,). MIC values were determined for *Staph aureus* obtained from clinical (n = 48) and subclinical (n = 68) cases of mastitis. SAS 9.1 was used to perform survival analysis based on type of mastitis (clinical or subclinical). Antimicrobial concentrations present in wells of the panel of the susceptibility test were used as “time” in the survival analysis. The event was defined as inhibition of bacterial growth, and isolates that not inhibited at the highest concentration tested were right censored. Kaplan-Meier survival curves of the each antimicrobial were performed for each strata of mastitis (subclinical or clinical). *Staph aureus* were resistant to at least 1 antimicrobial obtained from 9 of the 12 enrolled farms. Of isolates (n = 116), 29 (25%) were resistant to one or more antimicrobial agents. Of isolates, 33.8% (subclinical) and 40.0% (clinical) exhibited resistance to at least 1 antimicrobial. The greatest proportions of resistant isolates (11%) were detected for tetracycline. No resistance was observed for ceftiofur or cephalothin. Mastitis type was associated with MIC of erythromycin and tetracycline. Mastitis type was not associated with the MIC of the other antimicrobials. In this study, antimicrobial resistance was uncommon among the *S. aureus* isolated from bovine mastitis and there was homogeneity among clinical and subclinical isolates.

Key Words: Mastitis, *Staphylococcus aureus*, Sensitivity Test

T10 Comparison of in-vitro MIC's of gram positive pathogens isolated from cases of subclinical and clinical mastitis. M. D. Apparao¹, P. L. Ruegg^{*1}, A. Lago², S. Godden², R. Bey², R. Dingwell³, and K. Leslie³, ¹University of Wisconsin, Madison, ²University of Minnesota, St. Paul, ³University of Guelph, Guelph, ON, Canada.

The objective of this study was to compare the in-vitro minimum inhibitory concentrations (MIC) of Gram positive pathogens isolated from cases of subclinical and clinical mastitis. Isolates for this study were obtained from cases of subclinical and clinical mastitis that were enrolled in a multi-site, multi-herd controlled field study conducted in Minnesota, Ontario and Wisconsin. Laboratory procedures were as defined by the NMC (1999) and target pathogens (Gram positive cocci) isolated from milk samples were identified to the species level using the API test (bioMerieux). A broth micro dilution technique employing custom designed panels containing extended dilutions of 12 antimicrobial agents were used to determine the MIC. Statistical analysis was done using Proc Lifetest (SAS 9.1). Gram positive pathogens (n = 187) were isolated from quarter milk samples obtained from clinical (n = 51) and subclinical (n = 136) cases of mastitis. The MIC's were different for isolates obtained from subclinical and clinical mastitis cases for ampicillin, ceftiofur, enrofloxacin, penicillin-novobiocin and tetracycline (P < 0.05). Pathogen specific differences in the MIC's of subclinical and clinical mastitis isolates were also observed. The MIC's of penicillin, penicillin-novobiocin and spiramycin were different for cases of subclinical and clinical mastitis caused by coagulase negative staphylococci (n = 121). The MIC's of enrofloxacin, sulphadimethoxine and tetracycline were different for subclinical and clinical mastitis caused by streptococci (n = 26). The MIC's of tetracycline and oxacillin were different for subclinical and clinical cases caused by *Staphylococcus aureus* (n = 22) and “other” Gram positive mastitis pathogens (n =

18), respectively. The overall and pathogen specific differences in MIC's between subclinical and clinical isolates suggests that nature of infection (subclinical or clinical) should be taken into account while comparing MIC profiles or monitoring resistance of mastitis pathogens.

Key Words: Mastitis, Sensitivity Test, Antimicrobials

T11 Nystatin, pathogen-associated molecular patterns and bovine neutrophil activation. M. Worku* and A. Morris, *North Carolina A&T State University, Greensboro.*

Nystatin is an antifungal compound with potent proinflammatory properties, shown to inhibit lipid rafts. Lipid rafts are putative microdomains in the plasma membrane rich in lipids and shown to mediate many signaling events including TLR-4 signaling. A TLR2- and TLR1-dependent process serves as the molecular basis for the pro-inflammatory properties of Nystatin. The objective of this study was to evaluate the effect of Nystatin in LPS mediated TLR signaling and the subsequent proinflammatory cytokine response. Further to determine its effect as a lipid raft inhibitor in bovine neutrophils. Blood was collected from a clinically healthy Holstein Friesian cow. Neutrophils were isolated by differential centrifugation. Isolated Neutrophils were treated with LPS (100ng/1/4l) in the presence or absence of Nystatin (301/4g) for 15 min controls were maintained in PBS. RNA was then isolated using Tri-reagent (SIGMA). The quality and quantity of RNA was determined using the 2100 Agilent Bioanalyzer. Specific primers for CD14, IL1-B, IL-8, TNFa, NRAMP-1 and TLR-4 were used for reverse transcriptase PCR. Amplified products were run on a 2% agarose gel and visualized following staining with ethidium bromide. LPS treated Neutrophils had low levels of IL-1B expression. Expression of TNF- α or TLR-4 or CD14 genes was not observed. Nystatin did not inhibit the expression of IL-8 and Nramp1 genes. Treatment with Nystatin increased expression of the gene encoding IL-8 in both LPS treated and control PMN. Nystatin might have acted through the TLR found on the neutrophil and increased the expression of the gene encoding IL-8. Further studies are needed to ascertain if Nystatin is behaving as pathogen-associated molecular patterns (PAMP) to induce cell activation through TLR, signaling and secretion of cytokines to mediate biologic effects in bovine PMN. Further the results may have implications for the use of “nonimmunologic” drugs that serve as agonists for TLR. The associated activation can result in unintended beneficial and detrimental effects on animal health and well being.

Key Words: Nystatin, Neutrophil, Pro-Inflammatory Cytokine

T12 Macrolide and lincosamide resistance in staphylococci and streptococci isolated from quarters with persistent subclinical mastitis. M. D. Apparao, P. L. Ruegg*, and H. Khatib, *University of Wisconsin, Madison.*

The objective of this study was to examine the relationship between occurrence of ermB and ermC and in vitro susceptibility of staphylococci and streptococci isolated from subclinical mastitis. Cows with subclinical mastitis were randomly allocated to a “treatment” or “control” group. CMT positive quarters (n = 213) of cows in the “treatment” group received intramammary treatments using pirlimycin. No treatment was given to quarters (n = 208) of cows in the control group. Aseptic milk samples were collected pretreatment and 3 weeks later. A

“persistent” infection was defined as isolation of the same bacterial species from both pretreatment and post treatment milk samples. Persistent infections (54 infections; 108 pathogens) were confirmed using a PCR based methodology. Susceptibility of persistently infected pathogens was determined using broth micro-dilution. Identification of ermB and ermC was performed using a published PCR protocol. Statistical analysis was carried out using SAS 9.1. An association between presence of ermC and in vitro resistance was observed for both erythromycin and pirlimycin ($P < 0.05$). Of 16 isolates that demonstrated phenotypic resistance to erythromycin, 10 (63%) were positive for ermC whereas 3 (3%) of 92 erythromycin susceptible isolates were positive for this gene. Of 18 isolates that demonstrated in vitro resistance to pirlimycin, 9 (50%)

were positive for ermC gene whereas only 4 (4%) of 90 susceptible isolates were positive. No ermB were detected. Of 10 isolates positive for ermC that demonstrated in vitro resistance to erythromycin, 2 were susceptible to pirlimycin, indicating probable induction of ermC gene expression. No association was observed between either treatment or sampling period and presence of ermC. In conclusion, the association between the presence of ermC and in vitro resistance to macrolide and lincosamide antimicrobials suggests that routine screening for ermC may serve as an important tool for surveillance of antimicrobial resistance in bovine mastitis pathogens.

Key Words: Mastitis, Susceptibility Tests, Antimicrobials

Breeding and Genetics

T13 Using logistic regression model to analyse some environmental factors affecting mastitis incidence of primiparous Iranian Holsteins. H. Farhangfar*, A. Abedini, H. Naeemipour, M. R. Asghari, and M. H. Fathi Nasri, *Birjand University, Birjand, Iran.*

To analyze the effects of some environmental factors such as herd, year, season of calving, stage of lactation on mastitis incidence, a total of 101147 monthly test day somatic cell counts collected from 13977 Iranian Holstein heifers calved between 2002 and 2006 in 183 herds were used. The event of mastitis in cows was coded as 1 if their somatic cell count at specific test day was greater than 250000 cells per milliliter of milk yield sample. Although somatic cell score could be also analyzed as a continuous trait, this study aimed to evaluate mastitis incidence in a new approach. Logistic regression statistical method was applied to model the probability of mastitis incidence. In the model, fixed environmental factors of herd, year, season of calving, stage of lactation, milk (linear covariate) and age at first calving (linear covariate) were included. The model was fitted to the data using logistic procedure of SAS programme. The results obtained in this study indicated that all environmental factors had highly statistical significant ($p < 0.001$) effects on mastitis incidence. Spring calvers (April-June) were found to be more susceptible to mastitis than the other cows calving at different seasons suggesting that calving in the seasons other than spring could result in decreasing mastitis in herds. The results also revealed that the probability of mastitis incidence increased (with odds ratio of 1.029) as the age of cow at first calving increased while it decreased when the amount of milk yield (odds ratio of 0.960) during the lactation period increased. Genetic evaluation of animals for somatic cell score could decrease the level of mastitis incidence.

Key Words: Mastitis, Logistic Regression, Iranian Holsteins

T14 Genetic parameters estimation of somatic cell score in Iranian Holstein heifers using a random regression test day model. H. Farhangfar*¹, A. Abedini¹, H. Naeemipour¹, M. Alipanah², K. Shojaeian², and B. Mohammad Nazari³, ¹*Birjand University, Birjand, Iran,* ²*Zabol University, Zabol, Iran,* ³*Animal Breeding Centre, Karaj, Iran.*

A total of 101,147 monthly test day somatic cell scores (SCS, defined as $\ln(\text{SCC} \times 10^{-3})$) belonging to 13,977 Iranian Holstein heifers calving during 2002-2006 and distributed in 183 herds was used to estimate genetic parameters. A random regression test day model was used to estimate genetic and environmental variance and covariance components. In the model, fixed environmental factors of herd-year-season of production-province, age of cow at recording, Holstein gene percentage, stage of lactation, and random direct additive genetic and environmental effects were included. Orthogonal Legendre polynomials of order four (cubic) was applied to take account of the variation of somatic cell score during the lactation course at both genetic and environmental levels. The results found in the present research showed that heritability estimates of SCS ranged from 0.03 (month 2) to 0.07 (month 10) and that the second half of the lactation curve was more heritable than the first half. Phenotypic correlations among SCC at different lactation months were generally lower than the genetic correlations. Genetic correlations among adjacent lactation months were always greater than those obtained among months apart from. The same patterns were also observed for phenotypic and environmental correlations.

Key Words: Somatic Cell Score, Test Day Model, Iranian Holsteins

T15 Genetic parameters and trend estimation for milk and fat yields and fat percentage for primiparous Holstein population of Golestan and Mazandaran provinces of Iran using a univariate animal model. H. Naeemipour*¹, H. Farhangfar¹, I. Tahmasbi², and M. Bashtani¹, ¹*Birjand University, Birjand, Iran,* ²*Zabol University, Zabol, Iran.*

The main objective of the present study was genetic analysis of milk production traits for Holstein heifers in northern provinces of Iran. A total of 7844 first lactation 305-day and 2X milk and fat yields and fat percentage records from 7844 Holstein cows distributed in 139 herd and calved between 1987 and 2003 were used to estimate variance components implementing univariate animal models using DFREML approach. In the model, fixed effect of herd-year-season of calving, age at first calving as well as random effect of additive genetic effect were included. The results obtained in this study indicated that heritabilities for milk yield, fat yield and fat percentage were 0.20, 0.09 and 0.07 respectively. Low estimates of fat yield and fat percentage shows a high environmental variance indicating that little genetic gain could be obtained as the genetic selection is based on these traits. Annual genetic trends were estimated to be 3.4, 0.05 Kg/year and 0.0003% respectively. Positive genetic gain obtained for fat percentage indicates that the average predicted breeding value of animals increased for fat percentage along with milk yield over the period of time.

Key Words: Genetic Parameters, Holstein, Golestan and Mazandaran

T16 Genetic relationships between linear type traits, somatic cell score and longevity in Holstein cows of Iran. M.R. Bakhtiarzadeh*, M. Moradi Shahr Babak, and A. Pakdel, *University of Tehran, Tehran, Iran.*

The objective of the present study was to estimate the genetic parameters for 13 linear type traits, somatic cell score (SCS) and longevity in Holstein population of Iran. Two sets of data including 3000 records (for SCS) and 12226 observations (for longevity) for first lactation records on cows distributed across 219 and 1500 herd-year-season groups respectively were investigated. The genetic parameters were estimated by ASREML software and the fixed effects of models were included herd-year-season (in calving year), age in calving, age*age, days in milk and milk (for SCS). Heritability estimates for the type traits ranged from 0.033 to 0.29. The genetic correlation among type traits ranged from 0.01 to 0.83; among type traits and longevity ranged from 0.41 to -0.5 and among type traits and SCS ranged from 0.85 to -0.6. The genetic correlation between longevity and SCS were negative (-0.38) so that cows with more longevity had a lower SCS. The genetic correlation between body size traits and SCS were positive and between body size traits and longevity were negative. Therefore from genetic point of view we can conclude that cows with higher body size have higher SCS and lower longevity. The results of current study showed more attention should be paid to these type traits in the breeding programs for better animal welfare and to get more profit.

Key Words: Type Traits, Longevity, SCS

T17 Breed composition of the United States dairy cattle herd.

R. L. Powell*, H. D. Norman, and J. L. Hutchison, *Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD.*

Breed composition of the gene pool of all cows (purebred and crossbred) with pedigree data in the USDA national dairy database was summarized by birth year of cow. Partial breed contributions were assigned for individual cows. For cows born in 2005, 1.1% of all genes and 35.1% of genes in crossbreds traced to a female ancestor with breed reported as unknown; i.e., a dam without reported identification information. When a cow and her sire had the same reported breed but her dam's breed was unknown, the sire's breed was assigned to the dam, which decreased the percentage of unknown genes to 0.7 for all cows born in 2005 and to 6.7 for crossbreds. The percentage of the national herd that was crossbred increased from 0.4 for cows born in 1990 to 0.7 in 2000 and 1.6 in 2005. Since 2000, the proportion of genes from Brown Swiss, Jersey, Milking Shorthorn, and nontraditional US dairy breeds has increased, while the proportion from Ayrshire, Guernsey, and Holstein breeds decreased. For cows born in 2005, genetic composition was 0.4% Ayrshire, 1.0% Brown Swiss, 0.4% Guernsey, 90.8% Holstein, 6.5% Jersey, 0.2% Milking Shorthorn, 0.1% other breeds, and 0.7% unknown. Corresponding composition for crossbreds was 2.4, 9.2, 1.1, 44.0, 25.9, 9.3, 1.4, and 6.7%. The most frequent sire breed for crossbreds was Holstein until birth year 1999 and Jersey since then. Frequency of sire breeds for crossbreds born in 2005 was 42% Jersey, 27% Holstein, 13% each for Brown Swiss and Milking Shorthorn, and 5% for all other breeds. About 95% of all first-generation crossbred cows were mated to bulls of one of the crossbred's parental breeds, most frequently the sire breed. Tracing an animal's genetic background rather than relying on its coded breed provides a more complete and accurate representation of the extent of crossbreeding and changes in the genetic composition of the national dairy herd.

Key Words: Dairy Cattle Breed, Crossbred, National Dairy Herd

T18 Reproductive trends of dairy herds in the United States.

H. D. Norman, J. R. Wright, S. M. Hubbard*, M. T. Kuhn, and R. H. Miller, *Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD.*

Trends for reproductive traits were examined for U.S. Holstein and Jersey herds with records in the USDA national dairy database. Traits were days from calving to first service (DFS) and to last service, 70-d nonreturn rates (NRR) and conception rates (CR) for first through fifth services, days open, gestation length, and services per lactation for breedings from 1996 through 2005. Holstein DFS increased from 89 in 1996 to 92 in 2001 and then declined to 86 in 2005; no trend was observed for Jersey DFS. First-service NRR declined from 54 and 57% in 1996 to 46 and 52% in 2005 for Holsteins and Jerseys, respectively; first-service CR declined from 36 and 39% to 30 and 35%. As expected from the NRR decline, services per lactation increased from 2.1 in 1996 to 2.6 in 2005 for Holsteins and from 2.0 to 2.4 for Jerseys. Days to last service also increased by 16 d for both breeds. Days open increased during early years but have stabilized for both breeds. Gestation length showed no change across time for either breed. Data from 2005 breedings were examined for the same traits by parity for both breeds and by geographic region for Holsteins. Later parities (>5) were associated with longer DFS, lower first-service NRR, and increased first-service CR compared with early parities (1 and 2) for both breeds; services per lacta-

tion remained fairly constant for Holsteins and increased slightly with parity for Jerseys. For both breeds, NRR for first and second services and CR for each service through fourth declined across parities. Southwest Holsteins had the fewest DFS (73 d) and lowest first-service NRR (36%); the Mountain region had the greatest DFS (93 d) and the highest NRR (48%). Southeast Holsteins had the lowest first-service CR (23%) and the most services per lactation (3.0); the Northeast had the highest CR (31%) and the fewest services (2.6). Trends likely were impacted by producer preference for animal age for herd retention and increased use of estrous synchronization and timed artificial insemination.

Key Words: Reproductive Trend, Conception Rate, Nonreturn Rate

T19 Impact of selection for increased daughter fertility on productive life and culling for reproduction.

H. D. Norman, J. R. Wright*, and R. H. Miller, *Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD.*

Selection for increased daughter pregnancy rate (DPR) over 2 generations was examined to determine if such selection had affected cow fertility and productive life (PL). Holstein artificial-insemination bulls with a predicted transmitting ability (PTA) for DPR based on ≥ 35 daughters were grouped by quintile based on PTA DPR. Then 25 cow groups were formed based on sire and maternal grandsire (MGS) quintiles. Cows had birth dates from 1988 through 1999 and calving dates from 1990 through 2005. Cows that changed herds or had unreported lactations for their first 5 parities were excluded as were herds with <10 cows. Data were available from 4,380,300 cows in 31,759 herds. Mean cow PL was 27.0 mo; time opportunity was a restricting factor. Mean PTA DPR was 2.0 for sires and 2.1% for MGS for the cow group with highest sire and MGS quintiles and -2.1% for both sires and MGS for the group with lowest sire and MGS quintiles. Least squares difference in PL was examined on a within-herd basis with cow birth year in the model. Cows from the highest sire-MGS quintile group had 4.2 mo longer PL than those from the lowest sire-MGS quintile group and were less likely to be culled for reproductive problems (10.0 versus 13.3%) based on reported reason for record termination. Difference in PL between cow groups with highest and lowest sire quintiles for PTA DPR ranged from 2.8 to 3.3 mo; corresponding difference for MGS quintiles ranged from 0.8 to 1.4 mo. Because each month of additional PTA PL is valued at \$29 in the current USDA lifetime net merit index, a 200-cow herd from the highest sire-MGS group for PTA DPR would be worth about \$7,500 more annually than a 200-cow herd from the lowest sire-MGS group without considering any additional income or expense associated directly with DPR. Selection for increased DPR across generations is expected to produce cows with longer herd life because they are less likely to be culled for reproductive problems.

Key Words: Daughter Pregnancy Rate, Productive Life, Fertility

T20 Modeling nuisance variables for phenotypic evaluation of bull fertility.

M. T. Kuhn*, J. L. Hutchison, and H. D. Norman, *USDA-ARS-AIPL, Beltsville, MD.*

This research determined which (available) nuisance variables should be included in a model for phenotypic evaluation of US service sire conception rate (CR), based on DHI data. Models were compared by

splitting data into records for estimation (n=3,613,907) and set-aside data (n=2,025,884), computing predictions using the estimation data, and then comparing predictions to bulls' average CR in set-aside data. There were 803 bulls used for comparison, after requiring a minimum of 50 records for estimation and 100 breedings in at least 30 herds in set-aside data. Correlations and mean differences were used to compare models. Nuisance variables considered were management groups based on herd-yr-season-parity-registry (HYSPR) classes, yr-state-mo, cow age, DIM, a short-cycle variable to account for lower CR for matings preceded by a breeding only 10 to 17 days prior, and various combinations of lactation, service number, and milk yield. Preliminary analysis led to selection of 305d-2x-ME milk yield as the production variable for consideration, and also showed that for each quantitative independent variable, categorical factors provided better bull fertility evaluations than modeling the effects as covariates. Two strategies for management groups were tested, one where HYSPR groups were required to have an absolute minimum number of records and a second where groups were combined across registry, season, and parity subclasses until a minimum group size was achieved. Combining groups to a target size of 20 but still including herd-years with at least 10 breedings maximized correlation with CR in set-aside data. Combining groups implies that some groups have multiple seasons and parities, hence consideration of yr-state-mo and lactation as additional factors. The final variables selected for inclusion were, in addition to HYSPR, yr-state-mo, lactation, service number, milk yield, cow age, short-cycle (yes/no), and the cow effect, partitioned as permanent environment and breeding value. This model maximized correlation with CR in set-aside (55.2%), minimized mean square error (3.25), and mean difference was 0.

Key Words: Bull Fertility

T21 Factors that affect abortion frequency in dairy herds in the United States. R. H. Miller*, M. T. Kuhn, H. D. Norman, and J. R. Wright, *Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD.*

Frequency of abortions was studied for lactating cows with 2,980,527 records in the USDA national dairy database. Lactations had been terminated between 1995 and 2005, and cows had been >151 d pregnant at lactation termination. Records without breeding dates were excluded. Abortion frequency for 2005 was 1.6%. Analyses were conducted with PROC GLM to determine effects of herd, year, month, parity (1, 2, ..., 7, ≥8), and gestation stage (152 to 181 d, 182 to 211 d, 212 to 241 d, and ≥242 d pregnant) at lactation termination as well as effects of breed (Holstein, Jersey, and other breeds including crossbreds) and 305-d standardized milk yield. Supplemental analysis examined effects of herd size (50 to 99, 100 to 199, ..., 900 to 999, ≥1,000 cow-years) and location (state). Abortions were most frequent in July and least frequent in December (difference of 0.38%). Abortion frequency decreased from parity 1 to parities ≥8 (difference of 0.52%). Gestation stage had the greatest impact on abortion frequency. Abortions were most frequent at 152 to 181 d pregnant, and trend in abortion frequency was nonlinear across gestation stage. Compared with ≥242 d pregnant, abortion frequency was 3.14% higher at 152 to 181 d pregnant and 1.07% lower at 212 to 241 d pregnant. Abortions for Holsteins and Jerseys occurred more frequently (0.38 and 0.07%, respectively) than for other breeds. Regression of abortion frequency on lactation milk yield was 0.26%, 0.26%, and 0.19% per 1,000 kg of milk for Holsteins, Jerseys, and other breeds, respectively. Regression differences primarily reflect breed differences. Abortion frequency was 0.95% higher for herds with 700 to

799 cow-years than for herds with 50 to 99 cow-years. California herds had the highest abortion frequency (2.18% higher than North Dakota, the state with the lowest frequency). Increased knowledge of factors that affect abortion frequency can aid in the development of management practices for reducing the incidence of abortion, e.g., more intense monitoring of cows 2 to 6 wk after mid-gestation.

Key Words: Abortion Frequency, Gestation Stage, Lactation Termination

T22 Heritability of dairy cow mortality and relationships between mortality and sire genetic evaluations for yield, somatic cell score, productive life and daughter pregnancy rate. G. W. Rogers*¹, J. B. Cooper¹, and J. S. Clay², ¹*The University of Tennessee, Knoxville,* ²*Dairy Records Management Systems, Raleigh, NC.*

Lactation records from 1239 Holstein herds in 9 Southeastern states processed by DRMS were utilized to estimate heritability of dairy cow mortality and the relationships between mortality and sire genetic evaluations for milk, fat, protein, SCS, productive life (PL) and daughter pregnancy rate (DPR). Herds were required to have a minimum of 10 years of continuous recording between 1982 and 2005. Binary mortality traits (1=CAR code 6 indicating lactation ending in death vs. 0=all other CAR codes) were developed separately for lactations 1, 2 and 3 or later (3+). To estimate heritability, binary traits were analyzed using a logistic model where the model included sire (random), herd, year of calving, season of calving and age at calving. Number of cows (sires) ranged from 280,000 (1090) to 614,000 (1913). In addition, the binary mortality traits were analyzed using logistic regression with sire replaced by sire PTA (one trait per analysis). Sire PTA were categorized into quartiles and odds ratios for each quartile compared with quartile 4 were determined. Heritability for mortality on the underlying scale was low and ranged from .03 to .04. Odds ratios indicated that mortality tended to be lower for cows sired by bulls with lower PTA milk, protein and SCS, especially in lactations 3+. Odds ratios for fat percent were not consistent across lactations, but higher sire PTA for fat percent were favorable for mortality in lactation 2 and lactations 3+. Odds ratios for PL and DPR indicated that mortality was significantly higher for cows sired by bulls with lower PTA PL and DPR. Daughters of sires with PTA for PL or DPR in the lowest quartile were 22 to 31% more likely to end the lactation with death compared with daughters of sires in highest quartile. Selection for increased milk yield may have increased cow mortality but intense selection for increased PL and DPR will likely reduce cow mortality in the future.

Key Words: Dairy Cow Mortality, Heritability, Daughter Pregnancy Rate (DPR)

T23 Lactation patterns for dairy cattle in a multibreed dairy population in Central Thailand. A. Seangjun¹, S. Koonawootrittriron¹, and M. A. Elzo*², ¹*Kasetsart University, Bangkok, Thailand,* ²*University of Florida, Gainesville.*

Milk production in Thailand is based on a dairy population composed of Holstein (H) and fractions of various other *Bos taurus* and *Bos indicus* breeds (O). This population structure is the result of a national effort encouraged by the Thai government to increase milk production. Genetic

evaluations have been conducted by Kasetsart University and the Dairy Promotion Organization for milk yield, fat yield, and fat percentage since 1996. To further improve management and the ability to select animals under Thai tropical conditions, a more complete understanding of lactation characteristics is needed. The objective of this research was to study the lactation patterns of 5 lactation traits: initial yield (IY), peak yield (PY), days to peak (DTP), persistency (PST), and 305-d milk yield (MY) in 5 breed groups in a Holstein-Other breeds (HO) multibreed population in Central Thailand. The dataset included 5,713 monthly test-day records from 520 dairy cows raised in 108 farms from 1998 to 2006. Breeds groups were BG1 (purebred H), BG2 ($0.9687 \leq H < 1.00$), BG3 ($0.9375 \leq H < 0.9687$), BG4 ($0.875 \leq H < 0.9375$), and BG5 ($0.50 \leq H < 0.875$). Seasons were 1 = winter (November to February), 2 = summer (March to June), and 3 = rainy (July to October). The model for each trait included the fixed effects of herd-year-season, calving age, and breed group. Random effects were sire of cow and residual. Procedure Mixed of SAS was used for computations. Least squares means ranged from 14.16 ± 0.71 kg (BG5) to 16.04 ± 0.66 kg (BG4) for IY, from 18.23 ± 0.55 kg (BG5) to 19.84 ± 0.51 kg (BG4) for PY, from 36.51 ± 3.78 d (BG4) to 52.04 ± 9.74 d (BG1) for DTP, from 6.45 ± 0.24 (BG1) to 6.71 ± 0.11 (BG3) for PST, and from $4,083.74 \pm 103.50$ kg (BG5) to $4,317.15 \pm 111.56$ kg (BG3) for MY. Breed group differences were non-significant. However, BG3 performed better than BG1 and BG2 suggesting that nutrition, management, and tropical conditions in Thailand may have prevented them from reaching their production potential.

Key Words: Lactation, Multibreed, Tropical

T24 Relationships between reproductive traits of heifers and cows and yield traits for Holsteins in Japan. H. Abe*, Y. Masuda, and M. Suzuki, *Obihiro University of A & VM., Obihiro, Japan.*

The objective of this study was to investigate relationships between reproductive traits in heifers and cows and yield traits for Holsteins in Japan. Insemination and lactation records for cows calved between 1990 and 2003 in Hokkaido were obtained from Hokkaido Dairy Milk Recording and Testing Association. Age at conception (AC) and first service conception rates (CR) were calculated for heifers. Days open (DO) and CR were calculated for cows in first and second parities. The yield traits used were 305-d milk, fat and protein yields. A threshold animal model was applied for CR, and a linear animal model was applied for the other traits. For heifers, the model included herd-year and month of the first insemination as fixed effects. For cows, the model included herd-year of calving, month of calving, and age class of calving as fixed effects. Both models included the random animal additive genetic effect. The numbers of records were around 260,000, 780,000 and 640,000 for heifers, first parity, and second parity cows, respectively. Subsets of records were extracted for the two traits by the random sampling of herds, and genetic parameters were estimated either by the AI-REML method or the Bayesian method using Gibbs sampling. Heritability estimates were 13%, 2% for AC and CR in heifers, 3% for CR in cows, 6% and 4% for DO in first and second parities. Genetic correlations between AC and DO in first and second parities were 0.29 and 0.09, respectively. Genetic correlations among CR ranged from 0.33 to 0.93. Genetic correlations of yield traits with AC and CR in heifers ranged from 0.19 to 0.37, and -0.06 to 0.12, respectively. Genetic correlations between yield and reproductive traits in cows were antagonistic. As a result, reproductive traits in heifers and cows should be considered as separate traits. The relationship between yield and reproductive traits

in heifers was slightly preferable, suggesting that genetic selection of reproductive traits could be performed for heifers in Japan.

Key Words: Reproductive Traits in Heifers and Cows, Genetic Parameters, Holsteins in Japan

T25 Genetic aspects of the somatic cells count in dairy buffaloes reared in Sao Paulo state, Brazil. H. Tonhati*^{1,2}, G. M. Sanches¹, M. F. Ceron Munoz¹, L. G. de Albuquerque^{1,2}, R. R. A. B. Borquis^{1,3}, R. Sesana^{1,3}, and L. El Faro¹, ¹Sao Paulo University, Jaboticabal, Sao Paulo, Brazil, ²Conselho Nacional de Desenvolvimento Cientifico e Tecnologico, Brasilia, DF, Brazil, ³Fundacao de Amparo a Pesquisa do Estado de Sao Paulo, Sao Paulo, Brazil.

The goal of this work was to study the relationship between somatic cell count (SCC) and milk yield (MY). Were analyzed 9404 test-day records for SCC and MY obtained from 2198 lactations of 1052 Murrah buffaloes between 1997 and 2005. To quantify the decreases of MY in relation to SCC, the model included a random animal effect and the fixed effects of farm, calving order, year and season of calving and Somatic Cell Score (SCS) as covariate. For estimating genetic parameters, test day models were used for SCC transformed in SCSt ($SCSt = [\log_2(SCC/1000000)]+3$). For average of somatic cells count in the lactation (SCCt270) and milk yield to 270 days (MY270) the (co) variance components were estimated. SCC of every month of lactation were considered as different traits. The model included additive genetic, permanent environmental (for SCCt270 and for MY270) and residual random effects. Other fixed effects were: contemporary group; test-day and age of cow at calving as a covariate (linear and quadratic effects). For SCSt, contemporary groups were defined as herds-year-month of the control, and for SCCt270 and MY270 as herd-year-season of the calving. It was found that all effect influenced the expression of SCSt. For first parity females, there no relation between MY and SCC was found. The largest decreases of milk production were observed in female with more than one calving. This category should receive a special attention in relation to udder health. The farm, year and calving order effects should be considered in the comparison among animals for genetic evaluations. Heritability estimates obtained from single trait analyses ranged, among the months, from 0.06 to 0.50 for SCSt and 0.28 for SCCt270. Heritability estimates in double trait analyses oscillated between 0.65 and 0.28 for SCSt and up 0.66 for SCCt270. All correlations between SCSt and SCCt270 were positive, ranging from 0.50 to 0.91 (genetic) and from 0.59 to 0.82 (phenotypic). The genetic correlations between SCSt and MY270 ranged from 0.52 to 0.10 and the phenotypic correlation ranged from 0.37 to 0.0. The genetic correlation between SCCt270 and MY270 was 0.11 and the phenotypic correlation was 0.15.

Key Words: Genetic Evaluation, Variance Components, Longitudinal Data

T26 Computing options for multiple-trait test-day random-regression models. I. Aguilar*^{1,2}, S. Tsuruta¹, and I. Misztal¹, ¹University of Georgia, Athens, GA, ²Instituto Nacional de Investigación Agropecuaria, Las Brujas, Uruguay.

Data included 90,242,799 test day records from 5,402,484 Holstein cows in 3 parities. The total number of animals in the pedigree file was

9,326,754. Additionally, daily temperature humidity indexes (THI) from 202 weather stations were available. The effects of herd test day, age at calving, milking frequency and days in milk classes (DIM) were made fixed, and the effects of additive, permanent environment and herd-year were made random. Random effects were fit as random regression. Covariates included linear splines with four knots at 5, 50, 200, 305 DIM, and a function of THI of the 3rd day before the test day from a weather station closest to the farm. The first three lactations were used as separate traits, resulting in 15 by 15 (co)variance matrices for each random effect. The mixed model equations were solved using an iteration on data program with a preconditioned conjugate gradient (PCG) algorithm. Several preconditioners were used: diagonal (D), block diagonal due to traits (BT), and block diagonal due to traits and correlated effects (BTCORR). One run included BT with a "diagonalized" model in which the random effects were reparameterized for diagonal (co)variance matrices among traits (BTDIAG). Memory requirements were 8.7 Gbytes for D, 10.4 Gbytes for BT and BTDIAG, and 24.3 Gbytes for BTCORR. Computing times (rounds) were 14 d (952) for D, 10.7 d (706) for BT, 7.7 d (494) for BTDIAG and 4.6 d (289) for BTCORR. The convergence criterion for BTCORR showed high fluctuation that required either a moving average or a strict stopping criterion. The convergence pattern was strongly influenced by the choice of fixed effects. When sufficient memory is available, the option BTCORR is the fastest and simplest to implement; the next efficient method, BTDIAG, requires additional steps to diagonalization and back-diagonalization.

Key Words: Heat Stress, Multiple Trait Random Regression Model, Genetic Evaluation

T27 One predominant and preeminent common ancestor in Bell family. R. D. Shanks* and K. Boesche, *University of Illinois, Urbana*.

Purpose was to improve interpretation of inbreeding. As a means to increase interpretation, inbreeding was partitioned relative to the common ancestor that was the source of the inbreeding. To focus pedigrees, the family of Carlin-M Ivanhoe Bell (Bell) was used as a test sample. Forty sons with high inbreeding coefficients and nine grandsons of Bell were evaluated for their source of inbreeding. All but one evaluated son and all evaluated grandsons of Bell had the opportunity to share alleles identical by descent from Osborndale Ivanhoe (Ivanhoe). Ivanhoe was the grandsire of Bell. For twenty-one of the inbred sons, Ivanhoe was the only common ancestor as the source of inbreeding. Ivanhoe as a source of inbreeding was responsible for inbreeding ranging from .4% to 3.1% for the sons and from .2% to .4% for the grandsons. Additionally, Penstate Ivanhoe Star, a son of Ivanhoe, was a common ancestor for eight inbred sons of Bell. Penstate Ivanhoe Star was responsible for inbreeding of 6.25% or 3.125%. On the maternal side of the pedigrees, Ivanhoe was found within 3 to 6 generations of the sons and 5 or 6 generations for the grandsons. More diversity existed among the grandsons of Bell as only 2 grandsons had all of their inbreeding from Ivanhoe as the common ancestor. Inbreeding of the sample of sons ranged from .4% to 7.8%. Inbreeding of the nine grandsons ranged from .2% to 2.6%. Osborndale Ivanhoe was an Excellent bull and a legend in dairy cattle genetics. In 1992, 40 years after his birth, he was still related to more than 5% of the Holstein population. The vast majority of inbreeding within the Bell family has Ivanhoe as the source. Although the purpose of this study was to improve interpretation of inbreeding, results of the study were that the number of common ancestors was extremely limited. Inbreeding depression would be a function of the alleles available in the common ancestor. If few, but different, common ancestors would be

found in other sire families, the need to determine inbreeding depression within family may be warranted.

Key Words: Inbreeding, Holstein, Common Ancestors

T28 Heritability of genetic tolerance to Johne's disease. R. Zanella*¹, M. Settles¹, T. Fyock², R. Whitlock², Y. Schukken³, J. Van Kessel⁵, J. Karns⁵, E. Hoving⁴, J. Smith⁶, C. Van Tassel⁵, C. Gaskins¹, and H. Neibergs¹, ¹Washington State University, Pullman, ²University of Pennsylvania, Kennett Square, ³Cornell University, Ithaca, NY, ⁴Penn State University, University Park, ⁵USDA, ARS, Beltsville, MD, ⁶University of Vermont, Burlington, VT.

Johne's disease, also known as paratuberculosis, is a prevalent and economically important disease in cattle caused by bacterial infection of *Mycobacterium avium* subsp. *paratuberculosis*(MAP). Johne's disease often results in weight loss, lowered milk production, and death. MAP is excreted in feces and milk of infected animals which helps propagate the disease. Infection generally occurs in neo-natal calves, but clinical disease and detection are often delayed for 2 to up to 6 years, prolonging the exposure of the herd to MAP. Disease prevalence is estimated to be present in 75% of US dairy herds and is increasing. Current vaccination and treatments are ineffective and diagnostic methods detect less than 25% of infected animals, at one time. Cattle exposed to MAP may have three distinct responses: failure to develop disease (resistant animals), disease with little fecal shedding of MAP (tolerant), or disease with significant fecal shedding (intolerant-susceptible animals). The objective of this study was to determine the heritability of genetic tolerance to Johne's disease in 4 Holstein dairy herds. Genetic tolerance was determined by sequential diagnostic testing of 260 animals every 3-6 months followed by post mortem tissue examination. This testing regime represents the gold standard for Johne's diagnosis. MAP testing was conducted on a minimum of 4 tissue samples per animal. Comparison of fecal and tissue testing results was used to determine if cows were classified as resistant, tolerant or intolerant-susceptible. Heritability was calculated using an animal method. Selection of animals with genetic tolerance to Johne's would be advantageous by lowering infection pressure and extending the period between infection and clinical symptoms.

Key Words: Johne's Disease, Heritability, Tolerance

T29 Detection of polymorphism in bovine polymeric immunoglobulin receptor gene promoter region and association with milk IgA and IgM concentration. C. G. Zhang^{1,2}, J. Q. Wang*¹, D. P. Bu¹, G. L. Liu¹, J. B. Cheng¹, X. L. Dong^{1,2}, H. Y. Wei¹, L. Y. Zhou¹, G. Q. Zhao², and K. L. Liu¹, ¹State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China, ²Yangzhou University, Yangzhou, China.

The polymeric immunoglobulin receptor (pIgR) transports dimeric immunoglobulin A (dIgA) and tetramer IgM across the epithelial cell layers into the secretions of mammary gland. The object of this study was to detect bovine pIgR gene promoter polymorphism and its association with milk IgA and IgM concentration. Blood and milk samples (n = 189) from each cow were collected randomly from more than 1,600 animals in Beijing. Determination of IgA and IgM in milk samples were performed by a commercial sandwich enzyme-linked immunosorbent assay (ELISA) using the Bovine IgA and IgM ELISA Quantitation Kit.

SNPs were found by 25 dairy cows' blood genome DNA samples by PCR amplifying and sequencing. The SNPstream system (Beckman Coulter, USA) was used for genotyping for 189 individuals. The results indicated that SNP1 (-3128) and SNP2 (-3072) were the G/A variation and SNP3 (-2834), SNP4 (-2348) and SNP5 (-515) were the T/C variation. Seven haplotype block and ten main diplotypes were inferred by phase 2.1. Statistical analysis indicated that diplotypes had no effect on milk IgA and IgM concentration ($P > 0.05$). Duncan's multiple-range test showed the least square mean for milk IgA concentration (mg/ml) of diplotypes H1H1 (0.323 ± 0.042), H1H5 (0.421 ± 0.106) and H3H6 (0.486 ± 0.128) was significantly higher than those of H4H4 (0.206 ± 0.041) and H5H6 (0.051 ± 0.128) diplotypes ($P < 0.05$), whereas other diplotypes had no significant differences on the least square mean for milk IgA and IgM concentration ($P > 0.05$). Therefore, our findings implied that pIgR gene promoter SNPs had effect on milk IgA and IgM concentration.

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Key Words: pIgR Gene Promoter, IgA and IgM, SNPs

T30 Effect of marker-assisted preselection in Japanese dairy population. H. Ohmiya* and M. Suzuki, *Obihiro University of Agriculture & Veterinary Medicine, Obihiro, Hokkaido, Japan.*

The utility of the "modified bottom-up" approach to marker-assisted selections in a conventional progeny test scheme was examined on dairy breeding in Japan. In this scheme, genotyping the daughters to decide the genotypes for the quantitative trait locus (QTL) of their sires was not needed as in a usual bottom-up approach, which is the preselection scheme that uses marker information before a traditional progeny test. Because the cows are not tested for markers to be closely linked to a QTL in Japan, the development of selection schemes without genotyping the daughters for markers may benefit the Japanese dairy population. By computing the differences between the deviations of the breeding values and the genetic variance (G) in a population, it can be decided whether their sire is homozygous for locus controlling milk product. If the sires were identified as homozygous with allelic contrast smaller than G, the mean breeding value of the daughters from a sire is more favorable than that in a population used for generating candidate young bulls. Stochastic simulations of dairy population structures, methods of evaluation, and parameters similar to Japanese dairy population were used to evaluate each rate of the additional genetic gains of a traditional scheme using only progeny testing and BLUP with an animal model, a conventional bottom-up approach, and the modified bottom-up approach suggested in this study. These simulations under the 2 QTLs and 40 polygenes each with 4 alleles were replicated 20 times. It was found that these rates were increased by an average of 11.5% and 5% compared with a traditional progeny test scheme when conventional bottom-up and modified bottom-up approaches were used. Additionally, with the modified bottom-up approach, the dairy population improved more with only progeny testing but less than with the conventional bottom-up approach. When only dairy bulls are genotyped in Japan, this approach would be effective.

Key Words: Marker-Assisted Selection, QTL, Bottom-Up Approach

T31 Optimized measured genotype analysis for genome-wide quantitative trait loci mapping using dense SNP chips. J. R. O'Connell*, *University of Maryland School of Medicine.*

The availability of low cost, dense fixed content single nucleotide polymorphism (SNP) chips has changed the landscape of genetics. These chips provide sufficient density for linkage disequilibrium mapping to localize alleles that increase susceptibility to disease, determine variation of quantitative phenotypes or predict genetic merit for economically important traits.

A standard quantitative trait analysis for genome-wide SNP analysis is the mixed model measured genotype approach, which treats the genotype as a measured covariate while controlling for residual familial correlation through a polygenic component. The model easily incorporates dominant, recessive or additive models of single SNPs and joint, conditional or interaction analysis of multiple SNPs and genomic prediction using estimated regression parameters. Mixed model maximum likelihood estimation, however, is computationally challenging due to dense matrix operations required for a single analysis, making genome-wide analysis often infeasible. A computationally efficient approach is presented based on the diagonalization of the covariance-variance structure that replaces operations on dense matrices with diagonal matrices in the maximization.

A genome-wide association analysis of yield and conformation traits measured on 2602 Holstein bulls using the BovineSNP50 chip was performed to evaluate and validate the method. In total 38,000 SNPs with a minor allele frequency > 0.02 were analyzed using an additive model. As expected a SNP located at ~300kb on chromosome 14 near DGAT provided the most significant association for milk yield with a p -value $< 10e-41$. In addition a cluster of SNPs located around 50Mb on chromosome 15 reached genome-wide significance with p -values $< 10e-09$.

Key Words: Pedigree Analysis, Genomic Selection

T32 Effect of varying degree of relatedness in family designs on estimation of IBD probability and other parameters in QTL mapping based on variance component analysis. G. Freyer² and N. Vukasinovic*¹, ¹Newsham Choice Genetics, Saint Louis, MO, ²Research Institute for the Biology of Farm Animals, Dummerstorf, Germany.

In variance component approach the QTL effect is modeled as a function of probabilities that two alleles in the same or in different animals at a particular genomic position are identical by descent (IBD probabilities). Estimates of IBD probabilities and therefore, proper modeling and estimation of QTL variances depend on the number and informativeness of markers, the strength of linkage and linkage disequilibrium of markers and QTL, and the relatedness of animals in the pedigree. In this simulation study we investigate how the level of relatedness of animals in a pedigree influences IBD probabilities, their correlations to the IBD probability at the true QTL-position, and the quality of test statistic profiles. Four multi-generational pedigrees (FS) resembling real dairy populations were simulated. All pedigrees comprised 850 individuals. The final offspring of 9 sires originated from 2 founder (great-grand) sires. FS0 was non-inbred; FS1 contained an inbred sire from an aunt-nephew mating; FS2 contained a 25% inbred sire from a half-sib mating. In both pedigrees, the inbred sires had 78 final offspring each. FS3 was the same as FS2, except for increasing the number of offspring of the

inbred sire to 138. FS4 contained a sire originating from a mother by (inbred) son mating with 73 offspring. This design was used to demonstrate how extreme levels of inbreeding affect QTL mapping. Animals were assumed genotyped for 11 markers within a 55cM long putative QTL region, with one QTL explaining 15% of the phenotypic variance. The number of alleles was 2, 4, or 6, at unevenly spaced markers. Twenty replicates were run for each parameter combination. IBD probabilities for each cM in the segment were calculated using the nearest informative marker bracket. Estimation of QTL parameters was performed using maximum likelihood approach within the ASReml software. The results indicated that the existence of inbred animals in a pedigree may lead to more precise estimates of IBD probabilities and QTL parameters that are less sensitive to variations in simulation parameters.

Key Words: QTL Mapping, Inbreeding, Variance Components

T33 Spermatozoal transcriptome profile as marker for bull fertility and sperm motility: A potential tool to evaluate semen quality. N. Bissonnette^{*1,2}, J.-P. Lévesque-Sergerie^{1,2}, and G. Boissonneault², ¹*Agriculture and Agri-Food Canada, Sherbrooke, Québec, Canada*, ²*University of Sherbrooke, Sherbrooke, Québec, Canada*.

Fertility represents significant costs to the dairy industry and is still a major concern for dairy producers. Efforts are made to evaluate bull fertility in order to offer semen of the highest quality value. In a previous study, we had analyzed the sperm transcript content and found that bulls with different non-return rate, a measure of field fertility, contain a different profile (Lalancette et al. 2007, *Biology of Reproduction*, in press). This transcript panel comprising 3216 EST has been used to construct a microarray by automated spotting. Since motility is a prerequisite of high quality semen, we verified if spermatozoa collected from fresh semen and presenting different motility indexes could also display different transcriptome profiles. The transcript content of fresh spermatozoa isolated at the bottom fraction 90% (highly motile) of a Percoll step gradient was compared by microarray hybridization to the transcript extracted from the spermatozoa harvested at the 70%–90% interface (less motile). Spermatozoa derived from the same ejaculated bull semen, but displaying subtle yet different motility, contain different transcript abundance ($p < 0.001$). Among the genes of which expression was confirmed by real-time PCR, we validated some well-known transcript, notably that of protamine 1, whose encoded proteins are architectural and required for an adequate genome packaging. Uncharacterized gene such as a gene encoding a protein similar to human metalloproteinase was among the differentially expressed genes. Interestingly, expression of this candidate was predicted in December 2006 by automated computational analysis and was found and for which no bovine ortholog sequence has yet been reported. Analyzing the spermatozoal transcriptome would not only be helpful in determining bull fertility but could also be used in a semen quality analysis. Whereas this specialized cell has long been considered a vehicle that contains only a half-genome, it also contains remnant transcripts of spermatogenesis, whose profile can be used as a signature for semen quality.

Key Words: Fertility, Sperm Quality, Genetic Marker

T34 Molecular characterization of the bovine DDX3Y gene. W.-S. Liu^{*1}, A. Wang², Y. Yang¹, E. Landrito³, and H. Yasue⁴, ¹*The Pennsylvania State University, University Park*, ²*Virginia Polytechnic Institute and State University, Blacksburg*, ³*University of Nevada, Reno, NV*, ⁴*National Institute of Agrobiological Sciences, Tsukuba, Ibaraki, Japan*.

The DEAD box polypeptide 3, Y-linked gene (DDX3Y, also known as DBY, DEAD box gene on the Y) encodes a putative ATP-dependent RNA helicase. This gene belongs to the DEAD box protein family, characterized by the conserved motif Asp-Glu-Ala-Asp (DEAD). In the human, DDX3Y is located in the AZFa (azoospermia factor a) interval in the non-recombining region of the Y chromosome. Deletion of the AZFa region has been showed to disrupt spermatogenesis, causing subfertility and infertility in otherwise healthy men. We have characterized the bovine DDX3Y (bDDX3Y) gene. We found two transcripts for bDDX3Y, bDDX3Y-L and bDDX3Y-S, which correspond to the long and short transcripts of the human DDX3Y and mouse Ddx3y gene. The two bDDX3Y transcripts are identical except for a three-base-pair (AGT) insertion in the position of nt 2027 and an expanded 3'UTR (nt 2155-2790) in bDDX3Y-L. The bDDX3Y-S encodes a peptide of 660 amino acids (aa), while the bDDX3Y-L encodes a peptide of 661 aa as a result of the insertion of a serine (S) in the position of aa 634 in the bDDX3Y-L peptide. Both bDDX3Y isoforms contain the conserved motifs of DEAD-box RNA helicases. Expression analysis of the bDDX3Y gene in 12 bovine tissues by RT-PCR showed that both transcripts are predominantly expressed in the bovine testis. This project was supported by grants from USDA-CSREES-NRI to WSL (No. 2005-35205-15455 and No. No. 2005-35205-18653).

Key Words: DDX3Y Gene, Y Chromosome, Bovine

T35 A gene frequency model to map QTL using bayesian inference. W. He^{*1}, R. L. Fernando¹, J. C. M. Dekkers¹, and D. Gianola², ¹*Iowa State University, Ames*, ²*University of Wisconsin, Madison*.

Information for mapping of quantitative trait loci (QTL) comes from two sources: linkage disequilibrium (non-random association of allele states) and cosegregation (non-random association of allele origin). Information from LD can be captured by modeling conditional means and variances at the QTL given marker information. Similarly, information from cosegregation can be captured by modeling conditional covariances. Here, we consider a model where both conditional means and variances are modeled as a function of the conditional gene frequencies at the QTL. The parameters in this model include these gene frequencies, additive effect of the QTL, its location, and the residual variance. Bayesian methodology was used to estimate these parameters. The priors used were: logit-normal for gene frequencies, normal for the additive effect, uniform for location, and inverse chi-square for the residual variance. Computer simulation was used to compare the power to detect and accuracy to map QTL by this method with least squares using a regression model (LSR). LD was simulated in a chromosomal segment of 1cM with one QTL by random mating for 1000 generations in a population of size 500 and for 50 generations in a population of size 100. The comparison was studied under a range of conditions, which included SNP density of 0.1, 0.05 or 0.02 cM, sample size of 500 or

1000, and phenotypic variance explained by QTL of 2 or 5%. Both 1 and 2-SNP models were considered. Power of LSR ranged from 0.66 to 1.0, and was always higher than power of the Bayesian method (BM), which ranged from 0.56 to 1.0. The accuracy of BM to map QTL position, quantified by the root mean squared error, ranged from 0.107 to 0.189 cM, and was always better than the accuracy of LSR, which ranged from 0.134 to 0.260 cM. Results support that given a high SNP density, the gene frequency model can be used to map QTL with considerable accuracy even within a 1 cM region.

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Key Words: Bayesian Inference, Gene Frequency Model, Map QTL

T36 The study of gene delivery system in avian species using human adenoviral vector. D. R. Bae*, J. H. Shin, J. M. Reddish, J. D. Latschaw, M. P. Wick, and K. Lee, *The Ohio State University, Columbus.*

Adenovirus has been used in vivo and in vitro as a vector to carry a foreign gene for gene transfer. Several adenoviral vectors have been widely used to transfect a target gene into various cell types and tissues of various animal origins for studying gene function and also clinical application. However, the feasibility of the human recombinant adenoviral vectors system has not been evaluated in avian species. The objective of the present study was to evaluate this system in poultry. The primary muscle cells obtained from chicken, turkey, and quail were cultured and infected with recombinant adenovirus. Over 50% of chicken and turkey cells were infected by adenovirus containing green fluorescence protein (GFP) gene with less infection efficiency in quail. These cells were further tested with recombinant adenovirus containing GFP gene as a tracking marker and 3-hydroxyisobutryl-CoA hydrolase (HIBCH) gene as a target gene. Immunofluorescence analysis revealed that cells infected with adenovirus expressed both GFP and HIBCH protein, showing a successful tracking of the target gene by GFP expression. In addition, our western blot analysis showed that the expression of HIBCH protein in cultured primary muscle cells infected with the recombinant adenovirus. These data demonstrate the feasibility of using human recombinant adenoviral vectors as a tool to express foreign genes in the muscle cells of avian species. Depending

on the target gene, the adenoviral vector system will provide a new approach to study the role of target genes in muscle development and metabolism in avian species.

Key Words: Human Recombinant Adenovirus, Gene Delivery, Avian Species

T37 The use of machine learning techniques for analysis of high-dimension gene expression data sets. K. R. Robbins, W. Zhang, J. K. Bertrand, and R. Rekaya*, *University of Georgia, Athens.*

The analysis of microarray data has become common place in the field of animal science; however, due to the high dimensions and complex structure of many expression data sets, traditional statistical models may be inadequate for the analysis of such data. To address issues associated with commonly used methods for the identification of predictive genes sets, the ant colony algorithm (ACA) is proposed for use on data sets with large numbers of features and complex structures. The ACA is an optimization algorithm capable of modeling complex data structures without the need for explicit parameterization. The incorporation of prior information and communication between simulated ants allows the ACA to search the sample space more efficiently than other optimization methods. When applied to simulated data, as well as, a high-dimensional cancer microarray data set, the ACA was able to identify small subsets of highly predictive and biologically relevant genes without the need for simplifying assumptions. For simulated data, genes selected by the ACA to train a latent variable model yielded increases in prediction accuracy of 24.4%, 6.7%, and 10.3% when compared to genes sets selected by fold change (FC), t-test (T) and penalized t-test (PT), respectively. For the cancer data set, the ACA yielded increases in accuracy of 16.6% and 6.5% over the best performing test statistics and other optimization models. Furthermore, the ACA was able to converge to good solutions without the need for significant truncation of the data, as required by other optimization algorithms. The ACA was also able to achieve higher prediction accuracies using fewer selected genes when compared the test statistics. This was attributed to ability of ACA to model the complex gene interactions, reducing the collinearity in selected genes when compared with FC, T and PT.

Key Words: Ant Colony Algorithm, Machine Learning, Gene Expression

Dairy Foods: Cheese I

T38 Sensory and microbiological properties of cheddar cheese made with different fat content. M. A. Drake¹, C. J. Brighton², D. J. McMahon², and J. R. Broadbent^{*2}, ¹North Carolina State University, Raleigh, ²Utah State University, Logan.

Production of high quality lowfat (<6% fat) Cheddar cheese is a current industry goal in the U.S., but critical information of how fat reduction, and corresponding compositional changes in lowfat cheese such as lower salt-in-moisture content, influences sensory and microbiological properties is lacking. Specific knowledge of how fat reduction influences these properties could lead to identification of methods to enhance or minimize formation of specific flavors. Our objective was to characterize sensory and microbiological differences in Cheddar cheeses containing 32 (full), 16 (reduced), or 5 % (lowfat) fat (wet wt). Cheeses were manufactured in duplicate with a single-strain *Lactococcus lactis* starter culture and ripened at 8°C. After 2 wks, 3 mo, 6 mo and 9 mo, the cheeses were evaluated by a trained sensory panel using an established flavor language and sampled for starter and nonstarter lactic acid bacteria (NSLAB). Sensory results were evaluated by univariate and multivariate analyses to document the influence of fat reduction and ripening time on flavor. Cheeses with 5 % fat were characterized by a lack of milkfat flavor across ripening. Additionally, these cheeses lacked sulfur and brothy flavor development after 6 and 9 mo ripening compared to reduced and full fat cheeses and were instead distinguished by whey flavor and burnt flavors. Microbiological data also showed some interesting trends. First, starter populations remained stable out to 3 mo in lowfat and reduced fat cheeses before showing any decline, but in full fat cheese generally declined by at least 2 orders of magnitude by 3 mo. Additionally, NSLAB levels in low fat cheese exceeded 10⁶ by 6 wks, but populations in reduced or full fat cheese did not attain that level even after 6 mo. These results provide greater insight into the problems, and potential solutions, related to manufacture of high-quality lowfat Cheddar cheese.

Key Words: Lowfat Cheese, Cheese Flavor, Cheese Microbiology

T39 Comparison of Hispanic cheeses from US and country of origin manufacturers. L. A. Jiménez-Maroto*, A. López-Hernández, and S. A. Rankin, *University of Wisconsin, Madison*.

US-made Hispanic cheeses are routinely criticized by ethnic consumers for a lack of authenticity when compared to cheeses manufactured in the countries of origin. In order to authenticate and characterize such deficiencies several assessments were conducted including microbial testing, sensory profiles, chemical composition, and functional character. Commercial samples of three different types of Hispanic cheeses (fresh, pasta filata, aged) were acquired from domestic (n=44) and country of origin (n=40) manufacturers. Proximate analysis of the cheeses was conducted using standard methods. A modified melt-flow apparatus was employed to ascertain the melt character. Quantitative descriptive analyses (QDA) of cheese flavor, texture, and appearance were conducted by thirteen trained panelists and the results analyzed using principal component analysis (PCA). None of the samples tested positive for the presence of food pathogens. Cheeses from non-US manufacturers had lower salt, higher pH and moisture, similar lipid and protein content, and often contained many non-traditional ingredients including vegetable oil, caseinates, nonfat dry milk, modified starch, stabilizers, and preservatives. Melt character of pasta filata and fresh cheeses were consistent between US-made and foreign Hispanic cheeses, but aged

cheeses varied dramatically in melting character. Cheese color, shape, and packaging varied for all types of cheeses comparing domestic and country of origin manufacturers. The most significant flavor attribute differences between cheeses were salt, bitter, buttery, cowy, milkfat, oxidized, unclean and rancid notes. These results provide some level of understanding of the differences between cheeses made in the US and those made in their countries of origin. Knowledge of these differences will allow manufacturers to improve the perceived authenticity of products in the US market.

Key Words: Hispanic Cheese, Sensory Profile, Melt Character

T40 Evaluation of mineral compositions in reduced-fat and full-fat caprine milks and their Cheddar-type cheeses. W. Nouria*, T. H. Terrill, and Y. W. Park, *Fort Valley State University, Fort Valley, GA*.

Reduced fat dairy products have been increasingly popular among consumers. Although characteristics of reduced fat bovine milk products have been studied, mineral compositions of such products have little been reported, especially in caprine milk products. Two lots each of reduced-fat (RF) and full-fat (FF) Cheddar-type caprine cheeses were manufactured to evaluate 20 major and trace mineral compositions. The cheeses were made at the University dairy plant using bulk milk from Saanen, Alpine, and Nubian goat herd. RF cheeses were made using cream separated goat milk by a separator (Model PG-57, Hoegger Suppl. Co., Fayetteville, GA). Minerals of milks and cheeses were quantitated by an Inductively Coupled Plasma Optical Emissions Spectrometer (Thermo Jarrel Ash Enviro 36, Worcester, MA), using argon as the carrier gas and the EPA method 6010. The maximum fat reduction in caprine cheeses was only 21.4%, from 28 % to 22% (FF vs. RF). Mean major mineral contents (ppm, wet basis) of the RF and FF milks were: Ca 1004, 1128; P 834, 945; K 1198, 1102; Mg 114, 132; and Na 456, 509, while mean trace mineral contents (ppm) of the two treated milks were: Fe 0.786, 0.892; Mn 0.038, 0.075; Cu 6.25, 6.24; and Zn 6.94, 7.24, respectively. For the corresponding RF and FF goat cheeses, the mean major mineral (ppm) were: Ca 9242, 8662; P 6011, 5613; K 1300, 1173; Mg 569, 527; Na 3105, 3035, while mean trace mineral (ppm) were: Fe 13.34, 14.45; Mn 0.559, 0.913; Cu 22.03, 24.06; Zn 38.54, 44.22, respectively. There were no differences in major mineral levels between RF and FF cheeses. However, Ca:P ratio of both RF and FF cheeses were greater than those of milks (1.53 vs. 1.20), indicating Ca was retained more than P in cheese compared to the original milk. Cu and Zn contents of milk and cheeses were higher than those of other reports. Mo content of FF cheese was greater than RF cheese, suggesting that fat globule membrane-bound xanthine oxidase was higher in FF than RF cheeses.

Key Words: Reduced-Fat, Goat Milk Cheese, Mineral Composition

T41 The effect of aging on low, reduced, and full fat cheddar cheese on texture. N. R. Rogers*, M. A. Drake, and E. A. Foegeding, *North Carolina State University, Raleigh*.

There is a desire to produce low fat cheese with textural and flavor properties similar to full fat cheeses. Towards that end, a systematic study

of textural and flavor changes was initiated. This report will address the changes in textural properties. Cheddar cheeses with full (32%) reduced (16%) or low (6%) fat were prepared and aged at 8°C for 9 months at Utah State University. The cheeses were sampled initially at 2 weeks, followed by points at 3, 6, and 9 months. At each time point, cheeses were assessed by a trained texture panel as well as rheological tests that determined fracture properties at three different strain rates, creep/recovery tests, stress sweeps to determine the linear viscoelastic region, and a pressure sensitive tack test using a dental composite probe.

At the initial time point, the low fat cheeses and full fat cheeses were very similar in texture, with the low fat cheeses being slightly more deformable and cohesive ($p < 0.05$). As the cheeses aged, the low fat cheeses lost firmness but maintained their springy texture. The full fat samples also had decreased firmness, but unlike the low fat samples, lost their springiness. Chewdown sensory properties, such as smoothness and cohesiveness, increased in all cheeses with aging; however, the changes in these properties were much greater in full fat as compared to low fat cheeses. During storage, the greatest differences across all cheeses were seen in the first 3 months. Changes over 3 to 9 months were in a similar direction but at a slower rate. The rheological tests conducted also showed that the low fat cheeses were more elastic and deformable than the full fat. Also, similar relative magnitudes and rates of changes were seen in the instrumental analysis as in the sensory.

Low fat Cheddar cheese started out with a similar texture to full fat cheeses; however, within the first three months, changes occurred that resulted in distinctively different textures for low fat and full fat cheeses.

Key Words: Lowfat, Cheese, Rheology

T42 Survey of the fatty acid profile including *cis-9*, *trans-11* conjugated linoleic acid of some Oklahoma cow cheeses. G. Davila El Rassi* and V. Banskalieva, *Oklahoma State University, Stillwater.*

Although Oklahoma cheeses (OKCh) are very well accepted by consumers, no information concerning their fatty acid composition (FAC) was available. The objective of this survey was to study the FAC, particularly the content of the beneficial *cis-9*, *trans-11* conjugated fatty acid (CLA) of OKCh and to compare to some non-OKCh. Fifteen OKCh, Christian: Cheddar Raw Milk and Cheddar Cowboy; Hardesty: Cheddar, Mozzarella and Pepper Jack; Lovera: Caciocavallo; Swan Brothers: Mozzarella Part Skim Milk, Colby Pasteurized Milk, Colby Raw Milk, Sharp Cheddar Pasteurized Milk (SCPM), Sharp Cheddar Raw Milk, Mild Cheddar Pasteurized Milk, Mild Cheddar Raw Milk (MCRM) and Cheddar Hot Pepper Pasteurized Milk; Watonga: Long Horn, and nine non-OKCh: Munster, Baby Swiss, Colby Jack (CJ), Parmigiano Reggiano, Mild Brick, White Cheddar, Sharp Cheddar, Extra Sharp Cheddar and Medium Cheddar were included in this study. The average percentage of saturated (SFA) and monounsaturated fatty acids was not different between non-OKCh and OkCh. In non-OKCh the percentage of cholesterol raising SFA was between 36 and 49%, whereas in OKCh it was between 31 and 42%. The n-6 PUFA/n-3 PUFA ratio varied between 2.1-4.6 and 2.8-5.0, respectively for non-OKCh and OKCh. The proportions of CLA ranged between 0.49 and 0.63% for non-OKCh, whereas in OKCh the proportions of CLA ranged between 0.64% (four cheeses) to 0.83 -1.23% (eleven cheeses). The CLA content in the OKCh was between 4.1 and 11mg/g lipid; the lowest - in Hardesty (4.1-4.8 mg/g lipid) and the highest - in SCPM, MCRM and the two Christian (9.6, 10 and 10.7-11, mg/g lipid, respectively). In non-OKCh the average content of CLA was 5.14 (mg/g lipid), with extreme values for Muenster and CJ

(0.96 and 8.6 mg/g lipid). Across all studied cheeses, a linear positive relationship between *trans-11* C18:1 and *cis-9*, *trans-11* CLA was found. The data obtained show that the FAC and CLA contents of OKCh were in the same range or even better than some of the non-OKCh.

Key Words: Cheese, Fatty Acid, *cis-9*, *trans-11* CLA

T43 Mapping consumer preferences for mild cheddar cheese. S. L. Drake*¹, P. D. Gerard², and M. A. Drake¹, ¹*North Carolina State University, Raleigh*, ²*Clemson University, Clemson, SC.*

Cheese consumption in the United States has tripled in the past thirty years with Cheddar cheese accounting for 4.5 kg per capita in 2005. Flavor is an important factor in consumer selection of cheeses. Mild Cheddar cheese is the classification used to describe Cheddar cheese that is not aged extensively and has a "mild" flavor. In contrast Cheddar cheese labeled as "sharp" is expected to have a stronger flavor and may be more aged. However, there is no legal definition or age limit for Cheddar cheese to be labeled mild, medium, or sharp, nor are the flavor profiles or flavor expectations of these cheeses specifically defined. Little research has focused specifically on mild Cheddar cheese flavor, but studies with Cheddar cheeses suggest that a diverse array of flavors and flavor intensities may be preferred by consumers. The objectives of this research were to document the distinct flavor profiles among commercially labeled mild Cheddar cheeses, and to determine if diverse consumer segments existed for these mild Cheddar cheese flavors. Descriptive sensory profiles of a representative array of mild-labeled Cheddar cheeses ($n = 22$) were determined using a trained sensory panel and an established cheese flavor sensory language. Nine representative Cheddar cheeses were selected for consumer testing. Consumers ($n = 215$) assessed the cheeses for overall liking and other consumer liking attributes. External preference mapping, cluster analysis and discriminant analysis were conducted on the collected data. Mild Cheddar cheeses were diverse in flavor with many displaying flavors typically associated with more age (sulfur, brothy, nutty flavors). Four distinct consumer clusters were identified. The key drivers of liking for mild Cheddar cheese were: color, cooked/milky, whey and brothy flavors and sour taste. An orange color was preferred by three of the four consumer segments. Mild Cheddar cheese acceptance varies among consumers but consumers have distinct preferences for specific flavor profiles and color. These results can help manufacturers understand consumer preferences for mild Cheddar cheese.

Key Words: Cheddar Cheese, Consumer Preferences, Mapping

T44 Manufacture of cheddar cheese with added sodium gluconate. C. Phadungath*¹ and L. E. Metzger², ¹*University of Minnesota, St Paul*, ²*South Dakota State University, Brookings.*

During the aging process of hard-type cheese especially Cheddar cheese, small white spots that can be seen often without magnification, can appear within and on the surface of cheese between two and six months of aging. The crystals have previously been identified as calcium lactate crystals (CLC). One approach to preventing CLC is to add sodium gluconate to the cheese during salting. Sodium gluconate increases the solubility of calcium and/or lactate in the cheese serum phase. The objective of this study was to determine the manufacture

and composition of Cheddar cheeses with different levels of sodium gluconate addition. Six Cheddar cheeses with two levels of salting (2 and 2.5%) and three sodium gluconate addition levels (0, 0.5 and 1%) were manufactured. All cheeses were made using a stirred-curd procedure and replicated three times. Two salting rates were obtained by dividing cheese curd (at pH 5.6) into two equal-weight halves; each half was salted with 2 and 2.5% (by weight of cheese curd) sodium chloride. In order to obtain six treatments, each of the salted halves was separated into three equal-weight batches and mixed with 0 (control), 0.5, and 1.0% sodium gluconate, respectively. After sodium gluconate addition, the curds were hooped, pressed for 16 hour, vacuum-sealed in polyethylene bags, and transferred to a ripening room at 6 to 8°C. After 1 week of storage, compositional analyses (pH, moisture, salt, fat and protein) and gluconic acid concentration were determined. Mean pH, moisture, salt, fat and protein content of the cheeses ranged from 5.06 to 5.32, 36.98 to 38.15%, 1.65 to 2.13%, 30.96 to 32.98%, and 25.6 to 26.1%, respectively. At both salting levels, the pH and moisture contents were significantly ($p < 0.5$) increased in the treatments with added sodium gluconate. The concentration of gluconic acid in the low salt treatments was 0.26 and 0.61% for the 0.5 and 1.0% addition level, respectively, whereas the concentration in the high salt levels was 0.32 and 0.51%, respectively.

Key Words: Cheddar Cheese, Calcium Lactate Crystals, Sodium Gluconate

T45 Changes in residual sugar and water-soluble organic acids during ripening of Cheddar cheese with added sodium gluconate. C. Phadungath*¹ and L. E. Metzger², ¹University of Minnesota, St Paul, ²South Dakota State University, Brookings.

During Cheddar cheese ripening, lactose is converted to glucose and galactose or galactose-6-phosphate by starter and non-starter lactic acid bacteria. These sugars are primarily converted into lactic acid during the manufacturing process. However, under stressed condition (low pH and high salt) present during cheese ripening, bacteria utilize alternative pathways, which can result in formation of various organic acids. The objective of this study was to determine if the level and type of residual sugar and organic acids produced during ripening was impacted by sodium gluconate addition to Cheddar cheeses. Six cheeses with two salting rates (2 and 2.5%) and three sodium gluconate addition levels (0, 0.5 and 1%) were manufactured. The cheeses were analyzed for residual sugar (lactose) and water-soluble organic acids (acetic, butanoic, citric, formic, gluconic, lactic, orotic, propanoic, and uric) at 1-week, 3-month and 6-month of ripening by using a cation-exchange-column HPLC externally equipped with a refractive index detector. The organic acids were detected using the UV detector set at 210 and 285 nm, and the refractive index was used for quantification of carbohydrates. The results indicated that at 1-week of ripening, Cheddar cheeses with a higher concentration of gluconic acid had significantly lower concentration of lactic acid ($p < 0.05$), but significantly higher concentration of lactose ($p < 0.05$), while there was no differences ($p > 0.05$) in acetic, butanoic, citric, formic, orotic, propanoic and uric acids among treatments at all ripening times. The concentrations of butanoic and propanoic acids gradually increased over time ($p < 0.05$) in all treatments, whereas the concentrations of orotic acid and lactose gradually decreased over time ($p < 0.05$). Minor changes in the levels of acetic, citric, formic, lactic, and uric were also observed throughout ripening in all treatments.

Key Words: Cheddar Cheese, Organic Acids, Cheese Ripening

T46 Flavor chemistry of cheddar cheeses with varying fat contents. R. E. Miracle*¹, D. J. McMahon², and M. A. Drake¹, ¹North Carolina State University, Raleigh, ²Utah State University, Logan.

A current industry goal is to produce a 75 to 80 % fat reduced Cheddar cheese that is tasty and appealing to consumers. Despite previous studies on reduced fat cheese, information is critically lacking in understanding the flavor chemistry of reduced and low fat Cheddar cheeses and how it differs from its full fat counterpart. Specific knowledge of the nature of these differences could lead to identification of methods to enhance or minimize formation of specific key flavor compounds. The objective of this study was to characterize volatile compound changes with fat reduction in Cheddar cheeses. Cheddar cheeses with 5, 16, or 32% fat (wet weight) were manufactured in triplicate with a single strain starter culture and ripened for 2 weeks, 3 mo, 6 mo and 9 mo. At each timepoint, volatile components were extracted by solid phase microextraction (SPME) and by solvent assisted flavor evaporation (SAFE) followed by gas chromatography mass spectrometry (GC-MS) for compound identification. Gas chromatography-olfactometry (GC-O) with aroma extract dilution analysis (AEDA) was also applied to identify aroma-active volatile components. More than 45 aroma-active compounds were characterized in the cheeses by GC-O. Free fatty acids (butyric, hexanoic, nonanoic, and decanoic), furaneol, sotolon and saturated hydrocarbons were present at higher concentrations in low fat cheeses compared to full fat Cheddar cheeses while lactones (gamma nonalactone, gamma decalactone, delta decalactone) were predominant in full fat cheeses. The volatile components of low fat Cheddar cheeses were distinct from full fat cheeses.

Key Words: Cheese Flavor, Flavor Chemistry, Low Fat

T47 Development of cholesterol-reduced block type process cheese made by crosslinked β -cyclodextrin. S. Y. Kim, E. K. Hong, and H. S. Kwak*, *Sejong University, Seoul, Korea.*

The present study was carried out to examine the physicochemical and sensory properties in cholesterol-reduced block type process cheese made by crosslinked β -cyclodextrin (β -CD). For process cheese manufacture, 82% of aged Cheddar cheese, 10% butter, 3% emulsifying salts, 5% skim milk powder and 10% water were added in the cooker. The raw materials were heated at 85°C with a rotary agitation of 500 rpm for 3 min. The composition of process cheese treated by crosslinked β -CD was similar to the control and cholesterol removal reached 91.0%. No significant difference was found in total short-chain free fatty acids between groups. All color values were significantly lower in cholesterol-reduced process cheese than those in the control. All rheological properties except brittleness in the cholesterol-reduced process cheese were not significantly different from those in the control. Most of sensory properties were similar between cholesterol-reduced and the control cheeses. In the cholesterol-reduced process cheese, yellowness was significantly lower, while crumbly texture was significantly higher compared with the control. The overall acceptability score of cholesterol-reduced cheese was significantly higher than that of the control. Based on these results, no profound difference was found in most physicochemical and sensory properties between cholesterol-reduced block type process cheese and the control. Therefore, this study may suggest the possibility to develop the cholesterol-reduced block type process cheese using crosslinked β -CD.

Key Words: Block Type Process Cheese, Crosslinked β -cyclodextrin, Cholesterol Removal

T48 Physicochemical and rheological characterization of cream cheese made from freeze-dried milk powder. S. H. Kim, S. Lee, and H. S. Kwak*, *Sejong University, Seoul, Korea.*

Cream cheese was produced from freeze-dried milk powder milk (FDMP) through a continuous multi-stage process and its physicochemical and rheological properties were characterized. The composition of the FDMP cream cheese was 56.03% moisture, 33.12% fat, and 7.97% protein which was comparable to that of the commercial cream cheese made from raw milk. A slight increase in specific gravity was observed in the FDMP cream cheese while there was no significant difference in color between the samples made from FDMP and raw milk. Furthermore, the viscoelastic properties of FDMP cream cheese were investigated by using dynamic shear measurements. When a strain sweep test was performed at a fixed frequency of 1Hz, the cream cheese sample exhibited the linear viscoelasticity within a strain of 0.005%. In a frequency sweep test, both storage (elastic) and loss (viscous) moduli increased with increasing frequency, showing weak gel-like behaviors. Also, the viscoelastic properties of FDMP cream cheese exhibited temperature-dependence. Even, the storage moduli measured at 5°C were almost an order of magnitude higher than those at 25°C. Thus, the results indicated that the FDMP cream cheese had similar composition and physicochemical properties to the cream cheese made from raw milk. In addition, it was shown to rheologically behave like a weak-gel.

Key Words: Cream Cheese, Freeze-Dried Powder Milk, Rheology

T49 Effects of manufacturing parameters on the chemical, functional, and rheological properties of Queso Chihuahua. D. L. Van Hekken*, M. H. Tunick, R. Kwoczek, J. J. Shieh, and P. M. Tomasula, *USDA-ARS, ERRC, Wyndmoor, PA.*

The quality variations noted among Queso Chihuahua, a semi-hard cheese made in northern Mexico traditionally from raw milk, are due to the diverse manufacturing conditions used to make the cheese, the compositional and microbiological differences in the cheesemilk, and heat treatment (raw versus pasteurized). In this study, we examined the effects of manufacturing parameters on the chemical, functional, and rheological properties of Queso Chihuahua made with pasteurized milk in order to identify the processing steps that result in cheese with properties similar to that of the traditionally made raw milk cheese. Based on the results of our earlier survey of manufacturing protocols and quality traits of Queso Chihuahua made in Mexico, we manufactured 36 2-kg blocks of cheeses using different cooking temperatures (32, 38, or 44°C), pH at the time of drain (6.0 or 6.3), and overnight pressing pressures (0.96 or 1.9 kPa). Temperature during the cooking step and pressure used in overnight pressing significantly influenced the moisture, protein, salt, and ash content of the cheese as well as the hardness, chewiness, and shear stress, strain and rigidity at the point of fracture. Pressing pressure affected lactose content of the cheese and its viscoelastic properties while cooking temperature impacted the pH of the final cheese. All cheeses had excellent melt properties. Queso Chihuahua cheeses made with pasteurized milk and cooked at 38°C, drained of whey at either pH 6.3 or 6.0, and pressed overnight at 1.9 kPa, were the closest in compositional, functional, and rheological properties to the raw-milk cheeses. This study demonstrates that through careful selection of manufacturing conditions cheese makers will be able to develop pasteurized versions of Queso Chihuahua that mimic the traditionally-made cheeses.

Key Words: Cheese, Queso, Manufacture

T50 Characterization of organic acid and carbohydrate profiles of commercial Swiss cheese samples. H. Zhang* and L. E. Metzger, *South Dakota State University, Brookings.*

The objective of this study was to characterize the profiles of organic acids and carbohydrates in Swiss cheese. Ten commercial Swiss cheese samples from five companies were collected from local grocery stores (Brookings, SD). Cheese samples were extracted with 0.013N H₂SO₄ at 65°C using a high-shear mixer-homogenizer. A high performance liquid chromatograph method with a photodiode array detector set at 210 and 285nm and refractive index detection was employed to simultaneously analyze short-chain, water soluble organic acids and carbohydrates in the cheese samples. Rezex ROA-organic acid H⁺ column (300×7mm, 8 μm, Phenomenex) was used for the separation and isocratic elution was achieved using a mobile phase of 0.013N H₂SO₄ aqueous solution at a flow rate of 0.6 mL per minute. Lactic, acetic, propanoic, butanoic, citric, pyruvic, succinic acid, isovaleric (3-methylbutanoic) acid, and glycerin were detected in all ten Swiss cheese samples. However, their concentrations (g/100g cheese) were varied; the respective ranges for the compounds mentioned above were 0.0506-0.1479, 0.0272-0.1877, 0.0160-1.4185, 0.1804-0.3208, 0.4848-1.5903, 0.0553-0.1476, 0.0259-0.1072, 0.1394-0.5071, and 0.3694-0.8980. Galactose was detected in nine of the ten samples, and samples that had a higher concentration of galactose also had a higher concentration of pyruvic acid. Lactose was detected in five samples and the concentrations ranged from 0.0304 to 0.0958. Formic acid and 2-methylbutanoic acid were only detected in three samples and their concentrations ranged from 0.1065 to 0.1669 and from 0.1095 to 0.1445 respectively. These results and the well-documented organoleptic diversity of Swiss cheese warrant further investigation to determine the association between flavor attributes and organic acid and carbohydrate profiles as well as their relationship to consumer preferences of Swiss cheese.

Key Words: Swiss Cheese, Organic Acids, HPLC

T51 Surface roughness affects the formation of calcium lactate crystals on Cheddar cheese. P. Rajbhandari*, C. Ogg, and P. S. Kindstedt, *University of Vermont, Burlington.*

Calcium lactate crystals that sometimes form on Cheddar cheese surfaces are a significant expense to manufacturers. Previous researchers have identified several ost-manufacture conditions such as storage temperature and packaging tightness that contribute to crystal formation. Anecdotal reports suggest that physical characteristics at the cheese surface, such as roughness, cracks, and irregularities, may also affect crystallization. The aim of this study was to evaluate the combined effects of surface roughness and packaging tightness on crystal formation. Four 25 mm-thick cross-section specimens were cut perpendicular to the long axis of a retail block (ca. 300 g) of smoked Cheddar cheese using a wire cutting device. One cut surface of each specimen was lightly scored with a cheese grater to create a rough, grooved surface; the opposite cut surface was left undisturbed (smooth). The four specimens were vacuum packaged at 10, 100, 500, 900 mbar (extremely tight to extremely loose, respectively) and stored at 1°C. Digital images were taken 1, 4 and 8wk following the first appearance of crystals. Area occupied by crystals and number of discrete crystal regions (DCR) were quantified by image analysis. The experiment was conducted in triplicate. Effects of storage time, packaging tightness, surface roughness and their interactions were evaluated by Repeated Measures ANOVA. Surface roughness, packag-

ing tightness, storage time and their two-way interactions significantly affected crystal area and DCR number. Extremely heavy crystallization occurred on both rough and smooth surfaces when packaged loosely (500 and 900 mbar), and on rough surfaces with slightly loose packaging (100 mbar). In contrast, the combination of rough surface plus very tight packaging (10 mbar) resulted in dramatic decrease in crystal area and DCR number. The combination of smooth surface plus very tight packaging virtually eliminated crystal formation by eliminating available sites for nucleation. The data suggest that the cut-and-wrap step in commercial Cheddar cheese production is a critical control point for crystal formation.

T52 Influence of native casein concentrates on process cheese texture. P. Salunke* and L. E. Metzger, *South Dakota State University, Brookings.*

Milk Protein Concentrate (MPC) produced with an ultrafiltration based process is commonly used in process cheese product formulations. However, the use of MPC can result in various texture defects including a soft body and restricted melting characteristics. These texture defects are believed to be related to the substantial amount of the whey proteins present in MPC. Recently, Native Casein Concentrate (NCC) produced in a microfiltration based process has been developed. NCC is similar to MPC except a portion of the whey protein is removed. The objective of the current study was to determine the impact of NCC on the texture of process cheese. Three replicates of process cheese product formulations were produced from three different batches of NCC and MPC. Each formulation was standardized to 25.0 % fat, 1.89% salt, 44.0% moisture and 17.0% protein. In each formulation the MPC or NCC utilized contributed 10.5% protein. Other ingredients in the formulation included water, butter, cheddar cheese, deproteinised whey, salt, lactic acid, disodium phosphate and sodium citrate. Each formulation was manufactured in Rapid Visco Analyzer (RVA). In the RVA the blend of ingredients was mixed at 1000 rpm and heated to 95°C in two minutes. Subsequently the cheese was mixed at 160 rpm for a minute. The cheese was then transferred to electroplated copper molds and cooled overnight at 4°C. After cooling five samples of each formulation were evaluated using Texture Profile Analysis (TPA) at 25°C. The hardness, springiness, gumminess and chewiness of the process cheese product were significantly increased with the NCC formulation. The mean value of the three NCC replicates was 5002g, 0.124, 728g, 92g.sec whereas the mean values for the MPC replicates was 3319g, 0.085, 488g, 42g. sec respectively for hardness, springiness, gumminess, chewiness. The results demonstrate that the texture of process cheese products can be modified with the use of NCC.

Key Words: Process Cheese, Native Casein Concentrate, Rheology

T53 The effect of culture combinations on swiss cheese flavor quality. N. A. Kocaoglu-Vurma*¹, A. Eliardi¹, M. A. Drake², L. E. Rodriguez-Saona¹, and W. J. Harper¹, ¹*The Ohio State University, Columbus*, ²*North Carolina State University, Raleigh.*

Propionibacterium freudenreichii is mainly responsible for eye formation and also is a major contributor to the flavor of Swiss cheese. *Lactobacillus helveticus*, in turn, influence the growth and fermentation products of *Propionibacteria*. A better understanding of the effect of such interactions between different strains of the starter cultures on commercial product

quality is useful for industrial culture selection. The objective of this study was to evaluate the effect of culture combinations on the quality of Swiss cheese manufactured under commercial conditions.

Cheeses were produced by four commercial Swiss cheese manufacturers using two different culture combinations. Cultures consisted of the same *P. freudenreichii* and *Streptococcus thermophilus* strains, but varied in the type of *Lactobacillus helveticus* strain (LSA and LSB). Cheese samples were evaluated right out of warm room, at 4 months, and 7 months after the manufacture for bacterial counts, and mid-infrared (MIR; 4000-700 cm⁻¹) spectroscopy. The cheeses were also profiled by a trained sensory panel at 7 months after manufacture. At the end of warm room, there were no differences in *Propionibacteria*, and *S. thermophilus* counts, however total *Lactobacillus* counts were approximately 1 log CFU/g lower in cheeses manufactured with *L. helveticus* LSA. The infrared analysis allowed classification of samples by manufacturer, and culture combinations. The wavenumber 1122 cm⁻¹, corresponding to S-O vibration modes, was shown to give the highest discrimination when samples were classified by manufacturer. For cheeses produced by a single company, the wavenumbers 1330-1377 cm⁻¹ contributed highest to the discrimination of cheese samples by culture combination. The sensory descriptors, vinegar, dried fruit, and cabbage received higher scores when *L. helveticus* LSA was used. The attributes fresh fruit, butyric, and metallic were not detected in any of the samples. The study of culture interactions under commercial manufacturing conditions provides a basis for the selection of starter strains for industrial applications, as the product quality is determined by both the starter cultures and manufacturing conditions.

Key Words: Swiss Cheese, Spectroscopy

T54 Iodine content in sheep and goat cheese produced in Sardinia (Italy). G. Pulina*^{1,3}, F. Aghini-Lombardi², M. Frigeri², G. Battacone¹, R. Rubattu¹, G. Garzella², L. Grasso², and A. Nudda¹, ¹*University of Sassari, Sassari, Italy*, ²*University of Pisa, Pisa, Italy*, ³*AGRIS Sardegna, Olmedo Loc. Bonassai, Sassari, Italy.*

Iodine deficiency disorders have been described in several surveys conducted in European countries. Dairy products could be a valuable source to increase iodine intake in human diet. The aim of this study was to evaluate the iodine content in sheep and goat cheese produced in the Sardinia region (Italy). Cheese samples (n. 23 and n. 49 from sheep and goat milk, respectively) from 9 dairies located in different areas of Sardinia were collected at different months of production (from December to July). Iodine concentration of cheese was determined, after alkaline mineralization, using the Sandell-Kolthoff reaction.

The iodine concentration averaged 23.02 µg/100 g (ranging from 8.03 to 52.84 µg/100 g) in sheep cheese and 21.71 µg/100 g (ranging from 10.57 to 73.95 µg/100 g) in goat cheese. The iodine content did not differ between sheep and goat cheese (P = 0.73).

The iodine concentration was significantly influenced by season. In both species the highest iodine concentration was found in cheese produced during winter months (26.33 and 38.90 µg/100 g in sheep and goats, respectively) compared to spring months (21.13 and 14.23 µg/100 g in sheep and goats, respectively) and summer months (20.61 and 17.42 µg/100 g in sheep and goats, respectively). A significant effect of the different dairies on iodine concentration has been observed (P<0.01).

In conclusion, these preliminary results suggest that the iodine concentration in cheese from sheep and goats milk: a) did not differ between the two species; b) varied markedly with season, being higher in winter; and c) was too poor to provide an adequate iodine intake, even if dairy

products are second only to fish as suppliers of iodine in human diet. *Acknowledgements: Research supported by the Ministry of University and Research (FISR grant).*

Key Words: Iodine, Cheese, Sheep and Goat

T55 Three-dimensional microscopy using stereoscopy applied to scanning electron microscopy imagery. M. Caccamo*¹, G. Impoco², L. Tuminello¹, and G. Licitra^{1,3}, ¹CoRFiLaC, Regione Siciliana, Ragusa, Italy, ²IPLAB, Catania University, Catania, Italy, ³D.A.C.P.A., Catania University, Catania, Italy.

Scanning electron microscopy (SEM) is a powerful tool to study cheese microstructure. Although providing high resolution digital scanning, SEM flattens the 3D scanned surface and therefore does not allow direct in-depth measurements. Stereoscopy mimics the features of the human visual system by reconstructing 3D information from 2D images. Recovering depth is based on the parallax between corresponding points in different images. These algorithms and the underlying equations have been tailored to optical cameras, but are also valid for SEM imagery, the SEM image formation being approximately the same as that of a thin lens. Two kinds of cheese texture, pressed and pasta filata, were analyzed using stereoscopy. Several SEM images of each sample were taken with a small displacement (0.03mm vertically, 0.04mm horizontally) at 1000× magnification. Scans were automatically aligned, such that the structures in small overlapping areas matched between different images. 3D models of the scanned surface were generated using a software that mimics human binocular vision. Results were not satisfactory mostly due to sensor noise and to the lack of well-recognizable objects in the scene. Two experiments were designed to improve the quality of the 3D models: i) displacement with respect to the specimen plane, and ii) tilting of the specimen mount. In the first experiment, the specimen mount was displaced and a series of overlapping images was acquired. We used small displacements to correlate corresponding images and large displacements for 3D reconstruction to enlarge the parallax effect. This choice improved the output 3D models. Displacement values given by the SEM device and needed for reconstruction were not accurate enough. Values were corrected via software to obtain robust metric measurements. The second experiment employed only tilting of the specimen mount. A small angle was preferred to avoid losing track of the surface features. Both methods yielded better results than arbitrary specimen orientation. Reconstructed 3D surfaces showed the possibility to perform direct metric measurements of the surface of the specimen.

Key Words: Electron Microscopy, Microstructure, Stereoscopy

T56 Prediction of curd moisture content by near infrared light scattering over a range of stirring speed and cutting intensity during cheese-making. M. J. Mateo*¹, D. J. O'Callaghan¹, C. D. Everard¹, C. P. O'Donnell², C. C. Fagan², M. Castillo³, and F. A. Payne³, ¹Moorepark Food Research Centre, Teagasc, Fermoy, Cork Ireland, ²University College of Dublin, Dublin, Ireland, ³University of Kentucky, Lexington.

Every cheese has a specification regarding its optimum content of moisture which relates to the final quality of cheese. This crucial parameter determines the shelf-life of the cheese. If the moisture content is higher

than the standard the cheese will be more perishable and will be less acceptable to the consumer. On the other hand, cheeses having less moisture than the standard are more costly to produce. An online fiber-optic light backscatter sensor is being investigated for better control of curd moisture content. The aim of this study was to evaluate light backscatter at 980 nm during syneresis to improve the prediction of curd moisture content under the influence of two experimental variables namely stirring speed and cutting intensity.

The experiment was performed using three stirring speeds (10, 16 and 22 rpm) and three gel cutting intensities (4.2, 8.3 and 12.5 total revolutions), with three replicates (n = 27). The trials were carried out using recombined whole milk in an 11 L double-O cheese vat, in which the light backscatter sensor was installed. The milk was coagulated under constant conditions at pH 6.5 and 32°C. Samples for determining curd moisture content were taken from the cheese vat at 10 min intervals up to t = 75 min.

A linear model was developed for predicting Mc with five significant (P < 0.001) distinct terms, i.e. light backscatter ratio, time after cutting, stirring speed, milk fat content and cutting intensity (SEy = 1.10 g/100g, R² = 0.83).

These results showed the potential of the light backscatter syneresis sensor technology to predict curd moisture content changes during syneresis in the cheese vat under a wide range of stirring speeds and cutting intensities, but in-plant calibration would be required to take account of technological factors.

Key Words: Curd Moisture Content, Light Scattering, Prediction

T57 Effect of various starches on the properties of a processed Swiss-type cheese product. M. C. M. Soledad* and W. J. Harper, *The Ohio State University, Columbus.*

The study explores the possibility of using starch as an ingredient in processed cheese products. Starches are versatile food ingredients which open opportunities for cost and fat reduction, and, control of textural and melting properties. The study aimed to evaluate the effect of various starches on the properties of a processed Swiss-type cheese product and differentiate them based on flavor profile. A Stephan UMC5 processed cheese maker was used to prepare the samples composed of natural Swiss cheese, water, starch, disodium phosphate, lactic acid, and trisodium citrate. Eight starches were compared with a control (without starch), consisting of four native starches, namely: waxy corn, potato, tapioca, and wheat; and, four modified starches, namely: acid-modified dent corn, instant waxy corn, blend of hydroxypropylated and oxidized potato, and thin-boiling potato. Samples were evaluated for texture (texture profile analysis, TPA) and melting behavior (modified Schreiber test). TPA results suggest that starch addition may significantly increase hardness and chewiness. The control had an average hardness value of 385g whereas, 800-2200g for those made with various starches. The average chewiness value of the control was 187 whereas, 440-1400 for those made with various starches. Modified Schreiber test results suggest that starch addition may significantly reduce the spread during melting. The average increase in cheese disc circumference of the control was 122mm whereas those made with the various starches were in the range of 50-100mm. Fourier transform infrared spectrometry coupled with multivariate analysis was used to differentiate the samples based on water-soluble flavor compound profile which provided information on possible differences in ingredient interaction based on the starch

used. This study may contribute to the formulation of processed cheese products and elucidate the effect of varying the type of starch on its properties.

Key Words: Starch, Processed Cheese, Texture

T58 Influence of comminuting curd on curd particle size, moisture content and cohesiveness of 50%-reduced fat cheddar cheese.

D. J. McMahon* and C. Brotherson, *Utah State University, Logan.*

Comminuting cheese curd can be used as a tool for incorporating value-added ingredients into cheese without adversely affecting the whey generated during cheesemaking. Such a reduction in curd particle size does, however, change the physical properties of the cheese and expulsion of whey during pressing. We investigated the influence of comminuting reduced fat cheddar cheese curd on particle size, moisture retention during pressing, and cohesiveness of the resultant cheese. A 50%-reduced fat cheddar cheese was made using a stirred curd method and after salting, 30-lb batches of curd were comminuted in a bowl chopper for 15, 30 or 45 s. Samples of comminuted curd were mixed with an anti-caking agent and passed through a sieve stack with openings from 12.5 to 1 mm. Other portions of the curd were placed in round plastic hoops and pressed at either 35 or 70 kPa for 2, 4, 8 or 20 h. Cheeses were then vacuumed packaged and stored at 6°C and texture profile analysis performed at 1, 3, 6, 10, 15, 30 and 60 d. Non-comminuted curd had a broad size distribution of 1 to 9.5 mm with most of the curd particles being collected on the 2, 4 and 6.3 mm mesh sieves. Chopping for 15 s reduced the particle size to 1 to 4 mm (most of curd being collected on the 2 mm mesh sieve). Further chopping reduced particle size to 1 to 2 mm. Whey expulsion during pressing was retarded in comminuted cheese curd and after 20 h the experimental cheeses contained more moisture (49.1%) than the control cheese (47.4%). After pressing (d 1) the control cheese had 49% cohesiveness while cheeses made from comminuted curd had only 30% cohesiveness. During storage, cohesiveness increased for all cheeses; to 68% by d 15 for the control cheese, while the experimental cheeses initially decreased through d 5 before increasing to 41 to 50% by d 30. Thus, comminuted curd particle knitting is delayed during the initial storage period, but increases proportionally during storage. This may be an advantage in reduced fat cheeses that have a tendency to be more rubbery than full fat cheeses.

Key Words: Cheese, Curd Size, Cohesiveness

T59 Preparation of low fat fresh panela type cheese with ω -3 fatty acid. E. Paz-Gamboa*¹, M. Montero-Lagunes³, S. Cruz-Díaz¹, M. Esquivel-Vera¹, H. S. García-Galindo², C. E. Martínez-Sánchez¹, and E. Herman-Lara¹, ¹*Instituto Tecnológico de Tuxtepec, Tuxtepec, Mexico*, ²*Instituto Tecnológico de Veracruz, Veracruz, Mexico*, ³*Campo Experimental la Posta, Veracruz, Mexico.*

Fresh panela cheese is a product with a high consumption in Mexico, thus it is desirable to improve its nutritional value. In addition, the ω -3 fatty acids have demonstrated benefits to the human health. The docosahexaenoic acid (DHA) is a component of the ω -3 fatty acids and it is important during the fetal development, childhood, and the adult age. However, this component is limited in some foods. Therefore, the objective of this work was to produce a fresh low fat cheese added with DHA and to evaluate its physical-chemical, microbiological and sensory properties.

Panela was elaborated with fat milk concentrations of 1.5 and 2.5 % and 30, 45, and 60 mg/30 g Martek DHA™, respectively. For each treatment, a control cheese was used. Moisture, ash, protein, and fat contents were evaluated. The retention level of DHA was measured by means of gas chromatography. A microbiological test was conducted in order to monitor for the presence of *Salmonella*, *Staphylococcus aureus*, and total coliforms. Additionally, a triangular test with a trained panel was established for the sensory analysis.

Results showed that the addition of DHA did not affect significantly the physical-chemical composition of the cheese when compared with the control product ($P < 0.05$). A retention level of DHA of 3.4165 to 5.4706 mg/g fat was obtained for all the treatments. However, the product elaborated with 1.5% fat milk and the addition of 45 mg of DHA gave an average retention of 5.4706 mg/g fat, thus this treatment was judged as the best option for the enrichment process. The microbiological analysis according to the NOM-121-SSA1-1994 satisfied the sanitary quality. The sensory evaluation demonstrated that cheese with added DHA did not produce odd flavors.

This research demonstrated that there is an alternative to consume a cheese with a high nutritive value and a methodological base for developing new products.

Key Words: Cheese, ω -3 Fatty Acid, Low Fat

Extension Education

T60 Management practices used in Alabama beef production I: Impact of herd size. W. F. Owsley*, J. B. Elmore, M. F. Elmore, L. A. Kriese-Anderson, W. C. Rutherford, S. V. Free, and L. S. Saunders, *Auburn University, Auburn, AL.*

In the spring and fall of 2007, producers attending two state-wide producer meetings and 21 of the 27 Alabama livestock markets were asked to participate in a survey to assess the level of management on Alabama beef farms. A total of 699 surveys were completed. Survey responses were entered in spreadsheet format, and sorted by the cow inventory: <10, 10-30, 31-50, 51-100, 101-150, 151-250, >250. Over 90 percent of farms in each category were cow/calf. Of the farms reporting 51-250 cows, 15 percent also stockered calves, compared to 34 percent for over 250 cows. Nineteen percent of the farms with <250 cows expected to receive over 50 percent of their income from cattle, compared to 73 percent of farms over 250 cows. Most farms surveyed (59%) calved year-round or had a split calving season. As herd size increased, the number of farms working calves increased. Vaccinations and deworming were the most observed management practices on calves and cows. The number of farms working cows did not vary with herd size (90 percent). Veterinarians were involved in working cows and were the primary source of herd health information on 40 percent farms surveyed. Notebooks were the primary records storage system for farms regardless of size (40 percent). Only 20 percent of farms used computers for keeping cow and/or calf records. Breeding practices were also similar across all farms surveyed, with 67 percent using natural mating with registered bulls. Farms with large cow herds culled a higher percentage open cows, but culling was similar for other traits. Tailoring Extension programs based on herd size may be helpful for some management skills, but herd size had only limited impact on overall herd management.

Key Words: Beef Quality, Management, Herd Size

T61 Management practices used in Alabama beef production II: Impact of source of herd health information. W. F. Owsley, J. B. Elmore*, M. F. Elmore, L. A. Kriese-Anderson, W. C. Rutherford, S. V. Free, and L. S. Saunders, *Auburn University, Auburn, AL.*

In the spring and fall of 2007, producers attending two state-wide producer meetings and 21 of the state's 27 livestock markets were asked to participate in a survey to assess the level of management on Alabama beef farms. A total of 699 surveys were completed. Participants were asked to identify their primary source of herd health information (SOURCE): veterinarian, feed store, magazine, internet, Extension. Responses were sorted by information source to help develop a targeted Extension education program. Of the producers using their feed store as SOURCE, 70 percent expected cattle to make up less than 25 percent of their income, compared to 48 percent (veterinarian) and 44 percent (Extension). Farms with less than 10 cows used veterinarians and feed stores as SOURCE 45 and 34 percent, respectively. Farms with over 250 cows used veterinarians and feed stores as SOURCE 62 and 0 percent, respectively. Extension was SOURCE evenly across herd size (18 to 22 percent) except for farms with less than 10 cows (9 percent). SOURCE

had little impact on whether calves were worked, but did affect specific management practices. Sixty percent of the farms using veterinarians, magazines and Extension as SOURCE castrated calves, compared to 40 and 30 percent for internet and feed stores, respectively. Farmers using feed stores as SOURCE reported a lower incidence of performing routine management practices on the cow herd, calf and cow records. Farms using Extension as SOURCE reported a higher rate of premises ID. Farms using feed stores as SOURCE were less likely to cull cows on disposition, feet, udders, teeth and eyes, and were less likely to cull open cows. Most farms keeping calf or cow records used a notebook for record storage, except for those using the internet as SOURCE. Over 50 percent of those farms used computers for records. Based on the results of this survey, Extension partnering with information outlets like feed stores and livestock markets could have a significant impact on management practices used in beef production.

Key Words: Cattle, Management, Herd Health

T62 Commercial cow and calf data in Alabama herds: 1988 to 2007. L. A. Kriese-Anderson*¹ and M. F. Elmore², ¹*Auburn University, Auburn, AL,* ²*Alabama Cooperative Extension System, Auburn, AL.*

Since 1988, a PC-based cow/calf production program has been available in Alabama through the Alabama Beef Cattle Improvement Association. From 1988 to 1999, birth and weaning information were the only data entered into the program. From 2000 to present, producers were able to input as much performance data into the program as desired. Each producer must have a minimum of nine pieces of information available on each calf. They include unique sire, dam and calf identification, sire and dam breeds, dam and calf birth date, weaning date and weaning weight. From this minimum amount of data, adjusted weaning weights (WW) and ratios are calculated and provided back to the producer to aid in selection and culling decisions. Since 1988, 288 herds have inputted 110,195 WW from over 35,000 dams. Large herds (n>100 head) contributed the most number of records (n=69,715) followed by medium herds (n= 30 to 99 head; 33,241 WW) and small herds (n<30 head; 7239 WW). Editing WW records to fit within BIF Guidelines for calf age at weighing, records within 4 SD of the mean and sire breeds with more than 100 progeny records, provided 74,148 WW records for analysis using the mixed procedure of SAS. Independent variables included herd, year, herds size and sire breed. Herd was considered a random effect. Effects of year, sire breed and herds size were all significant at P<0.01. WW of calves from small herds were significantly heavier (LSMEANS = 250 kg) than from medium (LSMEANS = 243 kg) or large herds (LSMEANS = 243 kg). There were 22 sire breeds or composites in the dataset. Angus- (n=29,515) and Simmental-sired (n=20,132) calves were the most numerous. Simmental sired calves were significantly heavier than Angus sired calves by 6.91 kg. Charolais sired (n=8,436) calves were intermediate for WW. Using a regression approach, WW increased 1.4 kg/yr in these Alabama herds from 1988 to 2007. Examining dam information, commercial cows averaged 3.7 calves before exiting the herd with an average calving interval of 383.6 days.

Key Words: Beef, Commercial Herds, Adjusted Weaning Weight

T63 A single fleece test method improves premium wool traits in range sheep flock. T. Wuliji¹, T. Borda², H. Glimp¹, L. Gome-Raya¹, and W. Rauw¹, ¹University of Nevada, Reno, ²Borda Ranch, Fernley, NV.

The OFDA2000 is the latest wool technology designed for on-farm testing of greasy fleece in assistance to sheep selection and wool clip preparation. The test provides more than a dozen wool characteristics including mean fiber diameter, fiber length, and fiber variation using a small wool staple sample from mid-side of sheep. The test procedure requires only 45 seconds per sample run and can measure at 80 samples per hour speed. We adopted a single fleece test method at pre shearing for replacement ewe selection and color ear tag identification for extra fine (blue), fine (green), medium (red) and coarse (black) categories. These categories correspond to average fiber diameter ranges of 18 μ and less, 18.1 to 20.1 μ , 20.2 to 22.5 μ , and 22.6 μ and coarser fleece category. Six years of single fleece testing has been carried out on the replacement ewes at the ranch. The shearing classes established at two year old ewes were highly repeatable. A random follow-up test of 100 three year old ewes at 2006 shearing indicated that over 96 % of those stayed within the original fleece test assigned category. The single test fleece characteristics on the Borda Ranch showed that an overall fining ($P < 0.05$) in average micron (Mean \pm SE from 23.9 \pm 0.23 to 22.4 \pm 0.09, 21.6 \pm 0.10, 20.8 \pm 0.12 and 20.9 \pm 0.13 μ ; increasing ($P < 0.05$) fiber length (Mean \pm SE from 56.0 \pm 0.68 to 77.0 \pm 0.41, 79.9 \pm 0.31, 75.3 \pm 0.58 and 86.7 \pm 0.48 mm respectively for test year 2003 to 2008; and improving comfort factor and reducing wool trait variation in the replacement ewes. The flock size was increased from 1660 ewes at 2006 shearing to 2400 ewes at 2008 shearing, and the average fleece weight has gradually increased over the last few years (e.g., 4.51 kg per head in 2006 vs. 4.98 kg per head in 2007). Wool price premium between fine vs. coarse categories were varied from 16% to 49% in those sale seasons. The single fleece test information not only allows producers to class their clips in the price premium categories but also assists in flock selection and culling decisions.

Key Words: Range Sheep, Wool, Fiber Diameter

T64 Minimum sampling requirement for prediction of hay forage quality from monoculture or mixed grass fields. R. S. Milliken¹, M. S. Gadberry², E. B. Kegley^{*3}, J. A. Jennings², and J. T. Richeson³, ¹University of Arkansas Division of Agriculture Cooperative Extension Service, Marshall, ²University of Arkansas Division of Agriculture Cooperative Extension Service, Little Rock, ³University of Arkansas Division of Agriculture, Fayetteville.

Accurate forage quality values are critical when developing a balanced supplemental ration for beef cows. Large (1.2 \times 1.5 m), round hay bales from 2 locations in central Arkansas were individually analyzed for chemical composition (CP, NDF, ADF) to determine the minimum sampling rate required to achieve an accurate forage analysis for either monoculture grass hays or mixed grass hays. The monoculture field consisted of 3.24 ha of Tipton 44 bermudagrass, which was determined through forage inventory by step-point method to be 90% of the stand. A 4.9-ha mixed grass field was also inventoried and was highly variable ($P < 0.0001$) in species composition. Fifty-one bermudagrass and 73 mixed grass large round bales were individually core-sampled 6 times with a 1.9-cm i.d., 46-cm-long Star Multi-Forage Sampler (Star Quality Samplers, Edmonton, AB, Canada). Wet chemistry was used to determine CP,

ADF, and NDF concentrations of each bale. From these factors, percentage TDN was calculated using equations developed and currently used in Arkansas; TDN = 111.8 + 0.95(%CP) - 0.36(%ADF) - 0.7(%NDF) and TDN = 73.5 + 0.62(%CP) - 0.71(%ADF) for bermuda and mixed grass, respectively. For each hay lot, the Survey Select procedure of SAS (SAS Inst. Inc., Cary, NC) was used to generate 10,000 random hay samples for sampling rates ranging from 5 to 75% in increments of 5%. Potential sampling outcomes for each sampling rate were generated, and a baseline for an acceptable degree of error within samples was set at the mean \pm 1 percentage unit for TDN and CP. Results indicate that forage samples should include cores from at least 30% of all bales of a monoculture/pure forage stand and 35% of all bales when sampling a mixed/native grass field to achieve a representative hay sample useful for ration balancing.

Key Words: Sampling Rate, Nutrient Composition, Forage

T65 Demonstration of a formulation approach to include corn-milling co-products in lactating dairy rations. K. J. Machacek* and P. J. Kononoff, University of Nebraska, Lincoln.

In 2007, the U.S. dry milling corn ethanol industry produced approximately 13 million metric tons of feed co-products and the dairy industry continues to be a key market. Based on results reported by a commercial feed laboratory, dried distillers grains plus solubles (DDGS) are low in starch (6.0 \pm 5.4%) but contain high levels of NDF (33.3 \pm 4.8%), CP (30.4 \pm 4.1%), and ether extract (13 \pm 3.0%). Numerous research trials at the University of Nebraska-Lincoln have demonstrated that dairy rations may be formulated to contain as much as 30% DDGS (DM basis) and maintain normal production levels. The objective of this demonstration is to outline a practical ration formulation approach (using CPM-Dairy version 3.0) that seeks to include DDGS at 15 and 30% of the ration DM and maintain normal milk production. Thirty random samples of DDGS originating from one ethanol plant were evaluated for CP, NDF, ADF, acid detergent insoluble crude protein (ADICP), and ether extract (EE). In vitro NDF digestibility (24 and 48 h) was also measured (75.5 and 86.3%, respectively). Three rations were formulated to contain increasing amounts of DDGS (0%, 15%, and 30%) while maintaining a similar intake (20 kg/d), and metabolizable protein (MP) and metabolizable energy (ME) allowable milk (35 kg/d). Forages, corn, and soy-based proteins were replaced as the amount of DDGS increased. Rations had similar concentrations of NDF (35%), increased amounts of CP (18, 18, and 19% for 0, 15, and 30% DDGS, respectively), but were formulated to contain decreasing concentrations of starch (26.1, 21.9, 19.7%). With increasing levels of DDGS, model predicted fermentable NDF increased (12.5, 13.8, and 13.4%), and fermentable starch decreased (21.8, 18.3, and 16.5%). In summary, feed co-products such as DDGS are valuable for inclusion into dairy rations and may be included at 15 and 30% of the ration DM and contribute to supplying adequate levels of MP and ME to support lactation.

Key Words: Co-product, Dairy, Ration Formulation

T66 The Virginia Phosphorus Feeding Incentive Program. C. C. Stallings*, K. F. Knowlton, R. E. James, M. D. Hanigan, B. G. Cox, J. L. Welsh, T. M. Horn, S. M. Puffenbarger, and M. C. Scott, Virginia Polytechnic Institute and State University, Blacksburg.

To reduce the potential for phosphorus (P) runoff into streams a project was undertaken to use feed management as a tool to reduce P excreted by dairy cows. A survey was sent to all Virginia dairy farms (806) asking for information related to nutrient management practices, and assessed potential interest in an incentive-payment project to reduce overfeeding of phosphorus. Interested farms were contacted, visited, and signed to the project. The program provides free feed testing for major nutrients and minerals every two months for three years, ration consultation on request, educational materials and updates via a newsletter, and educational meetings for both producers and nutritionists. In addition a P Report is provided to producers after each set of samples are submitted and analyzed. On this report the amount of P fed was calculated and compared to the requirement for cows in that herd. The P requirement and dry matter intake were calculated according to NRC based on producer-reported body weight, milk production, and fat test. The result is expressed as P consumed as a percent of required. There were 215 herds that signed up for the project. Currently 128 herds have completed enough samplings (5) to have a year end summary prepared calculating eligibility for payment. Nine herds fed P within 5% of required and qualified for the highest year-end payment (\$12/cow), 32 fed P at 105 to 115% of required for a \$6/cow pay rate, 25 fed P at 115 to 125% for a \$3/cow pay rate, and 62 herds fed more than 125% of required P and did not qualify for payment. The remaining 87 herds have not completed their first year or submitted enough samples for a summary. The Virginia P Feeding Incentive Program has engaged producers and their advisors in an ongoing dialogue about herd feeding practices. More than 50% of producers completing sufficient sampling for year 1 evaluation have earned an incentive payment, and average dietary P consumed declined by 2.9% or 2.6 grams/cow/day.

Key Words: Phosphorus, Incentive, Feed Management

T67 Financial performance of dairies in Florida and Georgia in 2006. L. O. Ely¹, A. deVries², R. Giesy², M. Sowerby², B. Broadus², and C. Vann², ¹University of Georgia, Athens, ²University of Florida, Gainesville.

The Dairy Business Analysis Project (DBAP) includes an annual survey of the financial performance of dairies primarily located in Florida and Georgia. Its objective is to document the dairies' financial success using standardized, accrual accounting methods in order to calculate benchmarks and provide feedback on the dairies financial strengths and weaknesses.

Twenty-six dairies submitted financial data in 2006. Twenty-two dairies were included in the summary results. Of these, 16 were located in Florida, and 6 in Georgia. The average herd size was 1,163 cows and 684 heifers with 18599 lbs. milk sold per cow. The average culling rate was 31%. There was an average of 20 FTE workers per farm and 1.01 million lbs milk sold per FTE worker. Total revenue per cwt. was \$19.36 / cwt with \$16.79 / cwt milk income. The average total expense was \$18.56 / cwt. The largest expense items were purchased feed (\$7.17 / cwt), labor (\$3.13 / cwt), livestock (\$1.60 / cwt) and milk marketing (\$1.17 / cwt). Net farm income from operations was \$0.53 / cwt and net farm income was \$0.70 / cwt. The debt to asset ratio was 0.40, the rate of return on assets was 0.03, the rate of return on equity was 0.03, and the operating profit margin ratio was 0.03. Total revenue and expenses decreased with herd size in 2006. Herds with 450-1000 cows had the middle total revenue (\$19.06 / cwt) and expenses (\$17.93 / cwt) which resulted in the highest net farm income (\$0.91/cwt). The herds with the highest milk production (>19,800 lbs / cow / year) had the lowest total

revenue (\$19.16 / cwt) and the lowest expenses (\$17.25/ cwt) resulting in the highest net farm income (\$1.59 / cwt).

Key Words: Dairy, Financial, Management

T68 Organic dairy short course for ag professionals. D. G. Johnson¹, J. M. Moynihan², M. J. Forbord³, and L. Paine⁴, ¹University of Minnesota, Morris, ²Minnesota Department of Agriculture, St. Paul, MN, ³Sustainable Farming Association of Minnesota, Starbuck, MN, ⁴Wisconsin Department of Agriculture, Trade and Consumer Protection, Madison, WI.

“Organic Dairy 101: A workshop for dairy support professionals” targeted providers of advice and service to dairy farms, including: veterinarians and vet students, inspectors, lenders, Extension agents, farm management instructors, consultants, mentor farmers, county feedlot officers, state environmental staff, and advisory teams for dairy planning and development. The 6-hour workshop was held in 4 locations in Minnesota and 3 locations in Wisconsin. Wisconsin workshops targeted veterinarians. The core of programs for Minnesota were planned by a broad-based statewide committee with representatives of the target groups, organic farmers, the Sustainable Farming Association of MN, and agency and education personnel. Local planning committees selected from a menu of speakers and topics, emphasizing local resource people when possible. In Minnesota topics included an overview of National Organic Program organic requirements, farmer insights and virtual farm tours, veterinary practice for organic dairy, economics of organic production, organic crop production, grazing, and dairy nutrition. “If a client asked you questions about the following, how well do you think you could answer?” before (A) and after the workshop (B), (Scale 1 to 5 : 1=Not at all; 5=Like an expert). Responses were tabulated from 47 of 90 participants in the first two workshops. A) What is the Federal Organic rule? A 1.26; B 3.38. B) How do farmers/processors get certified organic? A 1.98; B 3.76. C) Does organic require more than not using antibiotics/synthetics A 2.56; B 4.04. D) Does organic farming “work”? A 2.62; B 4.11. E) What motivates farmers to switch to organic? A 2.36; B 3.87. F) How do organic farmers keep cows healthy? A 1.98; B 3.69. G) What veterinary treatments are allowed for organic cattle? A 1.47; B 3.26. H) What is the market outlook for organic dairy? A 2.00; B 3.74. To the question: “Overall, was this workshop worth the time and effort of attending?”. Yes = 46; No=1. Notable comments: Veterinarians want to learn more about treatments for organic cattle and the evidence behind them; farmer perspectives were valuable;an accredited certifying agency should be included in the program.

Key Words: Organic Dairy, Dairy Professionals, Workshop

T69 Good dairy sanitation workshops in Central American countries. G. Pena¹, M. West¹, D. Orellana², A. Young¹, and D. E. Diaz¹, ¹Utah State University, Logan, ²USDA-FAS, Washington, DC.

During 2007 Utah State University in collaboration with the USDA-Foreign Agricultural Service conducted four 3-day workshops on good dairy sanitary practices in Guatemala, El Salvador, Honduras and Nicaragua. These workshops were conducted to support the efforts of the Dominican Republic-Central America Free Trade Agreement. Training workshops include two days of classroom lecture plus a one day hands

on farm visit. Topics covered during these workshops included milking techniques, mastitis; milk quality from the farm to your table; heat stress; vaccination protocols and residues in milk and milk handling, storage and transport. Over 400 participants attended the workshops which included among the participants dairy producers, farm employees, government personnel, and milk cooperatives. A pre and post test of 20 questions was given to all participants utilizing the I-clicker testing equipment and software (Macmillian, New York, US), which ensured anonymity while allowing comparisons between individual pre and post test results. Questions were read and explained to all participants. Data was analyzed utilizing a paired sample t-test to determine workshop impact. Participants at all workshops showed a 29.1% improvement in their post test results ($P < 0.001$). Because of the increase in consumption of imported dairy products from participating countries programs such as this will help improve the quality of the dairy products that enter the United States.

Key Words: Milking Techniques, Workshops, Dairy Sanitation

T70 Spanish language training on proper milking techniques in the state of Utah. D. E. Diaz*, G. Pena, C. Israelson, J. Barnhill, and A. Young, *Utah State University, Logan.*

A series of workshops were conducted on proper milking techniques in the state of Utah for Spanish speaking dairy farm employees. The role

of extension in training this important sector of the dairy industry has been growing in the last decade. The language and cultural barrier make for an often undertrained workforce. The Dairy Extension group at Utah State University offers a series of workshops with hands on demonstration to Spanish speaking employees in our area. The objective of these workshops is to teach proper milking procedures to milkers in their native language to improve their understanding and comprehension of the material. Pre and post tests are conducted to measure impact of the program. These groups are better served in small group workshops with hand on demonstrations that emphasize both technical information and practical skills. A series of 5 workshops were conducted in 2007 in three counties in the state of Utah. Pre and post tests, which consisted of ten questions, were given to all participants utilizing the I-clicker testing equipment and software (Macmillian New York, US) which ensured anonymity while allowing comparisons between individual pre and post tests results. Questions were read and explained to all participants. Data were analyzed utilizing a paired sample t-test to determine workshop impact. Participants at all workshops showed a 31.5% improvement in their post tests results ($P < 0.001$). Spanish language training for Spanish speaking milkers should lead to improved milker knowledge, which in turn should lead to improved milking procedures, lower somatic cells counts and lower incidence of mastitis. This in turn should lead to better productivity of dairy operations and higher quality milk.

Key Words: Spanish Language Training, Workshop, Extension Education

Food Safety

T71 Crisis communications: The dairy plan. K. E. Olson^{*1}, S. L. Stevens², and D. Pelzer², ¹KEO Consulting, Schaumburg, IL, ²Dairy Management, Inc, Rosemont, IL.

Animal health or food safety emergencies whether the result of natural causes or terrorist introduction put producer markets at risk. The dairy industry "Crisis Readiness Program" has been developed to provide quick, accurate and appropriate responses to consumer concerns so market impacts can be minimized. The program is a collaborative effort of four national dairy organizations, each targeting a specific audience. Dairy Management, Inc. - consumers, International Dairy Foods Association - processors, National Milk Producers Federation - producers and U.S. Dairy Export Council - exporters and importers. The American Dairy Science Association (ADSA) provides a science link for the public. Local, state and regional entities, associated with the national organizations extend the program reach to all areas of the nation. The plan is designed to help the industry speak with "One Voice"; however, to be most effective it must be more than just industry. A broad network has been developed to facilitate this. Scientific experts are used to assure that messages are accurate, communications experts assure messages are communicated in a manner easily understood by target audiences. Working relationships with ADSA, federal, state and local government agencies and animal health officials familiarize them with industry plans and help assure that consistent messages are delivered by all parties. Three websites are utilized. www.Dairyreponse.com (producer section) is an open resource on animal health topics. During a crisis it will provide news updates and links to government information on the operational response. A password protected site is provided for industry communicators and a "dark site" is ready to be activated for media and consumers if an emergency strikes. Other tools include a quarterly newsletter with preparedness updates, annual crisis drills, media training and participation in government workshops. Efforts are ongoing to expand the network involved in the plan assuring that all producer and consumers receive accurate, easily understood information about the safety of dairy products in a timely manner in an emergency.

Key Words: Food Safety, Animal Health, Communications

T72 Determination of antibiotic residues in farm hens eggs. H. F. Ahmed^{*1}, I. M. Aman¹, and S. E. Zahran², ¹Kafr El-Sheikh University, Kafr El-Sheikh, Egypt, ²Animal Health Research Institute, Tanta, Egypt.

A High Performance Liquid Chromatography (HPLC) was used for the determination of antibiotic residues in farm hens eggs collected from EL-Gharbia Governorate, Tanta City, Egypt. 26.7%, 36% and 44% of the examined samples contained amoxicillin, oxytetracycline and tetracycline with mean values of 1.67±0.51, 44.8±21.6 and 17.5±4.6 ppm, respectively. The highest distribution of amoxicillin (50%) lies within the range of 0.5 - < 1 ppm, of oxytetracycline (33.34%) lies within the range of 10 - < 20 ppm, while that of tetracycline (55.2%) lies within the range of 4 - < 12 ppm. The drugs were identified as the parent drug after the application of replicate injection of matrix standard of pure (0 to 100 µg/ml). The illustration calibration graphs showed acceptable linearity in this range for the purpose of measuring with correlation coefficient (r²) values of 0.9998 for amoxicillin, 0.9828 for oxytetracycline and 0.9951 for tetracycline. The average recovery rates from egg samples spiked with 50, 20, 10 and 1 ppm ranged from 84 to 90.1% (SD 0.6 to 2.0) for

amoxicillin, from 98.4 to 99.5% (SD 1.0 to 1.2) for oxytetracycline and from 82 to 99.8% (SD 0.5 to 1.0) for tetracycline.

Key Words: Antibiotic, Eggs, HPLC

T73 Intestinal microbial affects of yeast products on weaned and transport stressed pigs. S. Weedman^{*1,2}, M. Rostagno², J. Patterson¹, A. Kiess¹, and S. Eicher², ¹Purdue University, West Lafayette, IN, ²USDA-ARS, West Lafayette, IN.

Study objectives were to determine effects of a commercially available yeast product (XPC, Diamond-V Mills) and stress of transportation on *Escherichia coli*, coliforms, and *Lactobacilli* populations in the intestine of weaning pigs. In a RCB design with a 2 x 2 factorial arrangement of yeast (Y) and transport (T), 54 pigs were used (n=12 per treatment and 6 baseline pigs). XPC was delivered orally in milk to provide 0.1g/kg of BW and controls (C) received milk only from d 4 to 21 (weaning). Pigs were transported (n=24) or moved (n=24) to nursery housing then supplemented with 0.2% XPC or a grain blank in wk 1 and 2 diets. Samples collected on d1 pre- and d 1, 4, 7, and 14 post-transport included mesenteric lymph node (MLN) and jejunal (Jj), ileal, and cecal contents. Data in parentheses are for YT, Y, CT, and C, treatments respectively. Jejunal coliforms; ileal *Lactobacilli*, coliforms, and *E. coli*; and cecal *Lactobacilli*, coliforms, and *E. coli* were affected (*P<0.05) by sampling day (Table 1). Transport by d (P=0.01) and transport by yeast (P=0.10) interactions were detected such that pigs had more *E. coli* in the cecum on d 1 post-transport (7.6^{ab}, 6.11^b, 7.9^a, 6.6^{ab}) than on d 7 (5.9^b, 7.5^a, 5.2^b, 6.0^{ab}). Yeast treatment stabilized coliform counts. Day 1 jejunal coliform counts were greatest (P<0.01) in CT (8.4^b, 7.8^b, 9.8^a, 8.1^b). Only one Y pig had *Salmonella* recovered from MLN on d 7 compared to 3 in all other treatments (P=0.07). Data show transport effects on intestinal microbial concentrations and modulation by the yeast product.

Table 1. Mean bacterial counts (cfu/g of sample) by d across treatments

d	Lactobacilli			Coliforms			<i>E. coli</i>		
	Jj	Ileum*	Cecum*	Jj*	Ileum*	Cecum*	Jj	Ileum*	Cecum*
1	8.0	8.3	8.4	8.5	8.5	8.0	6.3	7.5	7.1
4	8.8	8.8	9.2	9.3	9.8	9.2	5.0	6.2	6.7
7	8.8	9.1	8.9	9.8	9.8	9.5	5.4	6.4	6.1
14	7.6	8.1	8.2	9.8	9.8	9.8	5.0	5.2	5.6

Key Words: Intestinal Bacteria, Swine, Yeast

T74 Identification of risk factors associated with increased coliform counts in bulk milk. J. Pantoja^{*}, C. Hulland, D. Reinemann, and P. Ruegg, University of Wisconsin, Madison.

The objective was to identify risk factors associated with increased coliform counts of raw bulk tank milk. Data were collected from 16 dairy between July, 2006 and July, 2007. Cows were milked in parallel parlors (n = 10), herringbone parlors (n = 5) or a rotary parlor (n = 1). Most farms (n = 11) had direct loading of milk. Herd size ranged from 200 to 2350 lactating cows. The 13-month average SCC by herd ranged from 89,500

to 316,770 cells/mL. Cows were housed in freestalls with sand (n = 11), shavings (n = 2) or biosolids (n = 3 herds). Farms were visited monthly and daily somatic cell (SCC), standard plate count (SPC), coliform count (COLI) and laboratory pasteurized count (LPC) were downloaded from the processor website. Increased bacterial counts were defined as: 1) COLI > 50; 2) LPC > 200 and 3) SPC > 30,000 CFU/mL. The monthly proportion (MP) of increased COLI was used as a response variable in a generalized mixed model as a function of season (spring, summer, fall and winter), bedding type, udder cleanliness (clean, slightly dirty, dirty and very dirty) teat end condition (no ring, smooth ring, rough and very rough), liner cleanliness (clean, slightly dirty, dirty and very dirty), SCC and MP of increased LPC and SPC. The 13-month proportion of increased COLI counts varied widely among farms (17 to 87%). The MP of increased SPC and LPC were positively associated with the MP of COLI counts ($P < 0.01$). There was a significant seasonal variation in the MP of COLI ($P < 0.01$). The greatest MP of COLI was observed during winter, as compared to the other seasons. Farms that used biosolids as bedding were 1.4 times more likely to have increased MP of COLI counts as compared to farms that used sand or shavings, with the greatest effect observed during summer ($P < 0.01$ for the interaction term between bedding and season). Herds with greater proportions of very rough teat ends were more likely to have increased COLI counts than herds with smaller proportions of very rough teat ends.

Key Words: Coliforms, Bacteria, Milk Quality

T75 Effects of distiller's grains and dry-rolled corn supplementation in steam-flaked corn grain-based diets on fecal shedding of *Escherichia coli* O157:H7 and *Salmonella*. M. E. Jacob*, J. S. Drouillard, D. G. Renter, J. T. Fox, and T. G. Nagaraja, *Kansas State University, Manhattan*.

Escherichia coli O157, a food-borne pathogen normally residing in the gut of cattle, causes illness in thousands of people each year. Previous work indicated a positive association between feeding cattle distiller's grains (DG), an ethanol fermentation byproduct, and fecal prevalence of *E. coli* O157. It is not known whether DG supplementation has any effect on fecal shedding of *Salmonella*, another major food-borne pathogen. Previously, feeding dry-rolled corn (DRC) compared to steam-flaked corn (SFC) diets was shown to reduce fecal prevalence of *E. coli* O157. Our objectives were to determine the effects and interactions of DG and DRC supplementation of SFC-based finishing diets on fecal shedding of *E. coli* O157 and *Salmonella* spp. Approximately 720 cattle were blocked by BW and assigned randomly to one of 28 feedlot pens. Pens were randomly assigned one of four dietary treatments. A 2x2 factorial arrangement of treatments was used; 0 or 25% dried-DG with solubles (DDGS) and 0 or 25% DRC added to finishing diets containing steam-flaked corn and alfalfa hay. Ten fecal samples were collected from the surface of each pen before cattle began treatment diets, and at least once every two weeks after final finishing diets were initiated. Fecal samples were cultured for *E. coli* O157 and *Salmonella*. The overall prevalence

of *E. coli* O157 and *Salmonella*, regardless of treatment diets, in fecal samples were 5.1 and 23.7%, respectively. Prevalence of fecal *E. coli* O157 was not different for cattle fed diets with and without DG ($P > 0.2$). Prevalence also was not affected by the addition of DRC ($P > 0.7$), week of sampling ($P > 0.7$) or the DDG x DRC interaction ($P > 0.4$). Fecal *Salmonella* prevalence was not affected by supplementation of DG ($P = 0.9$) or DRC ($P = 0.7$). Sampling week impacted *Salmonella* prevalence ($P < 0.01$), which ranged from < 1% (week 1) to 77.5% (week 17). In conclusion, DG, with or without DRC supplementation, had no effect on fecal *E. coli* O157 or *Salmonella* prevalence in cattle.

Key Words: *E. coli* O157, Distiller's Grains, Dry-Rolled Corn

T76 Effects of the dicarboxylic acids malate and fumarate on *E. coli* O157:H7 and *Salmonella* Typhimurium populations in pure culture and mixed ruminal culture in vitro fermentations. T. R. Callaway*, T. S. Edrington, R. C. Anderson, N. Krueger, and D. J. Nisbet, *ARS, Food and Feed Safety Research Unit, College Station, TX*.

The dicarboxylic acids malate and fumarate increase ruminal pH, reduce methane production, increase propionate and total VFA production, and reduce lactic acid accumulation in a manner similar to ionophores. The mechanism by which these acids affect the ruminal environment is reported to be through stimulation of the ruminal bacterium *Selenomonas ruminantium* to utilize lactate to form propionate via the succinate-propionate pathway. Therefore dicarboxylic acids have been suggested for use as non-antibiotic modifiers of the ruminal fermentation, but their impact on the overall microbial ecology of the rumen and gut remains unknown. Therefore this study was prepared to determine if the addition of dicarboxylic acids to ruminal fermentations affected populations of the human pathogens, *Escherichia coli* O157:H7 and *Salmonella* Typhimurium. Pure cultures of *E. coli* O157:H7 strain 933 and *S. Typhimurium* were grown with malate and fumarate added at 0, 1, 5, 10 and 20 mM (v/v; n=3 of each acid concentration) at 39 C for 24 h. Neither dicarboxylic acid inhibited ($P > 0.1$) the growth rate or final populations of *E. coli* O157:H7 or *S. Typhimurium*. Ruminal fluid was collected from concentrate fed cows (n=2) and *E. coli* O157:H7 and *S. Typhimurium* were added to separate ruminal fermentations. Fumarate and malate were added to these in vitro pathogen fermentations at concentrations of 0, 5, 10 and 20 mM (v/v; n=2 of each acid concentration) and were incubated at 39 C for 24 h. Again, the addition of malate or fumarate did not affect ($P > 0.1$) populations of *E. coli* O157:H7 or *S. Typhimurium*. However, final pH was increased ($P < 0.05$), the acetate:propionate ratio was decreased ($P < 0.05$), and total VFA production was increased ($P < 0.05$) by > 10 mM dicarboxylic acid addition. These results confirm that dicarboxylic acids can modify the ruminal fermentation, but they do not directly or indirectly influence populations of *E. coli* O157:H7 or *S. Typhimurium* in pure or mixed ruminal fluid fermentations.

Key Words: Organic Acids, *E. coli* O157:H7, *Salmonella*

Forages and Pastures I

T77 Estimating losses of dry matter from alfalfa-orchardgrass mixtures following rainfall events. W. K. Coblenz* and W. E. Jokela, *US Dairy Forage Research Center, Marshfield, WI.*

Studies designed to assess the effects of natural or simulated rainfall events on wilting experimental hays often have been hampered by questionable and erratic estimates of DM recovery following wetting. An alternative methodology for measuring losses of DM may be to use water-insoluble, cell-wall constituents as internal markers. Our objective was to verify this approach using insoluble cell-wall constituents [neutral-detergent fiber (NDF) without additives, NDF with alpha-amylase, NDF with sodium sulfite, NDF with alpha-amylase and sodium sulfite, acid-detergent fiber (ADF), hemicellulose, cellulose, and acid-detergent lignin] as internal markers. Forages consisted of 100, 75, or 50% alfalfa (*Medicago sativa* L.; wet basis), with the balance comprised of orchardgrass (*Dactylis glomerata* L.; 0, 25, or 50%, respectively). Forage mixtures were sealed into 18 × 30-cm custom-made Dacron bags (53-um pore size), dried under forced air (50°C) to determine accurately the initial mass of DM in each bag, and then wetted under a rainfall simulator for either 1, 2, 4, 6, 8, or 12 h at a calibrated rate of 70 mm/h (70, 140, 280, 420, 560, or 840 mm, respectively). These procedures resulted in actual losses of DM ranging from 0 to 10.4%. Following treatment, recoveries of all markers were high (≥90.1%), but deviations from 100% were smallest for the NDF-based markers, as well as ADF and cellulose. Linear regressions of predicted (marker-based) recoveries of DM on actual values determined gravimetrically were especially good ($r^2 \geq 0.775$) when NDF-based markers were used to estimate recovery. In all cases, neither slopes ($P \geq 0.103$) nor intercepts ($P \geq 0.083$) differed from unity and zero, respectively. Among markers requiring multiple digestion steps, ADF exhibited acceptable estimates of slope (0.84) and intercept (14.5%) that did not differ from unity ($P = 0.222$) and zero ($P = 0.231$), respectively. Neutral-detergent fiber appears to be a particularly suitable internal marker for measuring recoveries of DM following wetting; however, this approach remains contingent on complete recovery of shattered leaf particles prior to conducting laboratory analysis.

Key Words: Internal Marker, DM recovery

T78 Influence of cutting time and swath type on intake, site, and ruminal metabolism of alfalfa hay. T. Shenkoru, H. Hussein, and T. Wuliji*, *University of Nevada, Reno.*

Alfalfa (*Medicago sativa*) is important high protein legume forage. However, its nutritional value can be affected by various environmental and managerial factors. Among them cutting time and drying process affect alfalfa composition and nutritive value. This study investigates the effect of cutting time and swath width of alfalfa hay on the extent of ruminal and duodenal digestion of structural, nonstructural carbohydrate components and protein. Four ruminal and duodenal cannulated Suffolk ewes (90.5 ± 9.8 kg initial BW and 18 mo old) were used in a 4 × 4 Latin square design. Acid insoluble ash is used to calculate duodenal flow and digestibility of nutrients. Treatments were arranged as a 2 × 2 factorial with the main factors being cutting time (AM vs. PM), and swath width [narrow (1.3 m.) vs wide (1.6 m.)]. No interaction effect between harvesting time × swath width was found for daily organic matter intake. The daily gram intake of organic matter (OM), neutral detergent fiber, acid detergent fiber, hemicellulose, cellulose and total

nonstructural carbohydrate (TNC) were higher ($P < 0.05$) for the narrow swath than wide swath. PM-harvesting increased ($P < 0.05$) TNC and nitrogen (N) intake from 216 to 260 g/d and 49.3 to 57.5 g/d, respectively. Ruminal digestion of structural carbohydrates, including TNC was not affected by treatments. Total short chain fatty acids, molar proportion of acetate and butyrate were not altered by treatments. However, PM-harvesting increased ($P < 0.05$) molar percentage of butyrate from 7.6 to 8.2 mol/100 mol. Branched chain fatty acids were not affected ($P > 0.05$) by treatments. Microbial N flow to duodenum was greater (16.5 vs. 13.4 g/d, $P < 0.05$) for PM- than AM-harvested alfalfa hays. Duodenal non-ammonia N and dietary N flow, including efficiency of bacterial protein synthesis (averaged 13.2 g N/kg OM digested), were not affected by treatments. The study indicated that PM-harvested hay and hay dried in narrow swath had a better nutritional quality compared with AM hay and hay dried in wide swath.

Key Words: Alfalfa, Cutting Time, Digestibility

T79 Plant maturity and genetic influences on *in vitro* NDF digestibility of alfalfa. A. Palmonari*¹, N. Brogna¹, G. Rossi¹, I. Fusaro², G. Biagi¹, and A. Formigoni¹, ¹*DIMORFIPA Università di Bologna, Ozzano dell'Emilia, Bologna, Italy,* ²*Dipartimento di Scienze Degli Alimenti Università di Teramo, Teramo, Italy.*

Aging and excess of environmental stress conditions negatively affect alfalfa NDF digestibility (NDFd). This study evaluated the influence of plant maturity on *in vitro* NDFd (IVNDFd) of different varieties of alfalfa. Two cuttings from different four alfalfa varieties (A experimental, B, C and D commercial) were analyzed, each in five replicates, for chemical composition (CP, ADF, ADL, NDF) and 24h IVNDFd with Tilley & Terry technique. All varieties were grown in the same location under the same climatic and agronomic conditions. Each variety was cut at two stages of maturity: 20 days (II) and 30 days (III) after previous harvest. During the trial, temperature and amount of rainfall were: (II) 33.1°C max, 17.3°C min and 15.7 mm ; (III) 34.01°C max, 18.2°C min and 34.9 mm. Samples were harvested by hands at a 5.0 cm height and immediately dried at 65°C in a forced air oven. No statistical differences were found among varieties for CP, ADF, ADL and NDF in collection II and III, but differences ($P < 0.01$, Table 1) were observed for IVNDFd. These results demonstrate that variety A maintains better IVNDFd as maturity advances.

Table 1. Least Squares Means.

CUT	Variety	C.P. (%DM)	ADF (%DM)	ADL (%DM)	NDF (%DM)	IVNDFd (%DM)
II	A	24.55	24.87	5.07	45.65	64.23 A
II	B	23.02	26.24	5.32	47.54	60.19 B
II	C	23.04	25.24	5.12	46.68	58.47 B
II	D	23.16	25.67	5.26	46.32	57.91 B
	SEM	0.23	0.21	0.17	0.28	0.65
III	A	20.55	25.77	5.43	48.66	59.79 A
III	B	22.03	25.41	5.46	49.27	54.14 B
III	C	20.94	26.42	5.61	48.94	50.04 B
III	D	20.47	25.33	5.32	48.78	53.49 B
	SEM	0.25	0.15	0.12	0.22	0.98

Values within rows within cut with different letters differ ($P < 0.01$).

Key Words: Alfalfa, Maturity, Neutral Detergent Fiber Digestibility

T80 Effect of a lactic acid-*Lactobacillus* product and bale moisture on forage quality, and voluntary intake and digestibility of crabgrass hay by lambs. L. Hardin¹, A. Killion¹, J. Caldwell¹, K. Coffey^{*1}, D. Philipp¹, and W. Coblenz², ¹University of Arkansas, Fayetteville, ²USDA-ARS, Marshfield, WI.

A 1.6-ha field of common crabgrass (*Digitaria ciliaris* [Retz.] Koel.) was divided into 12 plots that were used in a randomized complete block design with a 2 x 2 factorial treatment arrangement to determine the impact of a lactic acid-*Lactobacillus* hay preservative and moisture concentration at baling on post-storage forage quality, and intake and digestibility by lambs. Half of the plots within each block were treated with 81 mL/tonne DM of a solution containing 11% lactic acid and non-viable *Lactobacillus acidophilus* at the time of mowing (T) and half were not treated (U). Within T and U plots, half were baled at 18% (M18) and half at 28% moisture (M28). Six bales per plot were selected at random, weighed, and stored in insulated 6-bale stacks. Core samples were taken from 3 of the bales after 42-d of storage. Black-faced wether lambs (n=16) were allocated randomly by weight to receive 1 of the 4 treatment combinations. Hay was chopped, then offered ad libitum to lambs housed in individual 1.1 x 1.5-m pens with expanded metal floors. Following a 10-d adaptation, total feces were collected for 5 d using fecal bags and dried at 50 C. Ash, CP, and ADF did not differ (P \geq 0.15) among treatments, but NDIN and lignin were greater (P $<$ 0.05) and IVDMD was lower (P $<$ 0.05) from M28 vs. M18. Maximum bale temperature was higher (P $<$ 0.01) from M28 vs. M18 (55 vs. 35 C). Total DMI (g/d and g/kg BW) did not differ (P \geq 0.16) among treatments. In vivo DMD was greater (P $<$ 0.01) from M28 vs. M18 (55.5 vs. 50.1%) and from T vs. U (56.0 vs. 49.7%). Digestible DMI was greater (P $<$ 0.05) from T vs. U (12.7 vs. 10.1 g/kg BW). Therefore, treating crabgrass with a lactic acid-*Lactobacillus* product prior to baling may not affect forage quality, but may improve DM digestion and digestible DMI by lambs. Baling moist crabgrass hay may have negative impacts on some measures of forage quality but may increase DM digestion by lambs.

Key Words: Crabgrass, Digestibility, Lambs

T81 Harvest management effects on Tifton-85 bermudagrass greenchop nutritive value. Y. C. Newman*, C. R. Staples, A. T. Adesogan, A. R. Blount, and C. Mackowiak, University of Florida, Gainesville.

One way of minimizing costs in dairy nutritional programs is to grow forages of high nutritive value and quality that can be used as part of the ration and in addition be used to attenuate excess soil nutrients. Tifton-85 bermudagrass (*Cynodon spp.*; T-85) provides high yield and nutritive value but defoliation management practices and their implications in nutritive value have not been evaluated under intensive greenchop production. The objective of the study was to examine the effects of harvest management (harvest interval x stubble height) on nutritive value (CP, IVTD, TDN, NDF, ADF, NDF digestibility) of T-85 when harvested for greenchop. A factorial combination of harvest interval (21, 24, 27, and 35 d) and stubble height (7 and 14 cm) was arranged in a split-plot design in an on-farm study. Experimental units were 120-m² plots replicated three times. Data were analyzed using mixed model methodology through MIXED procedure of SAS. There were a total of 6, 5, 4, and 3 harvests during the 2007 season (June-Oct) for 21, 24, 27, and 35 d harvest frequencies, respectively. First year data show that stubble height did not have an effect (P $>$ 0.05) on nutritive value. There were interactions with harvest frequency (P \leq 0.01); therefore, data

was analyzed by harvest frequency. Crude protein was highest (217 g kg⁻¹) when forage was cut at 21 d and lowest (201 g kg⁻¹) at 35 d. NDF for 21 d was not affected by season and averaged 685 g kg⁻¹ but NDF digestibility declined toward the fall months; and was 720 g kg⁻¹ at 21 d and lowest (702 g kg⁻¹) at 35 d. In vitro true digestibility followed similar response. Harvest intervals of 21 days provides greenchop of excellent quality but 24 and 27 days seem to provide the best compromise for nutritive value, production and associated pests in production of T-85 greenchop.

Key Words: Tifton-85, Bermudagrass, Greenchop

T82 Chemical composition and nutritive value of forage silages produced in the Italian Po Valley. S. Colombini^{*1}, L. Rapetti¹, N. Rizzi², P. Amodeo², G. Galassi¹, and G. M. Crovetto¹, ¹University of Milan, Milan, Italy, ²Dairy Farmers Association of Lombardy, Crema, Italy.

In order to characterize the nutrient composition and the feed value of ensiled forages produced in the Po Valley, 92 silage samples were collected in 2004 and 2005: 15 corn, 15 wheat, 5 barley, 3 rye, 3 sorghum grain, 18 sorghum forage, 15 alfalfa, 11 Italian ryegrass and 7 permanent pasture. Samples were analyzed for chemical composition, N solubility and fermentative profile. The energetic content was determined according to the gas production (GP) technique (Menke and Steingass, 1989). Data were analyzed by GLM procedures of SAS.

Dry matter and crude protein contents were higher (P $<$ 0.001) for alfalfa (61.0 and 21.0%) and permanent pasture (57.6 and 17.0%) silages due to field wilting. Alfalfa silages were characterized by a high concentration (P $<$ 0.001) of NPN (8.3% DM).

Corn showed the highest gas production (P $<$ 0.001) at 24 hours (58.6 ml/200 mg DM), due to its starch content. Italian ryegrass also was very fermentable because of its highly digestible fibre. The NEI values (Mcal/kg DM) were 1.58 (corn), 1.46 (wheat), 1.45 (Italian ryegrass), 1.36 (permanent pasture), 1.33 (barley), 1.31 (sorghum grain), 1.29 (alfalfa), 1.22 (rye), 1.16 (sorghum forage).

Dry matter concentration was positively correlated (P $<$ 0.001) to pH, CP, fiber-bound N and sugars, and negatively correlated (P $<$ 0.001) to acetic, propionic and lactic acid, total organic acid, ethanol and NH₃-N. Lactic acid concentrations (% DM) were: 10.4% in barley, 8.0% in sorghum grain, 7.8% in Italian ryegrass, 6.9% in corn and wheat. Alfalfa (2.9%) and rye (2.4%) had lower (P $<$ 0.05) lactic acid content compared to barley, sorghum grain and Italian ryegrass. Rye also had the highest (P $<$ 0.05) concentrations of acetic (4.3%), propionic (1.4%) and butyric (2.4%) acids, and NH₃-N (6073 mg/kg DM). All the other silages had low VFA and NH₃-N contents (P $<$ 0.05). In conclusion, corn silage had the highest (P $<$ 0.001) NEI content, while alfalfa had the highest protein content, but with a high proportion of NPN. Italian ryegrass was very fermentable with a high nutritive value.

Key Words: Silage, Nutritive Value

T83 Nutritive value of sunflower silage associated with different by-products. R. H. de T. e Buschinelli de Goes^{*1}, A. C. Martinez², E. S. Miyagi³, C. O. de Abreu², R. de C. M. Tramontini², K. C. da S. Brabes¹, and E. R. de Oliveira¹, ¹Universidade Federal da Grande Dourados, Dourados, MS, Brasil, ²Universidade Estadual de Maringá, Umuarama, PR, Brasil, ³Universidade Federal de Goiás, Goiânia, GO, Brasil.

Sunflower plants (20.0%DM and 10.0%CP) were ensiled in experimental silos to evaluate the effect of adding soybean hulls or crushed sunflower seeds, and ensiling period, on the fermentation and nutritive value of sunflower silage. A 3X3 factorial treatment design was replicated 3 times. Treatments were: Control (100% sunflower plants; SS), SS+5% soybean hulls (SS+SBH) and SS+5% crushed sunflower seeds (SS+CSS) with 14, 21 or 28 days ensiling. At 28 days, pH of SS was lower (3.08; $P < 0.05$) than SS+SBH (3.32) and SS+CSS (3.25). A limitation of SS is DM content (19.93%). Adding soybean hulls or crushed sunflower seeds increased DM% to 31.32% and 27.77%, respectively. There was interaction ($P < 0.05$) between the days of fermentation and the treatments. There was no difference for DM presented by SS+SBH, for 14 and 28 days ensiling; however for SS+CSS, the 21 day ensiling presented mean of 30.37%, and 14 and 28 days ensiling didn't differ. For SS there was effect after 21 days of ensiling. Crude protein, ash, and ADF were not different ($P > 0.05$; mean = 11.62, 8.83, and 46.60 %DM, respectively). However ADIN was higher in SS (0.14%DM; $P < 0.05$) than SS+SBH (0.12) or SS+CSS (0.11). The SS+SBH contained more NDF (64.64%DM) and lignin (30.48%DM) and reflect the higher concentration of NDF in soybean hulls. At the 28 days ensiling, the SS+CSS presents the smallest value (mean = 56.62), and NDF for SS and SS+SBH was 62.98%, and 65.69%, respectively. The values of NDF (59.73%) and ADF (44.68%) in SS are comparable to plants with plants unproved hemicelluloses (HCEL), as the sunflower. Adding soybean hulls or crushed sunflower seeds did not alter the concentration of HCEL (mean = 15.37%DM). Adding soybean hulls or crushed sunflower seeds increased silage DM and NDF but did not affect silage CP and ADF.

Key Words: Soybean Hulls, Sunflower Crushed, Chemical Composition

T84 The use of hybrid or native corn byproducts for the manufacture of nutritional blocks or silages: A simulation model. J. M. Tapia-Gonzalez*¹, A. Tewolde-Medhin², W. E. Grant³, J. C. Martinez-González², H. Diaz-Solis⁴, A. Moreno-Valdéz⁵, O. D. Montañez-Valdez¹, and G. Rocha-Chavez¹, ¹CUSUR, Univ de Guadalajara, Cd. Guzmán, Jalisco, México, ²Unidad Académica Multidisciplinaria Agronomía y Ciencias. UAT, Cd. Victoria, Tamaulipas, México, ³Texas A&M University, College Station, ⁴Área de Recursos Naturales, UAAAN, Saltillo Coahuila, México, ⁵Área de Recursos Naturales, Instituto Tecnológico de Ciudad Victoria, Cd. Victoria, Tamaulipas, México.

A simulation study was carried out using the Software STELLA® II Ver 5 for comparing a real corn production system and corn byproducts (corn straw or green plant) for making multi nutritional blocks or silages respectively. Two types of corn were compared: the native corn against the INIFAP HV-1 variety. Nutritional blocks and silage are intended for cattle feeding during dry season and unspecific genotypes of steers or crosses of *Bos taurus* x *Bos indicus* were used for the present study. The simulation model was formed in several steps following the mathematical approach of seeding both types of corn with or without post seeding management; A hundred runs were performed each year (system simulations). Native corn crops with post-seeding management yielded the highest amount of corn and dry forage according with both the real and simulated model. The model revealed cycles of reduced pluvial precipitation (300 to 400 mm PP) which were insufficient for the proper grow and development of both the native and hybrid corn crops which in turns yielded less grain and byproducts. These data reveals the uncertain and adverse climatic condition of that geographic area. The

hybrid corn variety showed the lowest grain and forage yield out of 100 years of cropping. These values are in agreement with the observed real yields of this production system.

Key Words: Simulation, Multinutritional Blocks, Corn Silage

T85 Factors effecting corn silage starch hydrolysis potential. A. E. Dorshorst*, P. C. Hoffman, N. M. Esser, M. G. Bertram, and T. K. Seeger, *University of Wisconsin, Madison.*

Digestibility of corn silage starch influences lactation performance of dairy cows. To investigate nutritional markers that explain starch digestibility in corn silage a factorial (3x3x3x3) set of corn silages was developed. Three varieties of corn (110,93,74 d), were planted on three planting dates and harvested on three dates. Grain samples for each variety, planting and harvest date were obtained by selecting corn stalks immediately prior silage harvest and hand shelling grain. Grain samples were dried, determined for kernel density, DM, starch, P, CP, globulin-albumin, and zein proteins. Corn silage was chopped, and ensiled without or with two degrees of kernel processing (1 or 3 mm). Approximately 1.5 kg of fresh corn silage was placed into plastic bags, vacuum sealed, and allowed to ferment for 150 d. Triplicate samples were conserved. Corn silages were evaluated for DM, starch, NDF, P, mean starch particle size, starch particles/g, starch surface area and kernel processing score. Starch hydrolysis potential of un-dried, un-ground corn silages was determined by the procedures of Blasel et al., 2006 where the percentage of starch hydrolyzed to glucose by amylase and amyloglucosidase is determined. Main effects and their interactions of the factorial set of corn silages on starch hydrolysis potential were evaluated using the GLM procedures of SAS. As designed, variety, planting date, harvest date and kernel processing significantly ($P < 0.05$) altered starch hydrolysis potential in corn silage. Nutritional markers in corn silage or grain samples and were compared to starch hydrolysis potential in un-dried, un-ground corn silage using the CORR procedures of SAS. Starch hydrolysis potential of corn silages were negatively related ($P < 0.002$) to starch particle size ($r = -0.64$), whole plant DM ($r = -0.53$), zein protein ($r = -0.51$) and positively related to albumin-globulin protein ($r = 0.35$). Data suggest starch hydrolysis potential in corn silage decreases with advancing maturity (increasing DM) due to increased encapsulation of starch by zein proteins.

Key Words: Starch Digestibility, Corn Silage, Zein

T86 Comparing three different methods for assessing corn silage density. R. J. Norell*¹, M. Chahine², S. Hines³, T. Fife², M. De Hario⁴, and S. C. Parkinson⁵, ¹University of Idaho, Idaho Falls, ²University of Idaho, Twin Falls, ³University of Idaho, Shoshone, ⁴University of Idaho, Gooding, ⁵University of Idaho, Preston.

The objective of this study was to compare three methods for estimating corn silage density: core sampling (Core), Wisconsin density calculator (Calculator) and feedout method (Feedout). Eighteen storages were enrolled in the study (9 bunkers, 7 piles, and 2 piles with a bunker wall). Three core samples were collected with a Master Forage probe (DairyOne, Ithaca, NY) during each of two farm visits. Core samples were collected at mid height of the silage mass and were sampled at the center, left, and right of the silage face. The Wisconsin density calculators for silage bunkers and piles are available at (www.uwex.edu/ces/crops/)

uwforage/dec_soft.htm). Required inputs to the silage density calculator include: storage dimensions, loading rate, layer thickness, number of packing tractors, tractor weight, and percent packing time for each tractor. Silage face measurements were obtained during three farm visits (10 to 14 d intervals). With the Feedout method, density was calculated by dividing the weight of silage fed by the volume of silage removed during the interval between farm visits. Mean dry matter density (kg/m³) and SE for Core, Calculator, and Feedout were: 229.4±6.0; 234.8±8.2; and 253.0±16.8; respectively. Mean density did not differ between methods (p=0.18) but the variation in density between storages was significantly higher for Feedout (p<0.001) than Core and Calculator methods. Core density measurements were highly correlated with Calculator estimates (r=0.71, p<0.001) but not with Feedout density estimates (r=-0.06, p<0.82). The Feedout method did not perform satisfactorily due to non-uniform silage faces and the inherent challenges in measuring volume of silage fed at the farm level. Core sampling is recommended for measuring silage density and the Calculator method is recommended for evaluating alternatives during the packing process.

Key Words: Corn Silage, Density

T87 Effect of length of time ensiled on dry matter, starch and fiber digestibility in whole plant corn silage. C. M. Hallada*¹, D. A. Sapienza², and D. Taysom³, ¹Vita Plus Corporation, Madison, WI, ²Sapienza Analytica, LLC, Slater, IA, ³Dairyland Laboratories Inc., Arcadia, WI.

To test the hypotheses that starch and fiber digestibility in whole-plant corn silage change with time ensiled, two separate hybrids from two commercial dairy farms were sampled. All samples were taken from one incoming load of corn forage chopped with a commercial harvester at each farm. For each farm, this forage was divided and 750 g placed into each of 48 vacuum-sealed polyethylene bags (4 replications of 12 ensiling periods). The bagged, ensiled samples were maintained in a temperature controlled room (25°C, 55% RH). Each month over the next 12 months, four silo-bags from each hybrid at each farm were taken and frozen until analyzed. Silage samples were evaluated (fresh basis) for fermentation acids (HPLC, Shimadzu, Columbia, MD). Samples were dried at 62°C (forced air oven, Sheldon Manufacturing, Cornelius OR) to a constant weight, ground to pass a 6mm screen (Wiley Mill, Thomas Scientific, Swedesboro, NJ) and analyzed for total-tract starch digestibility (ttSTRD), 12-hour ruminal starch digestibility (STRD12), 30-hour ruminal NDF digestibility (NDFD30) and ruminal dry-matter digestibility at 12 hours (DMD12) and 30 hours (DMD30) via in-vitro methods (Sapienza Analytica Standard Procedures). Values for all digestibility measures increased with time ensiled (p < 0.05 to 0.001, ANOVA and quadratic effect by non-linear regression analyses (XLSTAT, Addinsoft, NY, NY)). During the six months of active change, ttSTRD changed approximately 1.63 units per month ensiled (p < 0.01) and NDFD30 changed approximately 1.16 units per month ensiled (p < 0.001). All other digestibility traits changed approximately 0.06 units per month ensiled (p < 0.05 to 0.001). The changes in digestibility values appeared to plateau after 6-months of ensiling.

Key Words: Corn Silage, Digestibility, Starch

T88 Effect of month of sample submittal on corn silage nutrient fractions, starch availability, NDF digestibility, and fermentation profiles measured at a commercial forage-testing laboratory. R. T. Ward*¹ and M. B. de Ondarza², ¹Cumberland Valley Analytical Services, Inc., Hagerstown, MD, ²Paradox Nutrition, LLC, West Chazy, NY.

The objective of the study was to determine if nutrient fractions, starch availability, NDF digestibility, and fermentation profiles in corn silage samples significantly differed according to the month in which they were submitted for laboratory analysis. Month of sample submittal was assumed to relate to length of crop fermentation. The dataset (n=19184) included corn silage samples between 25 and 45% DM from New York that were submitted to Cumberland Valley Analytical Services, Inc. between January, 2004 and February, 2008. All samples were analyzed using near-infrared (NIR) technique. Soluble CP (%DM) was lower from Sept through Nov (3.80) vs. from March through July (4.47) (P<0.05). Ammonia (%DM) was lower from Sept through Feb than during the rest of the year (1.24 vs. 1.40) (P<0.05). Sugar (%DM) was higher from Sept to Dec than the rest of the year (1.37 vs. 1.03) (P<0.05). Starch (%DM) was higher in samples received in Nov and Dec than during the rest of the year (30.83 vs. 29.41) (P<0.05). Starch availability was defined as the amount of starch degraded by a one-hour amylase and glucoamylase treatment at 40°C. Available starch (%DM) (n=8662) was lower during Oct and Nov than during the rest of the year (4.62 vs. 5.66) (P<0.05). NDF digestibility (30 h) (%NDF) (n=17745) was higher in samples received from Sept through Jan than the rest of the year (55.38 vs. 51.26) (P<0.05). Titratable acidity (meq/g) was lower from Sept to Dec than the rest of the year (6.56 vs. 8.41) (P<0.05) while pH was higher during that time (3.81 vs. 3.73) (P<0.05). Lactic acid (%DM) was lower from Sept to Dec than during the rest of the year (4.26 vs. 5.06) (P<0.05). Acetic acid (%DM) was lower from Sept to Feb than during the rest of the year (2.41 vs. 3.01) (P<0.05). These data suggest that at least four months are required for full fermentation of corn silage.

Key Words: Corn Silage, Fermentation Profile, Starch Digestibility

T89 Aerobic stability and silage quality parameters. Y. Acosta Aragón*, G. Boeck, A. Klimitsch, G. Schatzmayr, and S. Pasteiner, *Biomim GmbH, Herzogenburg, Lower Austria, Austria.*

The deterioration of silage under aerobic conditions was determined by physical, chemical, and microbiological factors. The aim of the present study was to determine the correlations existing between different silage quality parameters and the aerobic stability (AS).

Five different substrates (grass, alfalfa, clover, green wheat and whole crop maize) were ensiled under laboratory conditions in buckets (5 liters), using silage additives: a negative control (without); 3 variations of the biological silage product Biomim[®] BioStabil Plus in different proportions between homo- and heterofermentative lactic acid bacteria (LAB) (*L. plantarum*, *E. faecium* and *L. brevis*), and dosage in cfu/g silage (A, B and C); and 3 positive controls, two chemical silage additives (3.0 and (2.5l/ ton), and a mixture of *L. plantarum* (2 × 10⁵ CFU/g) and other chemical product. Each treatment had 2 repetitions. The opening of the model silos occurred after 50 days. The changes in the pH values, the fermentation acid contents, ethanol, as well as the AS during 7 days (differences over 2°C between the room temperature and the inner silage temperature were considered as a sign for instability), the dry matter (DM) losses (Honig, 1990) and an organoleptic assessment using a negative point system according to the DLG- Schlüssel

(2006) were measured. Correlations between selected parameters and AS were done using 2-tailed Pearson correlations.

The correlation between the AS and the proportion of hetero- to homofermentative LAB, acetic acid content, and total acid amount was positive ($P < 0.01$) correlated ($r = 0.37, 0.46$ and 0.30 ; for $n = 48, 47$ and 47 respectively). It corroborates the scientific results availing the use of heterofermentative LAB and their production of acetic acid for increasing the AS.

The AS was negatively correlated with fructose content, propionic acid and ethanol content, as well as with DM losses and organoleptic assessment (correlation coefficients of $-0.31, -0.41, -0.33, -0.82$ and -0.75 ; for $n = 44, 44, 42, 48$ and 48 respectively).

Key Words: Silage, Aerobic Stability, Silage Quality

T90 *Streptococcus bovis* as a silage inoculant: A second chance.

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Previous research indicated that *Streptococcus bovis*, a lactate producing ruminal bacterium, was similar or better than commercial silage inoculants (Jones et al., 1991). This study assessed the potential of two *S. bovis* strains, **JB1** (a bacteriocin negative strain) and **HC5** (a bacteriocin producing strain). Four treatments were used, uninoculated (Control), a commercial inoculant *Lactobacillus plantarum* (Ecosyl **MTD/1**), **JB1** and **HC5** using third cut alfalfa (50% DM, **AS1**) in 2005 and third cut alfalfa (38.3% DM, **AS2**) in 2006. All inoculants were applied at 10^5 CFU/g forage. Ten 0.5-L mini-silos were used for each treatment. Silages were allowed to ferment at 39°C for 1, 2, 4, and 60 days and analyzed for pH, ammonia-N, non-protein nitrogen (NPN), organic acids, and ethanol. Two mini-silos per treatment were opened after 1, 2, and 4 d, and four mini-silos on d 60. After 60 d with **AS1**, **MTD/1** was the only inoculant having $pH < 5.0$ (4.84). The pH values for **C**, **JB1**, and **HC5** ranged from 5.36 to 5.44. With **AS2**, pH was lower for **MTD/1** (4.57) and **JB1** (4.62) than **C** (4.73) and **HC5** (4.72) ($P > 0.05$). With **AS1**, ammonia was lower for **MTD/1** (1.62% TN) than **C** (1.97% TN), **JB1** (1.94% TN), and **HC5** (2.21% TN) ($P < 0.05$). With **AS2**, ammonia was lower for **MTD/1** (2.35% TN), **JB1** (2.34% TN), and **HC5** (2.46% TN), than **C** (2.59% TN) ($P > 0.05$). With **AS1**, lactate was greater for **MTD/1** (60.2 g/kg DM) than the other treatments ($P < 0.05$) whereas with **AS2** lactate was similar among treatments ($P > 0.05$). We conclude that *S. bovis* **JB1** was a more effective inoculant than **HC5**, and similar to the commercial inoculant in one of two trials. The inability of **HC5** to perform as well as (or out-perform) **JB1** maybe related a 10% slower growth rate, and the susceptibility of its cell-free bacteriocin to peptidases.

Key Words: *Streptococcus bovis*, Silage Inoculants, Lactic Acid

T91 An evaluation of the effectiveness of *Lactobacillus buchneri* 40788 to improve the aerobic stability of corn silage in farm silos.

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The objective of this study was to determine the effectiveness of inoculants containing *L. buchneri* 40788 (Lallemand Animal Nutrition,

Milwaukee, WI) on fermentation and the subsequent aerobic stability of corn silage stored in farm silos. Corn silage was randomly sampled from farms in Wisconsin and Minnesota using no inoculant ($n = 15$) or using an inoculant ($n = 16$) containing either *L. buchneri* 40788 alone or this organism combined with *P. pentosaceus* during May through June of 2007. All silages had been ensiled in the Fall of 2006. Corn silage that was removed from the silo face during the morning feeding was sampled, vacuumed sealed and shipped immediately to the University of Delaware for analyses. Silage samples were analyzed for DM, fermentation end products, aerobic stability and microbial populations. The population of *L. buchneri* in silages was determined using a real time-qPCR technique. Aerobic stability was measured as the time after exposure to air that it took for a 2°C rise above an ambient temperature of about 23°C. The DM and concentrations of lactic and acetic acid were 35.6 and 34.5%, 4.17 and 4.85%, and 2.24 and 2.41% respectively for control and inoculated silages. The concentration of 1,2 propanediol was greater ($P < 0.05$) in inoculated silages (1.26 vs. 0.29%). Numbers of lactic acid bacteria determined on MRS agar were not different between treatments. However, the numbers of *L. buchneri* based on real time-qPCR analysis was higher ($P < 0.05$) and averaged 6.46 log cfu/g compared to 4.89 log cfu for uninoculated silages. Number of yeasts was lower and aerobic stability was greater ($P < 0.05$) in inoculated silages (4.75 log cfu/g and 74 h of stability) than in uninoculated silages (5.55 log cfu/g and 46 h of stability). This study supports the effectiveness of *L. buchneri* 40788 on dairy farms.

Key Words: Corn Silage, *Lactobacillus buchneri*, Polymerase Chain Reaction

T92 The effect of *Lactobacillus buchneri* 40788 or *Lactobacillus plantarum* MTD-1 on the fermentation and aerobic stability of corn silages ensiled at two dry matter contents. W. Hu*, R. J. Schmidt, E. E. McDonnell, C. M. Klingerman, and L. Kung, Jr., University of Delaware, Newark.

Whole plant corn at normal and high dry matter (DM) contents (33.1 vs. 40.6%) was ensiled in quadruplicate 20-L laboratory silos to investigate the effects of inoculants *Lactobacillus buchneri* 40788 (LB) or *L. plantarum* MTD-1 (LP) on fermentation and aerobic stability. Aerobic stability was defined as the time after silo opening for silage temperature to reach 2°C above ambient. Chopped forage was used in a $2 \times 2 \times 2$ factorial arrangement of treatments: DM contents at 33.1 or 40.6%, LB at 0 (untreated) or 4×10^5 cfu/g, and LP at 0 or 1×10^5 cfu/g of fresh forage. After 240 days ensiling, an interaction effect of LB by forage DM content on concentrations of lactic and acetic acids was observed. For LB-treated silage in normal forage DM content, concentration of lactic acid on DM basis decreased (2.28 vs. 3.76%; $P < 0.01$), and that of acetic acid increased (1.78 vs. 0.93%; $P < 0.01$); whereas, for LB-treated silage in high forage DM content, concentration of lactic acid was unchanged (3.37 vs. 3.05%), and that of acetic acid increased (2.14 vs. 0.58%; $P < 0.01$) when comparing with LB-untreated silage. The effect of LP on concentration of lactic acid occurred only in silage with normal forage DM content (treated, 3.36% vs. untreated, 2.68%; $P = 0.02$). It was also shown that silage treated with LP had greater concentration of acetic acid (1.62 vs. 1.09%; $P < 0.01$) for silage with normal forage DM content, and lower concentration of acetic acid (1.14 vs. 1.57%; $P < 0.01$) for silage with high forage DM content when comparing with the LP-untreated silage. Appreciable amounts of 1,2-propanediol existed in all LB-treated silages with both forage DM contents (average 1.65%). Aerobic stability was improved consistently in all LB-treated silages

(average LB-treated, 189 h vs. LB-untreated, 50 h; $P < 0.01$), the silage with high forage DM content having greater aerobic stability than did the silage with normal forage DM content (268 vs. 109 h; $P < 0.01$). No effect of LP on aerobic stability was found in this experiment.

Key Words: Corn Silage, Inoculants, Aerobic Stability

T93 The effect of combining *Lactobacillus buchneri* 40788 with lactic acid bacteria on the fermentation, microbial populations and aerobic stability of brown midrib corn silage. L. J. Reich*, M. W. Hofherr, R. J. Schmidt, W. Hu, and L. Kung, Jr., *University of Delaware, Newark.*

The objective of this study was to determine the effects of combining *Lactobacillus buchneri* 40788 (LB) (Lallemand Animal Nutrition, Milwaukee, WI) with classical homolactic acid bacteria on the ensiling of corn silage. Mycogen F697, a brown midrib hybrid, was harvested at about 31% DM and was: a) untreated, or treated with b) LB (4×10^5 cfu/g of forage) and *Pediococcus acidilactici* (1×10^5 cfu/g) (LBPA), c) LB (4×10^5 cfu/g of forage) and *L. plantarum* (1×10^5 cfu/g) (LBLP), or d) LB (4×10^5 cfu/g of forage) and *P. pentosaceus* (1×10^5 cfu/g) (LBPC). Forage was ensiled in 20-L silos (quadruplicate per treatment) and the tops were sealed with an oxygen barrier plastic. After ensiling for 210 d, the top 10 cm of each silo was separated from the bottom 26 cm which added an effect of location to the design. Visibly spoiled silage from the top was weighed. Silages from both sections were analyzed separately for fermentation end products and microbial populations. Silage from the bottom section was also analyzed for aerobic stability and populations of LB by using a real time quantitative polymerase chain reaction. Untreated silage had more ($P < 0.01$) visible spoilage on the top than did inoculated silages. Untreated silage also had more ($5 \log$ cfu/g, $P < 0.01$) yeasts than inoculated ($< 2 \log$ cfu/g) silages in the top and bottom of the silos. There were treatment \times location interactions for all fermentation end products but the final concentrations of acetic acid and 1,2 propanediol were greatest ($P < 0.01$) for LBPC $>$ LBPA $>$ LBLP $>$ untreated. Untreated silage contained only 5.62 log cfu of LB per g of wet silage and was less than that found in inoculated silages (range 7.97 to 8.80 cfu/g). The aerobic stability of untreated silage was 186 h but it was greater ($P < 0.01$) for inoculated silages (average > 500 h). Although combining LB with various lactic acid bacteria resulted in differing magnitude of responses in fermentation end products, the combinations were equally effective in improving the aerobic stability of corn silage.

Key Words: *Lactobacillus buchneri*, Silage, Aerobic Stability

T94 Effect of the silage additive and the ensiled substrate on the silage quality parameters. Y. Acosta Aragón*, G. Boeck, A. Klimitsch, G. Schatzmayr, and S. Pasteiner, *Biomim GmbH, Herzogenburg, Lower Austria, Austria.*

Five different substrates (grass, alfalfa, clover, green wheat and whole crop corn) were ensiled under laboratory conditions in buckets (5 liters), using silage additives: a negative control = NC (without); 3 variations of the biological silage product Biomim® BioStabil Plus in different proportions between homo- and heterofermentative lactic

acid bacteria (LAB) (*L. plantarum*, *E. faecium* and *L. brevis*) of 1 : 1 and 1 : 10; and dosage in cfu/ g silage (1×10^5 and 1×10^6) (A, B and C); and 3 positive controls, two chemical silage additives (mixture of acids) D (3.0 l/ ton) and E (2.5l/ ton), and F, a mixture of *L. plantarum* (2×10^5 CFU/g) and a chemical product (mixture of acids and salts). Each treatment had 2 repetitions. Model silos were opened after 50 days. The following parameters were analysed: pH, fermentation acid content, ethanol, aerobic stability during 7 days and dry matter (DM) losses (Honig, 1990). For the analysis of variance between the groups (different silage additive or substrates) a one-way ANOVA procedure was conducted. Silage additives, across all forage species, affected ($P < 0.05$) silage pH ((A $>$ (NC = B = C = D) $>$ E = F), the proportion of acetic acid content in total acid (F $>$ ((NC = A = B = C = D) $>$ E) and aerobic stability ((A = B = C) $>$ (D = E = F) $>$ NC). Other parameters were not different. Propionic acid content and DM losses were not affected by the substrate. The final pH was different ($P < 0.05$) in the following order: alfalfa $>$ green wheat = clover grass = grass $>$ whole crop maize. This corresponds with lactic acid content reached by the substrates. Acetic acid content was very high for clover grass and green wheat (31.85 and 44.11 g/ kg DM, respectively) and not different from grass; but grass was in the range given by the DLG-Schlüssel (2006) of 15 to 30 g/kg DM as optimum. Aerobic stability was closely correlated to the acetic acid content which reached for these substrates (clover grass, green wheat and grass) 7, 7 and 6 days respectively.

Key Words: Silage, Additive, Substrate

T95 Effect of a microbial inoculant producing ferulic acid esterase on the fermentation and NDF digestibility of normal and BMR corn silages. M. W. Hofherr*, L. J. Reich, M. C. Der Bedrosian, M. C. Santos, W. Hu, and L. Kung, Jr., *University of Delaware, Newark.*

Three corn silage hybrids were untreated or treated with the Pioneer inoculant 11CFT (Pioneer Hi-Bred International, Inc., Johnston, IA) to determine its effects on silage fermentation and NDF digestibility (NDF-D). The three hybrids included Pioneer 33A87 (34% DM), Pioneer 33J57 (31% DM) and Mycogen F697 BMR (34% DM). The inoculant contained a strain of *Lactobacillus buchneri* capable of producing ferulic acid esterase and a strain of *L. casei*. The theoretical rate of inoculation achieved a final count of 1×10^5 cfu of *L. buchneri* and 1×10^4 cfu of *L. casei* per g of wet forage. Forages were chopped to a theoretical cut length of 1.9 cm and approximately 600 g were ensiled in quadruplicate, vacuumed and heat-sealed bags for each inoculant, hybrid and day of ensiling. Silos were opened for each treatment after 60, 180 and 360 days of fermentation. Silages were analyzed for nutrients and fermentation end products. The digestibility of silage NDF was determined using dried samples ground through a 6-mm screen in a Wiley mill, weighed into in situ bags (5.5×5.5 cm, 40 ± 15 microns, Ankom Technology) and incubated in rumen fistulated steers for 48 h. Steers were fed a diet consisting of 45% corn silage, 15% alfalfa hay and 40% concentrate. Over all sampling days, inoculation resulted in a lower concentration ($P < 0.01$) of lactic acid (4.34 vs 4.80%, DM basis) but a higher ($P < 0.01$) concentration of acetic acid (1.60% vs. 1.17%) compared to untreated silage. There was an inoculation \times hybrid \times day effect for acetic acid. The NDF-D averaged across all sampling days by hybrid was greatest ($P < 0.01$) for BMR (58.1%) compared to 33J57 (45.3%) and 33A87 (44.3%). However, there was a hybrid \times inoculation effect. Averaged over all sampling days, inoculation did not affect the

NDF-D of BMR (57.6 vs. 58.6%) but it improved NDF-D ($P < 0.05$) for 33A87 (45.3 vs. 43.2%) and for 33J57 (46.3 vs. 44.3%).

Key Words: Ferulic Acid Esterase, Silage, Digestibility

T96 Nutritive value of sorghum silage added bacterial inoculants. R. H. de T. e Buschinelli de Goes*¹, A. C. Martinez², C. O. de Abreu², and K. C. da S. Brabes¹, ¹Universidade Federal da Grande Dourados, Dourados, MS, Brasil, ²Universidade Estadual de Maringá, Umuarama, PR, Brasil.

Thirty six PVC silos (4 in. diameter with 40cm of height and capacity of 3.2L) were utilized to evaluate the addition of corn meal and bacterial inoculants (*L.plantarum*, *S.faecium*, and *Lactobacillus spp.*) on the quality of the sorghum silage harvested 125 days after planting. The inoculant was supplied in the dose of 2.0 forage mg/kg; the product contains 5.26×10^{10} CFU/g. A 3x2x6 factorial design with 3 levels of corn meal, 2 inoculant (none or inoculated), and 6 ensiling periods was applied in a randomized design with 02 replications. Corn meal was included at 0, 10, and 20% of natural matter. Silage was removed from each silo on day 0, 7, 14, 21, 28 and 35 after ensiling. The pH was not altered by the use of corn meal with or without inoculant. Silage DM was increased by corn meal inclusion ($P < 0.05$) but not by inoculant ($P > 0.05$). Neither corn meal inclusion or inoculant affected ($P > 0.05$) CP, EE, ash, NDF, NPN, ADIN, soluble N or total CHO (means = 15.47, 2.10, 10.83, 76.99, 0.72, 0.48, 1.12, 16.87, respectively). Silage crude protein (mean = 15.47%) is due to presence of panicle in the silage; the proportion of panicle might interfere in the ADIN. The length of fermentation, increased silage ADIN, for 20% of corn meal (mean = 0.54); and the CP after 21 days ensiling. The ADIN for 0%, and 10% of corn meal was 0.49. Silage ADF was not affected ($P > 0.05$) by inoculant but as reduced (45.17 vs 49.42 and 48.82%; ($P < 0.05$) with 20% corn meal inclusion. This suggests that 20% corn meal altered silage fermentation. The addition of inoculant not altered the quality of sorghum silage.

Key Words: Chemical Composition, Corn Meal, *L. plantarum*

T97 Microbial inoculant effects on in situ ruminal dry matter and neutral detergent fiber disappearance of corn silage. K. E. Cowles* and M. R. Murphy, University of Illinois, Urbana.

The efficacy of a prototype microbial inoculant on composition, and in situ ruminal dry matter (DM) and neutral detergent fiber (NDF) disappearance, of corn silage was evaluated. Two corn hybrids, Pioneer 31N27 (H1) and 33D31 (H2) were treated after harvest with either a control (no inoculant) or a blend of *Lactobacillus buchneri* and *L. casei* (Pioneer Hi-Bred, a DuPont Business, Johnston, IA) applied at 2 ml/kg of fresh forage in a completely random design with 32 mini-silos. Sixteen silos were opened 60 and 120 d post-ensiling. Disappearance of DM and NDF was measured after 24 or 48 h of ruminal incubation. At harvest, H2 was drier than H1 (34 vs. 40%; $P = 0.01$); crude protein, NDF, acid detergent fiber, nonfiber carbohydrate, ash, and pH were similar. Compositions differed after 60 d: lactate and lactate:acetate increased more, and acetate and propionate decreased more, for the blend applied to H2 than H1 (interactions $P \leq 0.02$). Percentages of DM, nonfiber carbohydrate,

acetate, and propionate increased more after 60 d when the blend was applied to H2 than when applied to H1 (interactions $P \leq 0.02$). Content of NDF, lactate, and lactate:acetate decreased more after 60 d when the blend was applied to H2 than when applied to H1 (interactions $P \leq 0.02$). The DM disappearance in the rumen of H2 after 60 d tended to be higher for the blend than for the control (36 vs. 38%, $P = 0.11$). After 120 d, DM disappearance of H1 was 6% higher (42 vs. 45%; $P = 0.11$) for the blend than for the control; whereas, it was unchanged for H2. An interaction of hybrid, treatment, and time in the rumen ($P \leq 0.02$) indicated that the blend enhanced ruminal DM disappearance of H2 but not H1. Ruminal disappearance of NDF for H2 after 60 d was 110% higher (11 vs. 24%; $P = 0.02$) for the blend than for the control. Neither treatment nor time of ensilage affected NDF disappearance for H1. After 120 d, NDF disappearance in the rumen of H2 was still 14% higher for the blend than for the control. Differences in composition and ruminal degradation of silages indicated that the blend improved conservation and feeding values of H2 but not H1.

Key Words: Corn Silage, Inoculant, Ruminal Degradation

T98 Impact of chloride fertilization and Silo-King® on the nutrient content, digestibility, and mycotoxin concentrations in corn silage. D. H. Kleinschmit*, D. P. Casper, and D. A. Spangler, Agri-King, Inc., Fulton, IL.

Producing corn silage from soils fertilized with Cl has resulted in improved forage quality via reducing the plant's susceptibility to mycotoxins. The feeding value of corn silage may be further enhanced by using a forage fermentation additive. The experiment was conducted using a 2 x 3 factorial randomized complete block design. Three blocks were randomly selected within a corn field and within each block, three plots were assigned to one of three fertilization treatments: 1) no fertilization (CON), 2) fertilization with CaCl at a rate of 227 kg/ha (CaCl), or 3) fertilization with KCl at 227 kg/ha (KCl). Two weeks prior to harvest, plant ears were inoculated via toothpicks with *Fusarium graminearum*. Within each plot, corn silage was either untreated (UNT) or treated with Silo-King® (SK; Agri-King, Inc., Fulton, IL) at a rate of 0.20 kg/tonne of fresh forage in triplicate silos and ensiled for 65 d. With the exception of having the greatest ($P < 0.01$) concentration of Cl (0.11, 0.37, and 0.34% for CON, CaCl, and KCl, respectively), CaCl had little impact on nutrient content of corn silage compared to the other fertilization treatments. Compared to CON, KCl had lower ($P < 0.05$) concentrations of ADF (30.6, 30.1, and 28.4%), NDF (50, 48.8, and 46.2%), and lignin (3.43, 3.38, and 3.16%) and greater ($P < 0.05$) concentrations of starch (24.3, 26.0, and 28.7%), thus numerically improving *in vitro* DM digestibility (64.0, 64.2, and 65.3%; IVDMD). Treating corn silage with SK lowered ($P < 0.01$) concentrations of ADF (31.2 vs. 28.2% for UNT and SK, respectively), NDF (50.5 vs. 46.2%), and lignin (3.47 vs. 3.18%) and increased ($P < 0.01$) concentrations of starch (23.6 vs. 29.0%) and crude fat (2.00 vs. 2.30%), thus improving ($P < 0.04$) IVDMD (63.7 vs. 65.4%). Chloride fertilization or treatment with SK did not affect mycotoxins. In conclusion, fertilizing with KCl shows potential to improve the digestibility of corn silage via reduced fiber components and increased the starch concentrations. Treating corn silage with Silo-King® at ensiling increased the digestibility of DM.

Key Words: Mycotoxins, Corn Silage, Chloride Fertilization

Graduate Student Competition: ADSA Production Division Poster Competition

T99 Ruminal and intestinal crude protein digestibility of triticale dried distillers grains with solubles. K. T. Wierenga*, G. B. Penner, and M. Oba, *University of Alberta, Edmonton, Alberta, Canada.*

The objective of this study was to compare in situ ruminal CP and in vitro intestinal CP digestibility (IVID) of triticale dried distillers grains with solubles (TDDGS) to those of soybean meal (SBM), canola meal (CM) and corn DDGS (CDDGS). The feedstuffs were incubated using nylon bags (50 µm pore) in the rumen of three lactating dairy cows fed a diet containing 27.8% NDF and 16.6% CP. Samples were incubated in the rumen for 0, 1, 2, 4, 8, 16, 24, 48 and 72 h to determine ruminal CP degradation. To determine IVID, samples ruminally incubated for 16 h were digested with HCl/pepsin and pancreatin. The soluble protein (%CP) was higher ($P < 0.001$) for CDDGS and TDDGS (30.2 and 31.0%, respectively) compared to CM (15.1%) and SBM (9.0%). The rapidly degradable protein (< 1h, %CP) was highest ($P < 0.001$) for CDDGS (30.9%) followed by TDDGS (22.5%), CM (9.1%), and SBM (6.1%). Degradation rate of slowly degradable protein was faster ($P < 0.001$) for SBM and CM (4.50 and 4.10 %/h, respectively) than CDDGS and TDDGS (1.87 and 1.80 %/h, respectively). Rumen degradable protein after 16h of incubation was higher ($P < 0.001$) for CDDGS and TDDGS (69.3% and 64.5% respectively) than CM (62.2%) and SBM (53.0%). However, as IVID (%CP) was highest ($P < 0.001$) for SBM (33.9%), followed by CM (18.4%), TDDGS (14.0%), and CDDGS (8.5%), estimated total-tract digestibility of CP was higher for SBM (86.8%) compared to CM, TDDGS, and CDDGS (80.7, 78.5, and 77.8%, respectively). Although DDGS has been generally accepted as a high RUP feed, the high RDP and rapidly degradable protein in CDDGS and TDDGS reported herein suggest more degradation in the rumen. Therefore, further investigation is warranted to determine the extent of ruminal CP degradation variations among different types of DDGS.

Key Words: Dried Distillers Grains with Solubles, In Vitro Intestinal Digestibility, In Situ Ruminal Degradation

T100 Heat treatment of bovine colostrum: Effect on viscosity, bacterial count and immunoglobulin G levels. J. A. Elizondo-Salazar*, S. C. Donaldson, B. M. Jayarao, G. R. Ziegler, and A. J. Heinrichs, *The Pennsylvania State University, University Park.*

A study was conducted to identify the optimal temperature and time at which heat treatment of bovine colostrum would least change viscosity and IgG levels yet reduce bacterial count. First milking colostrum with IgG levels > 50 g/L (measured by colostrometer) was collected from 30 Holstein cows and frozen at -20°C. Each sample was thawed at 4°C, thoroughly mixed and ten 10-mL aliquots were taken in sterile 15-mL screw-cap centrifuge tubes. Samples were heat-treated for 0, 30, 60, and 90 min at 63, 60 and 57°C using a water bath. Samples were evaluated for standard plate count (SPC), preliminary incubation count (PIC), coagulase-negative staphylococci (CNS) count, environmental streptococci (ES) count, coliform (CC) count, gram-negative noncoliform (NC) count, *Streptococcus agalactiae* (SAG) count, and *Staphylococcus aureus* (SA) count. IgG₁ and IgG₂ levels were determined in all samples using radial immunodiffusion. Viscosity was also measured using a digital viscometer. All heat-treatments reduced SPC, CC, NC, ES, CNS, SA, and PIC ($P < 0.05$). Heat-treatment at 60°C and above resulted in

significant denaturation of colostral IgG₁. However, colostral IgG₂ levels were not reduced when the temperature was held at 60°C for less than 60 min. Viscosity was not affected when temperature was held at 60°C for less than 60 min. The findings of the study suggest that heat-treatment of bovine colostrum at 60°C for 30 to 60 min may be used as an optimal temperature and timing, at which heat treatment of bovine colostrum would produce no significant changes in viscosity, a small reduction in IgG levels, and a significant reduction in bacterial count.

Table 1. Changes in viscosity, bacterial count and IgG levels in bovine colostrum after heat-treatment.

Temp. (°C)	Time (min)	IgG ₁ (g/L)	IgG ₂ (g/L)	Viscosity (Pa·s)	SPC (CFU/mL)
Control	Control	71.6 ^a	3.2 ^a	388 ^{ab}	39,753 ^a
57	30	66.8 ^{ab}	3.0 ^{ab}	95 ^a	7,019 ^{bc}
57	60	66.7 ^{ab}	3.0 ^{ab}	68 ^a	10,443 ^b
57	90	62.6 ^{ab}	2.9 ^{ab}	168 ^a	3,816 ^{bc}
60	30	56.7 ^{bc}	2.7 ^{abc}	106 ^a	4,283 ^{cd}
60	60	47.9 ^{dc}	2.6 ^{abc}	655 ^b	3,553 ^{bc}
60	90	40.5 ^d	2.4 ^{bcd}	7,139 ^c	230 ^d
63	30	27.7 ^e	2.2 ^{cd}	6,310 ^c	679 ^{de}
63	60	22.8 ^f	1.9 ^{de}	41,207 ^d	204 ^e
63	90	12.9 ^g	1.5 ^e	83,056 ^e	2 ^e

$P < 0.05$

Key Words: Colostrum, Immunoglobulins, Bacteria

T101 The effects of increased milking frequency during early lactation on milk yield and milk composition on commercial dairy farms. F. Soberon*, C. M. Ryan, D. M. Galton, and T. R. Overton, *Cornell University, Ithaca, NY.*

Holstein cows (n=398) entering either first or later lactation on four commercial farms were used to determine the effects of increased milking frequency (IMF) during the first 21 d postpartum. Cows were assigned randomly at calving within farms either to a control treatment (2× milking) or to an IMF group in which cows were milked 4× during the first 21 d postpartum followed by 2×. Cows assigned to the IMF group were milked at the beginning and again at the end of the normal milking routine during the 4× period. This resulted in minimum milking intervals for the 4× cows of 3.5, 4.5, 5.5, and 6 h for each farm. Results from the analysis of data from the three farms from which 7 monthly test days of production data were available indicated that early lactation IMF increased milk yield by 2.1 kg/d during the first 7 months of lactation (33.9 vs. 31.8 kg/d; $P < 0.01$). Interactions of treatment with lactation group were not significant. Overall percentages of milk fat (3.62 vs. 3.73; $P = 0.02$) and true protein (2.97 vs. 3.03; $P = 0.05$) were decreased by early lactation IMF; however, overall yields of milk fat (1.21 vs. 1.17 kg/d; $P = 0.04$) and true protein (1.00 vs. 0.95 kg/d; $P < 0.01$) were increased by early lactation IMF. Within-farm analysis using all the available test day information for each farm (7, 10, 7, and 5 test days, respectively) indicated that the magnitude of the milk yield response varied from 4 to 10% (3.1, 1.5, 1.8, and 1.8 kg/d for each farm). Early lactation IMF did not affect somatic cell linear score and did not affect body fat mobilization as assessed by BCS; however,

there was a tendency for serum NEFA to increase (485 vs. 427 $\mu\text{Eq/L}$; $P = 0.08$) and an increase in serum BHBA (12.2 vs. 10.4 mg/dl; $P = 0.03$) during the first 21 d postpartum for cows subjected to IMF. The number of cows diagnosed with subclinical ketosis (BHBA > 14 mg/dL) did not differ among treatments ($P = 0.87$). Results suggest that early lactation IMF has the potential to consistently increase milk yield on commercial dairy farms.

Key Words: Milking Frequency, Transition Cow

T102 Effect of abomasal infusion of butterfat, long chain fatty acids or CLA on milk fatty acid composition and mammary tissue lipogenic gene expression in lactating cows. A. K. G. Kadegowda^{*1}, J. J. Loo², L. S. Piperova¹, P. Delmonte³, and R. A. Erdman¹, ¹University of Maryland, College Park, ²University of Illinois, Urbana, ³FDA, College Park, MD.

Mammary tissue lipogenic gene expression and milk fatty acid composition were studied during abomasal infusion of butterfat, long chain fatty acids or CLA mixture in lactating cows. Eight rumen fistulated Holstein cows (49 \pm 20 DIM) were used in a replicated 4 \times 4 Latin square design. Treatments were: 1) Control (no infusion); or abomasal infusion of; 2) 400 g/d Butterfat; 3) 245 g/d LCFA (blend of 59% cocoa butter, 36% olive oil, and 5% palm oil) providing 50% of the 16:0 and the amounts of C18 FA, equivalent to that found in 400 g of butterfat (LCFA); and 4) 100 g/d conjugated linoleic acid (CLA, negative control), providing 10 g of t10c12 CLA. Lipid supplements were infused in equal portions 3 \times daily during the last 2 wk of each 3 wk experimental period. Compared with Controls, Butterfat infusion increased milk fat yield by 21% ($P < 0.02$), CLA decreased milk fat yield by 43% ($P < 0.001$), and LCFA had no effect on fat yield. Infusion of Butterfat increased (21%, $P < 0.05$) the yield of FA with $\leq 16:0$ -carbons. Milk yield of mono- and poly-unsaturated FA was greater in cows infused with Butterfat (by 33% and 29%) or LCFA (by 25% and 24%), compared to Control. Infusion of CLA reduced yield of all FA synthesized de novo (56%, $P < 0.001$) and reduced FA desaturation index (40%, $P < 0.001$). Expression of genes involved in FA uptake (LPL, CD36), intracellular FA activation and transport (FABP3, ACSS2, ACSL1), de novo FA synthesis (ACACA, FASN), desaturation (SCD), and trigacylglycerol synthesis (AGPAT6, GPAM) tended to increase by 30% to 40% due to Butterfat, while LCFA showed opposite effects. The expression of lipogenic genes were not modified by CLA. Results suggest that supply of short and medium chain FA with

Butterfat infusion might potentially up-regulate mammary lipogenic gene expression and increase milk fat yield in lactating cows.

Key Words: Lactating Cows, Fat Supplements, Gene Expression

T103 Production of Holstein and Jersey \times Holstein cattle grazing annual ryegrass/white clover pasture. J. C. Lopes*, A. P. Vilela, K. A. Weigel, K. A. Albrecht, and D. K. Combs, University of Wisconsin, Madison.

The objective of this trial was to compare milk production, milk composition and pasture intake of Holstein (H) and Jersey-Holstein crossbred (JH) cattle grazing high quality annual pasture. Fourteen primiparous 1/4 Jersey \times 3/4 Holstein cows (112 DIM, 495 kg BW) and fourteen primiparous Holstein cows (89 DIM and, 535 kg BW), were randomly assigned by breed to one of four-2.4 hectare paddocks. The four pastures were seeded in the spring of 2007 with a mixture of white clover (*Trifolium repens* L.) and Italian ryegrass (*Lolium perenne* ssp. Multiflorum.). All pastures were managed to offer cows approximately 30 kg of forage DM per day. The daily grazing area was estimated according to the pasture availability and the number of cows in each paddock. Cows were allowed to graze approximately 20 h/d and were milked twice daily. Supplemental concentrate was provided daily after each milking (7.2 kg/cow/d). Pastures were initially stocked with 7 cows per paddock, but as the summer progressed and pasture growth declined, one cow from each of the paddocks was removed to keep pasture availability constant and assure adequate supply of pasture. Pasture intake was estimated by difference in yield estimates from pasture quadrats clipped at a 5 cm stubble height before and after grazing. Pastures quality was high throughout the trial (41 \pm 1.6%, NDF, and 18 \pm 0.5%, CP). Milk yield/cow/d tended lower for JH than H (27.0, 29.8 kg/d, respectively $p < 0.07$) and 3.5% FCM was lower for JH than H (28.0, 30.0 kg/d respectively, $p < 0.01$). Milk fat percentage was similar for JH and H (3.6 \pm 0.1%). Fat corrected milk yield by paddock was higher for H than JH (1349, 1187 kg 3.5%FCM/paddock/week respectively, $p < 0.05$). Pasture DMI did not differ by breed (1133 kg DM/paddock/d). Grazing Holstein primiparous cows produced more milk from high quality pasture than Jersey-Holstein crossbreds. Breed did not affect pasture intake, the advantage was due to higher production per cow of the Holsteins than the Jersey-Holstein crossbreds.

Key Words: Dairy, Pasture, Grazing

Meat Science and Muscle Biology

T104 Effect of different moving devices at loading on incidence of downers, and carcass and meat quality in market weight pigs. J. A. Correa*¹, H. Gonyou^{2,3}, S. Torrey⁴, N. Devillers⁴, J.-P. Laforest¹, and L. Faucitano⁴, ¹Laval University, Quebec City, QC, Canada, ²Prairie Swine Centre, Saskatoon, SK, Canada, ³University of Saskatchewan, Saskatoon, SK, Canada, ⁴Agriculture & Agri-Food Canada, Sherbrooke, QC, Canada.

Despite the evidence about the negative effects on animal welfare and meat quality, the electric prod is frequently used by farm handlers and truckers to load pigs onto the truck. The objective of this study was to evaluate the effects of alternative moving devices, such as the paddle and compressed air prod, at loading on the incidence of downers and bruised carcasses and on meat quality (ultimate pH and blood splashes) in pigs. In a three week trial, a total of 284 animals (120±7 kg live weight) were randomly sorted out from the finishing pen in groups of 5 pigs and assigned to one of three moving procedures: 1) moving with an electric prod and board from the finishing pen to the truck (E); 2) moving with a board and a paddle from the finishing pen to the truck (P); 3) moving with a board and a paddle from the finishing pen and using a compressed air prod in the ramp before going into the truck (A). Data were analysed using an ANOVA for factorial designs, with group as the experimental unit. Treatment E resulted in 3 % downer pigs on arrival at the abattoir compared to none in treatments P and A. The proportion of bruised carcasses was lower in P and A pigs than E pigs (32 % vs 57 %). In this study ultimate pH values in the semimembranosus (SM) and adductor (AD) muscles were generally high, but were slightly higher ($P < 0.05$) in the SM and AD muscles from E pigs compared to those from P and A pigs. A higher proportion of blood splashes was found in the SM muscle of E pigs (31 %) compared to that of A pigs (19.4 %), with P pigs being intermediate (28.2 %). These results suggest that the use of a board in combination with a compressed air prod or paddle to handle pigs at loading can be recommended to replace the use of electric prod as it reduces animal losses during transport and decreases the incidence of bruised carcasses and blood-splashes.

Key Words: Pig, Handling, Meat Quality

T105 Identification of boar-tainted carcasses with an electronic nose. S. Ampuero¹, M. Amrhein², S. Dubois¹, and G. Bee*¹, ¹Agroscope Liebefeld-Posieux, Research Station ALP, Posieux, Switzerland, ²Online Control LTD, Lausanne, Switzerland.

Production of intact males on a large scale is greatly hindered by the lack of objective, reliable and fast methods to detect boar tainted carcasses. In a preliminary study we showed that a mass spectrometry (MS) based electronic nose was potentially suited to detect boar tainted samples. The aim of the present study was to develop a system consisting of a MS electronic nose (Smart Nose 151, LDZ, Switzerland) coupled with an automatic-sampler pyrolyser (CDS pyroprobe AS2500 APLUS). The chemometric classification models are established against reference classifications based on HPLC determination of the principal boar taint compounds in the adipose tissue: androstenone (A), skatole (S), and indole (I). The analysis is performed by introducing 0.5 µL of liquefied fat in a capillary tube. The gas phase produced by pyrolysis at 600°C is instantaneously transferred to the ionization chamber of the MS. The

generated data is recorded during 240 s by scanning between 10 to 250 amu at 50 ms/amu. Over a period of 12 months, a total of 353 adipose tissue samples originating mainly from Swiss Large White and Landrace boars and barrows were analyzed. Large variations in the age and BW at slaughter, the rearing conditions and the feeding regimes were present in the set of porcine adipose tissue samples. Between 60 to 80% of the samples were used to develop different classification models by multi-class SVM (Support Vector Machine) and variable selection via genetic algorithms. Based on sensory evaluations the reference classes were defined as (expressed per kg adipose tissue): **strong boar taint:** A > 1.0 mg or S and/or I > 0.16 mg, **no boar taint:** A ≤ 0.5 mg and S and I ≤ 0.16 mg, and **mild boar taint:** A > 0.5 or ≤ 1.0 mg and S and/or I ≤ 0.16 mg. Semi-external validations, with 17 to 42% of new samples not included in the models, reveal 98% of correct identification rates of strong boar tainted samples. The results of this study confirm that a fast, reliable and objective detection of boar tainted carcasses is possible.

Key Words: Boar Taint Detection, Electronic Nose, Pyrolysis

T106 Age at the beginning of the free-range fattening period affects subcutaneous fat quality of Iberian pigs. M. A. Latorre*, B. Prieto, D. G. Valencia, and M. P. Serrano, *Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain.*

The traditional productive cycle for Iberian pigs includes a final free-range fattening phase (from November to February) in which animal intake natural feed resources, mainly acorns and grass. This period has important consequences on the fat quality, which is determinant for elaboration of dry-cured products. The high level of monounsaturated fatty acids (FA) is one the most relevant quality aspects in fat from Iberian pigs. Currently, the reproductive planning of this system is based on two births per year (spring and autumn), beginning the free-range period with different age (18 or 12 months) but similar weight (110 kg BW), and being slaughtered with 160 kg BW (21 or 15 months old). In this context, a total of 40 Iberian pigs were used to study the effect of age at the beginning of the free-range fattening period on FA profile of subcutaneous fat; 18 months old (OP) and 12 months old (YP). YP were fed higher quantity of concentrates than P22 (4.5 vs. 2.5 kg/day) during the growing phase to achieve the fattening period at similar weight. Each treatment was replicated 20 times (one pig per replicate). OP had higher proportion of C14:0 ($P < 0.10$) and C15:0 ($P < 0.05$) than YP. However, YP showed higher percentage of C18:0 than OP ($P < 0.05$). In consequence, no effect of age on saturated FA was detected (28.77 vs. 29.14% for OP and YP, respectively; $P > 0.05$). On the other hand, OP had higher proportion of C18:1 ($P < 0.01$) and C20:1 ($P < 0.001$), and therefore higher percentage of monounsaturated FA (60.87 vs. 59.61%; $P < 0.01$) than YP. Fat from OP showed higher proportion of C18:4 ($P < 0.10$) but lower C18:2 ($P < 0.001$) than fat from YP. So OP had lower percentage of polyunsaturated FA than YP (10.36 vs. 11.25%; $P < 0.01$). It is concluded that Iberian pigs starting the free-range fattening period with 12 months of age have adequate fat quality but their results are worse than those showed by pigs starting fattening phase with 18 months of age.

Key Words: Age at the Fattening Period, Fat Quality, Iberian Pigs

T107 Effect of castration of females on meat quality and fatty acid profile of backfat in Iberian pigs reared under intensive production systems. M. P. Serrano¹, D. G. Valencia¹, R. Lázaro¹, A. Fuentetaja², and G. G. Mateos*¹, ¹Universidad Politécnica de Madrid, Spain, ²Copese, Segovia, Spain.

Iberian (IB) pigs are the ancestral dark-haired pigs of Spain. Currently, 80% of IB pigs are reared under intensive production systems and slaughtered at 140–150 kg body weight (BW). Both sexes are castrated. However, the production of heavy white pigs destined to dry-cured products is based on intact females (IF). Therefore, IF might be also an alternative to castrated females (CF) for IB pig production. A total of sixty crossbred (IB dam × Duroc sire) females, 80 d of age (17.6 ± 0.13 kg BW) was used to investigate the effect of castration of females on fresh meat quality and fatty acid profile of backfat (BF) of IB pigs reared under intensive production systems and slaughtered at 144 kg BW (269 d of age). Females were ovariectomized at 93 d of age (26.0 ± 0.19 kg BW). Meat samples were taken at m. Longissimus dorsi at the level of the last rib and BF samples were taken at the tail insertion. Each treatment (coded IF, CF) was replicated five times and the experimental unit was a pen with six pigs. Castrated females had 27.2% more fat and 2.7% less moisture in the m. Longissimus dorsi than IF ($P \leq 0.05$). Muscular fat content was lower for IF than for CF (6.6 vs. 9.1%; $P \leq 0.05$) but in all cases fat content was higher than required to generate high quality dry-cured products. Meat from IF was more lightness (higher L* value; $P \leq 0.01$), redder (10.1 vs. 7.5 for a*; $P \leq 0.001$), and had more intensive colour (16.7 vs. 11.2 for c*; $P \leq 0.001$) than meat from CF. Subcutaneous fat was more saturated (39.1 vs. 38.2%; $P \leq 0.05$) in CF than in IF, mostly because of the higher palmitic acid content ($P \leq 0.05$). Also, CF had lower linolenic acid content (0.61 vs. 0.68%; $P \leq 0.05$) than IF. We conclude that based on animal welfare, cost of castration, meat quality traits, and fatty acid profile, intact females are a good alternative to castrated females to produce high quality Iberian dry-cured products.

Key Words: Iberian Pigs, Female Castration, Meat Quality and Fatty Acid Profile

T108 Effect of conjugated linoleic acid, betaine or both on fatty acid composition of growing Iberian gilts. I. Fernandez-Figares*, J. M. Rodriguez-Lopez, L. Gonzalez-Valero, R. Nieto, M. Lachica, and J. F. Aguilera, *Spanish National Research Council, CSIC, Granada, Spain.*

We have demonstrated that growing Iberian gilts (an obese porcine genotype) fed betaine plus CLA show a trend towards decreased carcass fat content (J. Anim. Sci. 2008, 86:102-). The aim of the present study was to assess the effect of betaine, CLA or both on the fatty acid profile of the subcutaneous adipose tissue, renal fat and intramuscular fat of the semitendinosus and biceps femoris muscles. Twenty gilts (20 kg BW) were individually penned and fed at 95% *ad libitum* barley-soybean meal based diets (12% CP, 0.81% lysine and 14.8 MJ ME / kg DM) containing either no added betaine or CLA, 0.5% betaine, 1% CLA, or 0.5% betaine + 1% CLA. At 50 kg, pigs were slaughtered and samples immediately frozen at -80°C until analysis. Lipids were extracted and fatty acid methyl esters were prepared using sodium methoxide in methanol and used for fatty acid composition. Methyl esters were separated and quantified by gas-liquid chromatography using a Perkin Elmer GC fitted

with a flame ionization detector and a capillary (60m×0.25mm×0.2µm) column. Data were analyzed as a two-way ANOVA in a completely randomized design with treatment as the fixed effect. Significance was set at $P < 0.05$ and differences among means were determined using a Duncan t-test. Overall, betaine effects on fatty acid profile were only observed in the inner layer of fat, with lower percentage of palmitic acid and total saturated fatty acids and greater oleic acid and total mono-unsaturated fatty acids content compared to controls. CLA elicited an increase of both CLA isomers measured and total saturated fatty acids and a decrease of total monounsaturated fatty acids, iodine values and $\Delta 9$ -desaturase index in the fat depots studied and in intramuscular fat. Pigs fed with betaine + CLA presented similar fatty acid profile to those fed CLA diets. It is concluded that CLA altered lipid metabolism, producing lower concentration of monounsaturated fatty acids and increased concentrations of CLA isomers and total saturated fatty acids in the fat depots and intramuscular fat of Iberian pigs.

Key Words: Betaine and CLA, Fatty Acid Composition, Iberian Pig

T109 Effect of L-carnitine supplementation on the performance and pork quality traits of growing-finishing swine fed three levels of corn oil. J. K. Apple*¹, J. T. Sawyer¹, C. V. Maxwell¹, J. C. Woodworth², J. W. S. Yancey¹, and R. E. Musser³, ¹University of Arkansas Division of Agriculture, Fayetteville, ²Lonza, Inc., Allendale, NJ, ³Hubbard Feeds, Inc., Mankato, MN.

Crossbred pigs (n = 216) were used to test the interactive effects of supplemental L-carnitine and corn oil on the growth performance, carcass composition, and pork quality of growing-finishing swine. Pigs were blocked by BW (43.6 ± 1.0 kg), and pens (6 pigs/pen) were randomly assigned within blocks to dietary treatments arranged in a 2 × 3 factorial design, with 0 or 100 ppm L-carnitine and 0, 2, or 4% corn oil. At the completion of the 84-d feeding trial, pigs were slaughtered and bone-in pork loins were captured during carcass fabrication for measurement of pork quality attributes. Supplementing swine diets with L-carnitine did not ($P \geq 0.29$) affect overall ADG, ADFI, or G:F, and, even though overall ADG was similar ($P = 0.60$) across dietary corn oil levels, including 4% corn oil in swine diets reduced ($P < 0.05$) ADFI, leading to improvements ($P < 0.01$) in G:F. Neither L-carnitine supplementation ($P \geq 0.25$) nor dietary corn oil ($P \geq 0.14$) affected hot carcass weight, 10th rib fat and LM depths, or fat-free lean yield. The LM from pigs fed 2 and 4% corn oil received higher ($P < 0.01$) marbling scores and had greater ($P = 0.05$) percentages of i.m. fat than the LM from pigs fed 0% corn oil. Conversely, subjective and objective pork color, firmness, and water-holding capacity were not affected by L-carnitine supplementation ($P \geq 0.19$) or dietary corn oil ($P \geq 0.10$). Lastly, neither dietary corn oil level nor L-carnitine supplementation affected cooking losses ($P \geq 0.14$) or shear force values ($P \geq 0.10$) of LM chops. Therefore, increasing the level of corn oil in swine diets resulted in improvements in growth efficiency, and appeared to increase i.m. fat content of the LM without affecting pork color or water-retention properties; however, supplementing the diets of growing-finishing pigs with L-carnitine had little to no appreciable effects on growth performance, carcass composition, or pork quality.

Key Words: Corn Oil, L-carnitine, Swine

T110 Effect of L-carnitine supplementation on the fatty acid composition of subcutaneous fat and LM from swine fed three levels of corn oil. J. K. Apple^{*1}, J. T. Sawyer¹, C. V. Maxwell¹, J. W. S. Yancey¹, J. C. Woodworth², and R. E. Musser³, ¹University of Arkansas Division of Agriculture, Fayetteville, ²Lonza, Inc., Allendale, NJ, ³Hubbard Feeds, Inc., Mankato, MN.

Crossbred pigs (n = 216) were used to test the interactive effects of supplemental L-carnitine and corn oil on the fatty acid composition of s.c. fat and LM from growing-finishing swine. Pigs were blocked by BW (43.6 ± 1.0 kg), and pens (6 pigs/pen) were randomly assigned within blocks to dietary treatments arranged in a 2 × 3 factorial design, with 0 or 100 ppm L-carnitine and 0, 2, or 4% corn oil. Approximately 12 h after slaughter, samples of backfat were removed at the level of the last lumbar vertebra, whereas samples of LM were removed during pork loin fabrication 36 h postmortem. Supplementing diets with L-carnitine increased ($P < 0.05$) the proportion of minor SFA, *cis*-vaccenic (18:1c11), and minor MUFA, and tended to decrease ($P \leq 0.10$) weight percentages of linoleic (18:2n6) and linolenic acids (18:3n3) in s.c. fat. Conversely, the proportion of all SFA (especially palmitic [16:0] and stearic [18:0] acids), and all MUFA (specifically oleic [18:1c9] and 18:1c11) decreased linearly ($P < 0.001$), whereas the proportion of all PUFA, in particular 18:2n6, increased linearly ($P < 0.001$) in s.c. fat with increasing dietary corn oil. Moreover, the iodine value (IV) of s.c. fat was not ($P = 0.18$) affected by L-carnitine supplementation, but IV increased linearly ($P < 0.001$) from 61.1 to 76.2 as dietary corn oil increased in the diet from 0 to 4%. Even though the proportions of 18:1c9, total PUFA, and IV were similar among LM samples from pigs fed 0 or 4% corn oil, supplementing 2% corn oil diets with L-carnitine increased 18:1c9 and reduced total PUFA levels (especially 18:2n6) and IV (carnitine × corn oil; $P \leq 0.02$). Increasing the dietary inclusion level of corn oil from 0 to 4% increased the polyunsaturation of s.c. fat and the LM by 91 and 32%, respectively, whereas supplementing swine diets with L-carnitine appeared to increase the proportion of 18:1c9, at the expense of 18:2n6, in pigs fed 2% corn oil.

Key Words: Corn Oil, L-carnitine, Fatty Acid Composition

T111 Carcass and *Longissimus dorsi* characteristics of finishing pigs fed sweet potato (*Ipomoea batatas* [L] Lam.) meal. S. Pietroseoli^{*1}, O. E. Moron-Fuenmayor¹, A. Paez¹, and M. J. Villamide², ¹Facultad de Agronomía, La Universidad del Zulia, Maracaibo, Venezuela., ²ETSIA, Universidad Politécnica de Madrid, Madrid, España.

Sweet potato meal (SPM: 70% foliage: 30% tuber) was evaluated as a feed for finishing pigs to determine its effects on carcass and *Longissimus dorsi* (LM) characteristics. Thirty-six commercial hybrid Landrace × Duroc pigs (62.2 ± 1.3 kg and 134 ± 2 days initial BW and age, respectively) were randomly assigned to 12 pens (n = 2 castrated males and 1 female/pen) in a randomized complete block design with four replicates. Final BW and sex were used as covariates. The trial lasted 44 d, divided into two periods (P1 and P2) of three weeks each. Treatments under evaluation were T1: during P1 15%, and during P2 30%, of the commercial concentrate (CC) was substituted by SPM; T2 (control): 100% CC; T3: the levels of substitution of CC were 10 and 20% for P1 and P2, respectively. Pigs had *ad libitum* access to feed and water and were weighed weekly. Pigs averaged 99.6 ± 1.4 kg BW when harvested at a commercial facility. Carcass pH and temperature were recorded at 0, 6, 12 and 24 h *post mortem*. Treatments differed for white viscera ($P \leq 0.01$), loin yield ($P \leq 0.01$) and fat thickness (P

≤ 0.01). Most of the traits were not affected when the maximum level of CC substitution was 20%. These results indicate that SPM can be used as an alternative feedstuff for finishing pigs.

Table 1. Carcass and *Longissimus dorsi* characteristics of finishing pigs fed sweet potato meal

	T1	T2	T3	SE
Carcass yield %	66.5	67.9	67.0	0.51
Leg %	33.8	33.4	33.6	0.28
Shoulder %	34.9	34.4	34.5	0.27
Loin %	20.3 ^b	21.2 ^a	21.0 ^a	0.19
Belly %	17.2	17.5	17.3	0.22
Red viscera %	4.1	4.2	4.3	0.56
White viscera %	13.0 ^a	10.7 ^c	12.0 ^b	0.65
Carcass length cm	78.9	78.5	78.3	0.65
Thorax girth cm	74.9	74.7	74.3	1.39
Leg girth cm	67.7	68.3	68.5	0.06
Fat thickness mm	3.4 ^b	3.6 ^a	3.1 ^c	0.06
Loineye area cm ²	39.4	42.5	41.3	1.39
LM color	2.7	2.7	2.4	0.15
LM marbling	2.3	1.9	2.0	0.22

Key Words: Pigs, Sweet Potato, Carcass Characteristics

T112 Relationships of belly-flop measurements with smokehouse yield and fatty acid composition. J. W. S. Yancey^{*}, J. K. Apple, J. T. Sawyer, M. S. Lee, and M. D. Wharton, University of Arkansas Division of Agriculture, Fayetteville.

Boneless bellies (n = 192) were tested to determine the relationship of physical attributes, compression, smokehouse yield, and fatty acid (FA) composition of the primary and secondary lean, and seam and s.c. fat layers. Bellies were measured for thickness, length, width, processing temperature, moisture of fat and lean, and belly flop. Each belly was hung over a bar (skin-side up and skin-side down) at the midline of its widest point, and the distance between the two hanging ends was measured. Bellies were transported to a commercial bacon processor, injected, and smoked to determine smokehouse yield. Smokehouse yield was poorly correlated with belly-flop measurements ($r = 0.38$ and 0.36), but compression was not correlated with smokehouse yield. Throughout the study, values for belly-flop measured skin-side up were more highly correlated to physical attributes and FA composition than were those values for skin-side down. Furthermore, the correlation of belly-flop measurements was slightly higher with the FA composition of the lean than with those of fat. Although total SFA in the fat and lean was poorly correlated ($r = 0.18$ to 0.34), and MUFA content was low to moderately correlated ($r = 0.17$ to 0.59) with belly-flop measurements; palmitic acid (16:0) was highly correlated with belly-flop measurements ($r = 0.60$ to 0.71). PUFA, which comprised 16 to 17% of the seam and s.c. fat and 12 to 13% of the lean, had strong negative correlations with belly-flop measurements ($r = -0.60$ to -0.72), particularly 18:2_{n-6}, 18:3_{n-3}, and 20:4. Belly flop also had a strong negative relationship with PUFA:SFA ($r = -0.59$ to -0.73) and iodine value ($r = -0.60$ to -0.73). Although the relationship of belly-flop with smokehouse yield was low, belly-flop was a good indicator of FA composition, especially PUFA, and is a potential indicator of belly quality in bacon operations.

Key Words: Pork, Belly-Flop, Fatty Acid Composition

T113 Comparisons of fatty acid composition in pork belly primary and secondary lean, and seam and subcutaneous fat. J. W. S. Yancey^{*1}, J. K. Apple¹, J. T. Sawyer¹, M. S. Lee¹, and J. C. Woodworth², ¹University of Arkansas Division of Agriculture, Fayetteville, ²Lonza, Inc., Allendale, NJ.

Pork bellies (n = 192) were obtained from a commercial processing facility to determine differences in fatty acid (FA) composition between primary and secondary lean, and seam and s.c. fat. Total fat and lean layers did not differ ($P \geq 0.21$) in total SFA, C16:0, or C18:0 percentages, but within the fat layers, seam fat had greater ($P < 0.01$) levels of total SFA, C16:0, and C18:0 than did s.c. fat, and primary lean had greater ($P < 0.01$) levels than secondary lean. As expected, MUFA was the most abundant FA type in the bellies. Lean layers had greater ($P < 0.01$) total MUFA than did fat layers. Furthermore, s.c. fat had greater concentrations ($P < 0.01$) of MUFA than seam fat, and secondary lean had greater levels ($P < 0.01$) of total MUFA than primary lean. Fat layers of the bellies had greater levels ($P < 0.01$) of total PUFA, C18:2_{n-6}, and C18:3_{n-3} than did lean. Although seam and s.c. fat layers had similar ($P = 0.36$) concentrations of C18:3_{n-3}, the s.c. layer had greater levels ($P < 0.01$) of all other PUFA studied. Primary lean had greater concentrations ($P < 0.01$) of total PUFA, C18:2_{n-6}, C20:4, but lower concentrations ($P < 0.01$) than secondary lean of C18:3_{n-3}. Levels of CLA were not different ($P = 0.17$) between fat and lean in the bellies, but s.c. fat and secondary lean had greater concentrations ($P < 0.01$) of CLA than seam fat and primary lean, respectively. Fat layers had a greater PUFA:SFA and iodine value (IV; $P < 0.01$) than lean layers; moreover, s.c. fat layer and secondary lean had greater IV ($P < 0.01$) than seam fat and primary lean. Generally, it was found that fat layers of the bellies had more PUFA than lean layers, whereas lean layers had greater levels of MUFA. Within fat layers, s.c fat was more unsaturated than seam fat, and within lean layers, primary lean had greater concentrations of PUFA and SFA, whereas secondary lean had greater levels of MUFA.

Key Words: Pork, Belly, Fatty Acid Composition

T114 Influence of gender and slaughter age on meat and subcutaneous fat quality of heavy pigs destined to high quality dry-cured hams. M. A. Latorre^{*1}, G. Ripoll¹, L. Ariño², and B. Blanco³, ¹Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain, ²Integraciones Porcinas S.L., Teruel, Spain, ³Jamones y Embutidos Alto Mijares S.L., Teruel, Spain.

High quality, dry-cured hams under the protection and designation of “Teruel hams” trademark are produced from heavy pigs in a specific area of Spain. Although the star product from these animals is the ham, they also provide a lot of other high quality meat products. The pigs destined to Teruel ham are crossbred (Landrace × Large White) × Duroc barrows and gilts, slaughtered at 130 kg BW. Forty eight pigs, with an average age of 176 d were used to study the effect of gender and slaughter age on Longissimus dorsi quality and fatty acid (FA) profile of pigs destined to Teruel ham. Animals were fed a commercial wheat, barley, and soybean meal diet, containing 2,360 kcal NE/kg and 0.68% total lysine. There were three treatments; barrows slaughtered at 196 d of age (B; 130.8 kg BW), gilts slaughtered at 203 d of age (G1; 130.2 kg BW), and gilts slaughtered at 210 d of age (G2; 134.3 kg BW). Each treatment was replicated 16 times (one pig per replicate). Meat from B showed higher intramuscular fat content than meat from G1, with G2 being intermediate ($P < 0.05$). Also, loin from G1 and G2 had similar protein contents and both were higher than loin from B ($P < 0.01$). Meat

from G2 was more tender than meat from G1, with B being intermediate ($P < 0.05$). No effect of treatment was detected on MUFA proportion ($P > 0.05$) but B showed higher saturated FA percentage than G1, with G2 being intermediate ($P < 0.001$). Also, G1 and G2 had similar PUFA proportions and both were higher than B ($P < 0.01$). Thus, barrows had better meat quality but worse fat quality than gilts when slaughtered at the same BW. However, an increase by two weeks in the slaughter age of gilts, with regard to barrows, improves the quality and homogeneity of meat and fat of pigs destined to Teruel ham.

Key Words: Slaughter Age, Meat and Fat Quality, Pigs

T115 Carcass fatty acid composition of growing calves fed diets containing canola oil supplements. M. Eftekhari, K. Rezayazdi^{*}, A. Nikkhab, and A. Nejati javaremi, University of Tehran, karaj-Tehran-Iran.

The objective of this experiment was to study the effects of increasing dietary fat through the use of canola oil on fatty acid composition of growing calves. Twenty-four male Holstein calves were divided into three groups and submitted to three diets: control diet (C); a diet containing 2% canola oil (LC) and a diet containing 4% canola oil (HC) as DM basis. Diets were offered as ad libitum and twice daily (0800 and 1500). Calves were slaughtered after 4 month of feeding. The 9th through 11th ribs were obtained from the right side of each carcass and used for carcass composition analysis. Meat sample lipids were extracted by the method of Folch et al. (1957) and esterified fatty acids methyl esters were prepared according to Metcalf et al. (1966). The fatty acid methyl esters were analysed using a Unicam 4600 chromatograph, equipped with a flame ionisation detector and capillary column. Data were analyzed using analysis of variance for a completely random design using the GLM procedure of SAS software (2001) with initial BW of the experimental animals as a covariate.

Canola oil feeding had significant effects on fatty acid composition of longissimus muscle (Table 1). Feeding LC and HC diets increased ($P < 0.05$) the percentage of C18:0 and C18:1 and decreased ($P < 0.05$) the percentage of C16:0 and C16:1. There were no differences ($P > 0.05$) in the percentage of C14:0, C17:0, C17:1, C18:2 and C18:3 across treatments. The results of this study showed that canola oil had significant effects on healthful characteristics and fatty acid composition of longissimus muscle of calves.

Table 1. Effects of canola oil on fatty acid composition of longissimus muscle

Fatty acid	Treatment		
	C	LCO	HCO
14:0	2.89±0.2	2.85±0.16	2.49±0.11
16:0	29.1±0.38 ^a	25.35±1.24 ^b	23.72±0.93 ^b
16:1n7	5.35±0.44 ^a	4.25±0.31 ^b	4.18±0.12 ^b
17:0	1.44±0.09	1.41±0.18	1.23±0.06
17:1n7	0.49±0.09	0.59±0.04	0.44±0.02
18:0	23.02±1.26 ^b	24.76±1.5 ^{ab}	27.66±0.31 ^a
18:1	31.81±1.34 ^b	35.8±0.77 ^a	36.68±0.46 ^a
18:2	5.63±0.74	4.92±0.14	4.26±0.22
18:3	0.23±0.03	0.22±0.02	0.2±0.02

a,b Means in a row that lack a common superscript differ ($P \leq 0.05$).

Key Words: Canola Oil, Fatty Acid, Calves

T116 Effect of canola oil on performance and carcass characteristics of Holstein male calves. M. Eftekhari, K. Rezayazdi*, A. Nikkhah, and A. Nejati Javaremi, *University of Tehran, Karaj-Tehran-Iran.*

The objective of this study was to evaluate diet supplementation with canola oil on performance and carcass characteristics of growing calves. Twenty-four Holstein male calves were randomly divided into three groups and submitted to three diets: control diet (C); a diet containing 2% canola oil (LC) and a diet containing 4% canola oil (HC) as dry matter basis. Diets were formulated to meet or exceed nutrient requirements using the Beef NRC model (NRC, 1996) and to be isonitrogenous and isoenergetic. Diets were offered as total mixed ration (TMR), ad libitum and twice daily (0800 and 1500). Quantity of feed offered and refused was recorded daily and Calves were weighed monthly and slaughtered after 4 month of trial. Carcasses were weighed to obtain the hot carcass weight and graded to determine 12th rib backfat thickness and longissimus muscle area. Data were analyzed using analysis of covariance for a completely random design using the GLM procedure of SAS software (2001) with initial BW of the experimental animals as a covariate and effects of treatments were declared at $P < 0.05$.

Canola oil did not alter final BW and ADG ($P > 0.05$) (Table 1). Dry matter intake decreased significantly with the addition of canola oil whereas G:F was improved ($P < 0.05$). No differences were detected ($P > 0.05$) in carcass measurements except for backfat, in which calves were fed the HCO diet had more back fat compare to those fed the C diet. Empty body weight, hot carcass weight, carcass yield and longissimus muscle area, were not affected significantly by the treatments ($P > 0.05$).

Table 1. Effect of diet on performance and carcass characteristic of calves

	Treatment		
	C	LCO	HCO
final weight (kg)	374.00±14.68	387.87±18.48	395.75±19.39
ADG (kg)	1.15±0.06	1.21±0.07	1.30±0.03
DMI (kg/d)	8.42±0.24 ^a	7.86±0.30 ^{ab}	7.68±0.19 ^b
FCR	7.63±0.70 ^a	6.59±0.40 ^b	5.93±0.20 ^b
Hot carcass weight(kg)	229.48±15.57	241.22±9.80	237.46±12.47
Carcass yield (%)	54.06±0.32	55.93±1.32	56.52±1.51
LM area ^c (cm ²)	91.19±3.86	91.18±1.33	91.91±2.29
Backfat(cm)	1.05±0.06 ^b	1.25±0.06 ^{ab}	1.42±0.04 ^a

^c LM area: Longissimus Muscle area

Key Words: Canola Oil, Performance, Carcass Characteristics

T117 Characterization of meat quality and lipid profile from steers fed crude glycerol. H. L. Evans*, B. R. Wiegand, M. S. Kerley, J. H. Porter, K. S. Roberts, and B. A. Verseemann, *University of Missouri, Columbia.*

The objective of this study was to assess the optimum and maximum levels of crude glycerol for inclusion in beef cattle feedlot diets. Crude glycerol sourced from a biodiesel production facility was included at graded levels in feedlot diets of crossbred steers (n=72). Steers (225kg) were randomly assigned in pens of six steers each to one of four experimental diets with three replications each. Diets were formulated to include 0, 5, 10, or 20% glycerol. Calves were fed once daily. Pen was

the experimental unit. Blood samples were collected to measure initial and final circulating triacylglyceride, glucose, and glycerol levels. Steers were humanely slaughtered after reaching an average live weight of 537 ± 12 kg and an average 12th rib fat depth of 1.18 ± 0.13 cm. Meat quality measures of shear force tenderness and Hunter L*, a*, and b* (over 7 d shelf storage) were made. Longissimus dorsi samples were collected and intramuscular fat was extracted and prepared for fatty acid profile determination by gas chromatography. Statistical analysis revealed no differences ($P > 0.60$) for initial and final circulating triacylglycerides, glucose, or glycerol across treatment groups. Total lipid percentage within the longissimus differed ($P = 0.04$) among treatment groups and measured 2.67, 3.68, 2.37, and 2.91% (SEM = 0.29) for 0, 5, 10, and 20% glycerol, respectively. No differences were observed for any saturated fatty acids within the longissimus among treatment groups. However, C14:1 means differed ($P = 0.04$) and measured 0.454, 0.757, 0.751, and 0.481% (SEM = 0.087) for 0, 5, 10, and 20%, respectively. Other changes occurred in PUFA and were observed for C18:2N6 ($P = 0.02$), C20:2N6 ($P = 0.04$), C20:5N3 ($P = 0.10$), and C22:6N3 ($P = 0.06$). These changes tended to show increases with up to 10% glycerol inclusion and subsequent decreases at the 20% glycerol level. The biological significance of these changes is not yet clear. Overall, these data indicate that feeding up to 10% crude glycerol to finishing beef steers has no negative impact on certain blood lipid and energy parameters or meat quality measures related to color and lipid profile.

Key Words: Glycerol, Beef Cattle, Lipid Profile

T118 Sensorial characteristics of beef from heifers fed with different lipid supplements in the finishing phase. M. C. A. Santana*¹, P. H. M. Dian¹, R. A. Reis¹, A. V. Pires², G. Fiorentini¹, A. F. Ribeiro¹, M. A. A. Balsalobre³, and T. T. Berchielli¹, ¹São Paulo State University, Jaboticabal, São Paulo, Brazil, ²São Paulo University, Piracicaba, São Paulo, Brazil, ³Bellman, Mirassol, São Paulo, Brazil.

Meat sensorial or organoleptic characteristics are the attributes that make meat more or less appetizing; they are difficult to measure by instruments. The taste of certain bovine meat products can be influenced by the feed offered to the animal. Sensorial evaluation is important because it is capable of determining the product which will be offered to the consumer. The objective of this trial was to evaluate sensorial characteristics of beef from heifers fed different lipid supplements in finishing phase systems (FPS). The design was completely randomized in a 3×2 factorial arrangement of treatment fat supplements were, soybean grains, soybean oil and protected fat (MEGALAC-E), and two FPS, pasture or feedlot. Beef samples were appraised by 23 habitual beef consumers, randomly selected. The beef was previously thawed and roasted. Temperature was monitored using an insert thermometer until 70°C. Later, the samples were cut in cubes and identified by random numbers of three digits. The test was applied in a structured, hedonic scale of 9 points (1 displeased very much and 9 liked very much), and the flavor, texture and global acceptance attributes were evaluated. The flavor, texture and global acceptance of beef from feedlot animals were not influenced by the supplement. However, the meat from pasture systems showed a greater flavor grade and global acceptance using the MEGALAC-E and soybean oil supplement. The MEGALAC-E supplement had the highest grade for texture compared to the beef from pasture animals. The use of different supplements and FPS can influence the degree of sensorial acceptance on the part of the consumers.

Table 1. Means for the flavor, texture and global acceptance (GA) of the heifer meat from finishing phase systems (FPS) pasture (P) and feedlot (F), supplemented with soybean grains (SG), soybean oil (SO) and supplement with protected fat (ML).

Supplement/ FPS	Flavor/ P	Flavor/ F	Texture/ P	Texture/ F	GA/ P	GA/ F
SG	6.6b	7.0a	5.9b	7.3a	6.2b	7.1a
SO	7.3ab	6.4a	6.3b	6.9a	6.6ab	6.6a
ML	7.8a	7.0a	7.7a	6.9a	7.6a	7.1a

Means followed by different letters in the same column of same variables are different ($P < 0.05$).

Key Words: Lipid, Finishing Phase, Sensorial Acceptance

T119 Carcass traits of low and high residual feed intake Nellore (*Bos indicus*) steers. R. C. Gomes^{*1}, R. S. Araujo¹, E. Telles¹, S. L. Silva¹, R. D. Sainz², and P. R. Leme¹, ¹University of Sao Paulo, Pirassununga, SP, Brazil, ²University of California, Davis.

Studies aiming to evaluate the effects of breeding beef cattle for the feed efficiency trait residual feed intake (RFI) have shown most efficient animals (low-RFI) may produce leaner carcasses than least efficient cattle (high-RFI). However, most investigations were carried out using *Bos taurus* breeds (Angus and Hereford) which are known to produce fatter carcasses than zebu cattle. In this sense, 72 Nellore steers (313 kg initial BW) were fed a finishing ration for 74 days and had their feed intake measured individually. Cattle were weighed every 21 d and the lowest and highest 12 RFI steers were classed as low- and high-RFI groups. The selected animals were kept in individual pens and fed until reaching market finish. At harvest, carcasses were sectioned at the 12th rib, split into bone, trimmings and retail product yield and internal visceral organs dissected and weighed. Carcass traits were adjusted to a common final BW (503 kg). There were differences ($P < 0.01$) between low- and high-RFI groups for DMI (9.3 vs. 11.1 kg/d), feed:gain (6.4 vs. 7.6) and RFI (-0.80 vs 0.89 kg/d), but not for ADG (1.48 vs. 1.48 kg/d), final BW (441 vs. 448 kg), hot carcass wt (310 vs. 308 kg), dressing percentage (57.3 vs. 60.9 %), kidney, pelvic and inguinal fat (5.81 vs. 6.02 kg), total visceral mass (33.0 vs. 31.1 kg), LM area (72.6 vs. 73.7 cm²), backfat thickness (6.22 vs. 6.27 mm), marbling score (379 vs. 381), trimmings (20.4 vs. 21.0% cold carcass wt) and retail product yield (62.1 vs. 61.7% cold carcass wt, $P > 0.05$). Low-RFI steers tended to have heavier gastrointestinal tract ($P = 0.09$) and had less GI fat mass ($P < 0.01$) than high-RFI cattle. The most efficient Nellore steers produced carcasses of similar quality to those obtained from the least efficient cattle. However, the most efficient cattle stored less fat on the visceral mass, suggesting the chemical composition of BW gain differs between low- and high-RFI Nellore steers.

Key Words: *Bos indicus*, Feed Efficiency, Net Feed Intake

T120 Effects of genetic group and concentrate feeding on pH and temperature of beef carcasses. I. M. de Oliveira, P. V. R. Paulino*, M. I. Marcondes, J. Cavali, S. de C. Valadares Filho, E. Detmann, L. F. Prados, V. R. M. Couto, and M. F. L. Sales, Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.

Post mortem muscle pH and temperature variations can result in different meat quality attributes. Beyond that, pH and temperature are often used by regulatory agencies in Brazil in order to sort carcasses for export markets. Thus, the Brazilian beef cattle industry is concerned about

the main factors that can impact the final pH and temperature of beef carcass. Therefore, this trial aimed to evaluate pH and temperature in bovine carcasses of three genetic groups (Nellore, ½ Nellore × ½ Angus and ½ Nellore × ½ Simmental), finished in a feedlot, fed diets with two concentrate allowance levels (1 and 2% of body weight) and slaughtered at 22 months old, with 412.79, 496.29 and 496.24 kg of body weight, respectively. The experiment was a factorial completely randomized design with two concentrate allowance levels, three genetic groups and six replicates. The carcasses were split and stored in a cooler at 0°C. During chilling (24 h), carcass pH and temperature was measured every 2 h in the LM region. Concentrate level and the interaction between concentrate level and genetic group were not significant ($P > 0.05$) for both pH and temperature. There were differences ($P < 0.05$) among genetic groups for final temperature. The final temperature of Nellore carcasses (9.90°C) was higher ($P < 0.05$) than that observed on the ½ Nellore × ½ Angus carcasses (7.75°C), which did not differ ($P > 0.05$) from the ½ Nellore × ½ Simmental (8.85°C). Brazilian regulations state that bovine carcass temperature should not exceed 7°C after 24 h chilling in a cooler set at 2.5°C. This did not happen as evidenced by the carcass temperatures reported above. However, since the cooler had to be open every 2 hours in order to allow the measurement of pH and temperature, this may have contributed to carcasses not reaching the target final temperature of 7°C. No difference ($P > 0.05$) was observed for initial and final pH of the carcasses, with mean values of 6.35 and 5.47, respectively. The carcasses were adequate in quality as the final pH values were lower than the maximum value permitted (5.9-6.0).

Key Words: Nellore Cattle, Crossbred Steers, Quality

T121 Finishing changes in bovine muscle fiber types as influenced by genetic group and slaughter weight. R. Mello^{*1,2}, A. C. de Queiroz², M. H. de Faria³, P. B. Costa², F. D. de Resende³, G. F. V. Bayão², and C. A. Neves², ¹Universidade Federal de Roraima, Boa Vista, RR, Brazil, ²Universidade Federal de Viçosa, Viçosa, MG, Brazil, ³APTA, Colina, SP, Brazil.

The objective of this study was to investigate the genetic group and slaughter weight related changes of muscle fiber proportions in *Longissimus dorsi*. Thirty six young (20 mo) bulls, 18 crossbred F1 Red Angus × Nellore (½ RA ½ N) and 18 F1 Blonde D'Aquitaine × Nellore (½ BA ½ N) were used. The young bulls were finished in a feedlot and slaughtered at 480, 520 and 560 kg of body weight. A completely randomized experimental design of a 2×3 (2 genetic groups × 3 slaughter weights) factorial arrangement with six replicates was used. Muscle fiber types were determined by histochemistry and classified by a computerized image analysis system. Data were analyzed with SAS, using initial BW as a covariate. The table below shows the least-square means of muscle fiber type frequencies. The interaction between GG and SW was not significant for the different treatments. The relative frequency of type I fibers was not affected by GG and SW. The ½ RA ½ N young bulls had a higher frequency of type IIA fibers and a lower frequency of type IIB fibers than ½ BA ½ N young bulls, or vice-versa. Increases in SW were related to a higher frequency of type IIA fibers. The genetic group and slaughter weight did not influence the modulation of fibers with different twitch speeds, but influenced the proportion of fibers with different energy metabolisms. The crossbred F1 Red Angus × Nellore young bulls and heavier animals had a higher frequency of fibers with oxidative that glycolytic metabolism in the finishing phase on feedlot than F1 Blonde D'Aquitaine × Nellore and lighter animals.

Table 1. Least square means

Muscle fibers	Genetic Group (GG)		Slaughter Weight (SW)		
	½ RA ½ N	½ BA ½ N	480	520	560
Type I, %	21.8	16.9	17.3	21.5	19.3
Type IIA, %	36.8 ^A	29.6 ^B	25.4 ^b	37.8 ^a	36.5 ^a
Type IIB, %	41.3 ^B	53.5 ^A	57.3	40.7	44.2

Within a row, means followed by different capital letters and by different small letters differ ($P < .05$), respectively, among GG and SW by Tukey test.

Key Words: Feedlot, Histochemical Staining, Adenosine Triphosphatase Myofibrillar

T122 Meat cholesterol, saturated and unsaturated fatty acids of *Bos indicus* type feedlot heifers. M. P. de Oliveira^{1,3}, M. de B. Arrigoni¹, C. L. Martins¹, É. Rodrigues¹, D. D. Millen¹, R. D. L. Pacheco^{*1}, L. M. N. Sarti¹, R. S. Barducci¹, J. P. S. T. Bastos¹, T. M. Mariani¹, S. R. Baldin¹, T. C. B. da Silva², and H. N. de Oliveira¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Faculdade de Zootecnia/UNESP, Dracena, São Paulo, Brazil, ³Apoio FAPESP.

Information about cholesterol and fatty acids concentrations of different breed types is needed. This study, conducted at São Paulo State University (UNESP) feedlot, Botucatu Campus, Brazil, was designed to evaluate meat cholesterol, saturated (SFA) and unsaturated fatty acids (UFA) of *Bos indicus* based breed types (BT). The study used 40, 8-mo-old heifers (259.9±19.5 kg) of four BT: 10 Three-way-cross (1/2 Simmental, 1/4 Nellore, 1/4 Angus (TC)), 10 Simbrasil (5/8 Simmental, 3/8 Nellore (SB)), 10 CN (1/2 Charolais, 1/2 Nellore) and 10 CC (3/4 Charolais, 1/4 Nellore) fed for 130 days in a feedlot. Diets contained 50% high moisture corn, 21% cracked corn, 10% soybean meal, 10% sugarcane bagasse, 5% corn silage and 4% supplement (dry matter basis). Heifers were held off feed 16 hours prior to slaughter. After slaughter, LM samples were removed between the 12th and 13th ribs for muscle cholesterol concentration and for analysis of SFA and UFA of backfat. Cholesterol concentration was determined using commercial enzymatic kits. UFA and SFA were analyzed by iodine index. There was no BT effect ($P > 0.05$) on meat cholesterol (TC=73.33, SB=67.08, CN=66.73, CC=64.85 mg/100g), SFA percentage (TC=58.27, SB=57.48, CN=59.88, CC=58.05) and UFA percentage (TC=41.73, SB=42.52, CN=40.12, CC=41.95). In conclusion, the BT evaluated in this study did not affect LM cholesterol, SFA and UFA.

Key Words: Cholesterol, Fatty Acids, Heifers

T123 Effects of implanting and feeding zilpaterol on performance, carcass characteristics and subprimal meat yields of fed cows. S. Neill^{*1}, J. A. Unruh², T. T. Marston², J. R. Jaeger³, M. C. Hunt², and J. J. Higgins², ¹PIC, Hendersonville, TN, ²Kansas State University, Manhattan, ³Kansas State University Agricultural Research Center, Hays.

Our objective was to determine the effects of implanting Revalor-200[®] and feeding zilpaterol (Zilmax[®]) on the performance, carcass charac-

teristics and subprimal yields of cull cows fed for 70 d. Sixty crossbred cull cows were assigned to one of five treatments: 1) grass-fed on pasture (G); 2) concentrate-fed (C); 3) concentrate-fed and implanted with Revalor-200[®] (CI); 4) concentrate-fed and fed Zilmax[®] beginning on d 38 of the feeding period (CZ); and 5) concentrate-fed, implanted and fed Zilmax[®] beginning on d 38 of the feeding period (CIZ). Grass-fed cows were on native grass pasture and concentrate-fed cows were fed a ground sorghum and sorghum-silage diet. Concentrate-fed cows were limit-fed 11.3 kg DM/hd/d for the last 30 d of the feeding period. Although not significant, CIZ cows had the highest and G cows the lowest numerical gains for the final 34 d and total feeding period. Hot carcass weights and dressing percentages were higher ($P < 0.05$) for the concentrate-fed (C, CI, CZ, and CIZ) cows than G cows. Longissimus muscle area (LMA) was largest ($P < 0.05$) for CIZ cows and smallest for the G cows. Grass-fed cows had ($P < 0.05$) fewer kg of total subprimals and a lower percentage of total subprimals than concentrate-fed cows. In addition, CIZ cows had ($P < 0.05$) heavier total subprimal weights and a greater percentage of total subprimals than those from C cows. Feeding cull cows a concentrate diet improved carcass weight, dressing percentage, and subprimal yields compared to feeding cows a grass-based pasture diet. When feeding cull cows a concentrate diet, a combination of a Revalor-200[®] implant and feeding Zilmax[®] can maximize trimmed meat yields as indicated by dressing percentage, LMA and subprimal yields.

Key Words: Cows, Subprimal Yield, Zilpaterol

T124 Effects of implanting and feeding zilpaterol on retail display-color stability and palatability of strip loin and knuckle steaks from fed cows. S. Neill^{*1}, J. A. Unruh², T. T. Marston², M. J. Daniel², M. C. Hunt², M. E. Dikeman², and J. J. Higgins², ¹PIC, Hendersonville, TN, ²Kansas State University, Manhattan.

Our objective was to determine the effects of implanting Revalor-200[®] and feeding zilpaterol (Zilmax[®]) on retail-color display and palatability of strip loin and knuckle steaks from cull cows fed for 70 d. Strip loin (SL) and knuckle (KN) steaks were obtained from 53 crossbred cull cows assigned to one of five treatments: 1) grass-fed on pasture (G); 2) concentrate-fed (C); 3) concentrate-fed and implanted with Revalor-200[®] (CI); 4) concentrate-fed and fed Zilmax[®] beginning on d 38 of the feeding period (CZ); and 5) concentrate-fed, implanted and fed Zilmax[®] (CIZ). After 14 d of aging, trained visual panelist evaluated SL (longissimus muscle) and KN (rectus femoris and vastus lateralis) steaks daily for 5 d. Only on d 0, SL steaks from CIZ cows were darker red ($P < 0.05$) than steaks from CZ cows. No differences ($P = 0.19$) in discoloration of SL steaks were observed among treatments. For KN steaks, no differences ($P > 0.05$) in color (0-2 d) or discoloration (0-1 d) were detected among treatments early in the display period. On d 5, KN steaks from CI and CIZ cows were darker red ($P < 0.05$) than those from G cows. Also on d 5, KN steaks from CI and CIZ cows were ($P < 0.05$) more discolored than steaks from CZ, C and G cows. Sensory panelists found 14-d aged SL steaks from CI, C, and G cows were more tender ($P < 0.05$) than steaks from CIZ cows; and steaks from C and G cows were ($P < 0.05$) more tender than steaks from CZ cows. Off-flavors were highest ($P < 0.05$) for SL steaks from G cows. No tenderness differences ($P > 0.05$) were found among treatments for KN steaks. Feeding Zilmax[®] to Revalor-200[®] implanted cows resulted in SL steaks that were considered less tender. However, sensory panel and WBSF data indicate that further postmortem chemical and/or mechanical

tenderization would be recommended for steaks from all treatments to improve tenderness and acceptability.

Key Words: Cows, Sensory, Zilpaterol

T125 Influence of sarcomere length on aging and hydrodynamic pressure processing of beef muscle. B. Bowker*, J. Eastridge, E. Paroczay, and M. Solomon, *USDA-ARS, Beltsville, MD.*

The interacting effects of sarcomere length and tenderizing treatments on proteolysis and meat texture are not well understood. Extent of thick and thin filament overlap was hypothesized to influence the protein degradation and tenderness improvements associated with postmortem aging and tenderization techniques. The objective of this study was to determine the influence of sarcomere length, hydrodynamic pressure processing (HDP), and aging on the proteolysis and texture of beef longissimus muscle. One side of each beef carcass (n=4) was subjected to hip suspension (HS) while the opposite side was normally suspended (NS). At 48 h postmortem, longissimus muscles were removed and cut into anterior and posterior halves assigned HDP and control treatments. Steaks for Warner-Bratzler shear force (WBSF) determination and protein analysis were removed and aged at 4°C until 3, 7, and 14 days postmortem. Sarcomere length was greater (p<0.0001) in HS samples than NS samples (2.35 vs. 1.73 μm). WBSF was lower (p<0.0001) in HS samples compared to NS samples, regardless of HDP treatment or aging period. NS samples exhibited a greater (p<0.0001) decrease in WBSF with aging than HS samples. HDP treatment decreased (p<0.0001) WBSF in NS samples but had minimal effects on HS samples. SDS-PAGE analysis of whole muscle protein extracts revealed significant suspension method by aging interactions and strong aging effects. In HS samples there was a greater (p<0.05) decrease in the intensity of the 38 kDa band (relative to the actin band intensity) from 3 to 14 days than in NS samples. The intensity of a 95 kDa band was not influenced by aging in NS samples but was diminished by day 14 in HS samples. The intensity of several smaller bands (<14 kDa) in HS samples increased (p<0.05) more with 14 days of aging than in NS samples. Bands corresponding to 110 and 30-32 kDa increased with aging across all treatments. Overall data suggest that sarcomere length plays a major role in determining a muscle's potential for tenderization and further suggests that the impact of proteolysis on tenderness is mediated by sarcomere length.

Key Words: Sarcomere Length, Aging, Hydrodynamic Pressure Processing

T126 Influence of fiber type on palatability attributes of beef round muscles. M. J. Anderson*, E. Steadham, C. Fedler, K. Prusa, S. M. Lonergan, and E. Huff-Lonergan, *Iowa State University, Ames.*

Differences between muscle fiber types, including fiber diameter, method of metabolism, and glycogen content, can potentially affect several aspects of meat quality. The objective of this study was to determine the influence of fiber type, as defined by myosin heavy chain (MHC) isoforms, on palatability attributes of underutilized muscles from the round. Longissimus dorsi (LD), gracillus (GR), adductor (AD), sartorius (SAR), semimembranosus (SM), vastus lateralis (VL), and vastus intermedius (VI) were removed from 10 beef cattle carcasses 1d postmortem. Instrumental texture (star probe), sensory characteristics, pH, western

blotting for troponin-T degradation, and SDS-PAGE to determine the percentage of type I and II MHC isoforms were collected. Three bands were detected in the troponin-T western (Upper intact band, UI; Lower intact band, LI; 30kDa degradation product band, 30kDa) and compared to a 7d postmortem LD reference sample. A sample from bovine diaphragm served as a reference for type I myosin heavy chain. The VI had the highest percentage (P<0.01) of type I fibers and the lowest percentage (P<0.01) of type II fibers when compared to all other muscles (type I, 62.1%; type II, 37.9%). Across all muscles, the proportion of type I fibers was correlated to the intensity of the LI (r = -0.27; P=0.02), the intensity of the UI (r = -0.48; P<0.01), and juiciness (r = 0.26; P=0.03). The intensity of the 30kDa band tended to be correlated to pH (r = -0.22; P=0.07) and the intensity of the UI was correlated to star probe (r = 0.25; P=0.03). The data show that juiciness is associated with fiber type. While effective in the LD, the utility of troponin-T degradation as an indicator of degradation in all muscles may not be feasible. This is potentially due to the specificity of the antibody for individual troponin-T isoforms.

Key Words: Beef Round, Myosin Heavy Chain, Troponin-T

T127 Prevention of internal premature browning in cooked steaks packaged in high-oxygen modified atmosphere by increasing reducing ability through lactate enhancement. Y. H. Kim*, J. T. Keeton, and J. W. Savell, *Texas A&M University, College Station.*

Meats with higher concentrations of oxymyoglobin can develop brown color quicker at a lower temperature resulting in prevalence of "premature browning (PMB)" in cooked meat. Consequently, PMB defects would be a significant food safety issues if consumers rely on appearance of internal meat color for cooked meat as a measure of degree of doneness. A brown color due to metmyoglobin formation can be retarded through the metmyoglobin reducing activity (MRA) of muscle. NADH is the primary substrate for MRA. Lactate injection has been reported to improve color stability by the conversion of lactate to pyruvate via increased lactate dehydrogenase (LDH) flux and concomitant regeneration of NADH. Thus, it can be hypothesized that lactate inclusion may prevent PMB by increasing MRA through replenishing NADH. The objective of this study was to determine the effects of lactate inclusion on internal cooked color development of steaks packaged in high-oxygen MAP.

Eight beef strip loins were divided into 4 equal width sections, and one of four treatments (control, 0.3% phosphate, 2.5% L-lactate, and 2.5% D-lactate) randomly assigned to each loin section. Loins were injected at 10% of their raw weight. Injection with D-lactate was used to test our hypothesis because LDH only reacts with L-lactate to regenerate NADH. Steaks packaged in high-oxygen MAP were stored in the dark at 1°C for 10 days. Instrumental internal color of raw and cooked steaks, total reducing activity (TRA), and NADH concentration were measured. Data were analyzed by using the Mixed procedure of SAS. LSMeans were separated (P<0.05) by using least significant differences. Cooked steaks enhanced with 2.5% L-lactate maintained significantly higher a* values (redness), higher TRA, and had a higher NADH concentration as compared to other treatments. Enhancement with 2.5% D-lactate did not affect cooked color, TRA, and NADH. These results confirm that lactate inclusion prevents PMB of steaks packaged in high-oxygen MAP by increasing reducing ability through the conversion of lactate to pyruvate and the concomitant regeneration of NADH.

Key Words: PMB, Lactate, Color

Nonruminant Nutrition: Feed Additives

T128 The effects of Paylean® and α -lipoic acid on growth performance and carcass characteristics of finishing pigs. J. R. Bergstrom*, J. L. Nelssen, R. D. Goodband, M. D. Tokach, J. M. DeRouchey, and S. S. Dritz, *Kansas State University, Manhattan.*

A total of 48 gilts (initially 96 kg) were used to evaluate the effects of Paylean® and α -lipoic acid on late finishing pig performance and carcass characteristics. Pigs were blocked by weight and randomly allotted to one of four dietary treatments in a 22-d experiment. There were 2 pigs per pen and 6 pens per treatment. Pigs were fed corn-soybean meal-based diets formulated to 0.95% true ileal digestible lysine. Treatments were arranged as a 2 × 2 factorial with main effects of Paylean® (0 or 10 ppm) and α -lipoic acid (0 or 300 ppm). There were no Paylean® × α -lipoic acid interactions ($P > 0.36$) observed. For the overall study, ADG, final weight, and G:F were increased ($P < 0.04$) for pigs fed Paylean®. Pigs fed Paylean® had increased ($P < 0.04$) hot carcass weight (HCW), yield, loin eye area at the 10th-rib (LEA), and standardized fat-free lean (SFFL). Average backfat thickness (Avg. BF) tended ($P < 0.06$) to decrease for pigs fed Paylean®. Tenth-rib backfat increased ($P < 0.05$) for pigs fed α -lipoic acid. In conclusion, pigs fed 10 ppm Paylean® had improved growth performance and carcass characteristics. Feeding 300 ppm of α -lipoic acid did not affect growth performance, but did tend to increase 10th-rib fat depth.

Table 1. Growth and carcass data

Paylean®, ppm	0	0	10	10	SEM	Paylean® α -lipoic acid	P <	P <
α -lipoic acid, ppm	0	300	0	300				
ADG, g/d	932	1011	1127	1098	62	0.04		NS
G:F	0.37	0.37	0.43	0.42	0.02	0.01		NS
Final wt., kg	116.2	117.8	120.5	119.9	1.6	0.04		NS
HCW, kg	81.3	83.3	86.2	87.8	1.3	0.01		NS
Yield, %	70.4	70.8	71.7	72.9	0.6	0.02		NS
Avg. BF depth, mm	22	23	18	21	1	0.06		NS
10 th rib BF, mm	14	19	13	15	1	NS		0.05
LEA, cm ²	48.9	47.0	53.7	53.5	2.3	0.03		NS
SFFL, kg	46.4	45.3	50.4	50.0	0.9	0.01		NS

Key Words: Pigs, Paylean®, α -Lipoic Acid

T129 Effects of tannin added to low-iron antibiotic-free diet on performance, hematology, iron status, fecal microflora and incidence of diarrhea in weaned pigs. S. H. Lee, P. L. Shinde, J. Y. Choi, I. K. Kwon, S. I. Park, and B. J. Chae*, *Kangwon National University, Chuncheon, Kangwon-Do, Republic of Korea.*

This study investigated the effects of tannin added to low Fe antibiotic-free diets on the performance, hematological status, fecal microflora and incidence of diarrhea in weaning pigs. One hundred and eight weaned pigs (Landrace × Yorkshire × Duroc, 6.46 ± 1.04 kg initial body weight) were allotted to 3 treatments each comprising of 4 replicates with 9

pigs in each. The basal diet for each phase (Phase 1: d 0 to 14; Phase 2: d 15 to 28) was formulated to contain minimum Fe and the mineral premix used was prepared without addition of FeSO₄. Dietary treatments were: basal diet (low-Fe antibiotic free diet, T1), basal diet added with tannin (Albumin tannate, 0.025%, T2) and basal diet added with Fe and antibiotic (T3). Two piglets from each pen were bled at 14 and 28 d of experiment to determine their hematological status and plasma Fe concentration while feces were collected on d 14 to enumerate the microbial populations. Pigs fed with T1 diets had lower ($P < 0.05$) ADG (242 vs 264 and 271 g/d) and higher incidence of diarrhea (37.5%) than pigs fed T2 (26.4%) and T3 (36.1%) diets. The population of total anaerobic bacteria was highest in the feces of pigs fed T1 diet and lowest in those fed T2 diet, while the populations of *Bifidobacterium* spp. and *Lactobacillus* spp. was higher in pigs fed T1 diet than pigs fed T2 and T3 diets. The hematological status on d 14 was not affected by dietary treatments but on d 28 pigs fed T2 diets had lower ($P < 0.05$) erythrocyte count, hemoglobin and hematocrit values. The plasma Fe concentration on d 14 was lower ($P < 0.05$) in pigs fed T2 (87 μ g/dl) diet than pigs fed T3 (128 μ g/dl) diet while on d 28 pigs fed T1 and T2 diet had lower ($P < 0.05$) plasma Fe (86 and 70 vs 127 μ g/dl) than pigs fed T3 diet. These results suggest that tannin added to diets low in Fe without antibiotics resulted in performance of pigs comparable to pigs fed high Fe diets with antibiotics but tannin added to diets reduced incidence of diarrhea. However, tannin added to low Fe diets had a negative influence on the hematological and plasma Fe status.

Key Words: Tannin, Weanling Pigs, Fecal Microflora

T130 Effect of *Euchaena mexicana* Schrad diets on nutrient digestibility and nitrogen metabolism for Wulong Goose. B. W. Wang*, M. A. Zhang, X. P. Wu, G. L. Liu, and X. H. Jia, *Qingdao Nongye University, Qingdao, Shandong Province, China.*

One trial was conducted to study nutrition digestibility of *Euchaena mexicana* Schrad (EMC) diets for Wulong Goose. Thirty-two geese of 9 months old were selected and divided into four groups randomly, with eight geese in each group. Four groups were fed with the isocaloric and isonitrogenous diets of different EMC contents (12, 19, 25 and 31%), respectively. The results showed that, as dietary EMC increased, dry matter (DM) digestibility was decreased significantly, meanwhile the digestibility of crude fiber (CF), neutral detergent fiber (NDF) and acid detergent fiber (ADF) increased significantly ($P < 0.05$). The ratio of apparent essential amino acid (EAA) digestibility (except Leu) among the four groups had significant difference ($P < 0.01$). the content of NH₃-N in feces dropped ($P > 0.05$). There were no significant differences in net protein utilization (NPU), N apparent digestibility, N deposition and Ca apparent digestibility in different groups ($P > 0.05$). The apparent digestibility of P in different groups elevated, while there was significant difference between group D and A ($P < 0.01$), and there was significant difference between group D and B ($P < 0.05$).

Key Words: Wulong Goose, *Euchaena mexicana* Schrad, Nitrogen Metabolism

T131 Feeding different levels of zearalenone on growth, vulva size, and organ weight in postweanling female pig. Z. B. Yang¹, H. Zao¹, C. C. Chen², and F. Chi³, ¹Shandong Agricultural University, Taian, Shandong, PRC, ²Chaoyang University Technology, Taichuang, Taiwan, ROC, ³Oil Dri Corporation of Amercia, Chicago, IL.

A total of twenty postweanling female pigs (L × Y × D) weaned at d-21 with an average of 6.77±0.46 kg were used in the study. The pigs were randomly divided into four treatments with 5 pigs per treatment. Pigs were fed a corn-soybean meal-whey based diet with an addition of 0, 1, 2, or 3 ppm of zearalenone (ZEA, Fermentek, Israel) for 18 days. Feeds contained 0.90, 1.67, 2.33 and 4.33 ppm of ZEA in the four test diets individually. Pigs were weighed at the beginning and the end of trial. Feed intakes were recorded daily. Vulva length and width were measured at 3 days intervals. Pigs were killed at the end of trial, and individual organs were obtained and weighed. No differences were observed between treatments on weight gain, feed intake, or feed efficiency. However, vulva length and width were increased significantly (P<.05) as dietary ZEA concentration increased. When comparing the vulva size between d-1 and d-18 of each treatment, the size were 111, 174, 173, and 430% increased respectively in treatments 1, 2, 3, and 4. Organ sizes including uterus, ovary, kidney, liver, heart, lung, spleen, stomach, and intestines are shown in the Table 1. The size of reproductive system, kidney and liver were increased linearly as dietary ZEA increased (P<.05) On the other hand, heart, lung, spleen, and GI etc organ sizes showed no difference between treatments after feeding 18 days of ZEA. Due to increased size of liver, kidney and reproductive tract, a trend of decreased dressing percentage as dietary ZEA concentrations increased was obtained although it was not significantly different between treatments (P>.05).

Table 1. Percent organ weights to body weight of individual pig feeding different levels of zearalenone

Treatment	ZEA Intake, ppm	Ovary, Uterus	Kidney	Liver	Dressing %
1	0.90	.0625 a	.430 a	2.429 a	73.47
2	1.67	.0986 ab	.451 ab	2.535 ab	75.11
3	2.33	.1214 b	.502 b	2.759 b	72.46
4	4.33	.2410 c	.511 b	2.751 b	71.69

a, b, c - a significant difference between treatments (P < .05)

Key Words: Zearalenone, Vulva Size, Organ Weight

T132 Effect of probiotic and enzyme on fatty-liver performance and major cecum microorganisms in Landes Goose. B. W. Wang*, S. H. Yu, M. A. Zhang, L. Wang, B. Yue, L. Z. Jing, X. X. Wei, Y. C. Wang, Y. C. Fan, Q. L. Wang, Q. Zhang, and P. Sun, *Qingdao Nongye University, Qingdao, Shandong Province, China.*

To study the effect of probiotics and enzyme on fatty-liver performance, ninety 13-week-old Landes geese were selected and divided into three groups randomly, with five replicates each group and six each. The group one was the control and fed the basal diets, group two and three were the experiment groups fed the diets with an inclusion level of 0.3% probiotics and 0.3% enzyme respectively. The feeding trial lasted four weeks to measure the somatotype indexes, quality of fatty-liver and selected the cecums to culture microorganism. The results showed that,

in comparison with the control, the body oblique length, body weight and carcass weight in group two and three increased significantly (P < 0.05). With an average liver weight exceeding 1000g, there was an significant increase between the two groups and the control (P < 0.05), while the content of water, crude protein, crude fat and composition of fatty acid of liver in the two groups were not influenced (P > 0.05). The number of lactobacillus in the second group was 7.63 ± 0.52, increased by 4.53 times (P < 0.01), and the number of bifidobacterium was 6.34 ± 0.62, increased by 3.64 times (P < 0.01), and the number of escherichia coli was 5.43±0.46, reduced 66.62% (P < 0.01). The number of lactobacillus in third group was 7.48 ± 0.41, increased by 3.89 times (P < 0.05), the number of bifidobacterium was 5.62 ± 0.36, increased by 3.24 times (P < 0.05) and the number of *Escherichia coli* was 5.62±0.36, reduced 48.71% (P < 0.05). It was showed that, probiotic and enzyme preparation could promote the growth of lactobacillus and bifidobacteria, inhibit the growth of *E.coli* and maintain the good microorganism environment in intestinal in different extent; and promote the growth of Landes geese and formation of fatty-liver, improve the fatty-liver level, with no influence on the quality of fatty-liver.

Key Words: Landes Goose, Fatty-Liver Weight, Cecum Flora

T133 Study on the ferment characteristics and application effect of *Penicillium oxalicum* Currie & Thom producing pectinase. B. W. Wang*, L. Z. Jing, F. Y. Long, B. Yue, M. A. Zhang, S. H. Yu, Y. C. Wang, X. X. Wei, Q. Zhang, and Q. Feng, *Qingdao Nongye University, Qingdao, Shandong Province, China.*

Pectin was anti-nutrition determinant in animal feed. If one kind of effective enzyme which could degrade pectin was produced, the feed cost would be reduced and the problem that foodstuff competition between human and livestock would be eased. In order to determine process conditions of crude enzyme of pectinase and its effect on digestion and absorption of goose, the ferment condition was determined and the crude enzyme of pectinase was made. While twenty-four-month -old Wulong geese were selected and divided into four groups at random, and six geese in each group. Total feces collection method was adopted to determine the digestion of some nutrients. The content of pectinase in each experiment diet was 0.0%, 0.1%, 0.2% and 0.3%. The results indicated that the optimal composition of substrate was glucose 0.9g, (NH₄)₂SO₄ 1.2g, KH₂PO₃ 0.7g relative to 15g substrate; The best primary pH and time of ferment were 4.5 and 60h; The best temperature and optimum inoculum size were 30°C and 1.5ml. Combination with 5-fold concentration produced the highest gain rate of 89.89% (P<0.01). Under the same level of nutrition, the digestion of crude fiber was respectively 20.55%, 26.33%, 37.59%, 30.76% with the increasing of pectinase content; The concentration of NH₃-N in the third group was 1.20 mg/kg and significantly lower than other groups (P<0.01); The digestion of AA were relatively high (72.19%~94.27%). The apparent digestibility of Ca, P and the bacterium number of *Bifidobacterium*, *Lactobacillus* and Yeast in the feces in different groups first increased and then decreased with the increasing level of pectinase. So, supplementation with pectinase could increase the availability of nutrient in diet.

Key Words: *Penicillium oxalicum* Currie & Thom from Goose, Fermentation Characteristics, Digestion

T134 Live weight dependent responses to adding an enhanced milky flavor (Luctarom® Advance) to a piglet nursery feeding program. E. Roura*¹, G. Tedó¹, X. Puigvert², and I. Ipharragere¹, ¹Lucta SA, R+D Feed Additives, Barcelona, Spain, ²Universitat de Girona, Girona, Spain.

A trial was conducted with 192 Landrace × Large White newly weaned 23d-old pigs to study different dosing programs of an enhanced milky flavor (Luctarom® Advance) in feeds. Piglets were randomly allocated in a factorial design with 3 blocks of 8 pens according to initial body weight (light=5,78 kg; intermediate =6,66 kg; heavy=7,38 kg) and 4 dietary treatments differing only in amount of flavor. The pre-starter phase (0 to 14 d) flavor doses were 0 (T1) or 1500 ppm (T2, T3 and T4). The starter phase (14 to 28 d) flavor doses were 0 (T1), 500 (T2), 1000 (T3) or 1500 (T4) ppm. In the 1st week post weaning, the 3 equally flavored treatments on average resulted in 25% higher ADFI ($p < 0.05$) than T1 (90 vs 72 g). In the 2nd week, a flavoring by block interaction ($p < 0.05$) was observed because adding flavor increased ADG more in the light (from 182 to 242 g) than in the heavy (231 to 269 g) while decreased ADG in the intermediate (238 vs 223 g) groups. In the 1st week of the starter phase, T4 pigs ADG (555 g) was significantly higher ($p < 0.01$) than gains for T1 (485 g), T2 (457 g) or T3 (470 g). Furthermore a treatment by block interaction ($p < 0.05$) was observed showing that lowering the flavor dose to only 500 ppm (T2) compared to T4 (1500 ppm) had a live weight dependent response on ADG such that the light pigs grew similarly in both treatments (500 vs 498 g) but grew less in the intermediate (503 vs 554 g) and heavy (382 vs 609 g) groups. Overall piglets in T4 compared to T1 showed a 10% increase in ADG (345 vs 314 g, $P = 0.16$). We conclude that adding the enhanced milky flavor to feed results in higher ADG in weanling pigs compared to a non-flavored group. In the pre-starter phase, flavor addition is more effective among the lightest pigs. Decreasing flavor doses from pre-starter to starter diets results in a live weight dependent response in ADG such that the heavier the pigs the bigger the drop in the improvement in performance compared to the fully flavored group.

Key Words: Piglet, Growth, Flavor

T135 Identification of the porcine umami taste receptor dimer responsible for the taste of amino acids. E. Roura*¹, R. Holt², and K. C. Klasing², ¹Lucta SA, R+D Feed Additives, Barcelona, Spain, ²University of California, Davis.

Humans and mice perceive the umami taste via a trans-membrane heterodimeric receptor consisting of T1R1 and T1R3 proteins that are G-protein coupled to intracellular calcium release. To identify the porcine umami taste receptor, vallate papilla tissue samples were obtained from a 6-month-old male pig and total RNA was extracted, purified, and reverse transcribed. A porcine expressed sequence tag (EST) with high homology to human T1R3 was located in a public domain library (pig ESTs database from Iowa State University). The RACE PCR technique was used to obtain cDNA for adjacent 3' and 5' regions of the T1R3 EST sequence. Candidate PCR products were sequenced and the RACE process was repeated until the full length 2568 nucleotide sequence was determined. To obtain the pig T1R1 receptor sequence, degenerate PCR primers were designed that covered areas of high homology to the mouse, human, and cat genes. Primer sets were found that amplified a portion of the T1R1 and the complete 2535 nucleotide T1R1 sequence was obtained using the RACE PCR technique. Full length products of T1R1 and T1R3 were amplified by PCR, sequenced, and found to have

high (>80%) homology to respective genes from other mammals. The open reading frame of T1R1 and T1R3 was recombined into pcDNA6.2/V5-DEST Gateway vectors for expression in mammalian cells. CHO-K1 cells were transfected with both full-length pig taste receptors constructs and a mouse G alpha 15 G protein sub-unit construct. Transfected cells were seeded into 96-well-plates, loaded with a calcium detection dye cocktail and then exposed to individual amino acids. Ligand binding was determined by fluorescence using an ELISA plate reader. The porcine umami taste receptor was most sensitive to non-essential amino acids, with glutamic acid and alanine giving strong responses. In general, essential amino acids gave lower responses. These results indicate that the porcine umami receptor is tuned to detect amino acids.

Key Words: Pig, Umami, Taste Receptor

T136 Effect of virginiamycin on apparent ileal digestibility of amino acids by growing pigs. L. L. Stewart*¹, B. G. Kim¹, B. R. Gramm², R. D. Nimmo², and H. H. Stein¹, ¹University of Illinois, Urbana, ²Phibro Animal Health Co., Ridgefield Park, NJ.

Virginiamycin (VIR) improves the digestibility of energy and phosphorus, but effects of VIR on AA digestibility have not been documented. Thus we investigated the influence of VIR on apparent ileal digestibility (AID) of AA in growing pigs. A total of 15 barrows with an initial BW of 35.0 ± 2.7 kg were surgically equipped with a T-cannula in the distal ileum. Animals were randomly allotted to 3 dietary treatments during a 4-wk experiment. Dietary treatments included: 1) basal diet based on corn-soybean meal, 2) basal plus 11 ppm VIR, and 3) basal plus 22 ppm VIR. During wk 1, pigs were fed only a basal diet; during wk 2 to 4, treatment diets were provided. Ileal samples were collected on d 6 and 7 of each week. As presented in Table 1, the AID for most indispensable AA were improved in pigs fed 11 ppm VIR (Ile, Leu, Lys, Met, Phe, Trp, and Val; $P < 0.05$) or 22 ppm VIR (Ile, Leu, Met, Phe, Thr, Trp, and Val; $P < 0.05$) during wk 2 to 4. The AID for some dispensable AA were also increased in pigs fed 11 ppm VIR (Ala, Asp, and Tyr; $P < 0.05$) or 22 ppm VIR (Ala, Cys, Glu, Pro, and Tyr; $P < 0.05$). However, the AID of AA was indifferent between pigs fed 11 ppm VIR and those fed 22 ppm VIR. The present results indicate that dietary VIR improves ileal digestibility of most indispensable AA and that this effect is not further enhanced by providing more than 11 ppm VIR.

Table 1. Apparent ileal digestibility of indispensable AA during wk 2 to 4

Item	Virginiamycin, ppm			SEM	P-values	
	0	11	22		0 vs. 11	0 vs. 22
Arg	88.2	89.1	88.7	0.53	0.27	0.53
His	82.1	83.5	83.5	0.57	0.08	0.08
Ile	80.0	81.8	82.2	0.57	0.04	0.01
Leu	81.0	83.1	83.5	0.56	0.01	< 0.01
Lys	81.5	84.1	83.2	0.75	0.01	0.12
Met	83.1	85.6	85.3	0.62	< 0.01	0.02
Phe	80.3	82.4	82.6	0.57	0.01	< 0.01
Thr	71.6	73.4	73.9	0.80	0.11	0.05
Trp	73.2	78.3	79.3	0.90	< 0.01	< 0.01
Val	76.0	78.7	79.8	0.71	0.01	< 0.01

Key Words: Virginiamycin, Amino Acids, Digestibility

T137 Effect of β -glucanase on performance and apparent nutrient digestibility in weaned piglets. E. Grilli^{*1}, I. Kühn², A. Panciroli¹, and A. Piva¹, ¹*DIMORFIPA, Ozzano Emilia, Bologna, Italy*, ²*AB Enzymes GmbH, Darmstadt, Germany*.

Aim of the study was to evaluate the addition of β -glucanase (ECON-ASE[®] Barley P 700, AB Enzymes GmbH) on piglets growth performance and nutrient digestibility during 6 post-weaning weeks. Three-hundred and twenty four male piglets weaned at 21-28d (7.5 \pm 0.5 kg BW) were divided into 3 groups of 18 pens each (6 pigs per pen): a control group, receiving a barley-based diet (CTR); the ECO1 group, receiving the same diet added with β -glucanase at 17,500 BU/kg, and the ECO2 group, with enzyme added at 24,500 BU/kg. Animals were fed a 2-phase diet with no antimicrobials added. Piglets were weighed on the day of the study start (d0), at the end of the first phase (d19), and at the end of the study (d42). Feed intake was recorded daily. ADG and G:F were calculated between 0-19d, 20-42d, and 0-42d. From d15 to d19, and from d38 to d42 samples of fresh feces from 14 pens per treatment were collected daily to be analyzed for nutrient digestibility. Data were analyzed with 1-way ANOVA. During the period 0-19d ECO1 and ECO2 piglets had higher feed intake than piglets fed the CTR diet (+9.4% and +6.9%, respectively; $P < 0.05$). The ECO1 group piglets had higher ADG and BW at 19d when compared to CTR (+15%, and +5.7%, respectively; $P < 0.05$). Throughout the study (0-42d), ECO1 and ECO2 piglets tended to have higher ADG and higher BW when compared to CTR (ADG: +5.8%, and +7.6%, respectively, $P = 0.12$; BW: +4.6% and +5.1%, respectively, $P = 0.13$). Despite increased feed intake, G:F (0-42d) was significantly higher for the ECO2 group than for other groups (+6% than CTR group, $P = 0.047$). During the first phase (d15 to d19) DM fecal digestibility was improved by 5.6% in ECO1 than in CTR ($P = 0.02$) and crude protein and gross energy digestibilities were higher in ECO1 group than in CTR (+7.1%, and +8.6%, respectively; $P < 0.05$). Effects were similar but not significant in ECO2 group. Data demonstrated that especially during the first phase the enzyme stimulated feed intake and fecal apparent digestibility, thus improving growth performance of weaning piglets when their diet was supplemented with β -glucanase either at 17,500 BU/kg or at 24,500 BU/kg.

Key Words: Barley, β -Glucanase, Piglets

T138 Dietary supplementation of oregano essential oils on the performance of broilers under high altitude condition. L. Betancourt¹, C. Ariza-Nieto^{*2}, F. Rodriguez², V. Phandanouvong², A. Padilla¹, M. Hernandez¹, M. Hume³, D. Nisbet³, and G. Afanador-Tellez², ¹*Universidad Salle, Bogota, Colombia*, ²*CORPOICA, Bogota, Colombia*, ³*USDA, ARS, FFSRU, College Station, TX*.

This study evaluated the supplementation of the essential oils (EO) of different varieties of oregano in a feeding program for broilers maintained at high altitude. Two hundred and seventy 1-d old Hybro male broiler chicks were placed in 30 brooder cages under a completely randomized design. Cages were randomly assigned to 6 treatments: 1) control (C); 2) antibiotic, 500 ppm Chlortetracycline (AB); 3) 50 ppm of EO from *O. vulgare* H ground in Greece (OG); 200 ppm of EO from 3 varieties ground in Sabana of Bogota-Colombia, 4) *O. vulgare* H. (OBH), 5) *O. vulgare* L. (OBL) and 6) *O. marjoricum* (OBM). Broiler performance was determined at 3, 7, 14, 21, 28, 35 days of age. From day 21 to 25 chromium oxide (Cr₂O₃) was added at 0.5 g/kg of diet as indigestible marker for the digestibility study. Four chicks from each treatment were randomly selected for morphology measurements. Intestinal tissues were

collected from duodenum, jejunum, and ileum to measure crypt depth and villus height. The composition of essential oils was analyzed by GC/MS. Clear differences were observed between the oregano varieties with wide ranges in the content of carvacrol (3.7% to 50.8%) and thymol (4.7% to 21.5%). The minimal inhibition concentration (MIC) of the EO were tested on *Salmonella* Typhimurium ATCC 14028 and *Escherichia coli* ATCC 25922 using microdilution in broth. OBL showed the highest inhibitory activity with a MIC of 1.25 mg/ml and 0.63 mg/ml on *S. Typhimurium* and *E. coli*, respectively. Broilers supplemented with OBM had greater villus: crypt ratio in duodenum compare to OG group. Broilers supplemented with AB showed greater ileum protein digestibility (88.9%) when compared to C, OBGL, and OBGH (84.0, 82.8, and 76.2%, respectively), but similar to OBM (85.7%) and OG (84.7%). Broilers supplemented with OBM had greater ($P < 0.05$) body weight gain compared to OG on days 7 and 14 (101.9 vs. 93.9 g) and (244.0 vs. 222.6 g), respectively. Group OBL reduced mortality in 11.1% compared to group C. Oregano EO supplementation showed a biological growth potential on broilers under high altitude conditions.

Key Words: Oregano Essential Oils, Broiler, Gastrointestinal Health

T139 Isolation of a *Bacillus licheniformis* DK42 producing cellulase and xylanase, and properties of the enzymes. M. J. Kim, S. J. Lim, and D.-K. Kang^{*}, *Dankook University, Cheonan, Chungnam-do, Rep. of Korea*.

Cellulase and xylanase play an important role in improvement of the nutritional value of animal feeds. A bacterium DK42 producing xylanase and cold-active cellulase was isolated from pig feces. The isolate, DK42 strain, was found to be the Gram-positive, non-motile, catalase-positive, and spore-forming strain. Under an electron microscope, the cells were observed to be rod-shaped. The isolate was named as *Bacillus licheniformis* DK42, on the basis of carbon utilization and 16S rRNA gene sequences analysis. The extracellular cellulase and xylanase were partially purified by ammonium sulfate precipitation. Cellulase exhibited an optimum temperature and pH at 45C and 6.0, whereas xylanase exhibited an optimum temperature and pH at 55C and 6.0. Especially cellulase maintained approx. 50% of its maximum activity even at 4C, indicating that it is cold-active. Both cellulase and xylanase were stable after 2hr at 35C, whereas they lost their activities after 30min at 65C. The zymogram analysis of ammonium sulfate-precipitated fraction showed a distinct cellulase activity band on native PAGE.

Key Words: Cellulase, Xylanase, *Bacillus*

T140 Effect of dietary probiotic and/or prebiotic on humoral immune response of Ross broiler chickens. H. Ziaei^{*1}, M. A. Karimi Torshizi², M. Bashtani¹, H. Farhangfar¹, H. Naemipour¹, and A. Zeinali¹, ¹*Birjand University, Birjand, Iran*, ²*Tarbiat Modarres University, Tehran, Iran*.

An experiment was conducted on 240 one-day old male Ross broiler chickens to evaluate the efficiency of antibiotic alternatives growth promoters on bird immune response system. Chicks were fed in a block completely randomized design with 4 replicate pens (15 birds per pen). Experimental treatments were: (T1= control, T2= control + 15 ppm of Virginiamycin, T3= control + 15 mg probiotic Protexin /kg diet, T4=

control diet + 10 mg prebiotic Immnuwall /kg diet). For experimental immunization, four birds of 18 and 27 days old from each replicate were injected intravenously (brachial vein) with 0.1 ml of 0.5% sheep red blood cells (SRBC). Blood samples were collected after 5 days of inoculation to measure the antibody production. The results of the present study indicated that the antibody production was significantly ($P<0.05$) higher in experimental units treated under T3 and T4 as compared with the other treatments in 24 and 32 days of age. In addition, for the traits under consideration, non-significant difference ($P>0.05$) was found between treatments 1 and 2. It is therefore suggested that supplementation of diets with Probiotic and Prebiotic could increase immune function against the pathogens resulting in improving growth performance of broilers.

Key Words: Broiler, Probiotic, Prebiotic

T141 Assessment of the antimicrobial activity of carvacrol, cinnamaldehyde and capsicum oleoresin in stomach, jejunum, and cecum digestive content of weaned pigs using fermentation assay.

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The measurement of gas produced as a fermentation end product in vitro was used to study the antimicrobial effect of a plant mixture (XT) containing carvacrol (CAR), cinnamaldehyde (CIN) and capsicum (CAP). Increasing doses from 0 to 10000 µg/mL of the mixture were tested in stomach, jejunum and cecum contents 1 and 2 weeks after weaning at 21 days of age. No inhibition of the gas production was found in stomach and cecum content using 10000 µg/mL of XT. In jejunum, 10000 µg/mL produced a partial decrease on the gas production (20.0 vs. 29.5 mL, $P=0.001$). The different components of XT were tested separately using intestinal content of animals 1 week after weaning. Formic acid (FA) was included in the tests as a reference. In the stomach, CAR totally inhibited the gas production at 10000 µg/mL, whereas CIN and FA induced a partial inhibition (0.8 and 4.5 vs. 14.3 mL, $P<0.001$, respectively). CAP did not show any effect on stomach gas production until 10000 µg/mL. All compounds produced a decrease of gas production in jejunum content at 1000 µg/mL. However the effect of CAR, CIN and FA was more marked than the CAP effect compared to negative control (15.5, 16.0, 21.0 and 25.8 vs. 29.5 mL, $P<0.001$, respectively), and all three inhibited gas production at 10000 µg/mL whereas the CAP effect was unchanged. CAR, CIN and CAP were then tested in older animals, 5 weeks after weaning. CAR at 1000 µg/mL and CIN at 500 µg/mL both reduced gas production in jejunum (17.5 and 14.0 vs. 37.7 mL, $P<0.001$, respectively). The doses of 3000 µg/mL of CAR and 2000 µg/mL CIN partially inhibited gas production in cecum (21.5 and 24.4 vs. 28.8 mL, $P<0.001$, respectively). CAP was only active at doses higher than 10000 µg/mL. These experiments demonstrate that CAR and CIN present good antimicrobial activity at doses similar to the acidifiers.

Key Words: Plant Extracts, Formic Acid, Pig

T142 Effects of essential oils supplementation on growth performance, nutrient digestibility, blood characteristics, fecal noxious gas concentration and meat quality in growing-finishing pigs.

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Ninety six crossbred pigs (Landrace×Yorkshire×Duroc) were used to determine the effects of essential oils (AROMEX[®] ME) supplementation on growth performance, nutrient digestibility, immune response, fecal noxious gas and meat quality of growing-finishing pigs. Treatments were 1) NC (control diet without antibiotics), 2) PC (NC + 44 mg/kg tylosin to 6th wk; 20 mg/kg avilamycin to 16th wk) and 3) AROMEX[®] ME (NC + 0.01% AROMEX[®] ME). At 16 weeks body weight was higher ($P<0.05$) in PC and AROMEX[®] ME treatments (110.972 kg and 113.491 kg) than in the NC treatment (102.206 kg). During the all period of the trial, ADG (0.854 kg) and G/F (0.474) were significantly improved ($P<0.05$) by AROMEX[®] ME supplementation compared with NC treatment (0.802 kg and 0.436). Both of antibiotics (1.798 kg) and AROMEX[®] ME (1.802 kg) supplementation significantly decreased ($P<0.05$) ADFI compared with NC treatment (1.838 kg). At the end of 16 weeks, total protein and lymphocyte concentration of blood were increased ($P<0.05$) in PC (7.99 g/dL and 65.48%) and AROMEX[®] ME (7.93 g/dL and 64.48%) treatments compared with NC treatment (7.83 g/dL and 57.40%). IgG concentration was increased ($P<0.05$) in AROMEX[®] ME treatment (1428 mg/dL), compared with NC (1296 mg/dL) and PC treatments (1303 mg/dL). WHC was increased ($P<0.05$) in AROMEX[®] ME treatment (38.64%) compared with other treatments (32.05% and 34.24%). TBARS of NC (0.032 MDA mg/ 1000g) and PC (0.030 MDA mg/ 1000g) treatments were higher ($P<0.05$) than AROMEX[®] ME treatment (0.012 MDA mg/ 1000g). AROMEX[®] ME supplementation significantly reduced ($P<0.05$) ammonia (84.18ppm) and mercaptans (0.62ppm) emission compared with NC (92.92ppm and 0.75ppm) and PC treatments (94.02ppm and 0.87ppm) at the 7 days of the gas evaluation. In conclusion, the dietary addition of essential oils and antibiotic into diets for growing-finishing pigs improved growth performance, nutrient digestibility, and immune response. Essential oils can be used to partly replace antibiotics in diets for pigs without negative affects on growth performance, meat quality and reduced noxious gas emission.

Key Words: Essential Oil, Fecal Noxious Gas Concentration, Blood Profile

T143 Effects of dietary *Rhodopseudomonas capsulata*, *Rhizopus oligosporus* & *Aspergillus oryzae* on growth performance nutrient digestibility and blood characteristics in growing pigs.

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The current study was conducted to investigate the effects of dietary complex probiotics supplementation on growth performance, nutrient digestibility, blood characteristics and noxious gas emission of manure slurry in growing pigs. A total of forty eight pigs with an initial body weight of 20.12 kg were allotted to three dietary treatments (two pigs per pen with eight pens per treatment). Probiotics contained *Rhodopseudomonas capsulata*, *Rhizopus oligosporus* & *Aspergillus oryzae*. Dietary treatment included: 1) CON (basal diet), 2) Pro1 (basal diet + 0.1% complex probiotics) and 3) Pro2 (basal diet + 0.2% complex probiotics). The experiment lasted six weeks. Blood samples were acquired from the cervical vein into K₃EDTA vacuum tubes and clot activator vacuum tubes from 2 pigs in each pen at the end of the

experiment. Collected fresh feces and urine samples were stored in 2.6 L plastic boxes. After fermentation period, Gastec fas sampling pump was used for gas detection. One hundred mL of the headspace air in each plastic box was sampled approximately 2.0 cm above the slurry surface. Through the entire experimental period, ADG was increased with the increased complex probiotics supplementation level (linear effect, $P < 0.05$). However, neither ADFI nor gain/feed was influenced by the dietary treatments. Complex probiotics supplementation increased DM digestibility (linear effect, $P < 0.05$). Also, N digestibility was improved, with the Pro1 treatment having the highest value (linear and quadratic effect, $P < 0.05$). Supplementation of complex probiotics did not affect the WBC, RBC, lymphocyte and BUN concentrations in blood. The NH_3 -N emission from manure slurry was decreased with the increased level of complex probiotics supplementation (linear and quadratic effect, $P < 0.05$). Similarly, H_2S emission of manure slurry was also decreased significantly when complex probiotics was included in diet (linear effect, $P < 0.05$). In conclusion, dietary supplementation of complex probiotics can increase growth performance and decrease noxious gas emission of manure slurry in growing pigs.

Key Words: Complex Probiotics, Noxious Gas, Pig

T144 Effect of dietary organic acid mixture (lactic acid, formic acid, citric acid, butyric acid and phosphoric acid) on growth performance, organ weight, blood immunological parameter and intestinal villi morphology in broilers. H. D. Jang^{*1}, J. S. Yoo¹, Y. Huang¹, T. X. Zhou¹, J. H. Cho¹, J. D. Hancock², and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Kansas State University, Manhattan.

The study was conducted to evaluate the effects of dietary organic acid mixture (lactic acid, formic acid, citric acid, butyric acid and phosphoric acid) on growth performance, organ weight, blood immunological parameter and intestinal villi morphology in broilers. Dietary treatments were included 1) CON (basal diet), 2) OA1 (basal diet + 0.1% organic acid mixture) and 3) OA2 (basal diet + 0.2% organic acid mixture). Each treatment were allotted to twenty broilers per pen with eight replicate pens per treatment in a completely randomized design. Daily weight gain, feed intake and feed/gain were not significantly different among the treatments. In organ weight, gizzard was significantly higher in OA2 than CON (Linear effect= 0.034). However, spleen and intestine were not significantly different among the treatments. In blood immunological parameters, RBC, WBC and lymphocyte were not significantly different. In intestinal villi morphology, villi length was increased in OA1 compared to CON (Quadratic effect=0.050). Water content of feces was not significantly different among the treatments. In conclusion, 0.1% organic acid mixture was effective to improve gizzard and villi length in broilers.

Key Words: Complex Organic Acid, Blood Immunological, Intestinal Villi

T145 Effects of dietary supplementation of blended essential oil on growth performance, nutrient digestibility, blood profiles, fecal characteristics in weanling pigs. Y. Huang^{*1}, J. S. Yoo¹, H. J. Kim¹, Y. Wang¹, Y. J. Chen¹, J. H. Cho¹, J. D. Hancock², K. Y. Whang³, and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Kansas State University, Manhattan, ³Korea University, Seoul, Korea.

One hundred and twenty five crossed [(Duroc × Yorkshire) × Landrace] pigs (6.21 ± 0.02 kg initial body weight and 21 d average age) were used in the current experiment to determine the influence of dietary supplementation of blended essential oil on growth performance, nutrient digestibility, blood profiles, fecal characteristics in weanling pigs. Treatments were 1) NC (antibiotic free diet), 2) PC (NC diet + 44 mg/kg of tylosin), 3) T1 (NC diet + 0.1% of essential oil), 4) T2 [NC diet + 0.1% of essential oil (with 0.3% Benzoic acid)] and 5) T3 (NC + 22 mg/kg of tylosin and 0.05% of essential oil). ADG was improved ($P < 0.05$) in pigs fed 0.1% of essential oil with 0.3% Benzoic acid (295 g) at d 14 compared with PC and T1 treatments (266 g and 269 g). At the end of experiment, dry mater digestibility was improved ($P < 0.05$) in T3 treatment (78.67%) compared with T1 treatment (77.09%). Lymphocyte concentration in blood was greater ($P < 0.05$) in T3 treatment (64.78%) compared with NC treatment (50.14%). Fecal pH was the greatest ($P < 0.05$) in PC treatment (8.36) compared with NC, T1, T2, and T3 treatments (8.07, 8.06, 7.61 and 7.58, respectively). Amonia emission was increased ($P < 0.05$) in PC treatment compared with T1, T2, and T3 treatments (146.67, 70.00 and 74.67). Diarrhea appearance and score were tended to decrease in essential oil treatments partially. In conclusion, supplementation of blended essential oil could replace antibiotics to improve growth performance and remain the amonia emission with Benzoic acid supplementation.

Key Words: Essential Oil, Growth Performance, Fecal Characteristic

T146 Effects of reducing dietary crude protein, yucca and multi-carbohydase supplementation on egg production performance, nutrition digestibility, and fecal noxious gas contents in laying hens. Y. Huang^{*1}, Y. Hyun², H. S. Kim², Y. Wang¹, H. J. Kim¹, S. O. Shin¹, and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Seoul Feed, Co. LTD., Seoul, Korea.

The emissions of fecal noxious gases, including ammonia (NH_3), constitute principal concerns for the Korean poultry industry. The principal objective of this study was to determine whether different crude protein (CP) levels and several different supplementation techniques could reduce fecal gas emission and maintain the production performance of laying hens. Chickens were fed with the following diets: 1) T1 (CP 18%); 2) T2 (CP 16.5% + yucca 0.02%); 3) T3 (CP 15% + yucca 0.02%); 4) T4 (CP 15% + yucca 0.02% + α -1,6-galactosidase and β -1,4-mannanase multi-carbohydase 0.05%). Egg production, egg weight, eggshell breaking strength, eggshell thickness, nutrient digestibility, and fecal noxious gas emission characteristics were evaluated. Egg production and egg weight were not consistently altered by any of the treatments. Eggshell breaking strength and eggshell thickness were both significantly reduced by T3 and T4 treatments at the end of experiment ($P < 0.05$). Digestibility of amino acids (AA), with the exception of Gly, were significantly decreased by feeding low CP diet ($P < 0.05$). However, carbohydase supplementation significantly improve the digestibility of AA in the low CP treatments ($P < 0.05$). Dry matter (DM) digestibility was increased with reducing dietary CP levels ($P < 0.05$). Fecal sulfureted hydrogen (H_2S) and NH_3 emissions were significantly decreased in T3 and T4 treatments ($P < 0.05$). In conclusion, our results indicate that 1) Eggshell breaking strength, eggshell thickness, nutrient digestibility, and noxious gas emissions may be decreased by reductions in dietary CP. 2) Considering the decreasing levels of CP in the yucca treatment groups, yucca may exert some positive effects on egg production and weight. 3) Multi-carbohydase supplementation can significantly improve AA digestibility. 4) The reduction of dietary CP and yucca and multi-

carbohydrase supplementations would be expected to improve nutrient digestibility and fecal noxious gas emission in laying hens.

Key Words: Laying Hens, Yucca, Amino Acid Digestibility

T147 Effect of dietary microbial phytase on laying performance, egg quality, phosphorus utilization and nutrient utilization in laying hens. H. D. Jang^{*1}, Y. Hyun², H. S. Kim¹, I. W. Hwang³, J. S. Yoo¹, Y. J. Chen¹, J. H. Cho¹, and I. H. Kim¹, ¹*Dankook University, Cheonan, Chungnam, Korea*, ²*Seoul Feed, Co. LTD., Seoul, Korea*, ³*EASY BIO System, Inc, Seoul, Korea*.

The study was conducted to evaluate the effects of dietary microbial phytase on egg productivity, egg quality, phosphorus utilization and nutrient digestibility in laying hens. The animals used in the experiment were a total of 120 ISA brown laying hens (32 weeks old). Dietary treatments included 1) CON (basal diet), 2) LP (Low phosphorus diet) 3) NG (Low phosphorus diet + 0.03% Natuphos[®]Granule), 4) NC (Low phosphorus diet + 0.03% Natuphos[®] Classic). The laying hens were allotted at 6 laying hens per block with five replicate pens per treatment by completely randomized design. Through the whole period of experiment, egg production was significantly increased in CON and NG treatments compared to LP treatment ($P < 0.05$). CON, NG and NC treatments significantly increased their egg shell breaking strength and egg shell thickness compared to LP treatment ($P < 0.05$). Albumin height was higher in CON and NG treatments than LP treatment ($P < 0.05$). CON, NG and NC treatments resulted higher yolk color and haugh unit than LP treatment ($P < 0.05$). Calcium and Inorganic phosphorus contents in blood were higher in NG treatment compared to LP treatment ($P < 0.05$). Calcium retention of CON, NG and NC treatments were higher than LP treatment ($P < 0.05$). Phosphorus retention was increased in NG and NC treatments compared to CON and LP treatments ($P < 0.05$). LP treatment significantly increased their nitrogen, calcium and phosphorus excretion compared to CON, NG and NC treatments ($P < 0.05$). Dry matter digestibility and nitrogen digestibility were greater in NG treatment than CON, LP and NC treatments ($P < 0.05$). Crude ash was increased in CON, NG and NC treatments compared to LP treatment ($P < 0.05$). Calcium digestibility and phosphorus digestibility were significantly improved in NG and NC treatments than CON and LP treatments ($P < 0.05$). In conclusion, NG treatment improved egg production, egg quality, inorganic calcium and phosphorus, calcium and phosphorus retention and nutrient digestibility and decreased nitrogen and phosphorus excretion in laying hens.

Key Words: Microbial Phytase, Egg Quality, Laying Hens

T148 Effects of dietary biotite on growth performance, blood immunological parameters, stress concentration of serum and fecal malodor gas emission in growing pigs. H. D. Jang^{*1}, J. D. Kim², J. W. Hong³, J. S. Yoo¹, J. H. Cho¹, Y. K. Jeong⁴, and I. H. Kim¹, ¹*Dankook University, Cheonan, Chungnam, Korea*, ²*CJ CheilJedang, Seoul, Korea*, ³*DAESANG Famsco, Anseong, Korea*, ⁴*SEOBONG Biobestech, Co., LTD, Seoul, Korea*.

This study was conducted to evaluate the effects of biotite on growth performance, blood immunological parameters, stress concentration of serum and fecal malodor gas emission in growing pigs. 96

pigs[(Landrace × Yorkshire) × Duroc, 29.45 ± 1.35kg average initial body weight] were used in 42d growth trial. Dietary treatments included CON (basal diet), Solt2 (Basal diet+ Biotite 0.2%), Solt4 (Basal diet + Biotite 0.4%) and Solt6 (Basal diet + Biotite 0.6%). The pigs were assigned to the treatments according to body weight and each treatment had 6 replicates of 4 pigs per pen in a randomized complete block design. Nitrogen digestibility was significantly higher in Solt4 treatment than CON and Solt2 treatments (Linear effect = 0.016). Gross energy in Solt4 and Solt6 treatments was higher than CON treatment (Linear effect = 0.008, Quadratic effect = 0.019). There were not significantly difference on blood immunological (RBC, WBC, Lymphocyte and IgG) and stress parameter (cortisol, epinephrine and norepinephrine) among the treatments. At 5 day and 10 day, hydrogen sulfide was reduced in Solt treatment compared to CON treatment (5 day, Linear effect = 0.009, Quadratic effect = 0.037; 10 day, Linear effect = 0.009). At 5 day, acetic acid was significantly reduced in Solt treatments compared to CON treatment (Linear effect < 0.001, Quadratic effect < 0.001). At 15 day, acetic acid was significantly decreased in CON and Solt6 treatments compared to Solt2 and Solt4 treatments (Quadratic effect = 0.023). At 5 day and 10 day, Solt treatments was significantly decreased their total mercaptans compared to CON treatments (5 day, Linear effect = 0.029, Quadratic effect = 0.037; 10 day, Linear effect = 0.029). For the whole period, ammonia was significantly reduced in Solt2 and Solt4 treatments compared to CON and Solt6 treatments (5 day, Quadratic effect = 0.038; 10 day, Quadratic effect = 0.045; 15 day, Quadratic effect = 0.038). In conclusion, biotite improved nitrogen digestibility and gross energy digestibility. Also, it decreased fecal malodor gas emission in growing pigs.

Key Words: Biotite, Growth Performance, Fecal Malodor Gas Emission

T149 Use of fluidized bed technology for the development of sustained-release carvacrol pellets for a feed additive application. J.-P. Meunier^{*1}, J.-M. Cardot², and M. Alric², ¹*Pancosma Research, Geneva, Switzerland*, ²*University of Auvergne, France*.

In the field of animal feeding, the development of microencapsulated plant extract formulations intended to prolong the release of the active ingredients in the digestive tract requires to take into account a major technical limitation. The microparticles, before being consumed by the animal, must be incorporated in the feed and the whole must undergo a steam-pelleting phase. The feed will be subjected to high temperature and pressure before passing through a die to be transformed into pellets. The objective of this study was to assess the benefit of fluidized bed spray granulation applied to carvacrol microencapsulation into a core based on maltodextrin. Different amounts of hydrogenated rapeseed oil were applied on the core as coating to modify carvacrol release kinetics. The efficacy of the coating was tested in vitro using a flow through cell apparatus (CFC system). The time to achieve T90% values of dissolution increased with the increase in coating level from 10% to 30% (w/w) ($P < 0.05$), indicating the ability of the process to slow down release depending on the amount of hydrogenated rapeseed oil applied. Nevertheless, as CFC systems are ill suited for experiments with solid feed and thus limit their predictive values, follow-up studies were performed on the formulation coating at 30% using an in vitro dynamic model (TIM) that simulated more closely the digestive environment. A lower quantity of carvacrol dialyzed was recorded under fed condition vs. fasting condition with 19.1% ± 1.0 vs. 37.5% ± 2.7 respectively. This suggests a possible interaction between carvacrol and the feed matrix. Moreover, 47.7 ±

3.9% of the total carvacrol was dialyzed after 8 h digestion when feed had been granulated vs. $19.1 \pm 1.4\%$ when feed had not, which suggests that the feed granulation process could lead to a partial degradation of the microspheres. This study demonstrates the potential and the limitations of this technology to encapsulate feed additives.

Key Words: Carvacrol, Microencapsulation, In Vitro Model

T150 Effects of phytase and/or 25-hydroxyvitamin D3 inclusion on the performance, mineral balance and bone parameters of finisher pigs fed low phosphorus diets. D. A. Gahan, J. J. Callan, and J. V. O'Doherty*, *University College, Dublin, Ireland.*

Two 2×2 factorial experiments, a performance experiment and a mineral balance study were conducted to investigate the effects of *Peniophora lycii* (*P. lycii*) phytase enzyme and/or 25-hydroxyvitamin D3 on growth performance, mineral balance and bone parameters when offered to grower-finisher pigs (42 to 101 kg live weight). The dietary treatments were (T1) low-phosphorus (P) diet; (T2) low-P diet + 750 U/kg phytase; (T3) low-P + 25-hydroxyvitamin D3 (25-OHD3) diet, and (T4) low-P + 750 U/kg phytase and 25-OHD3 diet. Pigs offered both phytase (734 vs 710 g/day; se 0.008) and 25-OHD3 (736 vs 708 g/day; se 0.008) diets had higher carcass daily gains compared with non-phytase and non-25-OHD3 diets ($P < 0.05$). There was an interaction between phytase and 25-OHD3 on the apparent digestibility of ash ($P < 0.01$), P ($P < 0.001$), calcium (Ca) ($P < 0.001$) and on P ($P < 0.05$) and Ca ($P < 0.05$) retention. Pigs offered phytase only diets had higher ash ($P < 0.01$), P ($P < 0.001$) and Ca ($P < 0.01$) digestibility, and a higher P and Ca ($P < 0.05$) retention than pigs offered unsupplemented diets. However, when the combination of phytase and 25-OHD3 were offered, there was no effect on ash, P and Ca digestibility while P and Ca retention decreased compared with 25-OHD3 only diets. Pigs offered phytase diets had higher bone ash ($P < 0.01$), bone P ($P < 0.01$) and bone Ca ($P < 0.05$) concentrations than pigs offered non-phytase diets. Pigs offered phytase diets had significantly lower faecal P ($P < 0.05$) and higher urinary P excretion ($P < 0.05$) compared with non-phytase diets. Pigs offered 25-OHD3 diets had a higher nitrogen retention ($P < 0.05$) compared with non-25-OHD3 diets. In conclusion, pigs offered either phytase or 25-OHD3 diets had higher carcass daily gains compared with non-phytase and non-25-OHD3 diets. The beneficial effects of microbial phytase supplementation on ash, Ca and P digestibility were adversely affected when the combination of phytase and 25OHD3 were offered to pigs.

Key Words: Pigs, Phytase, 25-Hydroxyvitamin D3

T151 Effect of reducing dietary crude protein, yucca and multi-carbohydrase supplementation on growth performance, meat quality, nutrient digestibility, and fecal noxious gas contents in broilers. Y. Huang*¹, Y. Hyun², H. S. Kim², H. J. Kim¹, Y. J. Chen¹, J. H. Cho¹, J. D. Hancock³, and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Seoul Feed, Co. LTD., Seoul, Korea, ³Kansas State University, Manhattan.

Increased attention by regulatory agencies regarding agriculturally-generated atmospheric pollutants necessitates the consideration of emission reduction strategies in the feeding of broilers. The emissions of noxious gases, including ammonia (NH_3), are principal concerns of

the Korean poultry industry. The principal objective of this study was to determine whether different crude protein (CP) levels and several different supplementations could reduce the gas emission characteristics and effects on the growth performance of broilers. A total of 480 2-d-old Arbor Acre broilers were allotted to 4 treatment groups, each group included 6 replicates of 20 birds. The birds were fed on period 1: 1) T1 (CP 21%, ME 2969 kcal/kg); 2) T2 (CP 19%, ME 2863 kcal/kg + yucca 0.02%); 3) T3 (CP 17%, ME 2885 kcal/kg + yucca 0.02%); 4) T4 (CP 17%, ME 2881 kcal/kg + yucca 0.02% + α -1,6-galactosidase and β -1,4-mannanase multi-carbohydrase 0.1%) and period 2: 1) T1 (CP 19%, ME 3086 kcal/kg); 2) T2 (CP 17%, ME 2977 kcal/kg + yucca 0.02%); 3) T3 (CP 15%, ME 2978 kcal/kg + yucca 0.02%); 4) T4 (CP 15%, ME 2978 kcal/kg + yucca 0.02% + α -1,6-galactosidase and β -1,4-mannanase multi-carbohydrase 0.1%). Growth performance, carcass yield, nutrient digestibility, and fecal noxious gas emission characteristics were evaluated. Dry matter (DM) and nitrogen (N) digestibility were negatively affected ($P < 0.05$) by low dietary CP without carbohydrase. Digestibility of amino acids (AA) were significantly decreased by low CP diet ($P < 0.05$). However, carbohydrase supplementation can significantly improve AA digestibility in low CP treatment ($P < 0.05$). Breast yield was decreasing while abdominal fat yield was increasing with the decline of dietary CP levels ($P < 0.05$). Fecal NH_3 emission was significantly decreased in low CP treatments ($P < 0.05$). In conclusion, carbohydrase can be used to maintain AA digestibility when reduced CP diet is supplied and yucca supplementation and reduction in the CP level exert beneficial effects on the reduction of ammonia emissions.

Key Words: Broiler, Low Crude Protein, Carbohydrase

T152 Effect of dietary phytase on growth performance, carcass parameter, meat quality, nutrient digestibility and phosphorus utilization in broilers. H. D. Jang*¹, J. S. Yoo¹, H. J. Kim¹, S. O. Shin¹, Y. Huang¹, T. X. Zhou¹, Y. J. Chen¹, J. H. Cho¹, Y. K. Han¹, and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Sungkyunkwan University, Suwon, Korea.

The study was conducted to evaluate the effects of dietary phytase on growth performance, carcass parameter, meat quality, nutrient digestibility and phosphorus utilization in broilers. The experiment 1 was a total of 480 broilers (BW: 37.79g). Dietary treatments were included 1) CON (basal diet), 2) LP (Low phosphorus diet) and 3) CP (Low phosphorus diet + 0.05% coating phytase). The Broilers were allotted at 20 broilers per block with 8 replicate pens per treatment by completely randomized design. The experiment 2 was a total of 96 broilers (BW: 1,038g). Dietary treatments were included 1) CON (control), 2) LP (Low phosphorus diet), 3) NP (Low phosphorus diet + 0.05% normal phytase) and 4) CP (Low phosphorus diet + 0.05% coating phytase). The broilers were allotted at 3 broilers per block with 8 replicate pens per treatment by completely randomized design. Weight gain was significantly increased in CON compared to LP and CP treatments ($P < 0.05$). Calcium contents in blood was improved for CP treatment compared to LP treatment ($P < 0.05$). Carcass and CIE a^* of breast were significantly increased in CON compared to LP treatment ($P < 0.05$). WHC of breast was improved for CON and CP treatments compared to LP treatment ($P < 0.05$). Digestibility of dry matter and nitrogen were higher in CON compared to LP treatment ($P < 0.05$). Crude ash was greater in CON than CP treatment ($P < 0.05$). Calcium was improved for broiler fed CON and CP treatments compared with those fed LP treatment ($P < 0.05$). Digestibility of phosphorus was significantly reduce in LP treatments than CON and CP treatments ($P < 0.05$). Calcium retention was higher in

CON and CP treatments than LP treatment ($P < 0.05$). Phosphorus excretion was significantly reduced in NP treatment compared to CON and LP treatments ($P < 0.05$). Nitrogen and calcium excretion were significantly reduced in CON treatment compared to others ($P < 0.05$). In conclusion, CP treatment improved calcium contents in blood, WHC and pH of meat, digestibility of calcium and phosphorus, dry matter and calcium intake, nitrogen retention and calcium retention and decreased F/G and phosphorus excretion in broilers.

Key Words: Phytase, Meat Quality, Broilers

T153 Effects of δ -aminolevulinic acid and vitamin C supplementation on egg performance and quality and hematological characteristics in laying hens. Y. J. Chen^{*1}, I. H. Kim¹, K. Y. Whang², J. C. Park³, J. H. Cho¹, J. S. Yoo¹, Y. Wang¹, Y. Huang¹, H. J. Kim¹, and S. O. Shin¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Korea University, Seoul, Korea, ³National Institute of Animal Science, RDA, Cheonan, Chungnam, Korea.

This experiment was conducted to evaluate the effects of δ -aminolevulinic acid (ALA) and vitamin C supplementation on egg performance and quality and hematological characteristics in laying hens. A total of 252 Hy-line brown hens were randomly allotted to 6 dietary treatments: 1) CON (basal diet), 2) VC (basal diet with vitamin C 500 ppm), 3) ALA1 (basal diet with ALA 5 ppm), 4) ALA2 (basal diet with ALA 10 ppm), 5) AV1 (ALA1 diet with vitamin C 500 ppm) and 6) AV2 (ALA2 diet with vitamin C 500 ppm). There were 7 replications with 6 layers in adjacent three cages per each. During the 6-week experimental period, egg production was increased ($P < 0.05$) in AV2 (85.1%) treatment compared to other treatments (81.5, 79.7, 79.2, 79.7, 79.8) whereas egg weight was not influenced by dietary treatments. Egg shell color, thickness and breaking strength were not affected by ALA or vitamin C addition. Egg albumin height ($P < 0.05$) was higher in two AV (9.35, 9.42) treatments than other treatments (8.73, 8.44, 8.50, 8.76). Haught unit was greater ($P < 0.05$) in AV2 treatment (93.35) compared to CON (83.37), VC (86.10) and two ALA treatments (83.74, 83.18). Yolk color unit concentration was higher ($P < 0.05$) in ALA2 (8.85) and two AV treatments (8.90, 8.65) than other treatments (7.64, 8.08, 7.87). For the hematological characteristics, ALA and vitamin C had no effects on WBC, hematocrit, total protein, albumin and total iron binding capacity. Two AV treatments had greater ($P < 0.05$) RBC, hemoglobin and iron concentration compared to other treatments. The AV2 treatment (79.0%) also had greater ($P < 0.05$) lymphocyte concentration compared to CON, VA and AV1 treatments (70.8, 71.0, 66.5%). In conclusion, combine administration of ALA and vitamin C has positive influence on egg quality and can improve iron status of laying hens.

Key Words: δ -Aminolevulinic Acid, Egg Quality, Laying Hens

T154 Evaluation of supplemental α -aminolevulinic acid and vitamin C on growth performance, blood characteristics, immune organ weight and iron status in broilers. Y. J. Chen^{*1}, C. Y. Lee², I. H. Kim¹, J. H. Cho¹, J. S. Yoo¹, Y. Wang¹, Y. Huang¹, H. J. Kim¹, and S. O. Shin¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Jinju National University, Gyeongnam, Korea.

To evaluate the effect of δ -aminolevulinic acid (ALA) as immune modulator, 480 Arbor Acre male broilers were administrated 1 of 6 dietary

treatments. There were 4 replications per treatment and 20 broilers per cage. Dietary treatment included: 1) CON (basal diet); 2) VC (basal diet + vitamin C 500 mg/kg); ALA1 (basal diet + ALA 5 mg/kg); ALA2 (basal diet + ALA 10 mg/kg); AV1 (ALA1 + vitamin C 500 mg/kg) and AV2 (ALA2 + vitamin C 500 mg/kg). Treatment diets were provided for 5 weeks. The growth performance was not affected throughout the experimental period. Serum total protein (3.50 vs. 2.68 g/dL), albumin (1.62 vs. 1.32 g/dL) and hematocrit (26.7 vs. 24.2%) concentrations were higher ($P < 0.05$) in AV2 treatment than that in CON treatment. Serum hemoglobin concentration was increased ($P < 0.05$) 20%, 22%, 15% and 13% in AV2 treatment compared with CON, VC, ALA1 and ALA2 treatments, respectively. Iron concentration in serum was elevated ($P < 0.05$) in AV2 treatment (111.6 μ g/dL) compared with CON (73.0 μ g/dL) and VC (111.6 μ g/dL) treatments. However, the total iron binding capacity was not influenced by dietary treatment. The RBC concentration was higher ($P < 0.05$) in AV2 treatment than CON and VC treatments. AV2 treatment had greater ($P < 0.05$) liver weight than CON, VC and ALA1 treatments (2.74 vs. 2.33, 2.34, 2.35 g/100g BW). Liver iron concentration was higher ($P < 0.05$) in AV treatments (100.5, 93.5 μ g/dL) than other treatments while breast meat iron concentration was only increased in AV2 treatment (7.9 μ g/dL) compared to other treatments. The evaluated lightness of breast meat color was higher ($P < 0.05$) in AV1, AV2 and VC treatments (54.8, 54.7, 53.8) than other treatments. However, redness and yellowness were not affected by dietary treatment. In conclusion, dietary supplementation of δ -aminolevulinic acid combine with vitamin C can improve the immunity and iron status of broiler.

Key Words: δ -Aminolevulinic Acid, Iron Status, Broiler

T155 Effects of a microencapsulated blend of organic acids and natural identical flavors supplement to weaned pig diet. E. Grilli^{*1}, V. Pizzamiglio¹, M. R. Messina¹, L. Jørgensen³, H. Maribo³, R. Manini², and A. Piva¹, ¹DIMORFIPA, Ozzano Emilia, Bologna, Italy, ²Vetagro Srl, Reggio Emilia, Italy, ³Danish Pig Production, Copenhagen, Denmark.

Aim of the study was to investigate the effect of a microencapsulated supplement containing citric, sorbic acids, and natural identical flavors on piglets growth performance, mortality, and productivity during the 9 post-weaning weeks. The study was conducted at Danish Pig Production with the approval of the Danish Plant Directorate. Piglets were weaned at 5 weeks (7.6 kg BW), immediately divided in 2 groups (38 pens each, 7 pigs per pen), and were fed 2 experimental diets: the control non-medicated diet (CTR), or the control diet added with the microencapsulated blend at 3,000 ppm (Aviplus[®]; EP1391155B1, Vetagro Srl, Italy). Piglets received a 2-phases diet: the phase 1 was fed from d0 to d14 (20.7% CP, 6.3% EE), and the phase 2 from d14 to d63 (19.7% CP, 5.7% EE). The pigs were weighed per pen on d0, d14, and d63; the feed consumption was calculated at the same time intervals; mortality and treatments for diarrhea and other diseases were recorded. Performance data were analysed for normal distribution and prevalence of outliers, and were subjected to ANOVA with SAS; mortality was analysed with chi-square test. The Aviplus[®] group had higher ADG and G:F values than CTR in phase 1 (+22%, and +18%, respectively, $P < 0.05$), and higher G:F in phase 2 (+2%). The improvement registered in phase 1 was reflected in the overall period of the study (0–63 d: +5.7%, and +2.9% for ADG, and G:F, respectively, $P < 0.05$). Mortality was numerically higher for CTR than Aviplus[®] fed piglets (2.6% vs 1.2%, respectively, $P = 0.2$). The production value index calculated according to the Danish Pig Production procedure, was significantly higher for

the Aviplus® group than for the CTR one (+7%, $P < 0.05$). These results demonstrated that the supplementation of the diet with the lipid micro-encapsulated blend can improve productivity of weaners during the first weeks after weaning, thus improving the growth rate during the 7–30 kg body weight interval.

Key Words: Piglets, Microencapsulation, Organic Acids

T156 The effect phytase on growth performance, metatarsal and 10th rib bone characteristics, and tissue phosphorus levels in growing pigs. T. C. Tsai*, C. R. Dove, and M. J. Azain, *University of Georgia, Athens.*

The primary objective of this study was to determine the effect of phytase on phosphorus balance in various tissues. Barrows ($n=24$ barrows, 7-wk, average weight 18.50 kg) were randomly assigned to one of six diets. Diets 1 to 4 contained 0.13% available phosphorus (aP), and were supplemented with 0 (negative control), 500, 2500, and 12,500 U/kg phytase (Quantum, *E. coli* Phytase). Diets 5 (positive control) and 6 contained 0.35% aP, and 0 or 12,500 U/kg phytase. All diets met or exceeded NRC requirements except for phosphorus level in diets 1-4. Diets and water were ad libitum for 18 d. Phytase addition to the low aP diets improved ADG over that in the unsupplemented diet. Body weight and ADG were normalized in pigs fed high levels of phytase (2500, 12500 U/kg) relative to the positive control. Metatarsal bone ash and percent bone ash were increased by phytase addition. Similarly, phytase supplementation improved 10th rib bone weight, dry matter, and ash weight significantly. There were no phytase or dietary phosphorus effects on phosphorus concentration of heart, kidney, liver, muscle, and spleen. Phytase supplementation in the low aP diets improved growth performance, metatarsal and rib bone characteristics. Addition of a high level of phytase to a diet that is adequate in aP also resulted in improved performance and increased bone strength and ash. These results suggest that the phosphorus released by phytase is absorbed and contributes to improved bone growth and strength, which allows for greater rates of tissue accretion and increased body weight, but does not change tissue P concentrations.

Table 1. Effect of Phytase on Growth Performance and Bones Characteristics.

Diet	1	2	3	4	5	6	SEM	P Value
Gain, kg								
Day 0-18	8.32 ^a	9.6 ^{ab}	11.11 ^{bc}	11.09 ^{bc}	12.08 ^c	12.9 ^c	0.68	0.0037
Metatarsal								
Bone								
Ash, g	1.41 ^a	1.76 ^b	1.85 ^b	1.98 ^{bc}	1.92 ^b	2.18 ^c	0.07	<0.0001
Ash, %	28.3 ^a	32.9 ^b	34 ^b	34.5 ^{bc}	35.6 ^{bc}	37.4 ^c	1.08	0.001
Strength, kgf	42.3	54.6	67.1	69.4	69.1	61.4	6.3	0.0658
10th Rib								
Bone								
Ash, g	1.28 ^a	1.61 ^{ac}	1.78 ^b	1.95 ^b	1.92 ^b	2.36 ^c	0.15	0.0061
Ash, %	45.1	50.4	47.9	50.5	50	51.6	1.53	0.1159

Means within a row lacking a common superscript letter differ ($P < 0.05$).

Key Words: Phytase, Metatarsal and Rib Bone, Tissue

T157 Copra meal supplementation with mannanase on growth performance, pork quality and nutrient digestibility in growing-finishing pigs. D. H. Kim*, J. H. Yoon, W. S. Ju, Y. K. Hong, and Y. Y. Kim, *Seoul National University, Seoul, South Korea.*

This experiment was conducted to evaluate the effects of copra meal supplementation with mannanase on growth performance, pork quality and nutrient digestibility in growing-finishing pigs. Treatments were: 1) A: Negative control (basal diet), 2) B: Positive control (0% copra meal + 0.1% mannanase 800 IU), 3) C: (6% copra meal + 0.1% mannanase 800 IU), 4) D: (12% copra meal + 0.1% mannanase 800 IU), 5) E: (18% copra meal + 0.1% mannanase 800 IU). A total of 80 crossbred pigs ([Landrace x Yorkshire] x Duroc) with an average body weight of 27.2 kg (SE:0.720) were allotted to 5 treatments and 4 replicates with 4 pigs per pen in a randomized complete block design. Although copra meal contains high level of mannan which can not be digested by endogenous enzyme of the pig, it is very cheap and good source of energy like corn or sorghum. Mannan digestive enzyme, mannanase, was invented and manufactured commercially by CTCbio Ltd in Korea. During the experimental period, average daily gain (ADG) in treatment E (848 g) tended to be lower ($P > 0.09$) than treatment A (883 g), B (909 g), C (930 g) and treatment D (911 g). And feed:gain ratio (F:G ratio) of treatment E (2.93) was also higher ($P < 0.05$) than other treatments (A:2.75, B:2.59, C:2.69, D:2.79). During growing phase, the nutrient digestibility of crude protein in treatment E (79.7%) was lower ($P < 0.05$) than treatment A (89.8%), B (93.8%), C (88.9%) and treatment D (90.1%) which support the results of growth performance. Thiobarbituric acid reactive substance (TBARS) values of C (0.154), D (0.201) and E treatments (0.172) were higher ($P < 0.05$) than control treatment (A:0.141, B:0.128) which represented less saturated fatty-acid was accumulated when pigs were fed copra meal. These results suggest that 12% of copra meal can be supplemented in swine diet at the expense of corn and soy-bean meal resulted in reducing feed production cost.

Key Words: Copra Meal, Mannanase, Growing Pig

T158 Effects of virginiamycin on microbial ecology in ileal digesta and feces of growing pigs. M. Song*¹, L. L. Stewart¹, J. Barnes¹, B. R. Gramm², R. D. Nimmo², H. H. Stein¹, and J. E. Pettigrew¹, ¹University of Illinois, Urbana, ²Phibro Animal Health Co., Ridgefield Park, NJ.

A study was conducted to evaluate effects of virginiamycin on microbial ecology in ileal digesta and feces of growing pigs. Pigs ($n=15$, 35.0±2.7 kg BW) were surgically equipped with a T-cannula in the distal ileum. Pigs were assigned randomly to one of 3 dietary treatments: 1) a corn-soybean meal diet (CON), 2) CON + 11 mg/kg virginiamycin (V11), and 3) CON + 22 mg/kg virginiamycin (V22). During a 6-wk experiment, all pigs were fed the CON diet during wk 1, 5, and 6 and their respective treatment diets during wk 2, 3, and 4. Pigs were allowed *ad libitum* access to feed and water. Ileal digesta and fecal samples were collected on d 6 and 7 of each period to measure the number of bacterial cells by Gram's method and to use denaturing gradient gel electrophoresis (DGGE) to estimate the species diversity of the bacterial population (the number of bands) and quantitative measures of the similarity of population structures (banding pattern expressed by Sorenson's pairwise similarity coefficients (C_s)) among pigs within and between treatments. Virginiamycin treatments reduced ($P < 0.05$) the number of bacterial cells in ileal digesta for V22 (10.45 vs. 10.56 (CON), log (/g digesta), overall) and in feces for V11 and V22 (11.36 and 11.19 vs. 12.00 (CON), log (/g digesta), wk 4; 11.73 and 11.72 vs. 11.90 (CON), log (/g digesta),

overall) when virginiamycin treatments were imposed. Pigs fed V22 had fewer (22.13 vs. 26.83; $P < 0.05$) bands in ileal digesta than pigs fed CON over the entire experiment. There was no virginiamycin effect for the number of band in feces. In a few cases, specific bands were present in most pigs fed CON, but absent from most pigs fed virginiamycin treatments. There were no virginiamycin effects on intratreatment or intertreatment C_s values. In conclusion, virginiamycin reduces the number of total bacteria in ileal digesta and feces and eliminates some species of bacteria.

Key Words: Virginiamycin, Microbial Ecology, Growing Pigs

T159 Quantitative in vitro assay to evaluate yeast products concerning their binding activity of enteropathogenic bacteria. A. Ganner*, L. Fink, and G. Schatzmayr, *BioMin Research Center, Tulln, Lower Austria, Austria.*

Certain yeast products play an important role in protecting animals by displaying alternative adhesion sites to enteropathogenic bacteria. In the gastrointestinal tract those pathogens preferentially bind to the yeast cell wall and therefore animals are protected against infectious diseases. According to literature Mannan oligosaccharides (MOS) are the substances in the yeast cell wall which are responsible for binding of pathogens. Thus they have been discussed as antibiotic replacements in the past years.

In some publications it is questioned if the amount of MOS in the yeast cell wall is the substance responsible for immobilizing the enteric pathogens. Some test procedures are available to investigate the binding capacity of yeast products, however, there is no test assay described that aims on a quantitative measurement of the bacterial adhesion. Therefore we developed an in vitro microplate-based assay to determine the quantitative adhesion between enteric bacteria such as *E. coli* F4 and various yeast products by measuring the growth of the adhering bacteria by its optical density. The exponential phase of the adhering bacteria was determined and compared with the CFU/ml on the agar plate. A linear regression is compiled and the bacterial number bound to the yeast product is determined.

Different commercially available yeast cell wall, nucleotide and beta-glucan products have been tested for their ability to bind *E. coli* F4 quantitatively. The different cell wall products bound variably amount of *E. coli* F4, however binding capacity was not dependent on the amount of MOS. One cell wall product with 25% MOS bound 102 CFU/ml while another cell wall product with only 8% MOS bound 105 CFU/ml. In contrast, beta-glucan did not bind any bacteria. The nucleotide product bound 103 CFU/ml, suggesting that there is still a certain amount of cell wall fractions in that product. We believe that the cell wall structure plays an important role in pathogen immobilization, rather than just the total amount of MOS.

Key Words: *E. coli* Adhesion, Yeast, Bacterial Growth

T160 Exopolysaccharide produced by *Enterobacter cloacae* Z0206 improves the humoral and cellular responses of immunologically intact and immunocompromised mice. C. Xu, Y. Wang*, M. Jin, X. Yang, and Z. Xu, *Zhejiang University, Hangzhou, Zhejiang, P. R. China.*

The objective of the present study was to investigate the immunomodulatory activity of an exopolysaccharide produced by *Enterobacter cloacae* Z0206 (ECZ-EPS-1) on cellular and humoral immunity. The immunosuppressed mice were induced by cyclophosphamide (CP). 192 ICR male mice (18±2g) were randomly divided into 6 groups, each of which was designed 4 replicates with 8 mice in one cage per replicate. Three immunosuppressed groups were treated per os with ECZ-EPS-1 (0 mg/kg, 200 mg/kg and 400 mg/kg body weight (B.W.)) for 14 days, and CP was given intraperitoneally in a single dose of 50 mg/kg B.W. on the 12th day. Two immunologically intact groups were treated per os with ECZ-EPS-1 (200 mg/kg and 400 mg/kg B.W.) for 14 days. The dose volume was 0.4 mL. Control animals received same volume of normal saline. Indexes of immune organs, plaque forming cell (PFC) assay, quantitative hemolysis of sheep red blood cell (SRBC) (QHS), splenic lymphocytes proliferation, levels of subset of T lymphocyte, NK cell, IL-2 and TNF- α were studied in these animals. CP showed suppressive effects on immune organs weight and cellularity and other parameters of humoral immunity ($p < 0.01$) compared to control. ECZ-EPS-1 treatment (400 mg/kg B.W.) significantly ($p < 0.01$) increased PFC response in CP-treated animals compared to CP-treated animals alone. In QHS assay, ECZ-EPS-1 showed protection in CP-treated animals. ECZ-EPS-1 (400 mg/kg B.W.) can relieve immunodepression and significantly ($p < 0.01$) increase the spleen and thymus index, decrease CD8+ cells and stimulate the proliferation of T and B lymphocytes compared to CP-treated animals alone. ECZ-EPS-1 treatment itself produced no toxicity. The administration of ECZ-EPS-1 to CP-exposed animals resulted in improved humoral and cellular responses. ECZ-EPS-1 may be developed into a new kind of immunomodulation agent.

Key Words: Exopolysaccharide, Cyclophosphamide, Immunosuppressed Mice

T161 Feeding an encapsulated nutritional blend in combination with ractopamine improves feed conversion and loin depth in finishing pigs. J. W. Frank*¹, C. V. Maxwell¹, Z. B. Johnson¹, S. A. Hansen², and R. E. Musser³, ¹University of Arkansas, Fayetteville, ²Ridley Inc., Mankato, MN, ³SODA Feed Ingredients LLC, Mankato, MN.

Finishing pigs (GPK35 × EBX; n = 180, BW = 100 ± 0.7 kg) were allotted to 4 dietary treatments arranged as a 2 × 2 factorial (9 replicates/treatment) to evaluate the effects of feeding an Encapsulated Blend (EB) using Micropearls™ encapsulation technology fed at 2.27 kg/ton in combination with ractopamine (RAC; 4.5 g/ton) on growth performance and carcass measurements. The EB contained: fumaric, malic, citric, phosphoric, and lactic acids, L-carnitine, chromium picolinate, inulin, d-pantothenic acid, and niacin. All pigs were fed typical corn-soy diets with 0.05% L-lysine-HCl and 3% added fat. The control (CON) and EB blend diets were formulated to 0.7% total lysine and RAC and RAC+EB diets were formulated to 0.86% total lysine. There was no effect of feeding the EB or RAC on ADG or ADFI. RAC improved G:F compared to pigs fed diets without RAC ($P = 0.04$) and the EB improved G:F compared to pigs fed diets without EB ($P = 0.04$), however the interaction was not significant. Over the 24 d period, G:F for CON, EB, RAC, and RAC+EB treatments were 0.265, 0.296, 0.295, and 0.322, respectively. The final BW of CON, EB, RAC, and RAC+EB pigs were 123.1, 124.1, 124.1, and 125.9 kg. Feeding RAC increased the percentage carcass lean and ham lean, as well as, loin depth compared to pigs fed diets without RAC ($P < 0.02$). Feeding EB increased loin

depth (61.3 vs. 58.9 mm, $P = 0.04$) compared to pigs fed diets with no EB. Feeding EB also improved carcass lean (53.4 vs 53.0%) and ham weight (11.4 vs 11.1 kg) but these differences were not significant. The percentage carcass lean of CON, EB, RAC, and RAC+EB pigs were 52.5, 53.1, 53.4, and 53.7%. RAC and EB did not significantly increase ADG, ADFI, or final BW. However, RAC and EB significantly improved G:F and loin depth in an additive manner. This study demonstrates that RAC and EB can improve production parameters which are economically beneficial for swine production.

Key Words: Pigs, Encapsulated, Conversion

T162 Comparison of two encapsulated nutritional blends in combination with ractopamine on growth performance and carcass characteristics in finishing pigs. J. W. Frank^{*1}, C. V. Maxwell¹, Z. B. Johnson¹, S. A. Hansen², S. L. Johnston², M. De La Llata², and R. E. Musser³, ¹University of Arkansas, Fayetteville, ²Ridley Inc., Mankato, MN, ³SODA Feed Ingredients LLC, Mankato, MN.

Finishing pigs (GPK35 × EBU; n = 208, BW = 72.7 ± 0.6 kg) were allotted to 4 dietary treatments (9 replicates/treatment) to evaluate the effects of feeding two Encapsulated Blends (EB) using Micropearls™ technology in combination with ractopamine (RCT) on growth and carcass measurements. The first EB (EB1: 2.27 kg/ton) contained a blend of encapsulated fumaric, malic, citric, phosphoric, and lactic acids, added to L-carnitine, chromium picolinate, inulin, d-pantothenic acid, and niacin; while the second EB (EB2: 0.91 kg/ton) contained a blend where organic acids, L-carnitine, inulin, d-pantothenic acid, and niacin were encapsulated together. Phase 1 (d 0 – 18) diets were CON (0.8% Lys), RAC (0.8% Lys + 0 g/ton RCT), EB1 (0.8% Lys + EB1), and EB2 (0.8% Lys + EB2). Phase 2 (d 18 – 47) diets were CON (0.8% Lys), RAC (1.05% Lys + 4.5 g/ton RCT), EB1 (0.85% Lys + EB1 + 4.5 g/ton RCT), and EB2 (0.85% Lys + EB2 + 4.5 g/ton RCT). There was no effect of dietary treatment on ADG or ADFI during the study. Although G:F was lower in CON compared to RAC, EB1, or EB2 (0.282, 0.293, 0.296, or 0.297; respectively) these differences were not significant ($P = 0.15$). The final BW of the CON, RAC, EB1, and EB2 pigs were 124.0, 124.3, 125.6, and 126.2 kg, respectively ($P = 0.30$). Hot carcass weights were lower in CON compared to RAC, EB1, and EB2 fed pigs (92.8, 93.9, 94.1, and 95.2 kg; respectively), but these differences were not significant ($P = 0.34$). Carcass lean was lower ($P = 0.02$) in CON (52.4%) vs. RAC (53.5%) and EB1 (53.4%) pigs, with EB2 pigs being intermediate (53.0%). This research demonstrates that encapsulated blends fed to pigs with lower dietary lysine levels will provide equal or more efficient performance compared to ractopamine alone. In conclusion, feeding ractopamine and EB in combination provides improvement in traits economically beneficial to swine producers.

Key Words: Pigs, Encapsulated, Growth

T163 Effects of mannan oligosaccharide on growth performance and serum cytokines of weaned pigs. M. T. Che^{*}, R. W. Johnson, K. W. Kelley, and J. E. Pettigrew, University of Illinois, Urbana.

The experiment was conducted to determine responses of growth performance and serum cytokines to the dietary supplementation with mannan oligosaccharide (MOS) for weaned pigs. Weaned pigs (n=160, 6.5 kg,

20 days old) were randomly assigned to one of five dietary treatment groups on basis of body weight, gender, and origin of litter. There were 8 pens (replicates)/treatment and 4 pigs/pen. The 5 treatments were 1) 0% MOS (control); 2) 0.2% MOS fed for 2 weeks; 3) 0.2% MOS fed for 4 weeks; 4) 0.4% MOS fed for 2 weeks; and 5) 0.4% MOS fed for 4 weeks. Pigs were fed a 3-phase diet (1, 1, & 2 weeks per phase) with declining diet complexity. For the first 2 weeks, data from treatments 2 & 3 were pooled as 0.2% MOS, and 4 & 5 as 0.4% MOS because they had the same dietary level of MOS. Blood samples from each treatment (n=8, one/replicate) were collected weekly for determination of pro-inflammatory (TNF- α) and anti-inflammatory (IL-10) cytokines by ELISA. Over a 4-week study, there were no significant differences in average daily gain (ADG), average daily feed intake (ADFI), and gain:feed (G/F) among the treatment diets. Similarly, no treatment effects ($P > 0.05$) on the serum levels of TNF- α and IL-10 were seen. Interestingly, serum levels of TNF- α were high at Day 7 and declined at Day 14 whereas serum levels of IL-10 were low at Day 7 and increased at Day 14 (Table 1). In conclusions, addition of MOS to nursery diets showed no improvement in growth performance and seemed not to affect serum levels of cytokines in weaned pigs.

Table 1. Growth performance and serum cytokines of nursery pigs fed different dietary levels of MOS (means ± SEM)

Items	Dietary levels of MOS (%)			P
	0 ^a	0.2 ^b	0.4 ^b	
Days 0-14				
ADG, g	274±18	247±12	260±10	0.38
ADFI, g	327±24	284±11	292±9	0.10
G/F, g/kg	852±15	870±19	887±15	0.44
TNF- α , pg/mL				
Day 7	150.1±53.2	207.7±44.6	158.9±37.4	0.61
Day 14	33.4±2.4	34.3±4.1	32.0±3.4	0.90
IL-10, pg/mL				
Day 7	28.9±1.7	29.1±1.1	30.5±1.1	0.59
Day 14	56.9±9.7	81.9±13.0	126.0±35.8	0.23

^an = 8, ^bn = 16.

Key Words: MOS, Nursery Pigs, Serum Cytokines

T164 Fecal-oral transmission from sow to piglet of a *Bacillus* based direct-fed microbial (Adsero™) and its effect on clostridial shedding. A. Baker^{*1}, E. Davis¹, J. D. Spencer², R. Moser², and T. Rehberger¹, ¹Agtech Products, Inc., Waukesha, WI, ²JBS United, Inc., Sheridan, IN.

Two studies were conducted to determine the effect of a *Bacillus* based direct-fed microbial (Adsero™) on clostridial shedding in the sow and pig and transfer of Adsero™ spores from the sow to pig by fecal-oral transmission. In Exp. 1, 36 sows were divided into 4 treatments: control and Adsero™ (3.75 × 10⁵ cfu/g feed) fed for 2, 4, and 6 weeks prior to and throughout lactation. Fecal samples were collected to determine clostridial counts from 5 sows/treatment before Adsero™ supplementation, on d -1 prior to farrowing (d 0), and on d 3 and d 14 after farrowing. Pig fecal clostridial counts were also determined on d 14. Samples were also plated for the presence of Adsero™ on d -1 from 5 sows/treatment, on d 3 and d 5 from 3 piglet litters/treatment and on d 14 from sows and their respective litters. Clostridial counts in fecal samples did not differ

between control and treated sows ($P > 0.97$) or pigs ($P > 0.52$). Adsero™ was detected in the fecal samples of treated sows on d -1 and d 14 and in litters from treated sows on d 5 and d 14, documenting the fecal-oral transfer of Adsero™ from sow to pig. In Exp. 2, Adsero™ and control diets were fed 6 weeks prior to farrowing and throughout lactation to 30 sows. Gastrointestinal (GI) tracts from 15 pigs were collected on d 3 and d 10 of lactation for a total of 30 pigs/treatment. *Clostridium* was evaluated in the ileum and distal colon. *Clostridium* was reduced ($P = 0.07$) in the GI tract of pigs from treated litters on d 3. Pig GI tracts were plated for the presence of Adsero™ on d 3 but were not detected suggesting the reduction of *Clostridium* in the pig GI tracts resulted from clostridia reduction in the sow and environment. These data demonstrate the fecal-oral transmission of Adsero™ from sow to pig and indicate that pigs from sows fed Adsero™ harbor less *Clostridium* than those from unsupplemented sows. Although reduced clostridial shedding could not be demonstrated from fecal sampling, decreased *Clostridium* in the GI tract due to Adsero™ indicates GI tract measurements provide a more accurate assessment of clostridial populations.

Key Words: *Bacillus*, Swine, *Clostridium*

T165 Effect of carbohydrase enzyme supplementation on the performance and nutrient digestibility in growing pigs fed barley-wheat distillers dried grains with solubles based diet. I. A. Emiola*, B. A. Slominski, and C. M. Nyachoti, *University of Manitoba, Winnipeg, MB, Canada.*

An experiment was conducted to determine the growth performance and nutrient utilization in growing pigs fed barley-wheat distillers dried grains with soluble (DDGS) based diet supplemented with carbohydrase enzymes. Forty-eight growing pigs, housed 2 per pen, were randomly to 4 experimental diets (6 pens/treatment) on the basis of sex and BW. Treatments consisted of four diets; a positive control (PC) formulated to meet NRC (1998) nutrient requirement of growing pigs; a negative control (NC) formulated with energy and lysine reduced by 4 and 5% respectively, from the PC; NC supplemented with enzyme preparation A; and NC supplemented with enzyme preparation B. Enzyme A contained 2,600 units of xylanase, 1,200 units of glucanase, and 1,300 units of cellulose per kg of feed; Enzyme B contained 5,200 units of xylanase, 2,400 units of glucanase, and 2,600 units of cellulase per kg of diet. Chromic oxide was used as an indigestible marker and diets were fed as mash. The ADG was higher ($P < 0.05$) in the PC diet compared with the NC diet. Supplementing NC diet with enzyme preparations improved ADG ($P < 0.01$). Pigs fed enzyme supplemented diets had similar ADG compared with those fed with the PC diet. The ADFI was not influenced by the dietary treatments. Feed:gain ratio was higher ($P < 0.05$) in pigs fed the PC diet compared with those fed the NC diet, but not different from pigs fed the NC diets supplemented with enzyme. Addition of enzyme to the NC diet tended ($P < 0.10$) to improve F:G ratio. Compared with the NC diet, addition of enzyme preparations to NC diet improved ($P < 0.05$) ATTD of nitrogen, ADF, and crude fats and tended ($P < 0.10$) to improve NSP digestibility. The result indicates growing pigs can effectively utilize wheat DDGS at 30% inclusion level provided appropriate enzyme combination is included in the diet.

Key Words: Enzyme Supplementation, Pigs, Wheat Distillers Dried Grains with Solubles

T166 Pooled-analysis of data demonstrating the performance benefits of including mannan oligosaccharides in swine nursery diets. B. Corrigan*, D. Koehler, and G. Grinstead, *Vita Plus Corporation, Madison, WI.*

Data sets from seven separate trials having similar protocols were pooled for the purpose of strengthening the evidence concerning the effects of the addition of Mannan Oligosaccharides (MOS) to swine nursery diets. MOS are derived from yeast cell walls and are believed to bind and suppress enteric pathogens in the gut and have been shown to increase piglet ADG. Seven separate trials were conducted to evaluate the effect of the addition of MOS (Bio-MOS; Alltech, Nicholasville, KY) to nursery diets on piglet performance for the first 42 days post-weaning. The data represents performance from a total of 1,092 weaned pigs, 156 pigs/trial, with a pooled starting weight of 5.90 kg (17 to 22 days old). For each trial, pigs were randomly blocked by body weight to one of two treatments in a 30-pen nursery facility (13 pigs per pen) resulting in a pooled total of 36 reps. A typical four-phase nursery diet containing antibiotics was used as the **Control**, while the **MOS** treatment included 0.20, 0.10, and 0.05% MOS in diet phases I, II and III, respectively. Diet phases I,II,III and IV were fed from approximately d 0 to 7, 7 to 14, 14 to 28 and 28 to 42, respectively. Pig BW and feed disappearance were measured on approximately d 0, 7, 14, 21, 28 and 42 days post-weaning. ADG, ADFI, and G/F were calculated for all trials. The data were then pooled and analyzed to include the main effects of trial, rep and trt using the Proc Mix procedure of SPSS. Pigs consuming MOS were heavier on d 28 ($P < 0.01$; 15.34 vs. 15.01kg) and d 42 ($P = 0.07$; 24.93 vs. 24.57kg) than pigs fed the Control. ADFI was significantly ($P < 0.05$) increased by MOS from d 0 to 28 (0.432 vs. 0.419kg) and for the period from d 0 to 42 (0.623 vs. 0.609kg). Pigs fed MOS had greater ADG ($P < 0.05$) from d 0 to 28 (0.337 vs. 0.326kg) and d 0 to 42 (0.434 vs. 0.426kg). However, ADG was similar ($P > 0.05$) between trts from d 28 to 42 (0.604 vs. 0.605kg, respectively). F/G was similar ($P > 0.05$) between Control and MOS throughout the trial period. The pooled data demonstrate that the addition of MOS to nursery diets increases ADFI and ADG of piglets.

Key Words: Pigs, MOS

T167 Development and validation of a mastication simulator. A. Woda*¹, A. Mishellany¹, J. P. Meunier², O. François¹, M. Alric², and M. A. Peyron¹, ¹Faculty of Odontology, Clermont Fd, France, ²Faculty of Pharmacy, Clermont Fd, France.

The feed bolus obtained after mastication and the corresponding feed disruption process could be an important parameter to be studied for a better understanding of feed intake. However, the feed bolus collected before swallowing does not represent the whole feed bolus being swallowed. Therefore, a simulator of mastication was developed which allows collecting the whole amount of feedstuff.

The first aim of this study was to complete a simulator of mastication reproducing human masticatory behavior and producing a food bolus with similar texture than an in vivo food bolus. The second aim was to validate the simulator by comparing the food boluses obtained in vitro and in vivo.

Food boluses were obtained from both the simulator and 30 young (23.7 ± 2.2 years old) healthy and full dentate subjects chewing pea-

nuts and carrots. The food boluses were characterized by the particle size distribution. The boluses were cleaned in a 0.1 mm aperture sieve, dried and scanned. The photos were analysed with a specific software (PowderShape®, IST-Ag, Vickers, Switzerland). The average particle size (D50) was chosen as the dependent variable. Simulator calibration was realized by adjusting the different parameters (number of masticatory cycles, rotation and translation amplitudes of the mandibular piston head, masticatory force, temperature of the chamber, addition of artificial saliva).

Number of cycles and applied force were the predominant parameters in determining the in vitro particle size (D50). Setting the number of cycles at the mean value observed in vivo and choosing the force of the simulator allowed to obtain agreement between in vitro and in vivo values for each food. Addition of artificial saliva and control of the temperature only marginally influenced the D50 values.

The food boluses obtained in vitro with the simulator displayed the same D50 values that the food boluses produced in vivo. This apparatus could be an interesting tool to simulate the mastication of numerous animal species.

Key Words: Mastication, Simulator, In Vitro

T168 Effect of supplying mannan oligosaccharide (MOS) to pig diets on response to an immune challenge. I. F. Hung*¹, M. D. Lindemann¹, G. L. Cromwell¹, B. G. Kim¹, and M. G. Holt², ¹University of Kentucky, Lexington, ²VI-COR, Mason City, IA.

A modified yeast culture feed additive (Celmanax®; Vi-COR, Mason City IA) containing MOS, was used to evaluate the effects of supple-

mental MOS on responses in pigs challenged with lipopolysaccharide (LPS). Weaned pigs (BW: 6.0 ± 0.96 kg) were assigned to 3 treatments with 3 pigs/pen. The treatments included: 1) control basal diet [n = 24], 2) basal + low level MOS diet [0.02%, 0.01% for Wk 1-2 and 3-4, respectively; n = 12], and 3) basal + high level MOS diet [0.04%, 0.02%; n = 12]. After 4 wk, 32 pigs (2 pigs/pen; BW: 16.8 ± 0.62 kg) continued on test to examine the response to LPS injection. At 0 h (0600 on d 29), each pig received an i.p. injection of phosphate buffered saline (PBS; for half of Trt 1 pigs) or LPS (for all other pigs). At 2 h post-injection, the control pigs challenged with LPS lost weight compared with PBS-injected pigs (-145 vs. 341 g; P < 0.01) and had lower cumulative feed intake (CFI; 43 vs. 181 g; P = 0.01). Cumulative weight gain (CWG) or CFI differences were not detectable (P > 0.20) at 48 h post-injection. MOS supplementation had no effect on CWG or CFI. Respiratory rate of LPS-injected control pigs was higher than PBS-injected pigs at 3 h post-injection (83 vs. 38 breaths/min; P < 0.01) and was linearly decreased as MOS inclusion was increased in LPS-injected pigs (83, 68, and 64 breaths/min, respectively; P < 0.01). Rectal temperature was higher in the LPS-injected control pigs than in the PBS-injected pigs at 2 h (40.2 vs. 39.4°C; P < 0.01) and at 4 h (40.2 vs. 39.5°C; P < 0.01); MOS fed pigs had a lower rectal temperature than the LPS-controls at 2 h post-injection (40.2 vs. 39.9°C; P = 0.03). Serum cortisol values were higher in the LPS-injected control pigs than in the PBS-injected pigs at 2 h (16.3 vs. 10.0 mcg/dL; P = 0.03) and at 4 h (22.8 vs. 8.9 mcg/dL; P < 0.01) but were not moderated by MOS supplementation. The results showed that LPS challenge affects CWG, CFI, rectal temperature, respiratory rate, and cortisol levels and that dietary MOS supplementation reduced LPS-induced effects on respiratory rate and rectal temperature, but not on CWG, CFI or cortisol levels.

Key Words: Immune Stress, Mannan Oligosaccharide, Pigs

Physiology and Endocrinology: Immune Function and Health

T169 Alpha-linolenic acid exerts anti-inflammatory effect in 3T3-L1 adipocytes through mechanisms that involve activation of AMPK. K. M Ajuwon*¹, T. A Winters², B. Whisenhunt², and W. Banz², ¹Purdue University, West Lafayette, IN, ²Southern Illinois University, Carbondale.

Alpha-linolenic acid (ALA) (18:3n-3) is an omega-3 fatty acid that is found in abundance in many seeds and oils such as those from soybean, flaxseed and walnuts. It is the only plant derived omega-3 fatty acid that is consumed in large quantities in the U.S and in many parts of the world. Whereas the longer chain omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), have been shown to have cardiovascular and other health benefits, significant controversy still exists regarding the overall health benefits that can be obtained from ALA. Because adipose tissue inflammation is implicated in systemic inflammation that may eventually cause cardiovascular disease and insulin-resistance, we examined the possibility that ALA could exert anti-inflammatory effect in the 3T3-L1 adipocyte model. Fully differentiated adipocytes were pretreated with 150 and 250µM ALA for 6 h and then treated with lipopolysaccharide (LPS) (100 ng/mL) for 3 h. We then measured interleukin 6 (IL-6) mRNA expression with RT-PCR and protein secretion with ELISA. Treatment of adipocytes with LPS led to an induction of IL-6 mRNA and protein secretion ($P < 0.05$). This was attenuated by pretreatment of adipocytes with ALA ($P < 0.05$). To explore possible involvement of AMPK in the anti-inflammatory effect of ALA, we examined the abundance of phosphorylated and total AMPK using western blotting. We observed an induction of AMPK phosphorylation in ALA treated cells ($P < 0.05$). These results indicate that ALA exerts anti-inflammatory effect in adipocytes and also raise the possibility that AMPK is a mediator of this effect. Taken together, ALA could have health and growth benefits in both humans and animals due to its ability to attenuate inflammation.

Key Words: Adipocytes, Inflammation, AMPK

T170 Polarized interleukin-8 (IL8) secretion by swine jejunal epithelial cells (IPEC-J2) treated with soluble beta-glucan (BG). T. E. Burkey* and S. S. Shepherd, *University of Nebraska, Lincoln.*

Yeast BG may be a potential immunomodulator that could serve as a natural alternative to antimicrobial growth promoters. Beta-glucans are (1,3)-β-D-glucose polymers isolated from the yeast *Saccharomyces cerevisiae*. It has been established that BG induce enhanced phagocytic activity, increased production of reactive oxygen species and increased production of cytokines and chemokines. Beta-glucans may potentially activate receptors within the gastrointestinal tract, elicit a priming effect and initiate signaling cascades that may modulate innate as well as adaptive immune responses directed at potential pathogens. Intestinal epithelial cells are sources of chemokines, such as IL8, which lead to the recruitment of macrophages, lymphocytes, and polymorphonuclear leukocytes and may further initiate both the innate and adaptive immune responses. The objective of the current study was to evaluate the effect of soluble BG on IL8 protein secretion in IPEC-J2 cells. IPEC-J2 cells were grown to confluency on Costar Transwells, and treated apically with media alone (CTL), LPS (10 ng/ml), Zymosan A (100 µg/ml) or soluble BG (100, 10 or 1.0 µg/ml). IPECJ2 cells were exposed to the respective treatments for 6 h, and then the apical and basolateral media

were collected for subsequent quantification of IL8 by ELISA. No significant treatment by position (apical or basolateral) interaction was observed. However, this experiment resulted in a significant main effect of position where IL8 secretion was polarized in the apical direction when averaged across all treatments ($P < 0.0001$). In addition, when averaged across both positions, BG (100 µg/ml) tended to increase IL8 secretion compared to all other treatments ($P = 0.07$). The data suggest that soluble beta-glucan elicits IL8 secretion in IPEC-J2 cells and that this secretion is polarized in the apical direction.

Key Words: Swine Jejunal Epithelial Cells, Beta-Glucan, Interleukin 8

T171 The variation of IgG1, IgA and IgM concentration in blood and milk of dairy cows after implanting antigen-releasing device (ARD). C. G. Zhang^{1,2}, J. Q. Wang*¹, D. P. Bu¹, G. L. Liu¹, J. B. Cheng¹, X. L. Dong^{1,2}, K. L. Liu¹, H. Y. Wei¹, L. Y. Zhou¹, and G. Q. Zhao², ¹Chinese Academy of Agricultural Sciences, Beijing China, ²Yangzhou University, Yangzhou, China.

The objective of the study presented here was to determine if the variation in total immunoglobulin follows a similar pattern to the variation in specific anti-lipase antibody in blood and milk after implanting the ARD. Twenty healthy adult dairy cows in mid-lactation were divided into two groups (n = 20) according to milk yield (26.0 ± 3.5 kg), and days in milk (114 ± 34 d). Each cow of the test group was implanted with the three types of ARD (ARD1, ARD2 and ARD3) in the right iliac lymph node using an implantation gun. The trial period was carried out over 40 d. Milk samples were collected at d 0, 5, 7, 9, 15, 17, 20, 26, 30, 40 and blood samples were collected every 10 d. Total IgG1, IgA and IgM were measured by sandwich enzyme-linked immunosorbent assay (ELISA) using the Bovine IgG1/IgA/IgM ELISA Quantitation Kit. The results showed that total immunoglobulin concentration (mg/mL) in blood of test group animals (5.831 ± 0.284) was higher than control group animals (5.348 ± 0.245). IgG1 concentration (mg/mL) in milk reached a peak at d 9 (0.57 ± 0.11), 17 (0.52 ± 0.09) and 32 (0.51 ± 0.10), respectively, corresponding with the release of ARDs at d 0, 14 and 28. The IgA and IgM concentration failed to show the same regular patterns when compared with IgG1. In conclusion, the ARD implantation successfully increased total immunoglobulin, especially IgG1 concentration in blood and milk of dairy cows. (Research funded by Ministry of Science and Technology; 2006DFB32160).

Key Words: Immunoglobulin, Antigen-Releasing Device, Blood and Milk

T172 Canonical correlation of milk immunoglobulins, lactoferrin concentration and Dairy Herd Improvement data of Chinese Holstein cows. G. L. Liu¹, J. Q. Wang*¹, D. P. Bu¹, J. B. Cheng¹, C. G. Zhang^{1,2}, X. L. Dong^{1,2}, H. Y. Wei¹, L. Y. Zhou¹, and K. L. Liu¹, ¹Chinese Academy of Agricultural Sciences, Beijing, China, ²Yangzhou University, Yangzhou, China.

Immunoglobulins (Igs) together with lactoferrin (Lf) constitute an important antimicrobial system in milk and play key roles in the defense

mechanisms of mammary gland of lactating cows. The purpose of this work was to establish the relationship among the data in Dairy Herd Improvement (DHI) report and milk Igs and Lf concentration. We collected 299 individual milk samples randomly from more than 2,800 animals across six dairy farms in the greater Beijing area, and obtained the corresponding DHI data from the China DHI system. Concentrations of Igs and Lf in milk were determined by ELISA assay. The relationship among DHI data and milk Igs and Lf concentration was established using canonical correlation analysis. The results indicated that 4 canonical variables relating milk IgG1, IgA, IgM and Lf concentration as y variables with lactation number, stage of lactation, daily milk production, milk fat, protein, lactose, milk total solids and somatic cell score (SCS) as x variables were created. The canonical correlations of first and second pair of canonical variables were 0.662 and 0.469 respectively with highly significance ($P < 0.01$), and accounted for 91.6% of the data variability. Stage of lactation, daily milk production, milk protein and SCS were the significant factors affecting Lf concentration, and lactation number was the significant factors affecting IgG1. The first standardized canonical variation combination could be regarded as a predictable measure of Lf and IgM concentration, the second as a predictor of IgG1. These results may be useful for dairy producers to select cows with increased production of Igs and Lf using DHI data directly. (Research funded by Ministry of Science and Technology; 2006DFB32160)

Key Words: Dairy Herd Improvement Data, Immunoglobulin, Lactoferrin

T173 Mifepristone (RU486) modulation of dexamethasone-induced suppression of in vitro proliferation of equine lymphocytes. K.A. Gutierrez^{*1}, N. C. Burdick¹, J. G. Lyons¹, C. L. Barton¹, J. C. Laurenz², N. D. Cohen¹, N. H. Ing¹, and T. H. Welsh, Jr.¹, ¹Texas A&M University, College Station, ²Texas A&M University, Kingsville.

Adverse actions attributed to hypercortisolemia associated with Cushing's syndrome are reduced by the glucocorticoid receptor antagonist RU486 (Eur. J. Endocrinol. 157:561; 2007). Immunity may be compromised by cortisol and its synthetic analog dexamethasone (Dex; Am. J. Vet. Res. 56: 997; 1995). This study was designed to determine whether proliferation of equine lymphocytes is adversely affected by Dex, and if RU486 could modulate this negative effect. Jugular blood samples from 15 horses (4 breeds; 12 stallions; 3 geldings; 5-to-15 years of age; 450-to-800 kg BW) were collected and used to isolate lymphocytes by density gradient centrifugation. Separate cultures were established for each horse. Isolated lymphocytes (100,000 cells per well) were cultured in 96-well plates for 96 h in a humidified CO₂ incubator at 37°C in either medium alone (DMEM/F12), or medium containing concanavalin A (ConA; 0-to-5 µg/ml) with or without 1 µM Dex in the presence and absence of 1 µM RU486. Cell proliferation was determined by Promega CellTiter96 assay. Stimulation indices were determined relative to Control (medium alone) and differences in proliferation were determined by ANOVA. ConA dose-dependently increased ($P < 0.01$) lymphoproliferation (ED50 1.2 µg/ml). Dex inhibited ConA-induced proliferation

($P < 0.01$). Specifically, Dex reduced basal proliferation by 37%. At 0.625 and 1.25 µg/ml ConA, Dex reduced proliferation by 19.4 and 18.3%, respectively. Co-addition of RU486 reduced or prevented inhibitory action of Dex ($P < 0.01$). Specifically, RU486 attenuated by 1.59-fold Dex-inhibition of basal lymphoproliferation. The 4.1-fold increase in proliferation induced by 5 µg/ml ConA was reduced 24.9% by Dex; however, the presence of RU486 completely prevented Dex's action. Glucocorticoid antagonists may be used to study how immune functions are suppressed in horses that are phenotypically hypercortisolemic due to: 1) stress; 2) dexamethasone therapy; 3) Cushing's syndrome; or, 4) metabolic syndrome.

Key Words: Equine, Immune Function, RU486

T174 Bovine viral diarrhea virus, abnormal cervical mucous discharge and fertility in cows. S. Yavru^{*1}, M. Kale², M. S. Gulay², O. Yapici¹, O. Bulut¹, and A. Ata², ¹Selçuk University, Konya, Turkey, ²Mehmet Akif Ersoy University, Burdur, Turkey.

The aim of the present study was to describe whether Bovine Viral Diarrhea virus (BVDV) and appearance of cervical mucus discharge (CMD) have effects on reproductive performance of cows in estrus. For this purpose, CMD of 97 Holstein cows in estrus were evaluated visually before AI. To exclude the possible effects of reproductive problems related to nutrition deficiency, cows with body condition score lower than 2.5 were not included in the study. All cows were healthy and free of anatomical abnormalities of the reproductive tract. The CMD of cows in estrus was evaluated visually before AI. Animals having clear discharges (n = 50) with normal viscosity and without bad odor were grouped as normal cervical mucous discharge (N-CMD) group. The other cows (n = 47) with opaque mucus or mucus containing flecks of pus and purulent or mucopurulent material were grouped as abnormal cervical mucous discharge (A-CMD) group. Cows in estrus were inseminated with BVDV free frozen semen. Blood samples were tested by enzyme linked immunoassay (ELISA) for antigens (Ag) and antibodies (Ab) of BVDV. Presence of BVDV genome in mucus samples were tested by Polymerase chain reaction (PCR). No differences in hematocrit or plasma protein concentrations were observed between N-CMD (31.9 and 6.18%) or A-CMD groups (32.8 and 6.26%). First service conception rates (FSCR) were 64 and 61.7% for N-CMD and A-CMD groups, respectively ($P > 0.1$). Total of 55.7, 18.6 and 2.7% of cows were BVDV-Ag, BVDV-Ab and BVDV-PCR (+), respectively. Presence of BVDV-Ag, BVDV-Ab or BVDV-PCR (+) was not associated with A-CMD. FSCR was similar between BVDV-Ab positive (62.9%) and BVDV-Ab negative cows (62.8%). However, presence of BVDV-Ag decreased FSCR (27.8 vs. 70.9%; $P < 0.01$). Thus, the current study suggested that effect of A-CMD on FSCR is minimal. However, presence of BVDV-Ag in blood samples at the time of AI has a negative effect on fertility of Holstein cows.

Key Words: BVDV, Fertility, Cervical Mucus Discharge

Physiology and Endocrinology: Nutritional and Metabolic Effects on Growth, Reproduction and Lactation

T175 Measurement of adiponectin in lactating dairy cows. J. R. Raddatz*, A. N. Elias, and C. S. Whisnant, *North Carolina State University, Raleigh.*

Adipose tissue is now known to be part of the endocrine system as well as an energy storage depot. One of the recently discovered adipose secreted hormones is adiponectin. In rodents and humans adiponectin concentration decreases with increasing adiposity and has been reported to increase tissue sensitivity to insulin. No report of adiponectin secretion in cattle could be found. In the current project we used a commercially available human adiponectin kit (HADP-61 HK, Linco, Millipore) to measure adiponectin concentrations in lactating Holstein ($n = 26$) cows for the first 11 wk of lactation. Insulin and progesterone concentrations were also determined in weekly blood samples. Body condition scores and milk production data were recorded. Adiponectin concentrations increased from 8.3 ± 1.4 ng/mL in the first wk to 16.0 ± 2.7 ng/mL ($P < 0.01$) at wk 4 postpartum and then declined to remain at 12-13 ng/mL for the remainder of the study. Insulin concentrations increased from 5.6 ± 0.7 mIU/mL at wk 1 to 17.6 ± 2.2 mIU/mL at wk 3 and then declined to remain at 9-11 mIU/mL for the remainder of the study. Individual cows had consistently high or low adiponectin levels throughout the sampling period. Adiponectin concentrations did not correlate with body condition score or energy corrected milk yield. Nor did time of resumption of estrous cycles have any effect on adiponectin. Dilution of plasma as recommended by the manufacturer resulted in samples being below the sensitivity of the assay. Using undiluted plasma, adiponectin concentrations ranged 1-80 ng/ml whereas in other species concentrations were reported to be in the ug/ml range. Similarly samples collected from growing bulls were undetectable when diluted but in the 0-40 ng/ml range when assayed undiluted. Equine samples were assayed along with the bovine samples and the equine samples after the recommended dilution (1:500) were in the ng/ml range and after adjustment for dilution were 1-3 ug/ml, similar to values reported for horses in the literature. The human adiponectin kit may not accurately measure bovine adiponectin.

Key Words: Dairy Cattle, Adiponectin, Insulin

T176 L-carnitine stimulates the early postnatal myofiber formation in pig skeletal muscle. D. Loesel*, C. Kalbe, G. Nuernberg, and C. Rehfeldt, *Research Institute for the Biology of Farm Animals, Dummerstorf, Germany.*

Piglets of low birth weight exhibit a lower total number of skeletal myofibers at birth and throughout life compared with piglets of middle and heavy birth weight, which is associated with impaired (lean) growth, carcass and meat quality at market weight. To investigate, whether L-carnitine is effective in stimulating the early postnatal increase in the number of skeletal myofibers, 30 piglets of low (LW) and middle (MW) birth weight (each within one third of frequency distribution) from 6 German Landrace sows were supplemented once daily with 400 mg L-carnitine ($n=16$) or a placebo ($n=14$) from d 8 to 28 (weaning) of age. Offspring were slaughtered at d 29 of age to analyze blood plasma components, *semitehdinosus* (ST) muscle structural and functional prop-

erties, and body composition. Live weight gain and final body weight as well as the plasma concentrations of glucose, free fatty acids, urea, and IGF-I remained unchanged by treatment. Carnitine concentration in ST muscle more than doubled in response to treatment ($P < 0.0001$). The total number of ST myofibers was increased by 19% ($P < 0.05$) in treated LW pigs thereby reaching the unchanged level of MW littermates. Myofibers tended to be smaller ($P = 0.13$), and protein concentration and protein/DNA ratio were lower in treated pigs ($P < 0.05$). Specific ICDH activity as a marker of oxidative metabolism was increased ($P = 0.06$), whereas no differences were observed in muscular LDH, CK, and fiber type composition. Body composition was unchanged by treatment. Notwithstanding, the perirenal fat percentage tended to be decreased ($P = 0.10$), and L-carnitine-treated females exhibited lower percentages of dry matter and crude fat ($P < 0.05$). The results suggest that L-carnitine stimulates early postnatal myofiber formation in pig skeletal muscle, which may attenuate the negative consequences of low birth weight on growth, carcass and meat quality of pigs at market weight.

Key Words: Birth Weight, Body Composition, Muscle

T177 The assessment of complex I concentration in muscle mitochondria of crossbred steers with high and low residual feed intake (RFI). M. P. Davis*, J. H. Porter, and M. S. Kerley, *University of Missouri, Columbia.*

The objective of this study was to evaluate the relationship between complex I concentration in muscle mitochondria and RFI of steers fed a concentrate based-ration. Individual feed intake was recorded for 81 crossbred steers over approximately 150 d using the GrowSafe feed intake system. Residual feed intake was computed as the residual of actual intake minus expected intake. Expected intake was calculated using coefficients for averaging daily gain and mid-weight. The coefficients were generated from the linear regression of dry matter intake on metabolic mid-weight and average daily gain. Three efficient steers (average RFI of -0.78) and 2 inefficient steers (average RFI of 0.90) were selected for further evaluation. Tissue samples were taken at slaughter from the LM and mitochondria isolated using differential centrifugation. Complex I concentration was quantified from mitochondria. Immunocapture of complex I from the mitochondria was done using MitoProfile complex I Immunocapture kit (Mitosciences, Eugene, OR 97403). Complex I protein concentration was determined using bicinchoninic acid colorimetric procedures. Concentration of complex I tended ($P \leq 0.15$) to be greater in Low RFI (6.33 ± 0.48 $\mu\text{g}/\text{mg}$) steers than high RFI (4.08 ± 0.73 $\mu\text{g}/\text{mg}$) steers. The correlation between RFI and complex I protein concentration was -0.69. While only tending to be significant ($P \approx 0.19$) the magnitude of correlation is similar to that reported but the relationship between RFI and complex I is opposite than reported. The association of low RFI (improved efficiency) and higher complex I concentration does however agree with research reported for broilers. These results show that complex I may be influencing RFI and further research is needed to determine if complex I concentration can be used as a predictor of RFI.

Key Words: Muscle Mitochondria, Complex I, Residual Feed Intake

T178 Madin-Darby Bovine Kidney (MDBK) cells and liver tissue of periparturient cows share remarkable similarity in gene expression profiles. M. Bionaz*, R. E. Everts, H. A. Lewin, J. K. Drackley, and J. J. Loor, *University of Illinois, Urbana*.

The importance of fatty acids (FA) in regulating liver metabolism has been well-established in mammalian species and is becoming of interest in periparturient dairy cattle nutrition. Use of in vitro models to assess the effects of FA on bovine cells is crucial due to high costs of in vivo experiments as well as confounding effects of ruminal FA metabolism (e.g., biohydrogenation). In this regard, work from our laboratory with MDBK has demonstrated they represent a useful tool to study potential metabolic effects of FA. The objective of this study was to compare transcript abundance between MDBK cells and liver tissue of periparturient cows. For this purpose, transcript profiles of MDBK cells cultured in high-glucose DMEM and liver tissue from cows at -14, 1, 14, and 28 d relative to parturition were compared. A 13,257 bovine oligonucleotide (70-mers) array was used for transcript profiling. A total of eight microarrays in a direct dye-swap design were hybridized. Using a t-test, we identified 1,983 (15%) genes with different expression and 1,091 showing ≥ 2 -fold expression between MDBK and liver. We also selected 4,850 genes involved in several liver-specific functions (e.g., apolipoprotein metabolism, urea cycle) or metabolism (e.g., fatty acid metabolism, apoptosis) to assess their level of expression in MDBK vs. liver tissue. Analysis indicated that $60 \pm 14\%$ of the chosen genes had similar expression pattern between MDBK and liver. Genes involved in apolipoprotein metabolism, urea cycle, gluconeogenesis, and β -oxidation had greater abundance in liver vs. MDBK, while genes involved in glycolysis, TCA-cycle, and cell cycle had greater abundance in MDBK. Among transcription factors, liver was characterized by larger expression of *HNF4A* (27-fold), *RXRG* (2.2-fold), and *PPARA* (1.5-fold), while MDBK had greater abundance of *PPARG* (1.3-fold) and *NR1H2* (1.4-fold). This analysis allowed characterization of MDBK-specific transcripts and uncovered high similarity (60%) between this cell line and liver tissue of periparturient cows.

Key Words: Genomics, Microarray, Nutrition

T179 Effect of 17 β -estradiol on distal colon contractions and L-arginine-NOS-NO-cGMP-cGMP-PK1 pathway. A. Bulbul¹, K. Altunbas¹, H. A. Celik¹, G. Avci¹, O. Yildiz-Gulay*¹, and M. S. Gulay², ¹*Afyon Kocatepe University, Afyonkarahisar, Turkey*, ²*Mehmet Akif Ersoy University, Burdur, Turkey*.

Objectives were to determine the effect of estrogen on distal colon contractions and L-arginine-NOS-NO-cGMP-cGMP-PK1 α/β pathway. Six month-old female Sprague Dawley rats (n = 72) were divided equally into four groups (n = 18/group) and ovaries were removed. The control group (Ov) received sesame oil, whereas rats in E1, E2 and E3 groups received 25, 50 and 100 μg im injections of 17 β -estradiol in sesame oil, respectively. To determine time effect of estradiol injections, each treatment group was further divided into three sub-groups; the first sub-groups received single dose, the second sub-groups received 3 doses, and the third sub-groups received 6 doses of sesame oil or estradiol (24 h intervals). Rats in all sub-groups were sacrificed 18 h after the last estradiol injections. Distal colons were removed immediately after sacrifice. Smooth muscle contractions were recorded by force transducer and acquisition system to evaluate L-arginine-NOS-NO-cGMP pathway in colon. Expression of nNOS and cGMP-PK1 α/β in distal colon was also tested. The statistical significance was set at $P < 0.05$. The results

indicated that 17 β -estradiol injections decreased the distal colon contractions in a dose and time dependent manner. Moreover, L-arginine-NOS-NO-cGMP pathway was effective on the smooth muscle contractions in distal colon. Results from immunohistochemistry revealed that nNOS expression was not affected by estradiol injections. However, expression of cGMP-PK1 α/β declined significantly. In conclusion, although estrogen injections decreased the smooth muscle contractions in distal colon, this effect did not use L-arginine-NOS-NO-cGMP pathway.

Key Words: 17 β -estradiol, nNOS, cGMP

T180 Effect of ovarian steroids on distal colon contractions and L-arginine-NOS-NO-cGMP-cGMP-PK1 pathway. A. Bulbul¹, A. Yagci¹, K. Altunbas¹, H. A. Celik¹, G. Avci¹, O. Yildiz-Gulay*¹, and M. S. Gulay², ¹*Afyon Kocatepe University, Afyonkarahisar, Turkey*, ²*Mehmet Akif Ersoy University, Burdur, Turkey*.

The current study addressed the effect of ovarian steroids on spontaneous distal colon contractions and L-arginine-nitric oxide synthase (NOS)-nitric oxide (NO) pathway. Ovariectomized three to six-month old Sprague-Dawley rats were assigned to control (Ov; sesame oil; n = 10), estrogen (E; 10 $\mu\text{g}/\text{d}$; n=10), progesterone (P; 2 mg/d; n = 10), and progesterone and estrogen (EP; 10 $\mu\text{g}/\text{d}$ estrogen and 2 mg/d progesterone; n = 10) groups. Daily intramuscular injections were continued for 10 d. Rats in all groups were sacrificed 18 h after the last injection. Distal colons were removed immediately after sacrifice, tissue samples were replaced in isolated organ baths, and contractions against different solutions were examined. The level of statistical significance was set at $P < 0.05$. Results indicated that among the treatment groups, intensity of colon contractions decreased only in E group. Moreover, L-arginine-NOS-NO pathway reduced the intensity of contraction induced by electrical field stimulation (EFS). In E group, L-arginine decreased the efficacy of sodium nitroprusside (SNP), whereas cGMP was not effective on smooth muscle contractions. Among the groups, level of nNOS expression was similar in non-adrenergic non-cholinergic (NANC) neurons. However, cGMP-PK1 α/β expression in smooth muscle cells was decreased in E group. In conclusion, results from the current study indicated that NO induced the relaxation in distal colon via cGMP-cGMP-PK pathway. Estrogen also reduced the distal colon contractions. However, the data suggested that estrogen uses cGMP-PK to reduce the effectiveness of L-arginine-NOS-NO-cGMP-cGMP-PK pathway.

Key Words: Ovarian Steroids, cGMP, nNOS

T181 Effect of diets containing soybean meal or canola meal on blood metabolites in early lactation Iranian Holstein cows. F. Hosseini, A. Heravi Moussavi*, M. Danesh Mesgaran, and J. Arshami, *Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran*.

The aim of this study was to evaluate substitution of soybean meal with canola meal and measure its effects on serum glucose, cholesterol, urea nitrogen (BUN), and aspartate aminotransferase (AST) in early lactation Iranian Holstein cows. From d 5 to 56 postpartum, cows were fed diets that were isoenergetic containing soybean meal (SBM; n = 5) or canola meal (CM; n=5). Cows were housed in tie stalls and fed the TMR two times a day to allow 5 to 10%orts (as-fed basis). Blood samples were collected weekly throughout the study via venipuncture

from coccygeal vessels prior to the morning feeding and serum was separated using centrifugation. Serum metabolites were analyzed by enzymatic colorimetric assays using procedures modified from available kits. The data were analyzed using the MIXED procedure of SAS (2001) for a completely randomized design with repeated measures. The model contained the effects of treatment, week of treatment, cow within treatment and the interaction of treatment by week. The overall effect of treatment was tested using cow within treatment as the error term. Least squares means are reported throughout, and significance was declared at $P < 0.05$. Plasma glucose concentrations were similar among diets (60.38 and 60.76 ± 1.65 mg/dL, respectively). The effect of time was significant ($P < 0.05$). Diet and time had no effect on BUN. Plasma cholesterol concentrations were similar among the diets (143.38 and 141.21 ± 7.5 mg/dL, respectively). The effect of time was significant ($P < 0.01$) and plasma cholesterol increased over the study. Diet had no effect on AST (72.00 and 72.43 ± 4.63 U/L, respectively). The effect of time also was not significant. The results of this study demonstrated that substituting soybean meal with canola meal in the early lactation cows had no apparent effect on the blood metabolites.

Key Words: Dairy Cow, Soybean Meal, Canola Meal

T182 Effects of carbohydrate source and processing on serum progesterone and insulin concentrations of dairy cattle. P. Moriel^{*1}, T. S. Scatena¹, O. G. Sa Filho¹, R. F. Cooke², and J. L. M. Vasconcelos¹, ¹FMVZ-UNESP, Botucatu, Brazil, ²University of Florida, Gainesville.

Two trials were conducted to investigate the effects of carbohydrate source and processing on serum progesterone (P4) and insulin (INS) concentrations. In Exp. 1, 12 ovariectomized grazing Gir \times Holstein cows were stratified by BW and randomly assigned, in a crossover design, to receive a supplement based on finely ground corn (FC) or citrus pulp. Treatments were offered individually 2 \times /day at a rate 11 kg of DM/cow. Within each of the 2 experimental periods, cows were adapted to treatments from d 0 to d 14 and received an intravaginal P4-releasing device (CIDR) prior to the beginning of the study. On d 7 after CIDR implant, blood samples were collected immediately prior to, and 1, 2, 3, 4, 5, and 6 h after the first feeding of the day. In Exp. 2, the cows utilized in Exp. 1 were re-stratified by BW and randomly assigned to receive, in a crossover design, a supplement based on coarsely ground corn (GC), finely ground corn (FC), or high-moisture corn (HM). Treatments were offered individually 2 \times /d at a rate 11 kg of DM/cow. Within each of the 3 experimental periods, cows were adapted to treatments from d 0 to d 7. Blood samples were collected on d 7 after CIDR implant as in Exp. 1. Time effects ($P < 0.01$) were detected in Exp. 1 and 2 because P4 concentrations decreased 3 h after feeding, whereas INS concentrations increased 1 h after feeding. In Exp. 2, HM cows tended ($P = 0.09$) to have decreased P4 concentrations compared to GC cows (1.7 vs. 1.9 ng/mL), and had greater ($P < 0.01$) INS concentrations compared to GC and FC cows (8.8, 5.7, and 6.1 μ UI/mL, respectively). Data combined from both experiments indicate that cows with INS ≥ 4.5 μ UI/mL prior to treatment feeding had greater P4 concentrations at 1 h, but decreased P4 concentrations at 5 h compared to cows with INS < 4.5 μ UI/mL. In the present study, carbohydrate processing, but not carbohydrate source, affected serum P4 and INS concentrations of non-lactating dairy cows.

Key Words: Carbohydrate, Insulin, Progesterone

T183 Effects of prepartum 2,4-thiazolidinedione on plasma leptin and insulin sensitivity in transition dairy cows. K. M. Schoenberg^{*}, K. L. Smith, R. M. Ehrhardt, Y. R. Boisclair, and T. R. Overton, Cornell University, Ithaca, NY.

Administration of thiazolidinediones (TZD) has been shown to alter lipid metabolism in transition dairy cows. The objective was to determine the effect of prepartum TZD treatment on plasma leptin and insulin response. Holstein cows ($n = 40$) entering second or greater lactation were administered 0, 2.0, or 4.0 mg TZD/kg BW by intrajugular infusion once daily from 21 d before expected parturition until parturition. Plasma samples collected daily from 22 d before expected parturition through 21 d postpartum were analyzed for glucose, NEFA, and insulin. Plasma samples collected on d -14, -3, -1, 1, 3, 7, 14, and 49 relative to parturition also were analyzed for leptin. Data from 40 cows were used for prepartum analyses and 31 cows were used for periparturient (d -7 to +7) and postpartum analyses. Prepartum BCS was not affected by treatment but postpartum BCS was higher for TZD-treated cows (2.8, 2.9, 3.1; $P = 0.001$). There was a trend ($P = 0.15$) for a treatment by time effect on plasma leptin prepartum such that values were similar on d -14 but cows receiving 2.0 mg/kg BW TZD tended to have lower leptin as calving approached. Postpartum leptin tended ($P = 0.14$) to increase linearly in TZD-treated cows (2.3, 2.4, 2.5 ng/mL). Insulin response was assessed using the revised quantitative insulin sensitivity check index (RQUICKI = $1/[\log(\text{glucose}) + \log(\text{insulin}) + \log(\text{NEFA})]$) as applied to dairy cattle, and results suggested that TZD-treated cows had greater insulin sensitivity as calving approached (treatment by time; $P = 0.05$). During the periparturient period, there was a tendency for RQUICKI to increase linearly with increasing TZD (0.43, 0.43, 0.46; $P = 0.10$). Postpartum RQUICKI was increased linearly in cows treated with TZD prepartum (0.43, 0.44, 0.47; $P = 0.02$). These results suggest that TZD treatment may alter plasma leptin, but postpartum effects may be confounded with BCS differences. Changes in RQUICKI suggested that TZD treatment altered insulin sensitivity in periparturient dairy cows.

Key Words: Transition Cow, Thiazolidinedione, Leptin

T184 The effects of prepartum 2,4-thiazolidinedione administration to dairy cows on energy balance, growth hormone, and insulin-like growth factor-I during the transition period. L. A. Winkelman^{*}, K. L. Smith, R. M. Ehrhardt, and T. R. Overton, Cornell University, Ithaca, NY.

Administration of thiazolidinediones (TZD) to prepartum dairy cows has been shown to reduce plasma NEFA concentrations in the periparturient period and postpartum body condition loss. Data from Holstein cows ($n = 31$) entering second or greater lactation were used to determine whether late prepartum administration of TZD would affect periparturient energy balance (EB), plasma growth hormone (GH) and insulin-like growth factor-I (IGF-I) concentrations, and the ratio of GH:IGF-I. During the pre- and postpartum periods, cows were fed a common TMR for ad libitum intake. Cows were administered 0, 2.0, or 4.0 mg TZD/kg BW by intrajugular infusion once daily from 21 d before expected parturition until parturition. Plasma samples collected on d -14, -7, -3, -1, 1, 3, 7, 14, 28, and 49 relative to parturition were analyzed for GH and IGF-I by RIA. Prepartum plasma GH and IGF-I concentrations, and the GH:IGF-I ratio were unaffected by TZD treatment. Calculated postpartum EB increased linearly ($P = 0.05$) with increasing TZD dose (-4.9, -5.4, and -1.7 ± 1.2 Mcal/d for 0, 2.0, and 4.0 mg TZD/kg BW treatments, respectively). After parturition, there was a tendency for a

linear effect of prepartum TZD dose on plasma GH ($P = 0.07$) such that an increasing TZD dose prepartum was associated with lower postpartum GH concentrations (9.55, 8.26, and 6.82 ± 1.12 ng/ml for 0, 2.0, 4.0 mg TZD/kg BW treatments, respectively). Prepartum TZD treatment did not affect postpartum IGF-I, but there was a linear trend ($P = 0.12$) for a decreased postpartum ratio of GH:IGF-I (0.258, 0.240, and 0.174 ± 0.040 for 0, 2.0, 4.0 mg TZD/kg BW treatments, respectively). A more positive calculated EB after parturition was associated with lower GH concentrations in cows receiving the 4.0 mg TZD/kg BW treatment, but there was no apparent relationship between postpartum EB and IGF-I concentrations.

Key Words: Transition Cow, Thiazolidinedione, Growth Hormone

T185 The metabolic status during the dry period influences the ovulation of the first follicular wave postpartum in dairy cows. N. Castro^{*1,2}, C. Kawashima³, H. A. van Dorland¹, S. Richter¹, I. Morel⁴, A. Miyamoto³, and R. M. Bruckmaier¹, ¹University of Bern, Bern, Switzerland, ²Las Palmas de Gran Canaria University, Arucas, Spain, ³Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Japan, ⁴Agroscope Liebefeld-Posieux, Posieux, Switzerland.

The aim of this study was to investigate the effect of the nutritional status, liver function and key metabolic factors in the liver during the

dry period (dp) and early lactation on the resumption of the ovarian activity in dairy cows. 23 high yielding dairy cows were allocated in two groups based on the first ovulation postpartum (pp) as detected by milk progesterone (P4) profiles. Milk samples were collected thrice per wk from d 7 pp until a new pregnancy. Ovulations were identified by an increase of P4 to more than 1 ng/mL. 47.8% of cows showed the first ovulation within 3 wk pp (OC), while in the others, ovulation occurred later (AC). Blood samples were obtained biweekly from 9 wk antepartum (ap) to wk 9 pp and plasma concentration of β HB, NEFA, Glucose (Glu), T-cholesterol, IGF-I, Insulin (Ins), T3, T4, AST and GGT were measured. Liver biopsies were taken ap and pp to analyze mRNA expression levels of hormone receptors (GH-R, IR, IGF-R1) and key metabolic enzymes (PC, PEPCKc, PEPCKm). In addition BCS and energy balance (EB) during dp and pp were assessed. Data were analysed by repeated measures ANOVA. Areas under the curve were calculated for the entire periods dp and pp, respectively. OC during dp showed higher Glu, Ins, IGF-I and T3 than AC (3.64 ± 0.03 vs 3.42 ± 0.06 mmol/l, 5.99 ± 0.99 vs 3.89 ± 0.44 μ g/l, 173.09 ± 11.50 vs 133.04 ± 11.56 μ g/l and 1.26 ± 0.06 vs 1.07 ± 0.06 nmol/l, respectively). During the pp period only higher T4 and BCS in OC were found (48.38 ± 2.23 vs 44.46 ± 0.98 nmol/l and 2.93 ± 0.07 vs 2.72 ± 0.09 , respectively). Liver mRNA expressions and EB did not differ in dp and pp. In conclusion the metabolic status during the dp is crucial for the ovulation of the first follicular wave pp.

Key Words: Ovulation, Metabolism, Dry Period

Physiology and Endocrinology: The Hypothalamic-Somatotrophic Axis

T186 Assessment of third-ventricle cerebrospinal fluid concentrations of GHRH in cattle: Correspondence with serum concentrations of GH and influences of appetite-regulating peptides. M. G. Thomas^{*1}, M. Amstalden², D. M. Hallford¹, G. A. Silver¹, M. D. Garcia¹, D. H. Keisler³, and G. L. Williams⁴, ¹New Mexico State University, Las Cruces, ²Texas A&M University, College Station, ³University of Missouri, Columbia, ⁴Texas AgriLife, Beeville, TX.

Hypothalamic hormones, GHRH and somatostatin, are important regulators of adenohipophysal secretion of GH. Direct evaluation of these neuroendocrine events is an anatomical challenge in cattle. Objectives were to: 1) characterize the relationship of third-ventricle cerebrospinal fluid (CSF) concentrations of GHRH with concentrations of GH in circulation, and 2) assess the influence of acute administration of appetite-regulating peptides, leptin (anti-orexigenic) and neuropeptide Y (NPY; orexigenic) on release of GHRH. Six mature, well-fed, Braford cows fitted with third cerebroventricle and jugular vein cannulae were treated intracerebroventricularly with saline, leptin (600 µg), or NPY (500 µg) in a replicated 3 × 3 Latin Square. Third-ventricle CSF and blood were collected 10 min before and for an additional 220 min after delivery of treatments. Concentrations of GHRH in CSF and GH in blood were evaluated with RIA. Hormone secretion patterns were assessed with Pulse_XP software. Mean concentrations of GHRH and GH were similar among treatments as was frequency of pulses of GHRH and GH. Mean concentrations of GHRH and frequency of pulses were 2.2 ± 0.13 ng/mL and 1.2 ± 0.15 pulses/240 min, respectively. Concentrations of GHRH in CSF were weakly correlated ($r = 0.15$; $P < 0.03$) with serum concentrations of GH; however, 58.2% of the GH pulses were preceded by a pulse of GHRH and 90% of the GHRH pulses occurred within 2 samples preceding a pulse of GH. Area under the curve (AUC) values for saline, leptin, and NPY treatments were 4,887, 3,719, 6,058 ± 444, respectively. Relative to saline, leptin tended ($P < 0.10$) to suppress GH AUC. Concomitantly, NPY tended ($P < 0.10$) to increase GH AUC, which appeared to be a consequence of increased ($P < 0.05$) pulse amplitude. Infusion of NPY also increased ($P < 0.05$) AUC of GHRH relative to saline. Sampling CSF from the third-cerebroventricle appears to be a viable procedure for assessing hypothalamic release of GHRH coincident with anterior pituitary gland secretion of GH in cattle.

Key Words: Bovine, GHRH, GH

T187 IGF-I modulation of GH and LH secretion in the pig. C. R. Barb and G. J. Hausman^{*}, USDA, ARS, Russell Research Center, Athens, GA.

Three experiments (EXP) were conducted to determine the role of IGF-I in modulating GH and LH secretion. In EXP I, prepuberal gilts, 65 ± 6 kg BW and 140 d of age received intracerebroventricular (ICV) injections of saline ($n = 4$), 25 µg ($n = 4$) or 75 µg ($n = 4$) IGF-I and jugular blood samples were collected. In EXP II, anterior pituitary cells in culture collected from 150 d old prepuberal gilts ($n = 6$) were challenged with 0.1, 10 or 1000 nM [Ala¹⁵]-h growth hormone-releasing factor-(1-29)NH₂ (GRF), or 0.01, 0.1, 1, 10, 30 nM IGF-I individually or in combination with 1000 nM GRF. Secreted GH was measured at 4 and 24 h after treatment. In EXP III, anterior pituitary cells in culture collected from 150 d old barrows ($n = 5$) were challenged with 10, 100 or 1000 nM GnRH or 0.01, 0.1, 1, 10, 30 nM IGF-I individually or in

combinations with 100 nM GnRH. Secreted LH was measured at 4 h after treatment. In EXP I, serum GH and LH concentrations were unaffected by ICV IGF-I treatment. In EXP II, relative to control all doses of GRF increased ($P < 0.01$) GH secretion. Only 1, 10, 30 nM IGF-I enhanced ($P < 0.02$) basal GH secretion whereas by 24 h all doses except for 30 nM IGF-I suppressed ($P < 0.02$) GH secretion compared to control wells. All doses of IGF-I in combination with 1000 nM GRF increased ($P < 0.04$) the GH response to GRF compared to GRF alone at 4 h. In contrast by 24 h all doses of IGF-I except for 1 nM suppressed ($P < 0.04$) the GH response to GRF. In EXP III, all doses of IGF-I increased ($P < 0.01$) basal LH levels while the LH response to GnRH was unaffected by IGF-I ($P > 0.1$). In conclusion, under these experimental conditions the results suggest that IGF-I may directly modulate GH secretion at the level of the pituitary gland and although IGF-I increased basal LH secretion from pituitary cultures further examination of the role of IGF-I on LH secretion is needed.

Key Words: LH, GH, IGF-I

T188 Growth hormone directly stimulates insulin production from the bovine pancreatic islets. J. Feng^{1,2}, F. C. Gwazdauskas¹, and H. Jiang^{*1}, ¹Virginia Polytechnic Institute and State University, Blacksburg, ²Zhejiang University, Hangzhou, Zhejiang, China.

The objective of this study was to determine the effect of GH on insulin secretion in cattle and the mechanism responsible for this effect. Administration of 500 mg of recombinant bovine GH in a slow-release formulation caused a continuous increase ($P < 0.01$) in serum concentration of insulin and IGF-I in nonlactating, nonpregnant beef cows ($n = 8$) during the 7 d following the administration, with serum concentration of insulin being nearly 5 times greater on d 7 after GH administration than on d 1 before GH administration ($P < 0.01$). Treatment of isolated bovine pancreatic islets with 100 ng/mL of GH for 1 h, 10 ng/mL of GH for 24 h, or 100 ng/mL of GH for 24 h in the presence of 3.3 mM of glucose each increased secretion of insulin in the culture medium by 20 to 30% as compared to 3.3 mM glucose only ($P < 0.05$, $n = 6$). Treatment of the islets with 100 ng/mL of GH for 24 h in the presence of 3.3 mM of glucose increased insulin mRNA abundance in the cultured islets by nearly 200% ($P < 0.05$, $n = 4$) as compared to 3.3 mM glucose only. Immunohistochemical analyses using antibodies recognizing the bovine GH receptor and insulin indicated that GH receptor protein is expressed in at least some of the insulin-producing beta cells in the bovine pancreatic islets. Taken together, these results suggest that GH administration increases serum concentration of insulin in cattle and that this effect is at least in part due to direct action of GH on insulin gene expression and secretion from the pancreatic beta cells.

Key Words: Growth Hormone, Insulin, Islets

T189 Milk composition is not affected by retail milk labels regarding farm management practices. J. L. Vicini^{*1}, T. D. Etherton², P. M. Kris-Etherton², J. M. Ballam¹, R. D. Cady¹, M. F. McGrath¹, M. C. Lucy³, A. C. Fitzgerald¹, T. D. Klusmeyer¹, and M. F. Migliazzo¹, ¹Monsanto Co., LC, St. Louis, MO, ²Pennsylvania State University, University Park, ³University of Missouri, Columbia.

A survey was conducted to determine if composition of retail milk is affected by label claims related to dairy farm management. Retail milk samples (n = 334) from 48 states were collected. Samples were blocked in complete or incomplete blocks such that within a block all samples were collected on the same date, by the same collector, in the same city and state and were shipped in the same container. Milk was purchased with one of three types of labels: 1) conventional (no claims about type of management), 2) recombinant bovine somatotropin (rbST)-free (processor certified not from cows supplemented with rbST) and 3) organic (follows USDA organic practices). Only samples not labeled as ultra-pasteurized (UP) were selected but it is known that some organic milk was UP and this was not indicated on the label. None of the samples tested positive for antibiotics. An analysis for all samples was conducted and least-squares means within whole milk are presented below (values with unlike superscripts are different ($P < 0.05$)). Although some significant differences were detected, values were within normal ranges and indicate that management labels predict no meaningful differences in

composition. Consumption of all dairy products should be encouraged to achieve nutrient adequacy.

Table 1.

	Conventional	rbST-Free	Organic	SE†
Bacteria, 10^3 cfu/ml	11 ^a	26 ^b	22 ^c	7.8
Fat, %	3.30	3.38	3.38	0.024
Lactose, %	4.71	4.70	4.67	0.015
Protein, %	3.14 ^a	3.15 ^a	3.22 ^b	0.013
SNF, %	8.77	8.77	8.82	0.023
bST, ng/ml	0.005	0.042	0.002	0.0066
IGF-1, ng/ml	3.12 ^a	3.04 ^a	2.73 ^b	0.063
Progesterone, ng/ml	12.0 ^a	12.8 ^a	13.9 ^b	0.43
Estradiol, pg/ml	4.97 ^a	6.63 ^b	6.40 ^b	0.269
Price, \$/0.5 gal‡	2.03	2.66	3.46	0.115

†Weighted SE. ‡Not statistically analyzed. ^{a,b,c} $P < 0.05$.

Key Words: Somatotropin, bST, Organic

Ruminant Nutrition: Carbohydrates - Dairy

T190 Effects of beet pulp substituted for barley grain in fat cows ration at the late lactation. E. Mahjoubi*, H. Amanlou, D. Zahmatkesh, M. Ghilichkhan, and N. Aghaziaraty, *Zanjan University, Zanjan, Iran.*

In order to examine the effects of increasing concentrations of beet pulp (lipogenic nutrient) substituted for barley grain (glycogenic nutrient) on productive performance, BCS loss, and blood metabolites, 18 Holstein cows were used. The cows were 171 ± 16 d in pregnancy and 289 ± 35 d in milk at the beginning of the experiment. The cows's BCS were 4.12 ± 0.35 at the beginning of the trial. The cows were assigned randomly to three dietary treatments containing 1) 23.47% barley (0% beet pulp), 2) 14.87% barley (8.6% beet pulp), or 3) 6.27% barley (17.2% beet pulp). Substituting beet pulp for barley grain didn't affect FCM 3.5%, milk protein, lactose, total solid, and SNF percentage, but milk fat percentage (4.37, 4.91, and 5.18, $P < 0.003$) and milk energy (0.76, 0.82, and 0.84 Mcal/kg, $P < 0.02$) increased as beet pulp were replaced barley, respectively. A tendency was detected for a more negative BCS change (0.13, -0.09, and -0.12, $P < 0.13$) and back fat thickness (2.5, -0.4, and -1.6 mm, $P < 0.13$) with added beet pulp. Plasma glucose (65.83, 58, and 57.16 mg/dl, $P < 0.01$) and cholesterol (157.33, 122.4, and 120.8 mg/dl, $P < 0.03$) decreased as beet pulp were substituted for barley grain, respectively. No difference was found in the plasma content of insulin and NEFA between treatments. In summary, these results suggest that with inclusion beet pulp in fat cows diet during late lactation may be slightly reduce BCS safely and inhibit of concomitant low production with diet diluting.

Key Words: Fat Cow, Beet Pulp, Barley

T191 Intake and ponderal development of dairy heifers fed sugar cane and different protein levels diets. M. F. S. Queiroz^{1,2}, T. T. Berchielli^{1,2}, R. D. Signoretti³, A. F. Ribeiro^{1,2}, and P. H. M. Dian^{1,2}, ¹Faculdade de Ciências Agrárias e Veterinárias-UNESP, Jaboticabal, São Paulo, Brasil, ²Fundação de Amparo à Pesquisa do Estado de São Paulo-FAPESP, São Paulo, Brasil, ³Agência Paulista de Tecnologia dos Agronegócios, Colina, São Paulo, Brasil.

The objective of this work was to evaluate the intake, performance and ponderal development of heifers fed sugar cane and four different protein levels diets. The sugar cane (IAC 862480) was evaluated during August to November (winter/spring) and the diets concentrate was compound by corn meal, soybean meal, urea, ammonia sulfate and mineral mix, in different proportions, to obtain the protein levels (10, 12.5, 15 and 17.5% of crude protein) in 70:30 relation forage and concentrate. Twenty-four Holstein × Zebu crossbred heifers were maintained in individual stalls and *ad libitum* fed twice on day (8 and 16h) during the adaptation and experimental period, 15 and 62 days, respectively. The animals were distributed in a block-randomized design, with four treatments and six replicates. The heifers were weighed and their thoracic perimeter, hip and croup height were determined at the beginning and at the end of the experimental period, at every 21 days. There was no difference ($P > 0.05$) between different protein levels for intake, daily weight gain and ponderal development of dairy heifers. However, although similar statistic results, the high protein level diet, 17.5% crude protein, promoted the best feed conversion (8,3).

Table 1. Average dry matter intake, daily weight gain and ponderal development of dairy heifers

	Diets protein levels (%)				CV(%)
	10	12.5	15	17.5	
Intake ¹	7.3	7.4	7.4	7.6	11
Intake ²	2.6	2.6	2.7	2.8	7
Daily WG (kg)	0.82	0.87	0.87	1.01	37
FC	10.7	12.3	13.2	8.3	54
Hip height*	120	120	121	120	3
Croup height*	123	124	125	124	2
Thoracic perimeter*	156	158	156	156	3

Means in the same row with different letters are different ($P < 0.05$); CV(%)=Coefficient of variation; *cm; ¹kgDM/day; ²%BW; FC=Feed conversion (DM intake/gain)

Key Words: Feedlot, Heifer Reraising, Weight Gain

T192 Effects of different ratios of nonfiber carbohydrate to ruminal degradable protein on the performance of Holstein cows in barley based diets. H. Rafiee¹, A. Afzalzadeh¹, A. Khadem¹, and A. Asadi², ¹University of Tehran, Aboureihan Campus, Tehran, Iran, ²Isfahan University of Technology, Isfahan, Iran.

Nine multiparous midlactation Holstein cows averaging 171 ± 17 days in milk and 24.1 ± 3.2 Kg of milk/d were assigned into a replicated 3×3 Latin square design to study the effects of altering nonfiber carbohydrate (NFC) to ruminal degradable protein (RDP) ratio on performance and nutrient digestibility. NFC:RDP ratios were 4.07, 3.71 and 3.34. Ratios were achieved through altering RDP content of diets while NFC was held constant at 40% DM. Urea was supplemented as a source of RDP to decrease the ratio. Crude protein (CP) contents were 14.3, 15.3 and 16.3% DM respectively. Each period lasted 21 days with last 7 days for milk and feces sampling. Results were analyzed by MIXED models with effect of cow(square) as a random and days of sampling in each period as repeated measures. Differences declared as significant where $P < 0.05$. Results showed that indicators of nitrogen metabolic efficiency were more affected than milk yield confirming that low producing cows are less likely to respond to altering NFC:RDP ratio. Hence, balancing rations to further improve the nitrogen utilization efficiency may be of higher priority value.

Table 1: Effect of NFC:RDP ratios on milk production and composition, nutrient intake and digestibility

Trait	NFC:RDP ratios					Contrast	
	4.07	3.71	3.34	SEM	P<	L	Q
DMI, Kg/d	21.8	21.3	21.0	0.59	0.002	0.07	0.74
NI, g/d	423.2	466.3	489.4	16.17	0.003	0.01	0.62
Milk, Kg/d	22.9	23.0	23.4	0.92	0.36	0.48	0.83
Milk fat, %	3.31	3.44	3.36	0.12	0.66	0.67	0.69
Milk protein, %	3.00	3.07	3.08	0.02	0.003	0.01	0.29
MUN, mg/dl	11.20	12.88	13.90	1.18	0.04	0.07	0.42

NI;Nitrogen intake, L;linear effect, Q;quadratic effect

Key Words: Nonfiber Carbohydrates, Rumen Degradable Protein

T193 An alternative low-starch compared with a traditional high-starch calf starter results in similar growth rate and rumen development at weaning. M. Vestergaard*, L. Puggaard, A. Kosiorowska, S. K. Jensen, N. B. Kristensen, and J. Sehested, *Faculty of Agricultural Sciences, University of Aarhus, Foulum, Denmark.*

The objective was to evaluate the consequences on growth performance and rumen development of using an alternative low-starch concentrate (ALT) compared with a traditional high-starch concentrate (TRA) fed at normal (N) (6.4 kg/d) or low (L) (3.2 kg/d) milk feeding level until weaning at 8 weeks. In total, 64 new born HF calves in 8 male and 8 female blocks of 4 were used in a 2 × 2 factorial design. All calves received 6.4 kg/d of cow's whole milk (M) from d 3 to d 13 of age. From d 14, half the calves (treatment L) received only 3.2 kg/d of M. All calves had free access to artificially-dried grass hay (9.8 MJ ME/kg DM), to water, and to either TRA or ALT concentrates from day 3. TRA contained 350 and ALT 107 g starch/kg DM, whereas NDF was 136 and 296 g/kg DM, respectively. Protein content (203 g/kg DM) was similar, but ME was lower in ALT than in TRA (11.2 vs. 12.2 MJ ME/kg DM). L-calves had higher concentrate intake than N-calves (P<0.001). TRA resulted in higher hay intake than ALT (P<0.01). L-calves had lower (608 g/d) ADG than N-calves (766 g/d) with no effect of concentrate type. At 8 weeks of age, size of reticulo-rumen (P<0.001) and weight of rumen epithelium (P<0.02) were lower in N- compared with L-calves. Rumen papillae length was not affected by treatments. In conclusion, if calves have access to a nutritious hay-product, feeding low- or high-starch concentrate will both result in normal rumen development and similar growth performance at the given milk feeding level.

Key Words: Dairy Calves, Calf Starters, Performance

T194 Rumen available soluble, insoluble and total structural and non-structural carbohydrates and protein and their ratios: Effect of barley variety and growth year. P. Yu* and K. Hart, *University of Saskatchewan, Saskatoon, SK, Canada.*

The objective of this study was to investigate rumen available soluble, insoluble and total protein (CP), estimated structural (SC) and non-structural carbohydrate (starch: ST), degradation characteristic ratio of six barley varieties during three consecutive growth years of 2003, 2004, 2005) in order to determine the magnitude of the differences between the varieties and growth years which affect optimizing a diet composition with regard to rumen fermentation. All the barleys were coarsely rolled with a roller gap of 1.12 mm. Measured degradation kinetics in fistulated dairy cows were soluble fraction (S: ST, CP), undegradable fraction (U: SC, CP), lag time (T0: SC, CP) and rate of degradation (Kd: SC, ST, CP) of the insoluble but degradable fraction (D: SC, ST, CP). Rumen available soluble, insoluble, and total N, structural and non-structural carbohydrate and rumen degradation characteristic ratio were determined using the Rumen Degradation Ratio System. Based on the measured kinetics, degradation ratios were calculated between the total rumen available N and carbohydrates (FN/FCHO), rumen available soluble N and carbohydrates (SN/SCHO), and rumen available insoluble N and carbohydrates (EN/ECHO). The ratios showed significant differences among the varieties in FN/FCHO, ranging from 16.6 to 19.0 g/kg (P<0.01), no differences in SN/SCHO (P>0.05) with an average of 4.9 g/kg. The EN/ECHO was tended to be significant among the varieties (P=0.069) ranging from 18.4 to 21.3 g/kg. Also the year affected FN/FCHO (P<0.01) and EN/ECHO (P<0.01) ranging from 15.3 to 18.6 g/kg and 17.0 to 21.4 g/kg, respectively, but no effect on

SN/SCHO with an average of 4.8 g/kg. In conclusion, both the barley variety and growth years significantly affect rumen degradation kinetics of protein, estimated structural and non-structural carbohydrates. There were significant differences in FN/FCHO ratio (average 17.2 g N per kg CHO) among the barley varieties.

Key Words: Degradation Ratio, Barley Varieties, Growth Year

T195 Effects of dietary starch and unsaturated fat with Rumensin on milk fat depression in lactating dairy cattle. M. E. Van Amburgh*¹, J. L. Capper¹, G. D. Mechor², and D. E. Bauman¹, ¹*Cornell University, Ithaca, NY*, ²*Elanco Animal Health, Greenfield, IN.*

This experiment investigated the effects of starch level, polyunsaturated fatty acids (PUFA) from corn oil and Rumensin (Elanco Animal Health, Greenfield, IN), and their interactions on milk fat synthesis and fatty acid profile. Eighty Holstein cows were assigned to eight treatments within a randomized, blocked design with cross-over on oil addition. Cows were housed in tie stalls and fed ad libitum TMR for approximately 10% refusals. Each treatment consisted of three 21-day periods: in the first period a high- (267 g/kg DM) or low- (203 g/kg DM) starch TMR was fed, followed by the addition of Rumensin (13 mg/kg DM) and/or corn oil at 1.2% DM (280 to 310 g/d); this provided eight different diets formulated for an average DM intake of 22.9 kg/d in period two. In the third 21-day period, cows randomized to diets containing corn oil were switched to diets without corn oil, and vice versa. Data were analyzed using a mixed model approach and the model included period, random effects of cow and fixed effects of starch, Rumensin and oil and their interactions. Dry matter intake and milk yield were increased (P<0.01) in cows fed diets with added corn oil. Further, the addition of corn oil was the primary dietary factor responsible for the observed milk fat depression (MFD) 3.35 versus 3.05% (P<0.004). Milk fat concentration decreased by approximately 12% with the addition of corn oil and 16% with the addition of both Rumensin and corn oil. Rumensin did not induce milk fat depression in cows fed either high or low starch diets (P>0.05), but increased milk protein concentration from 2.99 to 3.07 (P<0.03). Cows fed the high starch diets also had greater milk protein concentration and yield (P<0.04). Comparing the milk fat concentration of t-10, c-12 18:2 of cows with MFD with previously reported data and equations related to MFD, the fatty acid profiles suggest that this CLA isomer was primarily responsible for the milk fat depression observed in this study.

Key Words: Rumensin, Milk Fat Depression, CLA

T196 Effects of conventional or brown mid rib hybrid silage fed at two levels on intake, milk yield and composition, and rumen fermentation of dairy cows. T. D. Edwards*, G. A. Varga, R. H. Chung, V. A. Ishler, and M. Martinez, *The Pennsylvania State University, University Park.*

The objective of this study was to evaluate the effects of Brown Mid Rib (BMR) vs. conventional corn silage fed at two levels on production and rumen fermentation. Eight lactating (DIM=160; four rumen-cannulated) Holstein dairy cows were used in a replicated 4x4 Latin-Square design with 2x2 factorial dietary arrangement (silage type and level). The diets were formulated to contain either 35 or 50% of ration DM from corn

silage, using conventional (CONV) and BMR genotype silage. The diets contained 16% CP, 34% NDF and 28% forage NDF; DM basis. Each experimental period was 14 d, 7 d adaptation and 7 d sampling. Daily milk weights were collected, with sampling from four consecutive milkings the last two days of each period for components. Rumen samples were taken at set points over the last 24 hours of the sampling period. Intake was higher (level effect: $P \leq 0.01$) for cows consuming the 35% vs. 50% level of corn silage inclusion (28.2 vs. 26.4 kg/d). There was an interaction ($P \leq 0.01$) on DMI such that cows on the BMR silage maintained DMI (27.5 kg/d) on both levels of corn silage inclusion while those provided CONV reduced DMI (28.8 vs. 25.4 kg/d). Cows fed the BMR corn silage at 50% produced significantly more milk (corn silage type effect: $P \leq 0.05$) than cows fed the CONV hybrid at 50% (48.6 vs. 43.64 kg/d). Efficiency for converting feed to milk was greater (level effect: $P \leq 0.05$) for 50% vs. 35% inclusion rate (1.76 vs. 1.67, respectively). Yields or percentages of milk fat, protein, and lactose were not significantly different across diets. Rumen pH and ammonia concentration were similar across treatments. No differences in VFA profiles were observed except that concentrations of isobutyrate and isovalerate were higher (corn silage type effect: $P \leq 0.05$) for cows fed CONV vs. BMR corn silage. Feeding BMR corn silage at 50% of ration DM did not affect DMI and maintained milk yield compared with CONV corn silage. Efficiency of converting feed to milk was affected more by the level of corn silage inclusion in the ration than type.

Key Words: Conventional Silage, BMR, Silage Hybrid

T197 The effect of dietary sucrose on dry matter intake, plasma metabolites, and lactation performance for Holstein cows during the first 4 weeks of lactation. G. B. Penner* and M. Oba, *University of Alberta, Edmonton, Alberta, Canada.*

This study was conducted to determine the effect of dietary sucrose concentration during early lactation on dry matter intake (DMI), plasma metabolites, and lactation performance. Fifty-three Holstein cows free of clinically diagnosed transition disorders were used in this study. Cows were fed one of two experimental diets immediately after parturition which contained either 0% (LS) or 4.5% sucrose (HS). Diets consisted of 40% barley silage, 10% alfalfa hay, and 50% of a common concentrate mix which differed in the sucrose concentration by including either sucrose plus urea or cracked corn grain. Both diets were formulated to contain 23.2% forage NDF and 18.7% CP. Data and samples were collected over a 3-d period each in wk 2, 3, and 4 of lactation. Milk yield and composition data were analyzed for wk 3 and 4 only. Dry matter intake was not affected by treatment, averaging 17.4 kg/d. Plasma glucose concentration tended ($P = 0.07$) to be higher for LS compared to HS treatment (54.9 vs. 52.5 mg/dl). A parity \times wk interaction ($P = 0.03$) was detected for plasma glucose: multiparous cows had lower plasma glucose than primiparous cows (51.1 vs. 56.2 mg/dl); however, plasma glucose increased from wk 2 to wk 4 (48.5 to 58.0 mg/dl) for multiparous cows, whereas there was no change in the plasma glucose concentration for primiparous cows. A parity \times treatment interaction was detected ($P = 0.02$) for plasma β -hydroxybutyrate (BHBA) concentration; multiparous cows fed HS (30.9 mg/dl) had higher plasma BHBA than multiparous cows fed LS (11.3 mg/dl) and primiparous cows fed HS (15.3 mg/dl) and LS (14.7 mg/dl). Milk and crude protein yields were not affected by treatment averaging 38.3 and 1.13 kg/d respectively. Feeding HS increased the milk fat yield (1.52 vs. 1.33 kg/d; $P = 0.02$) and tended to increase the milk fat concentration (3.91 vs. 3.60%; $P = 0.09$) compared to LS. These data indicate that feeding sucrose during

early lactation does not affect DMI or milk yield but can increase the yield and concentration of milk fat.

Key Words: Sucrose, Transition Period

T198 Efficacy of glycerol as a replacement for lactose in calf milk replacer. R. A. Ebert*¹, G. M. Willis², and J. K. Drackley¹, ¹*University of Illinois, Urbana,* ²*MSC, Dundee, IL.*

Glycerol (glycerin) is increasingly available from biodiesel manufacture and edible oil refining and has been used successfully in diets for chickens, pigs, and adult cattle; however, no information is available on its nutritional value in young calves. Our objective was to determine the effects on calf growth and health when glycerol replaced a portion of lactose in milk replacer. Holstein calves (6 male, 6 female) born at the University of Illinois dairy unit were assigned alternately to each of 2 treatments (24 calves total): control milk replacer or milk replacer supplemented with 15% glycerol. The experimental base milk replacer contained greater protein, fat, minerals, and vitamins so that when glycerol was added the composition would be the same as control, except that glycerol replaced some lactose. Calves were housed in individual hutches bedded with straw and had water freely available; no starter was offered until d 36. Calves were fed milk replacers twice daily from d 3 of life. Milk replacers contained 28% protein (all from whey proteins), 2.6% lysine, and 15% fat. Control milk replacer contained 40% lactose; glycerol milk replacer contained 25% lactose. Both replacers were reconstituted to 15% solids. Glycerol (liquid) was added to reconstituted base milk replacer at each feeding. During wk 1 milk replacers were fed at a rate of 0.25 Mcal/kg metabolic BW (about 1.5% of BW daily as powder) and from wk 2 - 6 at of 0.30 Mcal/kg metabolic BW (about 2% of BW daily). Starter was offered beginning on d 36. Milk replacer offered was reduced by half on d 43; calves were weaned at d 49. Measurements of BW and stature were made weekly through d 56. Calf BW through d 35 did not differ significantly between treatments (0.68 vs. 0.64 kg/d for controls and glycerol, respectively). Stature measurements (withers height, body length, heart girth) and measures of health (fecal scores, medical treatments) did not differ between treatments. Glycerol could be an acceptable replacement for at least 37.5% of the total lactose in milk replacer if economically favorable.

Key Words: Glycerol, Milk Replacer, Calves

T199 Effects of varying forage proportion and particle length on supply of amino acids. W. Z. Yang and K. A. Beauchemin*, *Research Center, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.*

Forage proportion and particle length are the main factors that contribute physically effective fiber (peNDF) to the diet, which helps prevent ruminal acidosis. This study aimed to investigate whether the supply of AA to the duodenum and digestibility of those AA in the intestines vary with particle length and forage proportion. Four ruminally and duodenally cannulated lactating cows were used in an experiment designed as a 4 \times 4 Latin square with a 2 \times 2 factorial arrangement of treatments. Four diets were formulated using two cuts of alfalfa silage, short (7.9 mm) and long (19.1 mm), combined with two ratios of forage to barley grain concentrate (35:65 and 60:40, DM basis). The content of N was 20.2% and 21.7% (DM basis), respectively, for low and high forage

diets. Intake of AA (range of 2.9 to 3.3 kg/d) was not affected by forage proportion although DMI was higher with low (20.6 kg/d) forage than with high (18.3 kg/d) forage diets. Overall, flows of microbial and total AA at the duodenum, and digestibility of AA (% of duodenal flow) in the intestine were higher with low forage (1.8 kg/d, 3.3 kg/d, and 67.6%, respectively) than with high forage diets (1.4 kg/d, 2.5 kg/d, and 63.6%, respectively). However, varying forage particle length did not affect the flow (short vs. long; 2.94 vs. 2.89 kg/d) or intestinal digestibility (short vs. long; 66.2 vs. 65.0%) of AA. The profiles of individual essential AA in the duodenal digesta were not affected by the dietary treatments. The proportion of duodenal essential AA (40.9% of total AA) was higher than the original diets (36.9%). The increase of essential AA proportion in the duodenal protein resulted from the higher essential AA in the microbial protein (45.9%) that flowed to the duodenum. These results indicate that increasing forage proportion to increase dietary peNDF reduced overall AA supply because flow and intestinal digestibility of AA were reduced. However, increasing particle length had only marginal effects on AA supply.

Key Words: Forage Proportion and Particle Length, Amino Acids, Dairy Cows

T200 Effects of barley grain processing and source of supplemental dietary fat on nutrient digestion and microbial protein synthesis in dairy cows. G. N. Gozho*, M. R. Hobin, and T. Mutsvangwa, *University of Saskatchewan, Saskatoon, Saskatchewan, Canada.*

The objective was to determine the effects of method of barley grain processing and source of supplemental fat on ruminal nutrient digestion, duodenal nutrient flow, and ruminal microbial protein synthesis. Four Holstein cows (656 kg BW; 80 DIM) fitted with ruminal and duodenal cannulae were used in a 4 × 4 Latin square design with 28-d periods and a 2 × 2 factorial arrangement of dietary treatments. Treatments were dry-rolled barley + whole canola seed (DC), pelleted barley + whole canola seed (PC), dry-rolled barley + flaxseed (DF), and pelleted barley + flaxseed (PF). Cows fed dry-rolled barley consumed 1.8 to 3.5 kg/d more DM compared to those fed pelleted barley. Ruminal pH and NH₃-N concentration were higher in cows fed dry-rolled barley compared to those fed pelleted barley. Cows fed dry-rolled barley consumed 1.8 to 3.5 kg/d more DM compared to those fed pelleted barley; consequently, intakes of OM ($P = 0.02$), NDF ($P = 0.007$) and ADF ($P = 0.03$) were higher in cows fed dry-rolled barley. Starch intake tended to be higher ($P = 0.08$) in cows fed dry-rolled compared to pelleted barley. Ruminal digestibility coefficients for starch, OM, and ADF were not affected by treatment; however, ruminal NDF digestibility tended to be higher for cows fed dry-rolled compared to pelleted barley. Duodenal flow of starch was greater ($P = 0.003$) in cows fed dry-rolled compared to those fed pelleted barley. Duodenal flow of microbial N was unaffected by diet,

and was 267, 287, 260 and 252 g/d in cows fed DC, PC, DF, and PF diets, respectively. The efficiency of microbial N synthesis (expressed as g microbial N per kg of OM truly digested in the rumen) were not affected by diet, and were 25.3, 28.8, 23.9 and 22.7 for cows fed DC, PC, DF, and PF diets, respectively. Attempts in our study to shift starch digestion to the rumen through barley grain pelleting were negated by a higher DM intake in cows fed dry-rolled barley diets.

Key Words: Dairy Cow, Duodenal Nutrient Flow, Microbial Protein Synthesis

T201 Wheat, barley, or corn grain based starters with different alfalfa meal levels for Holstein calves. M. Noroozi¹, H. Amanlou¹, G. R. Ghorbani², and A. Nikkhah^{*1,3}, ¹Zanjan University, Zanjan, Iran, ²Isfahan University of Technology, Isfahan, Iran, ³University of Illinois, Urbana.

Wheat grain (WG) has recently become more available in Iran's feed market, thus attracting new interest to its major use in ruminant diets. Given WG's lower cost and higher starch and protein fermentability than corn and barley grains, our objective was to determine the effects of offering either corn, barley, or WG based starters at three levels of alfalfa meal (AM) on weight gain, feed intake, blood metabolites, fecal properties and calf health. Following 3 days of colostrum and transition milk feeding, 54 Holstein calves were assigned to nine starters and received 4 L of whole milk daily at 0900 h and 2100 h from day 4 until day 70 of age in individual hutches. Treatments were starters made of either ground corn, barley or WG (47.9-60.9%) with 0, 5 or 10% AM, on a dry matter basis. Starters were formulated to maintain crude protein (21% of DM), NEm (2.20-2.44 Mcal/kg) and NEg (1.67-1.86 Mcal/kg) as comparable as possible among treatments. Body weight was recorded weekly between 1400 and 1500 h. Feces form, rectal temperature, diarrhea incidence, and general calf health were recorded twice daily. DMI (57.2 vs 62.2 and 62.8 kg), weight gain (33 vs 37.3 and 38.3 kg), and fecal firmness were lower ($P < 0.05$) in WG fed calves than in other calves, respectively. The type of grain did not affect blood metabolites and feed conversion ratio. Inclusion of AM at 5 and 10% reduced ($P < 0.05$) weight gain (36.7 and 32.8 vs 38.9 kg) and blood glucose (114 and 113 vs 129 mg/dl), increased feed conversion ratio (1.66 and 1.94 vs 1.65) and fecal firmness (1.81 and 1.78 vs 1.97; 1 = quite firm, 5 = watery), but did not affect blood total proteins and urea, compared to AM free starters. Results suggest that under current calf raising practices, WG may be used as the sole dietary cereal in calf starters when corn and barley are less available. These data did not support a necessity of using >5% AM in the starter for a superior weaning performance. Whether a blend of WG with other cereals may optimize rumen development and lower weaning age warrants future studies.

Key Words: Cereal, Alfalfa, Calf

Ruminant Nutrition: Fats - Dairy

T202 Effect of supplementation with sunflower oil (SO) or seeds (SS) combined or not with fish oil (FO) on conjugated linoleic acid (CLA) in milk from grazing dairy cows. G. A. Gagliostro^{*1}, M. A. Rodríguez², P. Pellegrini², P. Gatti², G. Muset², D. Garciarena¹, A. Ferlay³, and Y. Chilliard³, ¹*Instituto Nacional de Tecnología Agropecuaria, INTA, Balcarce, Buenos Aires, Argentina*, ²*Instituto Nacional de Tecnología Industrial, INTI, Buenos Aires, Argentina*, ³*Institut National de la Recherche Agronomique, INRA, Saint Genès Champanelle, France*.

The effectiveness of C18:2-rich supplements (SS vs SO) combined or not with FO to increase milk CLA (cis-9, trans-11C18:2) was evaluated in 64 Holstein grazing cows. During each milking corn grain (1.3 kg DM/cow) and a mineral-vitamin mix (0.25 kg) were consumed. Between the a.m. and p.m. milkings cows grazed a pasture at 11 kg DM/cow allowance. After the p.m. milking, cows (16/treatment) received four TMR diets over a 5-wk period: 1) SS = 74.7% corn silage (CS); 25.3% SS, 2) SO = 76.7% CS, 12.3% sunflower meal (SM), 11% SO; 3) SS-FO = 72.4% CS, 24.5% SS, 3.1% FO and 4) SO-FO = 74.3% CS, 11.9% SM, 10.6% SO, 3.2% FO. TMR intake (kg DM) averaged 7.52, 7.33, 3.45 and 4.63. Every week milk samples were collected and FA composition (GLC) were analyzed in a completely randomized design with repeated measures. A pre-trial period represented basal FA concentrations and used for covariance analysis. The average 5-wk concentrations (g/100g FA) of C12:0 (1.52) and C14:0 (6.39) were similar. Concentration of C16:0 was higher (P<0.01) when FO was included in the diet (20.49 vs 17.94). FO supply reduced (P<0.01) milk content of C18:0 (13.54 to 6.30) and cis-9 C18:1 (31.39 vs 19.2) and increased total trans-C18:1 (21.8 vs 10.56). Interactions (P<0.05) between sources of C18:2n6 (SS and SO) and FO were detected for C18:2n-6 and CLA. Concentration of C18:2n-6 was: SS (2.78), > SS-FO (2.10), >SO (2.04), >SO-FO (1.73). Concentration of C18:3n-3 was higher (P<0.03) with treatments including FO (0.68 vs 0.62). Pre-trial CLA concentrations averaged 1.08, 1.15, 1.12, and 1.11 for SS-FO, SS, SO-FO and SO respectively. Milk CLA content was sharply increased after lipid supplementation reaching a maximal value of 8.49 g/100g FA (± 2.25) at wk-5 in SS-FO. The highest average CLA concentration over the 5-wk was observed in SS-FO (6.07) followed by SO-FO (4.37), SS (2.96) and SO (2.36) treatments. Mixing lipid supplements with corn silage represents a feeding-strategy that may be easily carried out by the farmer in order to improve milk CLA and trans-C18:1 concentrations.

Key Words: Conjugated Linoleic Acid, Sunflower, Fish Oil

T203 Effect of dietary vegetable oil and antioxidant supplementation on dairy cattle performance and milk fat depression. M. He¹, H. S. Xin² and L. E. Armentano¹, ¹*University of Wisconsin, Madison*, ²*China Agricultural University, Beijing, China*.

This experiment was conducted to evaluate the effect of dietary supplementation of free vegetable oil with or without a commercial antioxidant (Agrado® plus, Novus International) on dairy cattle performance and milk fat depression. Twenty four multiparous Holstein cows (138±31 DIM) were divided by production into 2 blocks (Hi or Lo) of 12 cows each. Agrado (0 or 0.025% of DM, -A or +A) was randomly assigned to 6 cows per block resulting in a main plot randomized block design

with 20 df for error. These 4 groups of 6 cows each (-AHi, -ALo, +AHi and +ALo) were each fed 6 diets in a 6X6 Latin square design that was a split plot with 3wk periods. Dietary treatments were no added oil (CTRL), or 5% DM as free oil from palm (PALM), high-oleic safflower (OSAF), high-linoleic safflower (LSAF), linseed (LNSD) or corn oil (CORN). Diets were formulated to be iso-CP and iso-NDF, and consisted of approximately 40% alfalfa silage, 20% corn silage and 40% grain mix (DM basis). Data reported were analyzed using the mixed model of SAS (Y = agrado + block + block*agrado + oil + oil*agrado + oil*block + period + period*agrado + period*block). There was no main effect of Agrado feeding nor an Agrado by oil interaction for milk production parameters, but Agrado by block interaction was found for milk yield (P=0.09) and milk protein yield (P=0.08). Negative effects were associated only with the unsaturated fatty acids and linoleic acid appeared to be the most deleterious of the unsaturated fatty acids fed.

Table 1. Effect of vegetable oil on dairy cattle performance

	CTRL	PALM	OSAF	LSAF	LNSD	CORN	SEM
DMI, kg/d	22.44 ^{ab}	22.97 ^{ab}	24.80 ^a	22.97 ^{ab}	23.27 ^{ab}	21.13 ^b	0.99
Milk, kg/d	33.5 ^{ab}	34.5 ^a	33.7 ^a	30.5 ^b	33.6 ^{ab}	32.2 ^{ab}	1.33
Milk Fat %	3.41 ^a	3.43 ^a	3.04 ^b	2.85 ^b	3.07 ^b	3.05 ^b	0.11
Milk Protein %	3.24 ^b	3.24 ^b	3.30 ^{ab}	3.45 ^a	3.28 ^b	3.39 ^{ab}	0.06
Milk Fat, kg/d	1.14 ^{ab}	1.18 ^a	1.02 ^{bc}	0.86 ^d	1.02 ^{bc}	0.98 ^{cd}	0.05
Milk Protein, kg/d	1.09 ^a	1.10 ^a	1.10 ^a	1.03 ^a	1.08 ^a	1.08 ^a	0.04

^{ab}Least square means within a row not sharing a common superscript differ (P<0.05). Based on Bonferroni statistical test.

Key Words: Vegetable oil, Antioxidant, Milk fat depression

T204 Effect of close-up fat supplementation on first 90 days milk production of Holstein dairy cows. M. Danesh Mesgaran* and A. R. Heravi Mousavi, *Dept. of Animal Science (Excellence Center for Animal Science), Ferdowsi University of Mashhad, Mashhad, Iran*.

Effect of close-up fat supplementation and body condition score on first 90 days milk production was evaluated in high producing lactating Holstein cows. Data of 6 herds with average 112 milking cows were used. Body condition scores were recorded 50 days before and 45 days after the calving. All cows in each herd were dried off 50-70 days before expected calving and moved to a far-off dry herd with dry matter intake of 3 kg alfalfa, 5 kg corn silage, 1.5 kg wheat straw and 3 kg far-off concentrate (CP: 162 g/kg; ME:12.4 MJ/kg). The cows were moved to the close-up dry herd around 25 days before calving. Close-up dry ration (DM basis) was consisted of 2.2 kg alfalfa, 6.1 kg corn silage, 1.9 kg wheat straw, 5.2 kg concentrate (CP: 176 g/kg; ME: 13.2 MJ/kg), and 300 g of anionic salts. In 3 herds, the close-up ration was supplemented with 0.25 kg palm fat prills (99.5% fat). After parturition, all cows were fed a total mixed ration (as DM) based on 24% alfalfa, 14% corn silage and 60% concentrate. This ration met the requirements of high producing cows (CP: 180 g/kg; ME: 12.2 MJ ME/kg DM). Cows were inseminated around 60-85 days in milk after a presynch-ovsynch estrous synchronization program. During the first

90 days of lactation, weekly milk production was recorded. Data were analyzed using GLM procedure of SAS. Retained placenta, metritis and endometritis were lower in cows fed fat supplemented close-up ration compared with the non-supplemented cows. First 90 days milk yield was significantly influenced by close-up fat supplementation ($P < 0.05$). Milk yield of fat supplemented and non-supplemented cows was 41.3.8 and 39.6 kg/d/head, respectively. Milk yield appeared to be depressed in postpartum thin cows (BCS= 2.4) compared with normal cows (BCS= 2.9). Results of the present study indicated that fat cows (BCS more than 4.6 before dry off) resulting in lower milk production. It was concluded that relationship between close-up period fat supplementation and milk production in the first 90 days was a critical point.

Key Words: Close-Up, Fat, Milk

T205 Soybean oil and linseed oil supplementation affect profiles of ruminal microorganisms and fermentation parameters in dairy cows. D. P. Bu¹, S. L. Yang¹, J. Q. Wang^{*1}, Z. Y. Hu¹, D. Li¹, H. Y. Wei¹, L. Y. Zhou¹, and J. Loo², ¹State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, P. R. China, ²University of Illinois, Urbana.

The objectives of this study were to evaluate changes in ruminal microorganisms and fermentation parameters due to dietary supplementation of soybean and linseed oil alone or in combination. Four primiparous Holstein cows with permanent ruminal cannulas were randomly assigned to control (CK, 60:40 forage to concentrate) or CK with 4% soybean oil (LOC1), 4% linseed oil (LOC2), or 2% soybean oil plus 2% linseed oil (LOC3) in a 4 × 4 Latin square with 12-week periods. Forage and concentrate mixtures were fed at 0800 and 2000 h daily. Ruminal fluid was collected every 2 h over a 12 h period on d 19 of each experimental period. Ruminal pH and concentrations of acetate and propionate did not differ but butyrate (10.4 vs. 9.5 mmol/L) and total VFA (109 vs. 104 mmol/L) were lower ($p < 0.05$) with oil supplementation compared with CK. Concentration of ruminal NH₃-N (13.6 vs. 17.4 mg/dL) was greater ($p < 0.05$) due to oil compared with CK. Compared with CK, cows fed oil had lower ($p < 0.05$) cellulolytic bacteria (3.25×10^8 vs. 4.66×10^8 CFU/mL) and protozoa (9.04×10^4 vs. 12.92×10^4 CFU/mL) colony counts. Proteolytic bacteria (7.01×10^8 vs. 6.08×10^8 CFU/mL) counts, however, were greater ($p < 0.05$) in response to oil compared with CK. Among oil treatments, the amount of *B. fibrisolvans*, *F. succinogenes*, and *R. flavefaciens* in ruminal fluid (measured by real-time PCR) was substantially lower ($p < 0.05$) due to oil supplementation primarily when LOC2 was fed. *R. albus* concentration decreased by an average of 40% regardless of oil level or type. Overall, results indicate that some ruminal microorganisms, except proteolytic bacteria, are more susceptible to dietary PUFA supplementation above 2% of DM, particularly when linolenic acid-rich oils are fed. Dietary oil effects on ruminal fermentation parameters seemed associated with the profile of ruminal microorganisms.

Key Words: Soybean Oil, Linseed Oil, Rumen Fermentation

T206 Effects of soybean oil and linseed oil supplementation on digestibility of nutrient and milk composition in dairy cows. D. P. Bu, Z. Y. Hu, J. Q. Wang^{*}, S. L. Yang, D. Li, H. Y. Wei, and L. Y. Zhou,

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The objectives were to examine the effects of dietary supplementation of soybean and linseed oil alone or in combination on intake, apparent ruminal digestibility, and total tract digestibility of DM, OM, NDF, ADF, milk production and composition in dairy cows. Four primiparous Holstein cows with permanent ruminal cannulas were randomly assigned to control (CK, 60:40 forage to concentrate) or CK with 4% soybean oil (LOC1), 4% linseed oil (LOC2), or 2% soybean oil plus 2% linseed oil (LOC3) in a 4 × 4 Latin square with 12-week periods. Forage and concentrate mixtures were fed at 0800 and 2000 h daily. The results indicated that intake, apparent ruminal digestibility, and total tract digestibility of DM, OM, NDF, ADF were not affected by the oil supplementation ($P > 0.05$), however the fat supplement tended to reduce the digestibility of DM, OM, NDF, ADF on rumen and total tract ($P > 0.05$). Cows fed diets with fat supplementation did not alter milk production, milk Lactose and milk protein percentage or production ($P > 0.05$). Milk fat percentage, however, numerically decreased for cows fed diets supplemented with fat compared with that for cows fed the control diet (3.45% vs. 3.21%; $P < 0.01$). Cows fed supplemented fat had lower concentration of C16:0 and C16:1 ($P < 0.01$), but higher concentration of C18:0, trans-18:1, cis-18:1, C18:2, and C18:3 ($P < 0.01$) than did cows fed the control diet. The proportions of cis9, trans11 CLA were increased by 236%, 156% and 176% in LOC1, LOC2 and LOC3 treatments compared with cows fed control diet, respectively. Results showed fat supplementation (4% of diet DM) in dairy cows appeared to have a negative influence on rumen and total tract digestibility, but did not affect milk production, milk Lactose and milk protein percentage or production.

Key Words: Soybean Oil, Linseed Oil, Digestibility

T207 Effect of dietary linoleic acid and forage level on conjugated linoleic acid content in plasma and milk. D. P. Bu, J. Q. Wang^{*}, S. J. Liu, H. Y. Wei, and L. Y. Zhou, State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, P. R. China.

The objective of the study was to examine the effect of dietary linoleic acid (LA) and forage level on conjugated linoleic acid (CLA) content in plasma and milk. Twenty-four Chinese Holstein dairy cows, 117.6 ± 52 d in milk and 23.6 ± 4.63 kg/d milk were allocated to four treatments arranged in a 2 × 2 factorial design. Four treatments were a high forage (60% of dry matter basis) diet without LA (HFC), a high forage (60%) diet with LA (HFLA), a low forage (40%) diet without LA (LFC), or a low forage (40%) diet with LA (LFLA). LA was added through sunflower oil (contained 59% LA) by replacing the corn in the diet. Diets were isonitrogenous (average of 16.5%) and were fed as a total mixed ration 3 times a day. Milk yields were recorded twice a week and milk samples were collected weekly. Measurements were made during the last 6 wk of the 9 wk experimental period. Blood samples were taken from coccygeal vein or artery at 4h postfeeding at the end of the 9 wk experimental period. Data were analyzed with animal, period, LA level, forage level and two-way interaction between LA and forage level in the model. LA intake was increased when cows were fed either LA (140.2 vs. 446.6 g/d, $p < 0.001$) or low forage diet (284.0 vs. 302.8 g/d, $P < 0.001$). Milk fat content was 3.81^a, 3.11^{ab}, 3.60^a and 2.66^b in HFC, HFLA, LFC and LFLA respectively. Percentages of 8:0 to 14:0 and 16:0 in milk fat were decreased with LA addition ($p < 0.05$) Dietary forage

level did not alter de novo fatty acids (8:0 to 12:0), 14:0 and 16:0. Percentage of t11-C18:1 in plasma (1.50 vs. 3.69 %, $p>0.05$) and milk fat (1.12 vs. 5.67 %, $p<0.001$) were greater when cows fed LA. Despite a lack of difference in plasma percentage of c9t11 CLA, cows fed LA had greater c9t11 CLA (0.69 vs. 4.08 %, $p<0.001$) in milk fat. Overall, increasing dietary LA level decreased short and medium-chain fatty acids ($P < 0.05$) and increased ($P < 0.001$) t11-C18:1 or c9t11 CLA in milk fat. However, there was no interaction between forage level and LA addition on percentage of t11-C18:1 or c9t11 CLA in plasma and milk fat under present experiment condition.

Key Words: Forage Level, Linoleic Acid, Conjugated Linoleic Acid

T208 Milk fatty acid composition of dairy cows fed increasing amounts of linseed oil. C. Benchaar^{*1}, M. Eugène¹, C. Côrtes¹, A. V. Chaves¹, H. V. Petit¹, T. A. McAllister², A. D. Iwaasa³, and P. Y. Chouinard⁴, ¹Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Sherbrooke, Quebec, Canada, ²Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada, ³Agriculture and Agri-Food Canada, Semiarid Prairie Agricultural Research Centre, Swift Current, Saskatchewan, Canada, ⁴Laval University, Quebec, Quebec, Canada.

The objective of this study was to examine the effects of increasing dietary concentrations of linseed oil (LO) on milk fatty acid (FA) composition of dairy cows. Four primiparous cows (BW=566 kg, DIM=52 d) used in a 4x4 Latin square design (28-d periods) were fed a control TMR (CTL) or a TMR supplemented (DM basis) with LO at 2% (LO2), 3% (LO3), or 4% (LO4). Milk samples were collected during the last week of each experimental period. Preplanned contrasts (PROC MIXED, SAS) were: LO vs. CTL, linear and quadratic effects of LO supplementation. Significance was declared at $P < 0.05$. Milk fat content (g/100 g of FA) of C16:0 linearly decreased (27.0, 21.0, 19.1, and 17.4% for CTL, LO2, LO3, and LO4; respectively), whereas the concentrations of C18:0 (8.11, 10.2, 11.1, and 11.3%) and *cis*-9 C18:1 (14.2, 16.8, 17.1, and 17.6%) linearly increased with LO addition. The concentrations of several intermediates of ruminal biohydrogenation of polyunsaturated FA were also higher for the CTL vs. LO and linearly decreased with LO addition; including *trans*-10 C18:1 (0.25, 0.43, 0.51, and 0.76%), *trans*-11 C18:1 (0.78, 1.54, 2.05, and 2.86%), *cis*-9-*trans*-11 C18:2 (0.36, 0.68, 0.87, and 1.22%), *trans*-11 *cis*-15 C18:2 (0.050, 0.56, 1.03, and 1.68%), and *cis*-9 *trans*-11 *cis*-15 C18:3 (0.01, 0.07, 0.10, and 0.12%). The concentration of *cis*-9-*cis*-12 C18:2 linearly decreased with LO addition (2.06, 1.99, 1.91, and 1.83% for CTL, LO2, LO3, and LO4; respectively). Milk fat concentration of *cis*-9 *cis*-12 *cis*-15 C18:3 increased as the level of LO in the diet increased up to 3% but no further increase was observed when 4% of LO was fed (0.33, 0.79, 0.86, and 0.86% for CTL to LO4; respectively). Milk fat contents of *cis*-5 *cis*-8 *cis*-11 *cis*-14 *cis*-17 C20:5 (0.044, 0.058, 0.055, and 0.051% for CTL to LO4; respectively) and *cis*-5 *cis*-7 *cis*-10 *cis*-13 *cis*-16 C22:5 (0.051%; 0.011, 0.017, 0.014, and 0.012% for CTL to LO4; respectively) were quadratically affected by LO addition. Results of this study showed that adding LO to dairy cow diets can improve the nutritive value of milk fat by enhancing the concentrations of health promoting FA such as conjugated linoleic and omega-3 FA.

Key Words: Linseed, Dairy Cow, Milk Fatty Acids

T209 Digestion, milk production, and milk composition of dairy cows fed increasing amounts of linseed oil. C. Benchaar^{*1}, M. Eugène¹, C. Côrtes¹, A. V. Chaves¹, H. V. Petit¹, T. A. McAllister², A. D. Iwaasa³, and P. Y. Chouinard⁴, ¹Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Sherbrooke, Quebec, Canada, ²Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada, ³Agriculture and Agri-Food Canada, Agriculture and Agri-Food Canada, Semiarid Prairie Agricultural Research Centre, Swift Current, Saskatchewan, Canada, ⁴Laval University, Quebec, Quebec, Canada.

The objective of this study was to examine the effects of increasing amounts of linseed oil (LO) on digestion, milk production, and milk composition of dairy cows. Four primiparous cows (BW=566 kg, DIM=52 d) used in a 4x4 Latin square design were fed a control TMR (CTL) or a TMR supplemented (DM basis) with LO at 2% (LO2), 3% (LO3), or 4% (LO4). Each experimental period consisted of 21 days of adaptation and 7 days for sample collection. Preplanned contrasts (PROC MIXED, SAS) were: LO vs. CTL, linear and quadratic effects of LO supplementation. Significance was declared at $P < 0.05$. Dry matter intake (18.9 kg/d) and total-tract digestibilities of DM (63.5%), OM (65.1%), CP (65.3%), and ADF (46.6%) were not affected by LO addition. Milk production tended ($P=0.05$) to be higher for LO diets vs. CTL and linearly increased with LO supplementation (26.1, 27.3, 27.4, and 28.4 kg/d for CTL, LO2, LO3, and LO4; respectively). Production of FCM (26.5 kg/d) was not changed by LO supplementation. Feed efficiency (kg of FCM/kg of DMI) was linearly improved by LO addition (1.33, 1.38, 1.45, and 1.46 for CTL, LO2, LO3, and LO4; respectively). Milk contents of fat (3.78%) and lactose (4.70%) were not changed by LO supplementation. However, milk protein content was lower for LO diets vs. CTL and linearly decreased with LO addition (3.41, 3.33, 3.29, and 3.22% for CTL, LO2, LO3, and LO4; respectively). Somatic cell counts were lower with LO diets vs. CTL and tended ($P=0.06$) to linearly decrease with LO addition (22, 14, 15, and 14×10^3 /mL for CTL, LO2, LO3, and LO4; respectively). Supplementation with LO had no effect on milk yields of fat (1.04 kg/d) and protein (0.90 kg/d). However, milk yield of lactose was lower with CTL vs. LO diets and linearly increased with LO supplementation (1.20, 1.28, 1.28, 1.39 kg/d for CTL, LO2, LO3, and LO4; respectively). Results from this study showed that supplementing dairy cow diets with LO at 2, 3, or 4% of dietary DM had no effect on nutrient digestibility, milk fat percentage and yield, but decreased milk protein concentration without affecting milk protein yield.

Key Words: Linseed Oil, Nutrients Digestion, Milk Composition

T210 Effects of increasing amounts of linseed oil on ruminal fermentation, protozoa counts, and forage in situ ruminal degradation in dairy cows. C. Benchaar^{*1}, M. Eugène¹, C. Côrtes¹, A. V. Chaves¹, H. V. Petit¹, T. A. McAllister², A. D. Iwaasa³, and P. Y. Chouinard⁴, ¹Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Sherbrooke, Quebec, Canada, ²Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada, ³Agriculture and Agri-Food Canada, Semiarid Prairie Agricultural Research Centre, Swift Current, Saskatchewan, Canada, ⁴Laval University, Quebec, Quebec, Canada.

The objective of this study was to examine the effects of increasing amounts of linseed oil (LO) supplementation on ruminal fermentation characteristics, protozoa counts and forage in situ ruminal degradation

in dairy cows. Four ruminally cannulated lactating cows (BW=566 kg, DIM= 52 d) used in a 4×4 Latin square design were fed a control TMR (CTL) or a TMR supplemented (DM basis) with LO at 2% (LO2), 3% (LO3), or 4% (LO4). Preplanned contrasts (PROC MIXED, SAS) were: LO vs. CTL, and linear and quadratic effects of LO supplementation. Significance was declared at $P < 0.05$. Ruminal pH (6.35), ammonia-N (12.04 mM) and total VFA concentrations (139.1 mM) were not affected by LO addition. Supplementation with LO caused a quadratic change in acetate (A) proportion (61.9, 61.4, 61.2, and 62.3% for CTL, LO2, LO3, and LO4; respectively) and linearly decreased propionate (P) proportion (21.8, 21.8, 21.2, and 20.4% for CTL, LO2, LO3, and LO4; respectively). However, no change was observed in the proportions of A and P when LO diets were contrasted against CTL. Adding LO caused a quadratic increase in A:P ratio (2.88, 2.84, 2.91, and 3.07 for CTL, LO2, LO3, and LO4; respectively), but no difference in A:P was observed when LO diets were contrasted against CTL. Butyrate proportion was lower with CTL vs. LO diets and linearly increased with LO supplementation (12.2, 12.5, 13.1, and 13.0% for CTL, LO2, LO3, and LO4; respectively). Rate of ruminal degradation of DM of timothy hay was lower with LO diets vs. CTL and linearly decreased with LO addition (4.5, 3.8, 3.7, and 2.8 %/h for CTL, LO2, LO3, and LO4; respectively). Consequently, effective degradability of DM was also lower with LO diets vs. CTL and linearly decreased with the addition of LO to the diet (51.5, 50.3, 51.2, and 48.4% for CTL, LO2, LO3, and LO4; respectively). Total protozoa numbers (10.5×10^5 /mL) were not affected by LO addition. This study showed that supplementing dairy cow diets with LO at 2, 3, or 4% of dietary DM resulted in increased A:P ratio, decreased ruminal degradability of DM, but had no effect on total protozoa numbers.

Key Words: Linseed, Dairy Cow, Ruminal Fermentation

T211 The effects of long-term lipid supplementation on milk production traits and metabolic profile in dairy goats. G. Battacone^{*1}, A. Nudda¹, P. Nicolussi², A. H. D. Francesconi¹, P. Bonelli², and G. Pulina^{1,3}, ¹Dipartimento di Scienze Zootecniche, University of Sassari, Italy, ²Istituto Zooprofilattico Sperimentale della Sardegna, Sassari, Italy, ³AGRI Sardegna, Olmedo Loc. Bonassai, Sassari, Italy.

The use of lipid supplements to alter the fatty acid composition of ruminant dairy products has increased lately. Since these supplements have a high net energy value, they can influence the production traits of animals and increase their hepatic activity. This work aimed to evaluate the effects of long-term lipid supplementation on milk yield, milk composition and blood metabolic profile in dairy goats. Forty crossbreed dairy goats were divided into 2 iso-productive groups: one was fed the control diet (CON) and the other group was supplemented with 200 g of extruded linseed (LIN), which supplied 70 g of fat per day per head. The trial lasted 8 weeks. Once a week milk yield was recorded and milk samples were collected. Every two weeks blood samples were collected and analyzed for total bilirubin, creatinine, glutamic oxaloacetic transaminase, glutamic pyruvic transaminase, gamma glutamyl transpeptidase, alkaline phosphatase, total protein and urea nitrogen. Milk yield was about 15% higher in the LIN group than in the CON group (2369 vs. 2049 g/d; $P < 0.01$). LIN supplement increased milk fat content (3.77 vs. 3.33%; $P < 0.01$) and protein content (3.1 vs. 2.9%; $P < 0.01$) content compared to the CON group. The milk fatty acid profile was markedly influenced by lipid supplementation. The blood parameters evidenced a significantly higher glutamic oxaloacetic transaminase and glutamic pyruvic transaminase activity in goats

supplemented with fat than in the control. These data suggest that dairy goats fed the studied dose of lipid supplement for a long-term period might have had their hepatic metabolic activity increased compared with goats fed no lipid.

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Key Words: Dairy Goat, Fat Supplementation, Serum Parameters

T212 Effects of feeding whole linseed to Lacaune dairy ewes on lactational performances and CLA and N3 fatty acids content of the milk. R. Casals, M. V. Pol, E. Albanell, X. Such, M. A. Bouattour*, and G. Caja, *Universitat Autònoma de Barcelona, Bellaterra, Spain.*

This study was performed to investigate in dairy ewes the effects of feeding whole linseed (WLS) on dairy performances and milk fatty acids (FA) profile, particularly conjugated linoleic acid (CLA) and n3 FA. A total of 24 Lacaune dairy ewes were blocked in 2 pens of 12 animals, and used in a cross-over design with 2 periods of 21 days each. Treatments were: 1) C (control); 2) WLS (8.0% of total DM). Diets consisted of 52% forage (dehydrated whole plant corn and dehydrated alfalfa, 1/1) and 48% concentrate. Diets were isonitrogenous (16% CP) but with different EE (C: 1.5; WLS 3.5%). The addition of WLS had no effect on dry matter intake (3.6 kg/d) and milk yield (2.26 L/d), but increased ($P < 0.001$) milk fat content (6.0 vs. 6.9%) and yield (135 vs. 154 g/d). Milk protein (5.7%) and casein (4.4%) contents remained unchanged. Milk fatty acids composition was widely modified by the treatment, since short (19.3 vs. 14.8 mg/100 mg of total FA) and medium chain FA (55.3 vs. 41.1) were decreased, while long chain FA (25.1 vs. 43.8) were increased ($P < 0.001$). The milk from ewes receiving WLS had less saturated FA (80.3 vs. 68.2) content and more unsaturated fatty acids (19.3 vs. 31.7), being increased ($P < 0.001$) both MUFA (17.9 vs. 27.9) and PUFA (1.6 vs. 3.8). The enhanced milk fat quality was also evident through the higher amounts of n3 FA (0.6 vs. 2.1, $P < 0.001$), trans vaccenic acid (0.8 vs. 1.6, $P < 0.01$) and CLA (0.6 vs. 1.0, $P < 0.01$) and the lower atherogenicity index (4.9 vs. 2.3, $P < 0.001$). In conclusion, feeding WLS to dairy ewes is a useful way to obtain milk with a healthier profile of FA.

Key Words: Dairy Sheep, Linseed, Fatty Acids

T213 Effects of high oil corn (HOC) grain supplementation on milk production and plasma metabolites in grazing dairy cows. F. Luparia, D. A. Garcarena, C. A. Cangiano, and G. A. Gagliostro*, *Instituto Nacional de Tecnología Agropecuaria, INTA, Balcarce, Buenos Aires, Argentina.*

The effect of HOC (6.6% ether extract) vs conventional corn (CC, 2.25% ether extract) was evaluated in 44 Holstein cows in early lactation in a 2 x 2 factorial arrangement of two levels (4 and 8 kg/cow/d) and two genotypes of corn grain. During the first 17 days of lactation, cows were fed pasture ad-libitum, 4 kg/d of CC corn grain, 2 kg/d soybean meal and 0.2 kg/d of a mineral-vitamin premix. After a covariate period (8 to 17 DIM), herbage allowance was fixed at 11 and 17 kg pasture DM/cow/d for treatments with 8 and 4 kg of grain respectively. Supplements were thoroughly consumed by cows. Pasture intake averaged 12.2 and 9.1 kg DM/cow/d when cows consumed 4 and 8 kg of grain respectively. After 3 adaptation weeks, milk production was recorded daily and milk

composition was measured two days a week during 6 additional weeks. Body weight (BW) and body condition score (BCS) were recorded weekly. Blood was sampled at 10, 40 and 70 days postpartum. Data were analyzed as a completely randomized design with repeated measures adjusted by covariate. Milk yield (22.8 kg/d) and FCM (19.9 kg/d) did not differ ($P>0.05$). Milk composition was not affected by level of corn grain. HOC increased ($P<0.01$) milk fat content (32.5 vs 30.3 g/kg). Milk protein content was numerically increased ($P<0.18$) with HOC feeding (32.1 vs 31.3 g/kg). The efficiency of milk to cheese yield (kg of cheese/100 kg milk) was significantly ($P<0.02$) improved by HOC (9.04 vs. 8.69). Milk fat (0.715 kg/d) and milk protein yields (0.723 kg/d), changes in BW gain (0.51 Kg/d) and in BCS (-0.025) did not differ. Plasma concentrations of glucose (60.8 mg/dL), urea (22.8 mg/dL), triacylglycerides (214 mg/dl), cholesterol (124 mg/dl), NEFA (606 meq/L), insulin (0.9 ng/ml) and IGF-1 (211.7 ng/ml) where not affected by corn level or genotype. In spring pastures milk production was not affected by corn level or genotype but HOC improved fat and protein concentration and the efficiency of milk to yield cheese.

Key Words: High Oil Corn, Milk Composition, Grazing Dairy Cows

T214 Effects of high oil corn (HOC) on milk fatty acid composition in grazing dairy cows in early lactation. F. Luparia¹, P. Pellegrini², A. Rodríguez¹, D. A. Garciarena², and G. A. Gagliostro*¹, ¹Instituto Nacional de Tecnología Agropecuaria, INTA, Balcarce, Buenos Aires, Argentina, ²Instituto Nacional de Tecnología Industrial, INTI, Buenos Aires, Argentina.

The effect of high oil corn (HOC, 6.6% ether extract) vs conventional corn (CC, 2.25 % ether extract) on milk fatty acid (FA) composition was evaluated in 44 Holstein cows in early lactation in a 2 × 2 factorial arrangement of two levels (4 and 8 kg/cow/d) and two genotypes of corn grain.

During the first 17 days of lactation, cows were fed pasture ad-libitum, 4 kg/d of CC, 2 kg/d soybean meal and 0.2 kg/d of a mineral-vitamin premix. From day 17 postpartum, herbage allowance was 11 and 17 kg pasture DM/cow/d for treatments with 8 and 4 kg of grain respectively. Supplements were thoroughly consumed by cows. Pasture intake averaged 12.2 and 9.1 kg DM/cow/d when cows consumed 4 and 8 kg of grain respectively. At day 40 postpartum, milk FA composition was determined by GLC. The model used included corn genotype, corn level and interaction. Significant genotype × corn level interaction was not detected. The concentration of short (4.09 g/100g FA), medium (37.81) and long chain (50.26) FAs were not affected. The concentration (g/100g FA) of the hypercholesterolemic fraction of milk fat (C12:0, 2.01; C14:0, 7.84 and C16:0, 22.97) and the atherogenicity index of milk (1.66) were not affected. Concentration of vaccenic acid (VA, trans-11 C18:1) in milk fat resulted higher ($P<0.01$) when cows consumed 4 kg/d (3.17 g/100g FA) instead of 8 kg/d of corn grain (2.78 g/100g FA). Conjugated linoleic acid (CLA, 9c, 11t C18:2) tended ($P<0.08$) to be higher when cows consumed 4 kg/d (1.03 g/100g FA) instead of 8 kg/d (0.94 g/100g FA) of corn grain. The higher concentration of VA (+ 0.39 g/100 g FA) and cis-9, trans-11 C18:2 (+ 0.09 g/100 g FA) at the lower level of corn grain were probably explained by the higher pasture intake and pasture/corn grain ratio in the total diet. Supplementary HOC feeding did not induce changes in milk fatty acid profile of grazing dairy cows when pasture intake represented 50.1 to 69.5 % of total DMI.

Key Words: High Oil Corn, Conjugated Linoleic Acid, Grazing Dairy Cows

T215 Effects of dietary docosahexaenoic acid and free linoleic acid supplementation on fatty acid ratio in milk fat from dairy cows. S. J. Liu, J. Q. Wang*, D. P. Bu, S. Liang, L. Liu, H. Y. Wei, and L. Y. Zhou, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

The objective of this study was to evaluate fatty acid ratio in milk and milk composition from dairy cows supplemented with dietary docosahexaenoic acid (DHA) and free linoleic acid (LA). Four dairy cows with ruminal, ileac and duodenal fistulas were randomly assigned to control (CK, without additional oil supplement) or basal diet with 2.45% LA (LA), 2.45% LA plus 0.45% DHA (LA + DHA) and 0.45% DHA (DHA) in a 4 × 4 Latin square with 12-wk durational periods. Milk samples were collected on d 20 and d 21 of each experimental period and pooled for each animal. Pooled milk samples were analyzed milk composition and milk fatty acid profiles. Separation of fatty acids was achieved by gas chromatography. All data were analyzed using the MIXED procedure of SAS 8.2. The significance was declared at $p < 0.05$. Compared with CK, milk yield and milk fat content decreased when DHA was supplemented, but they did not differ among four treatments ($P>0.05$). Tricosanoic acid content of milk fat in DHA treatment increased, while total saturated fatty acid concentration did not change. In contrast to CK, total polyunsaturated fatty acid was improved by 100% in milk fat from combinational addition of LA and DHA ($P < 0.05$). In addition, saturated fatty acids to unsaturated fatty acids ratio in milk fat decreased ($P < 0.05$) from 3.18 in CK to 1.24 in LA treatment, while monounsaturated to polyunsaturated fatty acid ratio decreased ($P < 0.05$) from 5.94 in CK to 3.00 in DHA treatment. Taking together, our study indicated that fatty acid ratio was changed by dietary LA and DHA supplementation.

Key Words: Docosahexaenoic Acid, Free Linoleic Acid, Milk Fat

T216 Effects of rumen-protected fat feeding on glucose metabolism in high-yielding dairy cows. H. M. Hammon*, A. K. Langhof, K. Duske, F. Schneider, and C. C. Metges, *Research Institute for the Biology of Farm Animals (FBN), Dummerstorf, Germany.*

In dairy cows, feeding rumen-protected fat (RPF) influences milk production by increasing dietary energy density but at the same time, affects glucose metabolism. As glucose availability is important for milk production, the present study has investigated effects of RPF feeding on glucose metabolism in high-yielding dairy cows. Dairy cows (98 DIM; 2nd lactation) were fed for four weeks either a diet containing 5.6 % RPF with Ca-soaps mainly of C16:0 and C18:1 (F) or a control diet (C) based on corn starch (n=9 per group). Feed intake and milk yield were measured daily. Blood samples were taken once a week to measure plasma triglyceride (TG), NEFA, glucose, insulin, and glucagon concentrations and during a glucose tolerance test (GTT; 1 g/kg BW^{0.75} i.v.) after 12 h without food at the end of the study. Areas under the concentration curves for glucose and insulin were calculated. After slaughtering, liver samples were collected for quantification of mRNA levels of pyruvate carboxylase (EC 6.4.1.1), cytosolic phosphoenolpyruvate carboxykinase (EC 4.1.1.32), and glucose 6-phosphatase (G6-Pase; EC 3.1.3.9) by real-time RT-PCR. Data were analyzed using the Mixed Model or GLM of SAS, respectively, with diet and time or only diet as fixed effects. DMI, but not energy intake was slightly lower ($P < 0.05$) in F than C and plasma concentrations of TG and NEFA were higher ($P < 0.05$) in F than C. Plasma insulin concentrations decreased ($P < 0.05$), but the glucagon to insulin ratio increased with RPF-feeding.

During GTT, basal glucose concentrations were lower ($P < 0.05$) and basal glucagon concentrations tended to be higher ($P < 0.1$) in F than C. Hepatic mRNA levels of G6-Pase mRNA were lower ($P < 0.05$) in F than C and were positively related ($P < 0.01$) to basal plasma glucose. Feeding RPF did not affect milk yield, but reduced basal plasma glucose and hepatic gene expression of G6-Pase that might affect glucose availability for milk production.

Key Words: Dairy Cow, Fat Feeding, Glucose Metabolism

T217 Feeding rumen-protected fat (RPF) during the dry period: Effects on milk production and glucose metabolism in high-yielding dairy cows. H. M. Hammon*, K. Duske, A. K. Langhof, F. Schneider, H. M. Seyfert, and C. C. Metges, *Research Institute for the Biology of Farm Animals (FBN), Dummerstorf, Germany.*

The objective of the study was to determine effects of rumen-protected fat (RPF) in diets during late lactation and dry period on milk production and glucose metabolism after parturition in high-yielding dairy cows. Cows ($n=18$) were divided into 2 feeding groups 12 wk before expected calving and were fed either starch-based control diets (SD) or diets containing 3–5% RPF (FD) during late lactation (wk -12 to -9) and during far-off (wk -8 to -4) and close-up (wk -3 to -1) dry period. Diets were calculated to be isonitrogenous and isoenergetic. After parturition, all cows received a starch-based diet up to 98 DIM. Feed intake and milk yield were recorded daily. Plasma concentrations of glucose, NEFA, insulin, and glucagon were measured in blood samples taken at selected d before and after calving. Liver biopsies were taken 10 d before and at 1, 10, 28, and 95 d after calving to measure glycogen and fat content and mRNA levels of pyruvate carboxylase (PC, EC 6.4.1.1), cytosolic phosphoenolpyruvate carboxykinase (PEPCK; EC 4.1.1.32) and glucose 6-phosphatase (G6-Pase; EC 3.1.3.9). Data were analyzed by the Mixed Model of SAS with diet and time as fixed effects. DMI was higher ($P < 0.05$) during the far-off period in SD than FD. Milk yield was higher ($P < 0.05$) in SD than FD. Plasma glucose concentrations were lower ($P < 0.05$) in FD than SD during transition to lactation. Plasma glucagon tended to be higher ($P < 0.1$) in FD than SD before parturition. In liver, glycogen content decreased and fat content as well as PC, PEPCK and G6-Pase mRNA levels increased with onset of lactation, irrespective of prepartum feeding. PC mRNA levels were positively related to fat, but negatively related to glycogen content ($P < 0.05$, resp.). Feeding RPF during the dry period decreases milk yield and plasma glucose around parturition, but barely affect hormonal levels as well as hepatic glucose and lipid metabolism.

Key Words: Dairy Cow, Prepartum Feeding, Glucose Metabolism

T218 Influence of sunflower oil supplementation on milk conjugated linoleic acid and mammary tissue stearoyl-CoA desaturase, lipoprotein lipase, and acetyl-CoA carboxylase gene expression in Xinong Saanen goats. D. P. Bu¹, J. Q. Wang^{*1}, H. Y. Wei¹, L. Y. Zhou¹, and J. J. Loo², ¹*Institute of Animal Science, Chinese Academy of Agriculture Sciences; State Key Laboratory of Animal Nutrition, Beijing, China,* ²*University of Illinois, Urbana.*

This study examined the effect of supplemental sunflower oil (SFO) on milk fat trans-11-18:1 (vaccenic acid; VA) and cis-9 trans-11 conjugated linoleic acid (CLA) concentration and mRNA expression of stearoyl-

CoA desaturase (*SCD*), lipoprotein lipase (*LPL*), and acetyl-CoA carboxylase (*ACACA*) in mammary tissue from lactating goats. Twelve Xinong Saanen goats (36 ± 3 DIM) were fed a basal diet (CTL, 50:50 forage:concentrate) or CTL supplemented with 4% SFO in a cross-over design with 4 wk experimental periods. Mammary percutaneous biopsies were collected on d 27 of each experimental period. DMI (1.76 vs 1.84 kg/d) and milk yield (1.35 vs 1.63 kg/d) were greater ($P < 0.05$) with SFO. However, SFO resulted in lower ($P < 0.05$) milk fat % (3.70% vs. 4.33%). Concentrations of VA (1.7% to 5.7% of total fatty acids) and cis-9 trans-11 CLA (0.55% to 1.4%) in milk fat increased by ~3-fold due to feeding SFO. The mRNA abundance of *LPL* and *ACACA* in mammary tissue was 75% and 60% greater ($P < 0.05$) with SFO but *SCD* mRNA was 26% lower ($P < 0.05$). Increased supply of dietary lipid might explain greater *LPL* mRNA in mammary from goats fed SFO. Ruminant biohydrogenation of SFO likely resulted in production of trans-18:1 and/or CLA isomers that might have reduced *SCD* mRNA abundance. Despite the negative effect on *SCD* by supplemental SFO, greater supply of VA ensured that cis-9,trans-11-CLA synthesis in mammary tissue increased.

Key Words: Lactation, Milk Fat, Lipogenesis

T219 Feed intake, apparent digestibility, and milk composition of dairy cows fed whole flaxseed or/and Ca-salts of flaxseed oil. C. Côrtes^{*1}, D. C. Silva^{1,2}, R. Kazama^{1,2}, N. Gagnon¹, C. Benchaar¹, G. T. Santos², L. M. Zeoula², and H. V. Petit¹, ¹*Agriculture and Agri-Food Canada, Sherbrooke, Quebec, Canada,* ²*Universidade Estadual de Maringá Brazil and CNPq Brazil, Maringá, Paraná, Brazil.*

The objective of this study was to examine the effects of dietary whole flaxseed and Ca-salts of flaxseed oil on feed intake, apparent digestibility, and milk composition of dairy cows. Four lactating Holstein cows (BW = 602 kg; DIM = 64 d) fitted with ruminal cannulae were used in a 4 x 4 Latin square. Each experimental period consisted of 21 d of adaptation and 7 d of data collection. Cows were milked twice a day at 0730 and 1930 h. All cows were fed twice daily (0830 and 1530 h) for ad libitum intake (10% refusals). Four total mixed rations were formulated and contained no flaxseed product (CO), 5% (DM basis) whole flaxseed (WF), 2% Ca-salts of flaxseed oil (CF), or a mixture of 2.5% whole flaxseed and 1% Ca-salts of flaxseed oil (MF). Dry matter intake, apparent digestibility of DM, and milk composition were analyzed using the MIXED procedure of SAS. Tukey-Kramer multiple-comparison test was applied to separate means. Significance was declared at $P < 0.05$. Dry matter intake (DMI) and apparent digestibility of DM (DMD) were not affected by treatments. Milk yield and milk concentrations of fat and lactose were similar among treatments. Milk protein percentage tended ($P = 0.09$) to be higher for cows fed WF than for those fed CF (3.32% vs. 3.17%), however milk protein yield was similar ($P = 0.15$). This study suggests that feeding whole flaxseed or/and Ca-salts of flaxseed oil have no negative effect on cow performance.

Table 1.

	CO	WF	CF	MF	SEM	<i>P</i> -value
DMI, kg/d	22.1	22.7	21.6	21.5	0.42	0.32
DMD, %	64.7	64.1	65.5	65.2	0.59	0.47
Milk yield, kg/d	31.5	32.6	32.5	32.3	0.45	0.42
Milk fat, %	3.00	2.71	2.32	2.67	0.223	0.37
Milk protein, %	3.32	3.36	3.17	3.26	0.034	0.09
Milk lactose, %	4.74	4.79	4.80	4.80	0.028	0.54

Key Words: Dairy Cows, Flax Product, Milk/Digestibility

T220 Effect of dietary flax products on concentration of the mammalian lignan, enterolactone, in ruminal fluid, plasma, milk, and urine of dairy cows. N. Gagnon^{*1}, C. Côrtes¹, D. C. da Silva^{1,2}, R. Kazama^{1,2}, G. T. dos Santos², L. M. Zeoula², and H. V. Petit¹, ¹*Agriculture and Agri-Food, Sherbrooke, QC, Canada*, ²*Universidade Estadual de Maringá, Brazil, CNPq Brazil*.

Four rumen fistulated lactating Holstein cows were used in a 4 × 4 Latin square design to study the effects of dietary addition of flax products on concentration of the mammalian lignan, enterolactone (EL) in ruminal fluid, urine, plasma, and milk. All cows were fed the same diet for ad libitum intake. Flax hulls (1800 g/d) and flax oil (400 g/d) were placed in the rumen three times daily and/or infused for 23 h a day in the abomasum. Treatments were: 1) oil and hulls placed in the rumen + abomasal infusion of water (RUM); 2) oil and hulls infused in the abomasum (ABO); 3) oil infused in the abomasum and hulls placed in the rumen (ABORUM); and 4) oil placed in the rumen + hulls infused in the abomasum (RUMABO). Water was the carrier for infusion of hulls (ABO and RUMABO) and the same amount of water was infused in the abomasum when hulls were placed in the rumen (RUM and ABORUM). Experimental periods consisted of 21 d with 15 d of adaptation. Milk samples were collected twice daily from d 16 to 20 and pooled for lignan assay. Blood was withdrawn from the jugular vein 6 h postfeeding on d 20. Rumen contents were sampled on d 21 at 0, 2, 4, and 6 h after the morning meal and urine samples were taken 2 h postfeeding. Concentration of EL in ruminal fluid was determined at 0 h (baseline) and on samples pooled for 2, 4, and 6 h. Concentrations of EL in urine ($p < 0.001$), milk ($p = 0.001$), and plasma ($p = 0.04$) were significantly higher when hulls were placed in the rumen than when they were infused in the abomasum. Adding flax oil in the rumen or abomasum had no effect on EL concentrations in urine, milk, blood, and rumen. This study suggests that the rumen plays an important role in the metabolism of flax lignans and that urine and milk are good indicators of the mammalian lignan, EL, metabolism in dairy cows fed flax products.

Key Words: Enterolactone, Rumen, EIA

T221 Effect of four levels of lauric acid on ruminal protozoa, milk production and composition in dairy cows. A. P. Faciola^{*1}, G. A. Broderick², A. N. Hristov³, and J. A. Pires¹, ¹*University of Wisconsin, Madison*, ²*U. S. Dairy Forage Research Center, Madison, WI*, ³*Penn State University, University Park*.

Ruminal protozoa (RP) are the main contributors to bacterial protein turnover in the rumen; therefore, reducing RP may improve N utilization.

Medium-chain saturated fatty acids such as lauric acid (C12:0) have been shown to suppress RP. We tested lauric acid (LA) as a practical defaunating agent and assessed the effects of partial defaunation on N utilization, fermentation patterns, nutrient digestibility, milk production and milk composition. Forty-eight Holstein cows (8 fitted with ruminal cannulae) were blocked by DIM into 12 blocks of four cows (2 blocks of cows with ruminal cannulas) and randomly assigned within blocks to four balanced 4 X 4 Latin square diet sequences. The basal diet contained (DM basis) 29% alfalfa silage, 36% corn silage, 7.5% high-moisture corn, 6% soybean meal, 8% dry molasses, 12% ground corn, vitamin and mineral premix, 15.5% CP and 30% NDF. Diets differed in LA content: A) zero, B) 240, C) 480, and D) 720g/d. Each experimental period consisted of 21d for adaptation plus 7d for data collection. Data were analyzed using proc mixed in SAS. The results are reported in the table below. LA was effective in reducing RP; however, it also decreased DMI. LA fed at 240 g/d did not reduce yield of milk or FCM; however, higher levels were detrimental to milk production and composition.

Table 1.

Item	A	B	C	D	SEM	<i>P</i> > <i>F</i>
DMI, kg/d	24.4a	22.7b	20.7c	18.6d	0.5	<0.01
Milk yield, kg/d	33.6a	32.7ab	31.3b	28.8c	1.0	<0.01
3.5% FCM, kg/d	34.7a	33.5a	29.8b	26.6c	1.0	<0.01
Fat, %	3.7a	3.7a	3.2b	3.2b	0.1	<0.01
Fat yield, kg/d	1.2a	1.2a	1.0b	0.9c	0.04	<0.01
Protein yield, kg/d	1.02a	0.95b	0.94b	0.84c	0.03	<0.01
Lactose, %	4.85a	4.75b	4.65c	4.56d	0.04	<0.01
SNF, %	8.84a	8.68b	8.62bc	8.55c	0.06	<0.01
SNF yield, kg/d	2.92a	2.75b	2.66b	2.34c	0.08	<0.01
MUN, mg/dL	13.79c	14.68b	16.01a	16.69a	0.29	<0.01
Protozoa, x 10 ⁶ cells/ml	7.1a	5.1b	3.6c	2.5d	0.2	<0.01

Key Words: Lauric Acid, Protozoa, Dairy Cows

T222 Effects of differential supplementation of calcium salts of fatty acids (CSFAs) on dairy cows. F. T. Silvestre^{*}, T. S. M. Carvalho, J. E. P. Santos, C. R. Staples, and W. W. Thatcher, *University of Florida, Gainesville*.

Effects of CSFAs (Virtus Nutrition) on milk yield (MY), cervical discharge (CD), metabolic status, pregnancy rates (PR) and losses (PL) at 1st and 2nd AI were evaluated. Cows were randomly allocated to diets at -27 days postpartum (dpp; PO [Palm oil, 47% C16:0] vs SO [Safflower oil, 64% C18:2n-6]) and fed until 30dpp when within each diet further allocated to either PO or FO (Fish oil, 11% of C20:5n-3 + C22:6n-3) and fed until 160dpp. CSFAs were fed at 1.5% of the diet. Contrasts were PO vs SO, PO vs FO and interaction. CD (clear/flacks, mucopurulent and purulent) was evaluated at 8dpp (n=1118). Plasma samples were collected 3x/weekly from 0 to 35dpp for metabolite measurements (n=32). At 43dpp cows initiated a presynch comprised of PGF_{2α} 14d apart, followed by Ovsynch 14d later for 1st AI. All cows received a CIDR device at 18d after 1st AI, followed in 7d by CIDR removal and GnRH injection. At 32d after 1st AI, cows were ultrasounded (US) for pregnancy. Non-pregnant cows received PGF_{2α}, GnRH 56h later, a 2nd AI at 72h, and US at 32d after 2nd AI. PL was evaluated at 60d of pregnancy. Plasma progesterone at 2nd PGF_{2α} and

start of Ovsynch determined cyclicity. Plasma NEFAs, BHBA, glucose, BUN, and frequency of CD did not differ between PO and SO cows. Cyclicity was not affected by diets (80%, n=1117). PR for 1st AI at 32d (37.4%, n=1055) and 60d (33.3%, n=1048) was not affected by diets, but PL was lesser ($P<0.05$) in FO (6.3%, n=190) vs. PO (13.6%, n=198). PR for 2nd AI was higher at 32d ($P<0.05$) and 60d ($P<0.05$) in FO (36.9% [n=295], 34.4% [n=293]) vs. PO (27% [n=309], 23.7% [n=303]), respectively; PL was not affected by diets (6.5%, n=185). Overall PR was 54.5% (n=1084) at 32d and higher ($P<0.05$) at 60d in the FO (52.8%, n=528) vs. PO (45.4%, n=541). Overall PL was lesser ($P<0.05$) in FO (6%, n=297) vs. PO (12%, n=279). Monthly MY was greater ($P<0.02$) in SO (41.9kg, n=532) vs. PO (41.2kg, n=534). Feeding differential CSFAs during transition and breeding periods can benefit fertility and milk production of dairy cows.

Key Words: Fatty Acids, Reproduction, Milk Yield

T223 Effects of rumen protected CLA supplemented to dairy cows in late pregnancy and early lactation on milk yield and some milk features. G. Bertoni*, E. Trevisi, M. G. Maianti, and A. Gubbiotti, *Istituto Di Zootecnica, Universita' Cattolica Del Sacro Cuore, Piacenza, Italy.*

Dairy cows in the transition period suffer for the negative energy balance (NEB), which causes some metabolic diseases, as well as lower fertility. Conjugated linoleic acid (CLA) is quoted to reduce milk fat content and therefore the energy output that could alleviate the NEB. Nevertheless, the great change of milk composition could have some consequences on the creaming activity and overall on the cheese making traits, both of great importance in Italy. To evaluate the effects of CLA on milk traits, 8 dry cows (kept in a tied barn) were divided in two homogeneous groups receiving 20 g/d of rumen protected CLA (equivalent to 100 g of Luta-CLA® 20P, BASF, Germany) or 100 g/d of a mixture of rumen protected fats. Supplementation began approximately 30 days before calving and lasted 28 days after it. Besides daily milk yield, morning milk samples were taken two times a week for the first 3 months of lactation. Milk yield was numerically lower (45 vs 47 kg/d at 28th DIM) in the CLA cows, but the main results during the first month of lactation are those regarding milk composition and its technological traits: CLA has reduced milk fat content (2.8 vs 3.6%, $P<0.05$ at 28th DIM) and its creaming activity (61 vs 68%, N.S., average of 3rd and 4th week). On the contrary, the milk protein content of CLA supplemented cows was slightly higher and the curd firmness was increased (26 vs 21 mm, N.S., average of 3rd and 4th week) despite a similar clotting time. It is worthwhile that one-two weeks after the end of CLA supplementation, the above differences disappeared. The overall results suggest that CLA feeding at the end of pregnancy and in first month of lactation can contribute to lower the milk energy output. Nevertheless, the reduction of milk fat content could impair the fat creaming activity, which is essential for some typical cheeses (i.e. parmesan), although the short period of CLA use could minimize the risk.

Key Words: Conjugated Linoleic Acid, Milk Traits, Transition Period

T224 Energy balance indexes and blood changes of dairy cows supplemented with rumen protected CLA in late pregnancy and early lactation. E. Trevisi*, A. Ferrari, F. Piccioli-Cappelli, and G.

Bertoni, *Istituto Di Zootecnica, Universita' Cattolica Del Sacro Cuore, Piacenza, Italy.*

Transition dairy cows suffer for the negative energy balance (NEB) and for inflammatory-like conditions. Both can negatively affect DMI and incidence of metabolic diseases as well as fertility. Conjugated linoleic acid (CLA) is quoted to reduce milk fat content and hence the severity of NEB, but also to attenuate inflammatory phenomena. To evaluate the effects of CLA on DMI, BCS and metabolic profile in the transition period, 8 dry cows (kept in a tied barn) were divided in two homogeneous groups receiving 20 g/d of rumen protected CLA (equivalent to 100 g of Luta-CLA® 20P, BASF, Germany) or 100 g/d of a mixture of rumen protected fats (CTR). Supplementation began approximately 30 days before calving and lasted 28 days after it. Besides health status, daily DMI and milk yield, cows were checked weekly for body weight and BCS. Moreover, blood samples were taken two times a week when dry and for the first 90 days in milk (DIM), but daily 10 days before and after calving. The results suggest that a supplement of CLA improves the blood indexes of energy metabolism: glucose, NEFA and BHB (0.8 vs 1.6 mmol/l of CTR at 1-5 DIM; $P<0.01$). Moreover, it reduce the urea level, lower at 23-27 DIM (4.0 vs 5.2 mmol/l; $P<0.1$). The consequences of inflammatory conditions, that typically occur at calving time, appear also smaller after calving: e.g. CLA cows have showed higher levels of some negative acute phase proteins like lipoprotein as cholesterol (5.0 vs 4.3 mmol/l, $P<0.05$ at 20-30 DIM), albumin (36.3 vs 34.4 g/l, $P<0.1$ in the first 28 DIM) and thiol groups (less important reduction after calving). These changes agree with some other results: slightly lower rectal temperature around calving, higher DMI (19.3 vs 18.2 kg/d on average in first 28 DIM) and slightly lower reduction of body weight and BCS (0.29 vs 0.37 points). Thus CLA supplementation seems to improve some aspects of dairy cows transition: e.g. energy balance and inflammatory conditions.

Key Words: Conjugated Linoleic Acid, Blood Indexes, Transition Period

T225 Effect of different levels of fish oil and canola oil on milk production and composition of high producing Holstein dairy cows in early lactation. T. Vafa*, A. Naserian, A. Heravi Moussavi, M. Danesh Mesgaran, and R. Valizadeh, *Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran.*

The aim of this study was to evaluate the effect of different levels of canola oil or/and fish oil supplementation on dry matter intake (DMI), and milk production and composition in early lactating Holstein dairy cows. Eight multiparous early lactation Holstein cows (42±12 DIM, 40±6 kg daily milk yield) were fed a total mixed ration supplemented with either 0% oil (Control), 2% canola oil (CO), 2% fish oil (FO), or 1% canola oil + 1% fish oil (CoFo), according to a double 4 × 4 Latin square design. Each period lasted 3 wk; experimental analyses were restricted to the last week of each period. Diets were formulated to be isonitrogenous using NRC 2001. Cows were housed in tie stalls and fed the TMR two times a day to allow 5 to 10% orts (as-fed basis). Cows were milked 3 times per day and yields were recorded. Milk samples were collected from each milking on 1 d per wk and composited for analysis of fat, protein, and lactose. Data were analyzed as a replicated 4 × 4 Latin square using the GLM procedure of SAS (2001). The model included effects caused by diet, period, and cow. Least squares means are reported throughout, and significance was declared at $P<0.05$. Diet had no effect on DMI (24.92, 25.60, 23.70, and 25.84 ± 0.79 kg/d; for control,

CO, FO, and CoFo, respectively). Milk production was similar among the groups (34.41, 34.15, 32.93, and 34.55 ± 0.84 kg/d, respectively). Milk fat content (2.87, 2.70, 2.45, and 2.89 ± 0.21%, respectively), milk protein content (2.88, 2.86, 2.92, and 2.89 ± 0.07%, respectively), and milk lactose content were all similar among the diets. The results of this study demonstrated that the canola oil or/and fish oil supplementation in the diet of early lactation cows had no apparent effect on the DMI, and milk production and composition.

Key Words: Dairy Cow, Canola Oil, Fish Oil

T226 Effects of degree of unsaturation of supplemental dietary fat on ruminal fermentation, nitrogen metabolism, and urea nitrogen recycling in dairy cows. T. Mutsvangwa*, G. N. Gozho, and D. Kiran, *University of Saskatchewan, Saskatoon, Saskatchewan, Canada.*

The objective of this study was to evaluate the effects of degree of unsaturation of supplemental dietary fat on ruminal fermentation, nitrogen metabolism, and urea-N recycling. Four Holstein cows (693 kg BW; 92 DIM) with ruminal cannulae were used in a 4 x 4 Latin square design with 21-d periods. Dietary treatments contained 0% supplemental fat (control), 3.52% canola oil, 3.52% tallow, and 1.76% canola oil + 1.76% tallow. Diets were offered twice per day as TMR made up of 55% forage and 45% barley-based concentrate. Nitrogen balance was measured from d 16 to d 20, with concurrent measurements of urea-N kinetics using a single dose intra-jugular infusion of [¹⁵N¹⁵N]-urea on d 16. Dry matter intake, milk yield and milk composition were not affected by fat supplementation; however, milk fat content tended to be lower ($P = 0.10$) for cows fed canola oil. Ruminal protozoa were 2.63 x 10⁵, 2.75 x 10⁵, 3.72 x 10⁵, and 2.82 x 10⁵ counts/ml for control, canola oil, tallow, and canola + tallow mixture, respectively. Protozoal counts were higher ($P = 0.03$) in cows receiving supplemental tallow compared to those fed the control diet. Ruminal pH, and concentrations of NH₃-N, and individual and total VFA were not affected by source of supplemental fat. Urea-N production (189.9, 178.4, 182.8, 182.3 g/d), and urea-N entering the GIT (185.3, 174.6, 180.0, 177.8 g/d) were similar for the control, canola oil, tallow, and canola + tallow diets, respectively. Fractional urea-N transfers were unaffected by treatment. Results show that the source of supplemental fat did not affect protozoa counts or change ruminal fermentation patterns and, consequently, had no impact on urea-N recycling.

Key Words: Dairy Cow, Urea Kinetics, Nitrogen Metabolism

T227 Influence of dietary fats on hepatic gene expression in transition dairy goats. A. Agazzi¹, G. Invernizzi^{*1}, A. Campagnoli¹, M. Ferroni¹, A. Galmozzi², M. Crestani², and G. Savoini¹, ¹*Department of Veterinary Science and Technology for Food Safety, Milan, Italy,* ²*Department of Pharmacological Sciences, Milan, Italy.*

The aim of the study was to evaluate the dietary fats influence on hepatic gene expression in transition dairy goats. Eighteen second parity alpine goats from wk 2 before to wk 3 after kidding were assigned to 1 of 3 dietary treatments: C (n=6) basal diet, FO (n=6) basal diet plus 47g/d of protected fish oil, PO (n=6) basal diet plus 47g/d of hydrogenated palm oil. Feed consumption, live body weight (BW), milk yield and composition were assessed weekly. Blood samples were collected on 15,

7, and 2d before, and 2, 7, 15, and 21d after kidding for ALAT, ASAT, NEFA, glucose, BHBA, and cholesterol content. Bioptic samples were obtained 7d before and 21d after kidding and analyzed for mRNA content of peroxisome proliferator-activated receptor- α (PPAR α), carnitine palmitoyltransferase I (CPT1), long chain acyl-CoA synthetase (ACSL), very-long-chain acyl-CoA dehydrogenase (ACADVL), acetyl-CoA carboxylase (ACC1) and malonyl-CoA decarboxylase (MCD) by real time Q-PCR. Data were analyzed by a mixed procedure of SAS. No effects were observed on BW, plasma metabolites and milk composition. Milk yield was increased in PO vs. C (3.65kg/d, 2.42kg/d; $P < 0.05$). Higher expression of CPT1 and ACADVL were detected in C vs. PO goats before kidding ($P < 0.05$), while on day 21 PO increased PPAR α expression as compared to C ($P < 0.05$), and increased ACSL values as compared to C and FO animals ($P < 0.01$). Hepatic gene expression in an intra-group analysis evidenced decreased values in C from pre to post kidding for ACADVL and ACSL ($P < 0.05$), while ACSL was significantly decreased after kidding in FO subjects ($P < 0.05$). No variations were evidenced in PO animals from dry period to lactation. Correlation analysis evidenced a negative feedback of PPAR α on cholesterol plasma content by 42% ($P = 0.03$). Results suggest different mechanism of action of dietary saturated and unsaturated fatty acids in transition goat on hepatic gene expression.

Key Words: Goat, Nutrigenomics, Liver

T228 Reproductive performance of cows fed rolled flaxseed on two commercial dairies. N. R. Bork^{*1}, G. P. Lardy¹, J. W. Schroeder¹, K. A. Vonnahme¹, P. M. Fricke³, K. B. Koch², M. L. Bauer¹, and K. G. Odde¹, ¹*North Dakota State University, Fargo, ND, USA,* ²*Northern Crops Institute, Fargo, ND, USA,* ³*University of Wisconsin, Madison.*

The objective of this field trial was to study the effects of supplementing early lactation dairy cows with rolled flaxseed on reproduction. We hypothesized that fatty acids in flaxseed, namely C18:3n-3, may improve reproductive performance of dairy cows. Conducted on 2 commercial dairies with cows naive to flaxseed, treatments consisted of either their existing early lactation ration (CON; n = 252) or a similar ration, equal in protein, energy and fat, re-formulated with rolled flaxseed (FLX; n = 339; 0.85 kg DM/d). Cows were assigned randomly to treatment upon leaving the fresh pen (approximately 10 d postpartum) within parity (primiparous, P or multiparous, M; P-CON, M-CON, P-FLX, M-FLX). Statistical analysis for conception rate data included all cows in the study, and was performed using a mixed model. Cow was the experimental unit and data were analyzed as a split plot with pen being the whole plot error term (random term was treatment by parity by farm). Statistical analysis for other reproductive parameters including all pregnant cows was performed with a categorical model using logistical regression. First and second-service analysis included 1422 AI services. First-service conception rates did not differ ($P = 0.27$) among treatments (P-CON = 46.8 ± 4.0%; M-CON = 34.3 ± 3.1%; P-FLX = 41.1 ± 3.1%; M-FLX = 30.0 ± 2.8%). Treatment did not interact ($P \geq 0.27$) with season of the year, breeding method (AI at estrus vs. Ovsynch and timed AI), or farm. Analysis of services per conception for pregnant cows (CON = 1.92 ± 0.12; FLX = 1.95 ± 0.12; $P = 0.87$), days to first insemination (CON = 76.6 ± 0.8; FLX = 73.9 ± 0.7; $P = 0.11$), and days open (CON = 113.5 ± 3.7; FLX = 109.9 ± 3.2; $P = 0.53$) included 591 cows and did not differ between treatments. We conclude that feeding 0.85 kg/d (DM basis) of flaxseed during early lactation does not affect reproductive performance of dairy cows.

Key Words: Flaxseed, Reproduction, Dairy Cows

Ruminant Nutrition: Methods, Models and Other

T229 Measurements of net portal flux of nitrogen (N) compounds in ruminants: First step of a meta-analysis. R. Martineau^{*1}, I. Ortigues-Marty², J. Vernet², and H. Lapierre¹, ¹*Agriculture and Agri-Food Canada, Sherbrooke, Quebec, Canada*, ²*Institut National de la Recherche Agronomique, Theix, St Genès Champanelle, France*.

A first step in developing mechanistic models of nutrient use by ruminants is to accurately predict net portal absorption (NPA) of nutrients in relation with feed intake and composition. From the FLORA database (FLux of Nutrients through the Organs of Ruminant Animals; *Reprod. Nutr. Dev.* 46:527-546), all the studies simultaneously reporting apparently digested N and NPA of NH₃, urea, and AA were selected (n = 33 publications; 40 cattle and 71 sheep treatments). It was hypothesized that differences between inputs (digested N + urea-N uptake) and outputs (NH₃-N + total AA-N) across the portal-drained viscera, called NPA residuals, should average 0 assuming that unaccounted N (e.g. salivary N, peptides, nucleic acids) sums to 0. The NPA residuals [g N/(d•kg BW)] were different from 0 at the 95% confidence level (CL). Single corrections were applied to standardize the reported observations: NPA of urea-N and NH₃-N on plasma were corrected to a blood basis (hematocrit; 25%: sheep; 27%: cattle); NPA of NH₃-N measured with the Berthelot reaction were corrected to a glutamate dehydrogenase (GDH) basis (× 1.38); and finally, NPA of α-amino-N were corrected to a total AA-N basis (× 1.35). With all corrections applied, NPA residuals were not different from 0 but variability did not improve. These results suggest that before performing a meta-analysis on reported NPA, some corrections would need to be applied to better reflect the biology and chemistry of the nutrients absorbed.

Table 1.

NPA residuals (n = 111), g N/(d•kg BW)	Mean	SD	Min	Max	95% CL
No corrections	0.092	0.118	-0.31	0.44	± 0.022
With all corrections	-0.023	0.132	-0.39	0.33	± 0.025
When single corrections are made:					
- urea-N (blood basis; 22 corrections)	0.099	0.121	-0.31	0.52	± 0.023
- NH ₃ -N (blood basis; 21 corrections)	0.073	0.135	-0.34	0.39	± 0.025
- NH ₃ -N (GDH basis; 99 corrections)	0.036	0.120	-0.39	0.38	± 0.023
- AA-N (total AA-N basis; 81 corrections)	0.047	0.116	-0.31	0.38	± 0.022

Key Words: Portal, Nitrogen, Ruminant

T230 Diversity of rumen bacteria as revealed by multivariate analysis of 16S rDNA gene sequences. K. L. Liu¹, J. Q. Wang^{*1}, D. P. Bu¹, S. G. Zhao^{1,2}, H. Y. Wei¹, and L. Y. Zhou¹, ¹*State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China*, ²*Gansu Agricultural University, Gansu, China*.

To improve our understanding of the composition of rumen microbial community and factors may affect its composition, 2023 16S rDNA

sequences with length >1200 bp were retrieved from Ribosomal Database Project II and then subject to multivariate analysis. Using 97% minimum similarity as the threshold for any pair of sequences in a operational taxonomic unit (OTU), a total of 915 bacterial OTU were identified, among them 90% represented sequences from yet uncultured species. The terminal Chaol richness estimates suggested that the rumen microbial community could consist of 1720 species. Land distribution analysis by fLAND software indicated that *Firmicutes* and *Bacteroides* were the dominant groups in rumen, accounting 91% of the total taxa. *Cytophaga-Flavobacterium-Bacteroides* (CFB) bacterium from rumen appeared to be the farthest away from the common ancestor of the division, suggesting a strong host selection pressure and co-evolution. To investigate factors may affect the composition of rumen microbial community, six 16S rDNA libraries which totaled 905 sequences were collected from database. Principal component analysis (PCA) and hierarchical clustering were performed by UniFrac. On PCA plots, libraries from cows clustered together and separated clearly with that from castrated cattle, indicating host sex as the most important factor shaping the composition of rumen bacterial community. In addition, dietary forage: concentrate ratio was identified as the second important factor. Acknowledgement: Research funded by Ministry of Science and Technology (2006BAD04A08).

Key Words: Rumen Microbial Community, 16S rDNA Gene, Multi-variate Analysis

T231 Screening of ureases from a bovine rumen metagenomic library. K. L. Liu¹, J. Q. Wang^{*1}, D. P. Bu¹, S. G. Zhao^{1,2}, Y. X. Zhu³, H. Y. Wei¹, L. Y. Zhou¹, and Z. Y. Dong³, ¹*State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China*, ²*Gansu Agricultural University, Gansu, China*, ³*State Key Laboratory of Microbial Resources, Institute of Microbiology, Chinese Academy of Sciences, Beijing, China*.

Lack of sufficient protein forage has promoted the utilization of urea as a protein supplement in ruminant forage, which could be hydrolyzed by urease secreted by ureolytic bacterium in rumen. To get more information about rumen urease gene sequence, gene cluster structure, protein structure and function, rumen contents of a Holstein cow were collected and used as raw materials to construct a metagenomic library. A series of ways to clean bacterium cells and make plugs were developed, and high molecular weight DNA fragments with the size in excess of 2 Mb were finally extracted. After digestion with *Hind* III and separated by pulse field gel electrophoresis, DNA fragment ranged from 50-100 kb were collected and ligated to pCC1BAC vector to construct the library. The metagenomic library consisted of 153, 600 clones with the total capacity estimated to be 857 Mb. To screen ureolytic active clone from the library, a urease screen agar that take advantage of the visible phenotype of urease activity was employed. Eight clones were identified as ureolytic positive. Restrictive digestion analysis and enzymatic analysis suggested a high level of diversity existed among these clones. Further study addressing urease gene sequence, gene cluster structure, protein structure and function characterization is currently on the way. Acknowledgement: Research funded by Ministry of Science and Technology (2006BAD12B03).

Key Words: Metagenomic, Rumen BAC Library, Urease Screening

T232 Effect of fatty acids and malic acid on total gas production and methane release by batch culture. L. Liu, J. Q. Wang*, D. P. Bu, S. J. Liu, K. L. Liu, H. Y. Wei, and L. Y. Zhou, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

The objective of this study was to determine the effect of different concentrations of malic acid (0, 5, 10 mM) and degree of unsaturation of the fatty acids (stearic acid-SA; oleic acid-OA; linoleic acid-LA; linolenic acid-LNA) on total gas production and methane release using an automated cumulative gas production estimation system *in vitro*. The substrate (500 mg) contained alfalfa hay and corn (50:50). Rumen fluid was collected from two ruminally fistulated lactating cows. Substrate was incubated in 60 mL fermentation fluid (rumen fluid to McDougall buffer ratio was 1:2). Individual fatty acids were dissolved in 0.5 mL ethanol and added in fermentation fluid at 3.5% of diet DM. Each treatment contained four flasks. Incubations were carried out in batch cultures at 39°C for 36 h two times at a two-week intervals. The gas samples were collected by gas collecting bags and then methane content determined with a gas chromatograph. The results showed that total gas production and methane release decreased ($P < 0.01$) when the degree of unsaturation of the fatty acids increased. In contrast, total gas production increased ($P < 0.01$), whereas methane release decreased ($P < 0.01$) with malic acid level increment. The interaction of fatty acids and malic acid were characterized by decreased ($P < 0.01$) methane release. Results suggested that addition of unsaturated fatty acids and malic acid could inhibit methane release, and fatty acids-mediated depression in methane release was associated with the degree of unsaturation of the fatty acids.

Acknowledgement; Research supported by Ministry of Science and Technology (2006BAD12B03).

Table1: Effect of fatty acids and malic acid on total gas production and methane release.

		Tgas,mL	CH ₄ ,mmol
FA	SA	77.86 ^a	0.41 ^a
	OA	70.74 ^b	0.37 ^b
	LA	53.33 ^c	0.23 ^c
	LNA	50.31 ^c	0.22 ^c
MA(mM)	0	61.53 ^b	0.42 ^a
	5	64.36 ^b	0.34 ^b
	10	70.22 ^a	0.24 ^a
	SEM	1.86	0.005
P	FA	<0.001	<0.001
	MA	0.006	<0.001
	FA×MA	0.163	<0.001

Key Words: Malic Acid, Methane Release, Total Gas Production

T233 The use of simultaneous models for estimate in vivo nutrient digestibility of alfalfa hay and barley grain. H. Jahani-Azizabadi, M. Danesh Mesgaran*, R. Valizadeh, and H. Nasirimoghadam, *Ferdowsi University of Mashhad, Mashhad, Iran.*

In vivo total tract nutrients digestibility [Dry matter (DM), Crude protein (CP), Organic matter (OM) and Digestible organic matter in dry matter (DOMD)] from alfalfa hay and barley grain were evaluated using a direct

calculation (difference method) or simultaneous models. Eight Balochi lambs (49.5 ± 3.5 kg, body weight) were fed experimental diets made of four alfalfa hay: barley grain ratio (DM basis) as 1.0:0.0, 0.75:0.25, 0.50:0.50 and 0.25:0.75 in a 4×4 repeated Latin squares design. Each period consisted of 28 d with 7 d for feces collection. Nutrient concentrations of feed samples and feces were determined using standard procedures. For direct calculation, the data of first and third diets were used. Simultaneous models were provided using Polynomial regression models of SAS. Apparent DM, CP, OM and OMD digestibility of alfalfa hay and barley grain calculated by direct calculation were 0.61& 0.78, 0.74 & 0.69, 0.64 & 0.80 and 0.59 & 0.79, respectively. When simultaneous models were considered, a linear equation was significant ($P < 0.01$) for all nutrients. Therefore, the nutrient digestibilities of the feed samples were determined using this model (Table 1). Results of the present study might suggest that the simultaneous models appeared to give reasonable estimate rather than direct calculation.

Table 1. Simultaneous models and mean nutrient digestion coefficients of barley grain and alfalfa hay

Nutrient	Simultaneous models	R2	digestion coefficient	
			Barley grain	Alfalfa hay3
DM	Y=61.204(±0.66)	0.88	79.5	61.2
	+0.183(±0.04) X			
CP	Y=73.99(±0.66)	0.45	74.2	74
	+ 0.003(±0.04) X			
OM	Y=64.615(±0.63)	0.87	82.3	64.6
	+ 0.177(±0.041)X			
DOMD	Y= 59.45(±0.60)	0.91	78.5	59.4
	+ 0.191(±0.037)X			

1-Y= Nutrient digestion coefficient,2- X= Barley level in diets (%),3- When X= 0.0

Key Words: Simultaneous Models, Digestibility, Barley Grain

T234 In situ ruminal degradability of soybean and sunflower by-products. R. H. de T. Buschinelli de Goes*¹, R. de C. M. Tramontini², G. D. de Almeida², S. T. Cardim², J. Ribeiro², L. A. de Oliveira², and F. Morotti², ¹Universidade Federal da Grande Dourados, Dourados, MS, Brazil, ²Universidade Estadual de Maringá, Umarama, PR, Brazil.

The ruminal degradation of the dry matter (DM) and crude protein (CP) of the sunflower and soybean crushed, originating from of the cold compressing for the extraction of vegetable oil, was evaluated by the in situ technique, using three rumen fistulated zebu steers at pasture. The foods were grounded through 2mm screen and incubated directly in the rumen in nylon bags, in the times of 72, 48, 36, 24, 18, 12, 06, 03, and 0 hour. The potential degradation (PD) for the disappearance of DM, in the different incubation times were adjusted by a no-linear regression by Gauss-Newton's method, according to the equation $PD = A+B*(1-\exp(-ct))$, being PD = potential degradability, A = soluble fraction, B = potentially degradable fraction, c = degradation rate of the fraction B, and t = time of incubation. The effective degradability was calculated by the formula: $ED=a+(b.c)/(c+k)$, where k = rate of passage of 5%/h. The sunflower crushed contents a dry matter (DM) of 90.0% and crude protein (CP) of 22.0%, the soybean crushed presented 90.5% DM and 53.0% CP. The potentially degradable fraction of DM by the sunflower crushed was of 40.2% and 26.2% for to DM and CP, what provided medium ruminal degradation. The effective degradability for

the sunflower crushed was of 51.0% and 38.7%, with a soluble fraction of 22.4% and 29.9%, for to DM and CP. The soybean crushed presented soluble fraction of 36.6% and 20.7%, for to DM and CP, with a effective degradability of 72.5% and 69.9%, with a potentially degradable fraction of 66.2% and 81.5%, for DM and CP respectively. The sunflower crushed presented low values for the degradation rate of the fraction "b" of 2.5%/h for CP due to the high oil tenor (10%) and the high value of ADF (20.8%) that might have interfered in the degradation of this food, while the soybean crushed presented medium values of 7.5%/h for the degradation rate of CP. The ruminal degradation of the nutrients by the studied foods presented low soluble contents for the sunflower crushed different from the soybean crushed that presented extensive degradations rates for the insoluble fraction, that the sunflower crushed.

Key Words: Chemical Composition, Sunflower Crushed, In situ

T235 Rumen phosphorus metabolism in sheep. R. S. Dias¹, T. Soares², R. M. P. Pardo³, J. C. Silva Filho³, D. M. S. S. Vitti², E. Kebreab⁴, and J. France¹, ¹University of Guelph, Guelph, Ontario, Canada, ²Centro de Energia Nuclear na Agricultura, Piracicaba, Sao Paulo, Brazil, ³Federal University of Lavras, Lavras, Minas Gerais, Brazil, ⁴University of Manitoba, Winnipeg, Manitoba, Canada.

The objective of this work was to study the effect of different levels of P on its presence in saliva and the rumen. Moreover, other factors such as specific activity of P in rumen, saliva and plasma were assessed to provide information on P metabolism in ruminants. Twelve Santa Inês male sheep, weighting 30 kg were fed a basal diet comprising roughage, concentrate mixture (cassava flour, soya bean meal, and urea) and a mineral mixture. The treatments consisted of the basal diet supplemented with different amounts of monoammonium phosphate to provide 0, 2, 4 and 6 g P/animal/d, representing treatments T0, T2, T4 and T6, respectively. The % P in dry matter was considered highly deficient, deficient, adequate and excessive respectively. Animals were injected with ³²P and thereafter samples of blood were collected over 7 d, and rumen fluid and saliva samples were collected 96 and 144 h after injection. Phosphorus intake affected P in ruminal fluid, whereas P in saliva was not affected. The values for ruminal P turnover and endogenous entry calculated from P measurements were all affected by P intake. The percentage of endogenous P entering the rumen decreased with increased levels of P intake indicating lower endogenous P secretion for higher dietary P. The specific activity of P in saliva, rumen fluid and plasma were also all affected by P intake, and were statistically different between treatments, though they were numerically similar when compared with each other. The possibility of presence of an endogenous ruminal P source besides saliva is discussed (Smith et al. 1955). It is concluded from the results that P in ruminal fluid is maintained at adequate levels to attend the needs of micro-organism regardless of P intake.

Smith, A. H., M. Kleiber, A. L. Black and C. F. Baxter. 1955. Transfer of phosphate in the digestive tract. II. Sheep. *J. Nutr.* 57:507-527.

Key Words: Rumen, Phosphorus, Metabolism

T236 Evaluation of modeling procedure for fitting in situ degradation profiles. G. I. Zanton* and A. J. Heinrichs, *The Pennsylvania State University, University Park.*

In situ degradation of feeds is a common methodology used for describing the digestion rate and potential for ruminant feedstuffs. When the population estimates of parameters of nonlinear equations are required, nonlinear mixed modeling (NLMM) of in situ data may be more appropriate than a two-stage approach [TS; in which individual kinetic parameter estimates (PE) are obtained in the first stage and population estimates are obtained in the second by averaging], since NLMM allows information in common across subjects to be shared during estimation. Therefore, the objective of this experiment was to evaluate the accuracy and precision of PE determined by TS and NLMM using simulation techniques. Four in situ profiles were represented: long lag with degradation rates of 0.05 and 0.02/h and moderate lag with degradation rates of 0.12 and 0.05/h. For all analyses, a minimum of 3200 degradation profiles were simulated with time points representing 0, 1, 2, 4, 8, 16, 24, 48, 72, and 96 h of ruminal incubation. Parameters were simulated with a systematic source of variation associated with animal and period effects and normally distributed, random residual error. Under these conditions, acceptable levels of bias and precision were found for some models evaluated. Bias of PE of the models examined was different from 0 ($P < 0.05$) for more parameters (2.23X) with TS than NLMM, whereas PE were determined with lower precision for TS than NLMM 3.25X more. Study of the lagged, exponential model revealed that PE bias for TS were more sensitive to enhanced residual variation, level of replication, and sampling schedule than NLMM. When residual variation was low, precision of PE was not substantially affected by estimation procedure; when residual variation was high, precision of PE was generally improved by NLMM (>3X, maximally). Averaging skewed individual animal PE, resulted in considerably biased estimates of population parameters. From the results of these simulations it is concluded that, in most cases, NLMM is more appropriate than TS for producing unbiased, precise PE.

Key Words: In situ, Nonlinear Mixed Modeling, Ruminant

T237 Assessment of free amino acid supplementation on rumen microbial efficiency and nitrogen metabolism using a continuous culture system. M. A. Brooks*, J. H. Porter, and M. S. Kerley, *University of Missouri, Columbia.*

This purpose of this experiment was to study microbial efficiency (MOEFF) and nitrogen (N) metabolism in the rumen environment when differing levels of free crystalline amino acids were added to the diet. A continuous culture system with a fractional dilution rate 0.06 was set up to accommodate 6 treatments with 4 fermenters per treatment. Treatments contained a ground corn, soybean meal, and soybean hull basal diet with additional levels of an equal mix of L-Lys, L-Arg, and DL-Met added to the diet at varying levels (0%, 3%, 6%, 12%, 18%, and 6% blood meal as a positive control). After a 4 day acclimation, ammonia and pH of the fermenters were analyzed 1 h before feeding and 4 h after feeding for 3 days. At the end of study, N and organic matter (OM) were analyzed for the diets, bacteria, and effluent and MOEFF calculated. Ammonia concentrations rose as the free AA supplementation in the diets increased ($P < 0.001$). MOEFF was increased by protein supplementation ($P < 0.001$) compared to the free AA diets, and MOEFF responded quadratically ($P < 0.05$) to free AA supplementation. We concluded that peptide N was needed to maximize MOEFF. Free AA supplementation in the diet does not appear to supply peptides required for maximizing MOEFF. Our data agreed with previously published data that concluded AA degradation rate was more rapid than AA outflow

at feasible feeding levels. OM digestion was greatest for the 3% AA treatment ($P < 0.05$). The culture pH, measured 4 h after feeding was different among treatments ($P < 0.001$); however, the ranged within only 0.1 pH unit. Diet formulations will continue to move in the direction of formulating for AA requirements. In this process, provisions for the form of microbial N requirement must be met.

Key Words: Microbial Efficiency, Amino Acids, Rumen Fermentation

T238 Effect of pH on rumen fermentation and biohydrogenation of extruded soybean and linseed fatty acids in continuous culture.

M. C. Fuentes*¹, S. Calsamiglia¹, V. Fievez², and M. Blanch¹, ¹UAB, Bellaterra, Spain, ²Ghent University, Belgium.

Eight dual-flow continuous culture fermenters (1320 mL) were used in two replicated periods of 7 d (4 d adaptation plus 3 d sampling) to study the effects of pH (6.4 vs. 5.6) and diet (Soybean (SB) vs. Linseed (LS)) on rumen microbial fermentation, lipolysis and biohydrogenation, and DNA concentration of bacteria involved in lipolysis and biohydrogenation processes. Diets had a 40:60 forage to concentrate ratio (17.3 % CP, 29.2 % NDF) and similar ingredient composition, differing only in the fat supplement, with SB having extruded soybean (5.4 % DM) and LS having extruded linseed (6.2 % DM). Low pH reduced OM and NDF digestibility, ammonia N concentration and flow, bacterial N flow and CP degradation, and increased non-ammonia and dietary N flow. Low pH reduced linoleic acid (LA) and linolenic acid (LNA) apparent biohydrogenation (LA = 0.44 vs. 0.82; LNA = 0.54 vs. 0.84) and lipolysis (LA = 0.92 vs. 0.99; LNA = 0.94 vs. 0.99). Low pH reduced C18:0, t11-C18:1, c9,t11-conjugated linoleic acid (CLA), and increased t10-C18:1, C18:2, C18:3, t11,c15-C18:2 and t10,c12-CLA proportions in the effluent. Low pH reduced *Anaerovibrio lipolytica* (1.85 vs. 67.0 pg / 10 ng total DNA) and *Butyrivibrio* VA subgroup (315.5 vs. 1148.5 pg / 10 ng total DNA) and increased *Butyrivibrio* SA subgroup DNA concentrations (1907.0 vs. 1215.5 pg / 10 ng total DNA). Linseed diet increased ammonia N concentration and flow and tended ($P = 0.06$) to increase CP degradation. Lipolysis of LA and LNA was higher in LS compared with SB diet (LA = 0.98 vs. 0.92; LNA = 0.98 vs. 0.94). Linseed reduced C18:2 and t10,c12-CLA, and increased C18:3 and t11,c15-C18:2 proportions in the effluent. Concentration of *A. lipolytica* DNA was higher (43.4 vs. 25.6 pg / 10 ng total DNA) and that of *Butyrivibrio* VA subgroup was lower in LS compared with SB diet (652.5 vs. 811.5 pg / 10 ng total DNA). Low pH inhibited lipolysis and biohydrogenation. Extrusion of soybean seems to protect fat against lipolysis more than extrusion of linseed.

Key Words: pH, Lipolysis, Biohydrogenation

T239 Effect of pH and level of concentrate in the diet on biohydrogenation intermediates in a dual flow continuous culture.

M. C. Fuentes*, S. Calsamiglia, and P. W. Cardozo, UAB, Bellaterra, Spain.

Milk fat depression in cows fed high grain diets has been related to an increase in trans-C18 fatty acids (FA) in milk. Trans-C18 FA are produced as a result of the incomplete biohydrogenation of dietary polyunsaturated FA in the rumen. There seems to be a confounding effect between ruminal pH and quantity of concentrate in the diet on

biohydrogenation intermediates production. In the current experiment, the effect of pH (6.4 vs. 5.6) and two different forage to concentrate ratios (F:C) in the diets (70:30 F:C vs. 30:70 F:C) on rumen microbial fermentation, effluent FA profile and DNA concentration of bacteria involved in lipolysis and biohydrogenation processes was investigated in continuous culture. The study consisted of two experimental periods of 8 d (5 d adaptation plus 3 d sampling), with a 2 x 2 factorial arrangement of treatments. Both diets had a similar FA profile (44.0 % C18:2, 9.77% C18:3 of total FA). Low pH reduced OM and NDF digestibility, ammonia N concentration and flow, CP degradation and tended to reduce bacterial N flow, and increased non-ammonia and dietary N flow. Low pH decreased C18:0, t11-C18:1 and c9,t11-conjugated linoleic acid (CLA) and increased t10-C18:1, C18:2n6, C18:3n3 and t11,c15-C18:2 concentrations in the effluent. Low pH reduced *Anaerovibrio lipolytica* (32.7 vs. 72.1 pg / 10 ng total DNA) and *Butyrivibrio* VA subgroup DNA concentrations (588 vs. 1394 pg / 10 ng total DNA). The 30:70 F:C diet increased OM and NDF digestibility, non-ammonia and dietary N flow, and reduced ammonia N concentration and flow. The 30:70 F:C reduced t11-C18:1, c9,t11-CLA and tended to reduce ($P < 0.10$) t10-C18:1, and increased C18:2n6, C18:3n3 and t11,c15-C18:2 compared with the 70:30 F:C diet. Moreover, the 30:70 F:C diet increased *A. lipolytica* DNA concentration (65.2 vs. 39.7 pg / 10 ng total DNA). Results confirm that the low pH is responsible for the accumulation of biohydrogenation intermediates which cause milk fat depression, and not the concentrate of the diet.

Key Words: pH, Concentrate, Fatty Acid Biohydrogenation

T240 Comparison of *in vitro*, *in situ*, and *in vivo* methodologies to assess nutrient digestibility in ruminants.

L. E. Sims*¹, N. A. Pyatt², P. H. Doane², and S. S. Block², ¹Oklahoma State University, Stillwater, ²ADM Research Center, Decatur, IN.

This study compared *in situ*, *in vitro*, and *in vivo* methods of estimating digestibility of substrates having variable starch content. Starch content of substrates was 65% (corn; high), 39% (corn-forage; med-high), 28% (forage-corn; med-low) or 22% (corn fiber; low). Lactating dairy cows and beef steers were used for *in situ* evaluation. *In vitro* digestibility was determined using the Ankom Daisy System with ruminal inoculum from steers fed high-starch diets or lactating dairy cattle fed moderate starch diets. The mobile bag method was used to estimate post-ruminal digestibility of residue collected from *in situ* and *in vitro* incubations. The med-high and med-low substrates were fed as complete diets to 20 lambs to assess *in vivo* total tract digestion. Rate and extent (48 hr) of ruminal *in situ* DM, CP, NDF, and ADF digestion was greater for dairy versus beef whereas rate and extent of starch digestion was less. *In vitro* rate of DM digestion was similar whether beef or dairy ruminal fluid inocula was used but extent was greater for dairy. Across substrates, *in vitro* DM digestion estimates were about five to 10 percent greater versus *in situ* estimates. Med-high and med-low substrates had similar ($P > 0.10$) *in vivo* total tract digestibility. Ruminal (*in situ* or *in vitro*) and post-ruminal (mobile bag) digestibility or the sum of ruminal and post-ruminal estimates were compared with *in vivo* total tract digestion of med-high or med-low substrates. *In vitro* and *in situ* methods gave similar relative ranking among substrates but rate and extent of nutrient digestion differed. Selected methods can provide comparable estimates of nutrient digestion obtained in more time-consuming and expensive *in vivo* methods.

Table 1. Substrate Starch Content

Item	High (Corn)	Med-High (Corn-forage)	Med-Low (Forage-corn)	Low (Corn Fiber)
Ruminal DM digestion				
In situ – Beef (48 hr)	82.0	72.0	73.4	42.3
In situ – Dairy (48 hr)	90.4	78.9	83.3	60.7
Ankom – Beef Inocula	96.6	90.2	88.7	76.9
Ankom – Dairy Inocula	97.8	91.7	90	81.3
Total tract DM digestion				
Lamb in vivo	—	75.0	74.8	—
In situ residue in mobile bag	76.0	80.2	79.3	43.9
Ankom residue in mobile bag	90.6	87.8	86.6	57.8

Key Words: In vitro, In situ, Digestibility

T241 Effect of an enzymatic extract from *Agaricus bisporus* on *in vitro* digestibility of cell wall and dry matter. A. Ayala-Martinez^{*1}, S. S. Gonzalez-Muñoz², C. Vazquez-Gonzalez¹, G. Mendoza-Martinez³, M. Meneses-Mayo², and O. Loera-Corral⁴, ¹FMVZ-UNAM, Mexico D.F., ²Colegio de Postgraduados, Montecillo, Edo. Mexico, Mexico, ³UAM Xochimilco, Mexico D.F., ⁴UAM Iztapalapa, Mexico D.F.

The objective of this trial was to determine the effect of a commercial enzymatic extract (CE) from *Trichoderma* spp. and an extract from *Agaricus bisporus* (AE) on residual NDF, ADF and DM *in vitro* digestibility (IVDMD) of alfalfa, crop residues, barley straw, Taiwan grass and orchard grass. The experimental design was completely randomized with a factorial arrangement of treatments (5 × 3); an analysis of variance was performed and means were compared with Tukey test (P<0.05). For alfalfa residual NDF there were differences (P<0.05) between the treatment without extract, AE and CE at: 1) 12h: 91.8a, 79.45b, 75.4b; 2) 24 h: 83.9a, 72.1b, 71.4b; 3) 48 h: 68.7a, 49.9b, 59.9b; ± 1.1%. For alfalfa residual ADF there were differences (P<0.05) between the treatment without extract, AE and CE at: 1) 12 h: 75.1b, 95.7a, 82.2b; 2) 24 h: 74.0b, 94.0a, 59.0b; 3) 48 h: 66.2b, 95.7a, 50.0b; ± 1.1%. There were differences of DM *in vitro* digestibility (P<0.05) between the treatment without extract, AE and CE: 1) crop residues at 72 h (52.2b, 66.2a, 58.2a; ± 1.2%); 2) barley straw at 24 h (36.8b, 41.39a, 42.65a; ± 1.02%), 48 h (38.0b, 44.09a, 45.2a; ± 1.02%) and 72 h (41.2b, 48.1a, 48.9a; ± 1.02%); 3) Taiwan grass at 48 h (30.07b, 40.1a, 41.0a; ± 1.03%) and 72 h (31.9b, 46.2a, 42.3a; ± 1.03%). No differences were found for alfalfa and orchard grass (P>0.05). Therefore, it may be concluded that *in vitro* digestibility of residual NDF, ADF and DM, for different forages, do not change when using a commercial enzymatic extract from *Trichoderma* spp. or an extract from *A. bisporus*.

Key Words: Fibrolytic Enzymes, Cell Wall Digestibility, Fungi

T242 In situ dry matter degradation parameters of treated and untreated Sainfoin (*Onobrichis vicifolia*) a tanniferous legume forage. H. Khalilvandi*, K. RezaYazdi, M. Dehgan-Banadaki, N. Vahdani, and H. R. Khazanehei, *University of Tehran, Karaj, Tehran, Iran.*

Condensed tannins are phenolics belonging to the plant secondary compounds, which bind to plant proteins and other nutrients. Sainfoin is tannin rich, temperate legume forage, which its CT concentration fluctuated from 2.5 to 7.7 % of dry matter. Detrimental effects of CT are more probable in the case of high tannin concentration (more than 40 g/ kg DM).

In order to investigate different chemicals to improve degradation characteristics of sainfoin, an *in situ* experiment was carried out using 3 ruminally fistulated Holstein cows. Samples of forage were chopped 3-5 cm length, and then treated with solutions of KMnO₄ (0.03 M), NaOH (0.05 M), sodium bicarbonate (0.1 M), wood ash (180 g/L) with forage to reagent volume ratio of 1:4 (W/V), and one water soaking considered as blank for 6th and 7th treatment. 5% solution of PEG (6000 MW) was sprayed to forage with 1:1 ratio and urea (20g/ 100 ml/1 kg of DM) treatment applied respectively. All of above treatments carried out in 25°C temperature, for 20 min, with hand shaking. Urea treatment was done using adhesive rubber to create anaerobic conditions for 1 week. Treated forages then exposed to 40°C temperature in a forced air oven, for 48 hours. All forage samples were ground to pass 2 mm screen size (Wiley mill). Followed grinding, these feeds were sieved to remove particles > 0.45 mm. 5 g of forage samples were weighed into nylon bags (10×20 cm) with 53 µm pore size, to create sample size: surface area of 12.5 mg/cm². Duplicates were incubated for 4, 8, 12, 24, 48, 72 and 96h in ventral rumen.

Results showed that PEG treated forage has greater rapidly soluble fraction (a), but PEG could not increase potentially degradable fraction (b). Rate of degradation of b fraction was highest for wood ash (0.10240), and lowest for KMnO₄ (0.05113). Effective degradability in different rumen dilution rates were high for PEG treated Sainfoin compared to others. Treatment with KMnO₄ resulted in lowering effective degradability.

Key Words: Sainfoin, In situ Degradability, Tannin

T243 Accuracy of the n-alkanes technique for intake estimates in beef cattle fed with palisade grass (*Brachiaria brizantha* cv. Marandu). J. A. S. Morais¹, T. T. Berchielli¹, M. F. S. Queiroz^{*1}, A. Keli², A. de Vega², R. A. Reis¹, C. López², S. F. Souza¹, and G. Fiorentini¹, ¹Faculdade de Ciências Agrárias e Veterinárias/UNESP, Jaboticabal, São Paulo, Brazil, ²Facultad de Veterinaria, Universidad de Zaragoza, Zaragoza, Spain.

Animal performance is mainly determined by diet intake and digestibility, being the estimation of those parameters a difficult and not yet fully resolved task in grazing conditions. The objective of this research was to evaluate the n-alkanes methodology as markers to estimate the dry matter intake (DMI) in eight Nelore steers grazing palisade grass. Animals, in metabolism cage, were fed twice daily on (30 or 60 days regrowth) at 2.0% body weight. Animals were dosed twice daily during twelve days with paper pellets containing equal amounts of octacosane (C28), dotriacontane (C32) and hexatriacontane (C36). From day 10 to day 15 spot faecal samples were collected, directly from the rectum, at the same time of alkane dosing. N-Alkanes profiles in samples of grass, urine and faeces were extracted following the technique of the

ethanolic saponification for fourteen hours with alkane analysis carried out by gas chromatograph. The DMI estimates were not affected by the forage regrowth period ($P > 0.05$). Only the pair of alkanes C32/C33 did estimate adequately the DMI, underestimating the total intake at just 8%, while the pairs C31/C32 and C35/C36 under and overestimated the forage DMI in -15.3 and +18.8%, respectively, ($P < 0.05$). The n-alkanes methodology presented potential to estimate the forage DMI in tropical conditions.

Table 1. Forage dry matter intake (DMI) observed and estimated with C31/C32, C32/C33 and C35/C36 alkane pairs in steers fed with tropical forage (São Paulo – Brazil).

	Regrowth age, days		Mean	SEM ¹
Methods	30	60		
Actual DMI	4.20	4.32	4.26 ^b	0.147
Estimated DMI				
C31/C32	3.50	3.72	3.61 ^c	
C32/C33	3.60	4.15	3.88 ^{bc}	
C35/C36	4.46	5.65	5.06 ^a	

¹ Standard error of the mean; ^{abc} Means values within columns with different superscripts are significantly different ($P < 0.05$).

Key Words: Nellore, Palisade Grass

T244 The effect of non fibre carbohydrate on in vitro first order NDF disappearance of alfalfa. M. Danesh Mesgaran*, F. Rezaei, and A. R. Heravi Mousavi, *Ferdowsi University of Mashhad, Mashhad, Iran.*

The aim of this study was to determine the effect of supplementing sucrose or starch on in vitro first order NDF disappearance model of alfalfa. Samples of alfalfa were ground to pass 0.75 mm screen and dried at 80 °C for 48 h. One gram of non-supplemented or non-fiber carbohydrate supplemented samples (70 mg/g DM of feed sample as starch or sucrose) were incubated in a medium containing 40 ml cell-free rumen fluid, 60 ml mineral mixtures and 5 ml of cloth-cheese strained rumen fluid in a 200 ml bottle. Each bottle was finely bubbled with CO₂. Rumen fluid was obtained from 4 Holstein steers fed corn silage, alfalfa hay, wheat straw, barley grain and soybean meal (3.4, 2.4, 0.8, 1.6 and 0.8 kg/d DM, respectively). Bottle of each sample was incubated for 24, 48, and 96 h at 39°C (n=4). Then, bottle content was filtered through a 22 µm filter paper. Unfiltered NDF was determined. Data were analyzed using GLM procedure of SAS and applied to a non-linear first order model [$D(t) = D(i) \cdot \exp(-k \cdot \text{time}) + I$; where $D(t)$ is potentially digestible fraction of DM, $D(i)$ is potentially digestible residues, k is fractional rate constant of digestion (h^{-1}) and I is indigestible fraction]. Indigestible fraction of NDF of alfalfa hay was significantly ($p < 0.05$) increased when it was supplemented with starch (0.63, 0.64 and 0.76 for alfalfa, alfalfa+sucrose and alfalfa+starch, respectively). The lowest constant rate of digestion was observed when sucrose (0.007) was added to alfalfa. Constant rate of digestion of alfalfa and alfalfa+starch was 0.01 and 0.02, respectively. Results of the present study showed that the first order fractional rate of digestion of NDF of alfalfa might be influenced by source of NFC. Therefore, there is a need to determine the associated effect of a feed and nature of NFC on fractional rate constant of digestion and indigestible fraction for each forage or a composed diet.

Key Words: NDF, Model, Disappearance

oil sunflower meal treated with formaldehyde or sodium hydroxide. T. Mohammadabadi, M. Danesh Mesgaran*, and M. R. Nasiri, *Excellence Center for Animal Science, Ferdowsi University of Mashhad, Mashhad, Iran.*

This study was conducted to evaluate the effect of formaldehyde or sodium hydroxide on in situ ruminal disappearance and in vitro intestinal digestion of high oil (165 g/kg DM) sunflower meal (SM). Samples were: Untreated SM (USM), sodium hydroxide treated SM (SHSM, 40 g/kg DM), formaldehyde treated SM (F30SM and F60SM, 30 and 60 g/kg DM, respectively). Ruminal disappearance of sample was determined using four fistulated Holstein steers (400±12 Kg, body weight). Samples were weighed into nylon bags (19×12 cm, pore size 48 µm, n=6) and incubated in rumen for 12 h. An in situ/ in vitro enzymatic 3-step procedure was conducted to determine post-ruminal disappearance of the samples. In this procedure, a part of ruminal-undegraded nitrogen (after 12 h rumen incubation) was included in pepsin and pancreatin to determine post-ruminal protein disappearance of the sample. DM content of all intact and incubated samples was determined using air-forced oven (65°C, 48 h). Nitrogen concentration of the samples was determined using Kjeldahl method. Data were analysed using GLM procedure of SAS. Results indicated that ruminal DM and CP of F60SM was significantly ($P < 0.05$) lower (0.42 and 0.39, respectively) than USM (0.7 and 0.65, respectively). Formaldehyde and sodium hydroxide caused an increase in post-ruminal CP disappearance (0.44, 0.4, 0.33 and 0.27 for F60SM, F30SM, SHSM and USM, respectively). Total tract CP digestibility for F60SM, F30SM, SHSM and USM was 0.83, 0.85, 0.88 and 0.93. It was concluded that both formaldehyde and sodium hydroxide caused an increase in the ruminal and post-ruminal CP disappearance of high oil content sunflower meal.

Key Words: High Oil Sunflower Meal, 3-Step, Disappearance

T246 The effect of feed iodine supplementation on milk production traits in dairy goats. A. Nudda*¹, M. Decandia², G. Epifani², G. Battacone¹, G. Spanu¹, and G. Pulina^{1,2}, ¹University of Sassari, Sassari, Italy, ²AGRI Sardegna, Sassari, Italy.

Iodine requirements are higher for goats than for other ruminants. An adequate supply of dietary iodine can prevent iodine deficiency disorders in goats and increase the iodine content in milk. However, the effects of iodine-enriched diets on milk production traits of lactating goats have been poorly investigated. This work aimed to determine the effect of iodine supplementation to dairy goats on milk yield and composition. Thirty crossbred dairy goats were divided into 3 homogeneous groups. Each goat was supplemented with potassium iodide (KI) at 0 (control group), 400 (group 1), or 950 µg of KI/day (group 2). The dose of KI (76.5% of iodine) was dissolved in water and administered every day for 8 weeks. Milk yield and milk composition (fat, protein, urea) were recorded weekly. Milk yield was not influenced by KI supplementation and averaged 1229, 1227 and 1179 g/d per head in groups 0, 1 and 2, respectively. Milk fat content was higher ($P \leq 0.01$) in group 1 (4.12%) compared to group 0 (3.78%) and group 2 (3.84%). The protein content was similar in groups 1 and 2 (on average, 3.43%), and tended to be higher than in the control group (3.36%). On the contrary, the milk urea concentration was significantly lower in the groups that received KI supplementation (32 and 33 mg/dl in groups 1 and 2, respectively) than in the control group (37 mg/dl). In conclusion, the doses of KI used in this study did not influence milk yield and had favorable effects

on urea and, to a lower extent, protein contents in goats, suggesting an improvement of rumen activity, mainly of nitrogen utilization.

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Key Words: Iodine, Dairy Goat, Milk

T247 An examination of the intake and digestibility characteristics of ground ear maize for beef cattle. P. O'Hanlon, D. A. Kenny, T. M. Boland, G. P. Keane, and M. B. Lynch*, *UCD School of Agriculture, Food Science and Veterinary Medicine, University College Dublin, Ireland.*

Feed is the largest single cost in cattle production and as demand for cereal grain for non-agricultural purposes increases, elevating feed grain costs will impact on profitability. Ground ear maize (GEM) is a novel approach to potentially utilising the maize plant as a high energy forage based substitute for grain based diets and essentially consists of the corn and cob mix with a portion of the leaf material retained. The objective of this short term experiment was to compare the intake and digestibility characteristics of GEM with barley grain as a feed source for high producing beef cattle. GEM was ensiled for two months in round plastic wrapped bales. Young beef bulls (n=24) with a mean \pm sd liveweight of 356 \pm 20 kg were blocked on liveweight and age and randomly allocated within block to one of two treatments (1) GEM-based diet (GEM) (2) Barley-based diet (BAR). All animals were individually fed and soybean meal and barley straw were added to make both diets isonitrogenous (13.5% CP), isofibrous (27% NDF) and isoenergetic (17 MJ GE/kg DM). GEM was fed as a TMR, while concentrate and straw were offered separately for BAR. Feed intake was recorded for 14 days and diet digestibility was determined using the chromic oxide technique with faecal samples were collected on days 13 and 14. Animals on GEM had higher DMI (P = 0.07) compared with BAR. However, animals on BAR had higher (P < 0.01) digestibility of neutral detergent fibre, organic matter and dry matter and a tendency towards higher digestibility of N (P = 0.09) compared with those on GEM. In conclusion, these data indicate that ground ear maize is worthy of further investigation as a substitute for grain based diets. Longer term studies are required to assess effects on animal production and carcass quality.

Key Words: Ground Ear Maize, Beef Cattle, Feed Intake

T248 Comparison of procedures to detach particle-associated microbes from ruminal digesta in Rusitec fermenters. M. E. Martínez, M. J. Ranilla*, S. Ramos, M. L. Tejido, C. Saro, and M. D. Carro, *Universidad De León, Campus De Vegazana, León, Spain.*

Three different detachment procedures (DP) were evaluated for their ability to remove particle-associated microbes from incubation feed residues in Rusitec fermenters fed a 70:30 concentrate:alfalfa hay diet. Concentrate and hay were incubated in separate nylon bags, and incubation residues were treated independently. In the methylcellulose procedure (MET) feed residues were incubated at 38°C for 15 min with saline solution (0.9% NaCl) containing 0.1% methylcellulose with continuous shaking. In the stomacher procedure (STO) residues were

mixed with saline solution and homogenized with a stomacher for 5 min at 230 rev min⁻¹. In the freezing procedure (FRE) residues were immediately frozen at -20°C for 72 h, thawed at 4°C, and mixed with saline solution. All solutions were added at a rate of 3 mL/g of residue. Common to all treatments was storing at 4°C for 24 h after the treatment, homogenization, filtration, and resuspension of residues two times in the treatment solutions. Filtrates were centrifuged at 20,000 g for 25 min at 4°C to obtain microbial pellets. Microbial removal was estimated indirectly from removal of ¹⁵N. Each procedure was repeated in three consecutive days (n=3). There were no feed x DP interactions (P=0.15 to 0.91) in any variable. Both detaching efficiency and total recovery were affected by the DP (P<0.001), STO presenting the greatest values (mean values for both substrates of 63.2 and 25.5%, respectively), and FRE the lowest ones (44.3 and 18.4%). There were no differences (P=0.71) among the pellets obtained by the different DP in their N content, but pellets from MET had greater (P<0.05) ¹⁵N enrichments than those from STO and FRE. Pellets detached from hay presented greater (P<0.001) N content and ¹⁵N enrichments than those obtained from concentrate (mean values of 63.3 vs 55.7 mg N/g dry matter, and 0.152 vs 0.132% atoms in excess). Results suggest that STO was the most effective method to detach ruminal microbes from both concentrate and hay incubated in Rusitec fermenters

Key Words: Adhesion, Ruminal Microbes, ¹⁵N

T249 Effects of varying levels of fish oil, fed as a calcium salt, on rumen fermentation and biohydrogenation in continuous culture. C. M. Klein*¹, T. C. Jenkins¹, and K. D. Murphy², ¹*Clemson University, Clemson,* ²*Virtus Nutrition, Lancaster, PA.*

Fish oils, including docosahexaenoic acid (C22:6, DHA) and eicosapentaenoic acid (C20:5, EPA) have been found to have human health benefits and are used as fat supplements in ruminants. Transfer of omega-3 fatty acids from the ruminant diet, to meat and milk products, depends on their escape from microbial biohydrogenation in the rumen. Fatty acids are often fed as calcium salts to reduce biohydrogenation and lessen the negative effects on fermentation. To determine if fish oil protection was enhanced when incorporated in a matrix of palm oil fatty acids, this study examined the effects of varying the ratio of fish oil and palm oil calcium salts on ruminal fermentation and biohydrogenation. Ruminal microorganisms maintained in continuous culture were exposed to diets with 5% added fat as soybean oil or as calcium salts of fish oil and palm fatty acids in three combinations (45/55, 75/25, and 90/10). A control diet and the four fat diets were fed to fermentors in a 5x5 Latin square with 10 d periods. As expected, the acetate/propionate ratio decreased (P < 0.05) when soybean oil was added to the diet (1.78 for the control and 1.30 for SBO). The acetate/propionate ratios for the fish oil diets were not different from the SBO diet (1.22, 1.07, and 1.07 for the 45FO, 75FO, and 90FO diets, respectively). Of the three combinations of fish oil tested, the 45FO and 75FO did not differ in the amounts of EPA (43.8% and 40.8%) or DHA (40.8% and 33.3%) that disappeared. There were however, differences in EPA and DHA lost between 75FO and 90FO. Losses of EPA (59.8%) and DHA (55.8%) were greater (P < 0.05) for FO90 compared to either 45FO or 75FO. These results indicate that rumen protection of DHA and EPA is diminished when fish oil comprises more than 75% of a fish oil/palm oil calcium salt mix.

Key Words: Biohydrogenation, Fish Oil, Continuous Culture

T250 By-product of biofuels processing in the feeding of ruminant. J. A. G. Azevedo^{1,2}, D. S. Pina², N. K. P. Souza², J. C. M. Lima², A. S. Oliveira², C. V. Xavier², S. C. Valadares Filho², and H. J. Fernandes^{*3,2}, ¹Universidade Estadual de Santa Cruz - FAPESB, Ilhéus, Bahia, Brazil, ²Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil, ³Universidade Estadual do Mato Grosso do Sul- FUNDECT, Brazil.

This experiment was carried out aiming to evaluate the effects three levels (0.0, 8.0 and 24.0; and 0.0, 5.0 and 16.0 % of dietary DM) of inclusion of two by-products: sunflower (*Helianthus annuus*) and turnip (*Raphanus sativus*), respectively, on the intake and apparent total tract digestibility of DM, OM, CP, EE, NFC and NDF. Twelve crossbred heifers with averaging BW 263.0 ± 34.0 kg were used. The experiment was performed in two periods of 15 days, in which the last three days were used to make total fecal collection. The animals were held at individual sheltered pens of approximately 3 m² and fed twice daily at 08:00 and 16:00 h, allowing for up to 10% oforts. The corn silage was the only roughage in the diet, in which was incorporated a mix of urea/ammonium sulfate (9:1) aiming to maintain the same dietary CP levels among the diets (13.0% of DM). The animals were allocated in six 2×2 Latin square design in a simple reversion arrangement and all statistical analyses were performed using PROC MIXED of SAS. The intake and apparent digestibility of DM in the diet contain sunflower ranged 34 and 18% respectively, with the average of 1.8% BW and 62%, respectively. In the diet contain turnip, the DMI ranged from 1.2 to 2.6% BW and the apparent digestibility of DM ranged from 57.8 to 66.9%. The quadratic effects ($P < 0.05$) were observed by the levels of sunflower on the intake of DM, OM, CP, EE, NDF and apparent digestibility of EE. The levels of turnip affected quadratically ($P < 0.05$) the intake and apparent digestibility of EE. These results indicated that the level of inclusion of sunflower by-product that maximizes the intake of nutrients is the 7%, however the maximum level (16% of DM) did not affect the apparent digestibility of all nutrients with exception the EE. The maximum level of inclusion of turnip by-product (24% DM) did not affect either intake or apparent digestibility of DM, OM, CP, NFC and NDF.

Key Words: Alternative feed, Sunflower, Turnip

T251 In vitro gas production kinetics of biofuels by-products. J. A. G. Azevedo^{1,2}, D. S. Pina², J. C. M. Lima², N. K. P. Souza², C. V. Xavier², A. S. Oliveira², S. C. Valadares Filho², and H. J. Fernandes^{*3,2}, ¹Universidade Estadual de Santa Cruz, Ilhéus, Bahia, Brazil, ²Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil, ³Universidade Estadual do Mato Grosso do Sul- FUNDECT, Brazil.

This study was conducted aiming to evaluate the in vitro gas production digestion kinetics of biofuels by-product (sunflower, turnip, palm and castor). Four samples of each by-product were pre-dried in a forced air oven (60°C) and ground in a Wiley mill (1 mm screen). Samples (200mg) were weighed into 100 mL graduated glass syringes with pistons lubricated with Vaseline. Buffered mineral solution was prepared and placed in acclimatized room at 39°C under continuous flushing of CO₂. The ruminal fluid inoculum used in all experiment was obtained from the rumen fistulated heifers fed with corn silage and concentrate (70:30 DM ratio). Ruminal fluid was transferred into pre-warmed thermo flasks, filtered through four layers of cheesecloth and flushed with CO₂. Ruminal fluid was added to the buffered mineral solution (inoculum),

which was maintained in acclimatized room at 39°C under continuous flushing of CO₂. Inoculum (30 mL) was dispensed into syringes containing by-product samples. The clip was closed, the initial volume recorded, and gas readings for each syringe were manually recorded at 2, 4, 6, 8, 10, 12, 24, 26, 28, 30, 32, 36, 48, 52, 54, 56, 60 and 72 h after incubation. The recorded volumes were corrected for a blank incubation (i.e., buffered rumen fluid without sample). The rate and extent of gas production was determined by fitting of gas production profile with dual-pool logistic by Gauss-Newton algorithm (SAS NLIN procedure). The final gas volume yields from nonfiber carbohydrate (NFC) were highest to turnip and sunflower by-product (23.5 and 18.0 mL), while the gas yielded from fibrous carbohydrate (FC) were highest to castor and palm by-product (19.3 and 17.2 mL). The degradation rate of the NFC and FC to palm, sunflower, castor and turnip by-product were 0.0912 and 0.0255; 0.1533 and 0.0390; 0.1824 and 0.0267; 0.1297 and 0.0306 h⁻¹, respectively. The highest lag time was observed to palm by-product (5.08 h). It was concluded that the NFC presented the higher digestion rate than FC as expected. Therefore, by-product with high levels of NFC could provide more energy supply than by products with high levels of FC.

Key Words: Alternative Feed, Digestibility, Fermentation Kinetics

T252 Bacterial diversity in rumen fluid samples collected via oral lavage or rumen cannula. J. Pisel, S. L. Lodge-Ivey*, J. Browne-Silva, and M. B. Horvath, *New Mexico State University, Las Cruces.*

There are inherent limitations associated with cultivation-based methods for characterizing the composition of bacterial communities in the rumen. Cultivation-independent methodologies are available. Denaturing gradient gel electrophoresis (DGGE) of amplified fragments of 16S rRNA genes has become a widely used tool to assess the diversity of complex bacterial communities in a variety of environments. A study was conducted to determine if sampling the rumen contents ruminally via a cannula or orally via lavage tube would yield similar DGGE profiles of the bacterial community. Two species of ruminally cannulated animals were used for this study (cows n=2; sheep n=3). All animals were allowed ad libitum access to feed. Cattle were allowed fed a poor quality forage consisting of baled unprocessed sorghum-sudan straw (5% CP, 68% NDF; DM basis) while sheep were maintained on chopped alfalfa (18% CP, 40% NDF; DM basis). Ruminal fluid was collected once a week for 4 weeks from each animal using a plastic tube equipped with a suction strainer with a handheld suction pump through the rumen cannula or oral cavity. DGGE analysis and principal component comparison demonstrates that yield of bacterial diversity was not different between the two sampling methods ($P = 0.15$). However, species and/or diet sampled did influence the number of bands in the DNA band pattern in the DGGE analysis. Sheep had fewer bands per lane on DGGE gels which is equated to less diversity than cattle ($P < 0.01$; 25.1 vs 30.0). Additionally, when samples were grouped according to DNA band patterns groups were most stable according to individual animal and species rather than sampling method. These data indicate that collecting samples via a lavage tube or rumen cannula is more influenced by species and individual animal than sampling method. This knowledge will allow for sample collection from a greater population of animals and a reduction in cost associated with developing and maintaining ruminally cannulated animals.

Key Words: DGGE, Rumen Sampling, Rumen Microbiology

T253 Image analysis and microscopy in animal by-products characterization. A. Campagnoli, C. Paltanin, L. Maggioni, G. Savoini, V. Dell'Orto, F. Cheli, and L. Pinotti*, *Department of Veterinary Sciences and Technology for Food Safety, Veterinary Medicine Faculty, Milan, Italy.*

Aim of this study was to evaluate the potential of microscopic methods in association with computer image analysis to identify the source of meat and bone meal. For this purpose reference samples (SAFEED-PAP Project; VSA, University of Milan) containing ruminant (bovine and ovine) and non-ruminant (pig, rabbit, chicken, turkey) meat and bone meals were analysed by microscopic method (as described in Commission Directive 2003/126/EC). Through a CCD camera and an image analysis software (Image-for Plus 4.5.1, USA), 890 bone fragment lacunae images at X40 were obtained. Images have been enhanced and processed in order to obtain for each lacuna a monochrome mask on which 26 dimensioned and 4 no-dimensioned shape variables (constructed by combining the various size variables so that dimension units cancel out) were measured. Data were analysed by a cross-validated non-parametric classification method (kernel model applied in prediction by PROC DISCRIM of SAS statistic software). The results obtained indicated that: (i) the variables that best discriminated ruminants from non-ruminants were almost exactly the same as reported previously for mammalian and poultry; (ii) 87.54% of ruminant lacunae were correctly classified, and 12.46% incorrectly as non-ruminant. However 47.06% of non-ruminant lacunae were correctly classified (and 52.94% incorrectly classified as ruminant). To conclude, the use of microscopic methods in association with computer image analysis to identify ruminant from non-ruminant material in feedstuffs appears promising although further improvements (e.g. more defined statistical methods) are required. This work is funded by the European Commission, within the framework of the FOOD-CT-2006-036221 Project SAFEED-PAP

Key Words: Meat and Bone Meals, Bone Lacunae, Image Analysis

T254 Influence of a diet enriched in extruded linseed on fatty acid composition of goat cheese. A. Nudda*¹, G. Battacone¹, M. Addis², A. Pirisi², A. Mazza¹, and G. Pulina^{1,2}, ¹University of Sassari, Sassari, Italy, ²AGRIS Sardegna, Sassari, Italy.

This study aimed to assess the effect of long-term dietary supplementation with extruded linseed on goat milk and cheese fatty acid composition.

Forty-eight crossbreed dairy goats were allocated to 2 groups: one was fed the control diet (CON) and the other one was supplemented with 200 g of extruded linseed (LIN) which supplied 70 g/d of fat. The trial lasted 8 weeks. Bulk milk from each experimental group was collected weekly to produce a soft cheese type. Fatty acids were determined in milk and in 1-day and 20-day-old cheese. The FA content did not differ between milk and cheese. The cis-9, trans-11 CLA was higher in cheese produced from LIN milk than in cheese made from CON milk (1.22 vs. 0.85 g/100 g of fat; $P < 0.01$). The concentration of cis-9, trans-11 CLA in LIN cheese produced from supplemented-goat milk increased gradually until the fifth week (1.81 g/100 g of fat) of the trial and decreased afterwards. The C18:1 trans11 content was significantly higher in LIN cheese than in CON cheese (2.82 vs. 1.60 g/100 g of fat; $P < 0.01$). The content of linolenic acid (LNA) was much higher in LIN cheese than in CON cheese (1.6 vs. 0.67 g/100 g of fat; $P < 0.01$) and remained stable during all the experimental period. The CLA and LNA concentration did not differ between 1-day and 20-day-old cheeses. Goat diet

supplemented with a fat source rich in LNA for a long period resulted in an enhanced CLA content in cheese compared with the control diet. However, the concentration of CLA did not remain stable throughout the fat supplementation period.

Acknowledgements: Research supported by the Ministry of University and Research (FISR grant).

Key Words: Goat Cheese, Linseed, Fatty Acid

T255 Relationship between vaccenic acid content of ruminal bacteria and duodenal bacteria. S. J. Liu, J. Q. Wang*, D. P. Bu, S. Liang, L. Liu, H. Y. Wei, L. Y. Zhou, and K. L. Liu, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

Isomers of Conjugated linoleic acid (CLA), especially *cis*-9, *trans*-11 CLA and *trans*-10, *cis*-12 CLA have a wide range of benefits on human health. It was proved that some unique microorganisms could absorb vaccenic acid (VA) to reduce biohydrogenation, followed increasing CLA synthesis by Δ^9 -desaturase in mammary gland and adipose tissue. However, few reports have referred to the relationship between vaccenic acid of ruminal bacteria and duodenal bacteria. The objective of this study was to evaluate relationship of vaccenic content between mixed ruminal bacteria and duodenal bacteria in beef cattle. Four steers with ruminal cannulas were randomly assigned to control (CK, without additional oil supplement) or CK with 3% sunflower oil plus 1% fish oil (SF1), 2.5% sunflower oil plus 1.5% fish oil (SF2) and 2% sunflower oil plus 2% fish oil (SF3) in a 4x4 Latin square with iso-nitrogenous and 12-wk durational periods (forage to concentrate ratio was 65:35). Ruminal and duodenal digesta were collected every 4 h over a 24 h period on d 20, and d 21 of each experimental period and pooled for each animal, and pooled samples were stored at -20°C for bacteria separation according to different centrifuge method and fatty acids analysis was described by M. Sönnichsen. Regression analysis adopted the linear regression procedure of SAS8.2.

Our study showed that there existed linear regression relationship of vaccenic acid content between mixed ruminal bacteria and duodenal bacteria in beef cattle ($y = 1.15x + 0.09$; $R^2 = 0.87$, $P < 0.0001$). In the linear regressive equation, vaccenic acid content from duodenal bacteria (y value) was higher than that from rumen (x value). In conclusion, ruminal bacteria can effectively inhibit vaccenic acid hydrogenated in rumen, which increase vaccenic acid concentration of duodenal bacteria.

Acknowledgement: Research supported by Ministry of Science and Technology (2006DFB32160).

Key Words: Ruminal Bacteria, Vaccenic Acid, Hydrogenation

T256 Isolation of prominent lipolytic rumen bacteria. N. A. Krueger*, R. C. Anderson, T. R. Callaway, T. S. Edrington, and D. J. Nisbet, *USDA, ARS, Food and Feed Safety Research Unit, College Station, TX.*

Ruminant-derived foods contain high proportions of saturated fats, a result of ruminal biohydrogenation which rapidly saturates and thus limits the availability of free unsaturated fatty acids for assimilation. Strategies to enrich ruminant-derived foods with unsaturated fatty acids are desired as these are considered beneficial for good human health.

Lipolysis is a pre-requisite for biohydrogenation because saturase enzymes act only on free fatty acids. We conducted a descriptive study to isolate and characterize prominent lipolytic bacteria from the bovine rumen. Serial dilutions (10^{-1} to 10^{-10}) of ruminal fluid (from a pastured cannulated cow) were inoculated to roll tubes or plates containing buffered rumen fluid based agar supplemented with triolein, olive oil or linseed oil (2.5% wt/vol) as substrate for lipolytic bacteria. Medium within plates also contained rhodamine B dye specific for detection lipase expressing colonies. Inoculated roll tubes were incubated under 100% CO₂ and plates under N₂:CO₂:H₂ (90:5:5) for up to 7 days. Four colonies exhibiting characteristic zones of clearing and 15 colonies exhibiting fluorescence were isolated media inoculated with 10^{-4} to 10^{-10} ml of rumen fluid indicating that some were among the predominant flora containing 10^{10} colonies/ml. Biochemical and 16S rRNA gene sequence characterization revealed that none of these isolates were *Anaerovibrio lipolytica* or *Butyrivibrio* spp., bacteria considered major contributors to ruminal lipolysis but not isolated in this study. Recovered isolates were identified as *Clostridium chauvoe*, *Clostridium sporogenes*, *Propionibacterium acnes*, *Propionibacterium avidum* and *Staphylococcus epidermidis*. Results indicate that the ruminal population of lipolytic organisms is more diverse than previously thought and that efforts targeting this activity as a way to protect unsaturated fat from biohydrogenation will likely need to target more than just *A. lipolytica* or *Butyrivibrio* spp.

Key Words: Biohydrogenation, Lipolysis, Rumen Bacteria

T257 Biohydrogenation of vaccenic-1-¹³C acid by ruminal microbes in vitro. E. E. Mosley* and M. A. McGuire, *University of Idaho, Moscow.*

Efforts in the human food industry have focused on the elimination of trans fatty acids (TFA) from foods. Thus, it is vital for producers to limit the amount of TFA in beef and milk. Typically, the major trans isomer in beef and milk fat is vaccenic acid (VA). Understanding the rumen microbial modifications of VA will provide necessary information concerning biohydrogenation pathways. Our objective was to determine if VA is isomerized to other 18:1 isomers and if the isomerization and/or biohydrogenation to stearic acid is altered by other fat sources. Rumen in vitro cultures (25 ml) containing ¹³C-labeled VA at 0.25 mg/ml alone or combined with stearic acid, oleic acid, linoleic acid, linolenic acid, cis-9, trans-11 conjugated linoleic acid, corn oil or fish oil at varying concentrations (0.5, 1.0, or 1.5 mg/ml) were run under standard conditions. After 48 h, cultures were frozen, freeze dried, and direct methylated using methanolic-HCl and sodium methoxide. Fatty acid methyl esters (FAME) were converted to dimethyl disulfide derivatives (DMDS). The FAME and DMDS were analyzed by GC-MS. Significant ¹³C enrichment was found in stearic acid, cis- and trans-9, 12, 13, 14, 15, 16, and trans-10 18:1 isomers. All concentrations of fish oil inhibited the biohydrogenation of VA to stearic acid and increased the isomerization of VA to various 18:1 isomers when compared to cultures containing only VA ($P < 0.0001$). Cultures containing fish oil or oleic acid at 0.5 mg/ml contained the greatest enrichment for trans-13, 14, and 15 when compared to all other treatments ($P < 0.0001$). The biohydrogenation of VA by ruminal microbes in vitro involves the formation of positional isomers of cis- and trans-18:1 and stearic acid. Identifying the extent and profile of the TFA produced from VA in the rumen will allow the beef and dairy industries to be proactive in identifying new ways to provide more healthful products to the consumer. Supported in part by the Idaho Agricultural Experiment station and National Research

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Key Words: Vaccenic Acid, Trans Fatty Acids, Biohydrogenation

T258 WITHDRAWN

T259 Use of inter-organ glycerol fluxes to assess abdominal versus peripheral fat mobilization in transition dairy cows. M. Larsen and N. B. Kristensen*, *University of Aarhus, Tjele, Denmark.*

Glycerol flux data from 6 Holstein cows assigned to one of two treatments: No infusion (control; CON) or continuous abomasal infusion (INF) of 1500 g glucose/d (via the rumen) were used to test if fat mobilization differ between abdominal and peripheral tissues. Treatments were initiated at the day of second calving. Cows were fed the same dry-diet and the same lactation-diet, and both were fed in equally sized meals at 8 h intervals. Eight hourly sets of blood samples ($n = 2$ for hepatic vein with CON) were collected simultaneously starting 30 min before the morning feeding 12 days pre partum, as well as 4, 15, and 29 days in milk (DIM). Data was analyzed as a split-plot design and Student's *t*-test was used to test by treatment differences between pre partum and 4, 15 or 29 DIM, respectively. A strong correlation between arterial concentration of glycerol and arterial concentration of non-esterified fatty acids (NEFA) was observed across the data set ($P < 0.01$; $r = 0.88$; Glycerol = NEFA \bullet 0.070 ± 0.002). Except at 4 DIM with CON, the net portal flux and net hepatic uptake of glycerol were relatively constant at a level of 2 ± 1 and 11 ± 2 mmol/h, respectively. From pre partum to 4 DIM, the net portal flux and net hepatic uptake of glycerol tended to increase more ($P = 0.06$) for CON compared with INF (net portal flux: +5 and +1 mmol/h, respectively; net hepatic uptake: +29 and +1 mmol/h, respectively). Assuming no net absorption of dietary glycerol and that glycerol is metabolized solely in the liver, the ratio of abdominal to total fat mobilization was estimated by dividing net portal flux of glycerol by net hepatic uptake of glycerol. The ratio of abdominal to total fat mobilization was not increased ($P > 0.10$) from pre partum to 4, 15 or 29 DIM, or affected by treatment ($P = 0.94$). Thus, the ratio was remarkably constant across the data set (0.18 ± 0.02). In conclusion, the present study indicated similar rates of fat mobilization between abdominal and peripheral adipose tissues in transition dairy cows.

Key Words: Mobilization, Transition, Glycerol

T260 Correlation between UT-B mRNA abundance in ruminal epithelium and net portal flux of urea in transition dairy cows. B. A. Røjen*, P. K. Theil, M. Larsen, and N. B. Kristensen, *Faculty of Agricultural Sciences, University of Aarhus, Tjele, Denmark.*

The objective of the study was to test the hypothesis that abundance of UT-B mRNA in ruminal epithelium can explain variation in net portal flux of urea in transition cows. Six Holstein cows fitted with a ruminal cannula and permanent indwelling catheters were assigned to continuous abomasal infusion of 1500 g glucose/d (INF) or control (CON; no

infusion). Cows were fed the same dry and lactation rations in equally sized portions at 8 hour intervals. Eight hourly sets of blood samples were obtained from arterial, portal and hepatic catheters starting 30 min before morning feeding 12 days pre partum, as well as 4, 15, and 29 days post partum. Rumen papillae from the atrium were harvested at each sampling day. Abundance of UT-B mRNA was determined using real time RT-PCR and normalized by GAPDH mRNA abundance. Data was analyzed as a split-plot design using the mixed model procedure of SAS. The net portal flux of urea decreased (being less negative; $P < 0.05$) with INF compared with CON (-75 and -135 ± 13 mmol/h, respectively), and tended to decrease ($P = 0.08$) between 4 and 15 days post partum for INF compared with CON. Post partum abundance of UT-B mRNA was lowered to less than half (0.44) of the pre partum level ($P < 0.05$). No correlation ($P > 0.10$) between UT-B mRNA abundance and net portal flux of urea was detected when both pre- and post partum data were analyzed reflecting the large influence of reproductive stage on the UT-B mRNA abundance. However, weak correlations ($P = 0.04$ to 0.08) between arterial urea concentration and net portal flux of urea with UT-B abundance were observed when analysing only post partum data ($r = 0.487$ and $r = -0.426$, respectively). In conclusion data showed that UT-B abundance in ruminal epithelium appears to be strongly affected by time relative to calving. However, UT-B mRNA abundance only explained a small proportion of the variability in net portal flux of urea across individual cows, treatments, and days in lactation.

Key Words: Urea Transporter, Ruminal Epithelium, Dairy Cows

T261 Hepatic metabolism of alcohols in freshening Holstein cows. B. M. L. Raun* and N. B. Kristensen, *Faculty of Agricultural Sciences, University of Aarhus, Tjele, Denmark.*

Eight lactating Holstein cows (26 ± 7 kg milk/d; 14 ± 1 kg dry matter intake/d) implanted with a ruminal cannula and permanent indwelling catheters in major splanchnic blood vessels were used to investigate hepatic alcohol metabolism at day 4 of lactation. The hypothesis was that freshening dairy cows would have a low capacity for hepatic alcohol metabolism. Cows were randomly allocated to a 2 by 2 factorial design with one factor being level of branched chain alcohol (isopropanol from HMBi; 0.26 % of dry matter; Adisseo, France) compared with no addition of isopropanol (calcium carbonate) and the second factor being source of straight chain alcohols ethanol (1.5 % of dry matter) compared with propanol (1.1 % of dry matter). Cows were fed the same dry ration and fed the experimental rations from time of calving. The rations were fed in three equally sized portions daily at 8 hour intervals. Eight hourly sets of arterial, portal vein, and hepatic vein samples were collected. Data was analyzed as a 2 by 2 factorial design with samples within day as repeated measurements using the mixed procedure of SAS. The net portal flux of ethanol increased from 30 ± 8 to 74 ± 9 mmol/h with ethanol compared with propanol ($P < 0.01$) and the net portal flux of propanol increased from 16 ± 6 to 64 ± 5 mmol/h with propanol ($P < 0.001$) compared with ethanol. The net portal flux of isopropanol increased from 2 ± 4 to 13 ± 3 mmol/h ($P = 0.04$) with HMBi compared with calcium carbonate. Numerically net hepatic uptake of all three alcohols mirrored net portal flux and an increased hepatic uptake of propanol and isopropanol could be detected ($P = 0.04$ to $P < 0.001$). In agreement with the responsiveness in hepatic alcohol metabolism to increased alcohol absorption there were not detected any net splanchnic release of ethanol, propanol or isopropanol. In conclusion no limitation in liver capacity for metabolism of ethanol, propanol, and isopropanol

could be detected in freshening dairy cows fed rations containing alcohol levels spanning commonly observed variation in silage based rations.

Key Words: Alcohol, Dairy Cow, Metabolism

T262 Use of ARISA to monitor shifts in rumen microbial populations caused by changes in diet. S. E. Stebulis*¹, D. M. Stevenson², G. J. M. Rosa¹, and R. R. Grummer¹, ¹*University of Wisconsin, Madison,* ²*USDA-ARS-US Dairy Forage Research Center, Madison, WI.*

The objective was to determine whether automated ribosomal intergenic spacer analysis (ARISA) is sensitive enough to detect shifts in rumen microbial populations caused by dietary changes. Six ruminally cannulated, non-lactating, non-pregnant Holstein cows were sampled for rumen contents in a randomized cross-over design. Treatments were either high forage (HF) or low forage (LF) diets offered for ad libitum intake. High forage was composed of 43.7% neutral detergent fiber (NDF) and 31.2% non-fiber carbohydrate (NFC), while LF contained 25.5% NDF and 44.6% NFC. The trial consisted of 3 periods, an adaptation period (30 d), period 1 and period 2 (14 d each). Cows were switched between periods with no adaptation. Treatment sequences, including the initial adaptation period, were HF-LF-HF and LF-HF-LF. Rumen samples were collected 4 h after feeding on d 14 of each experimental period. Bacterial DNA was extracted from each sample, and the ribosomal intergenic spacer region was PCR amplified and used for ARISA. The effects of diet, fraction (liquid vs. solid), period, and cow on changes in rumen microbe population were analyzed using principal components methodology and Chi-squared tests. Rumen pH, analyzed with a mixed model, was significantly greater for HF than for LF (6.7 vs. 6.1 ± 0.08 ; $P < 0.001$). There were 253 total phylotypes (unique PCR amplicon lengths) detected using ARISA. Of these phylotypes, 25 were unique to an individual cow. There were 12 phylotypes only found in liquid and 3 only in solid fractions, and 16 only in LF and 2 only in HF. Treatment had a significant effect ($P < 0.05$) on 19 phylotypes. Thirty-two phylotypes were affected ($P < 0.05$) by fraction, and 19 were significantly different between cows ($P < 0.05$). Period affected only 6 phylotypes ($P < 0.05$). These results suggest that ARISA is sensitive enough to pick up differences in rumen microbial populations due to diet composition changes, and other factors such as rumen fraction and cow.

Key Words: Microbial Population, Diet, Rumen

T263 Evaluation of n-alkanes, chromic oxide and lignin as indigestible markers to estimate duodenal and fecal flows in lactating dairy cows. S. O. Juchem*¹, E. J. DePeters¹, J. M. Heguy¹, S. J. Taylor¹, and J. E. P. Santos², ¹*University of California, Davis,* ²*University of Florida, Gainesville.*

The objective was to compare estimates of duodenal and fecal flows obtained from 3 markers, being n-alkanes (ALK; internal, C31 and C33; external, C32 and C36), chromic oxide (CrO; external) and lignin (LIG; internal). Four lactating primiparous Holstein cows cannulated in the rumen and duodenum were utilized in a 4x4 Latin Square design experiment. Each period lasted 14 d, 10 d of adaptation and 4 d of sampling, whereas cows were subjected to 97% feed restriction during the last 4 d to prevent refusals. A new n-alkane slow releasing capsule (CAPTEC, Auckland, NZ) was placed into the rumen at d 0 of each

period in each cow. Chromic oxide was added at 0.11 % of diets DM. All diets had similar chemical composition, and alfalfa hay was the only forage source (47.7 % of DM). Five samples of duodenal digesta (2.5 L) and feces (~500 g) were sampled during the last 4 d of each period at different times in relation to feeding to create an average composite sample. Data were analyzed by the MIXED procedure of SAS, with a model that included effects of cow, period, diet, marker and the marker by diet interaction. DM intake was not affected by dietary treatments (20.1; 18.5; 19.5; 18.8 kg/d). Apparent whole tract digestibility of OM was highest ($P < 0.01$) for CrO (71.9%), intermediate for C31, C33 and LIG (64.0; 65.3; 65.5%), and lowest for C32 and C36 (59.6; 60.7%). Duodenal DM flow was highest ($P < 0.01$) when C32 and C36 dosed ALK were utilized (14.3; 14.4 kg/d), smallest for C31 and C33 dietary ALK (11.0; 10.9), and intermediate for CrO and LIG (12.3; 12.8 kg/d). Fore-stomach disappearance of NDF-ash free was highest ($P < 0.05$) for C31 and C33 (41.7; 42.1%), intermediate for CrO and LIG (34.8; 32.2%), and lowest for C32 and C36 (24.6; 23.9%). Disappearance of starch was lower ($P < 0.05$) for C32 and C36 ALK (52.4^c; 53.2^c%), however C31, C33 and CrO provided similar estimates (63.9^a; 64.2^a; 60.1^{ab}%), whereas LIG was intermediate (58.1^{bc}%). N-alkanes from feed provided estimates of diet digestibility that were close to CrO estimates, and can be utilized as an alternative indigestibility marker.

T264 The use of flow cytometry to assess rumen bacteria in dairy heifers limit fed different forage to concentrate ratios with *Saccharomyces cerevisiae*. G. J. Lascano* and A. J. Heinrichs, *The Pennsylvania State University, University Park.*

Counting total viable bacteria using colony-unit forming assays lacks accuracy, as this method only includes culturable bacteria capable of initiating cell division. Thus, viable bacterial counts are often underestimated and total counts unknown. Both live and total bacteria populations can be enumerated using fluorescent characteristics of cell membranes and flow cytometry. The objective of this experiment was to investigate viable and total rumen bacteria counts using LIVE/DEAD Backlight kit (Invitrogen, Corp.) when 3 levels of forage:concentrate (F:C) were fed to heifers at restricted levels of intake with or without the addition of *Saccharomyces cerevisiae* (YC, Yea-Sacc¹⁰²⁶, Alltech, Inc). Three cannulated, post-pubertal Holstein heifers (age 18 ± 1 mo) were fed corn silage (CS)-based diets in a 3-period (35 d) Latin Square design. Heifers were fed F:C treatment diets for 21 d, followed by 14 d with YC added (1 g/kg, as fed). High concentrate (HC) TMR (40% CS, 60% grain; 12.6% CP, 25% NDF), medium concentrate (MC) TMR (60% CS, 40% grain; 12.3% CP, 28% NDF), and low concentrate (LC) TMR (80% CS, 20% grain; 12.4% CP, 35% NDF) were fed once/d. Rumen fluid was sampled at -2, 0, 2, 4, 6, 8, 10, 12 h after feeding. Samples were immediately stained with LIVE/DEAD kit and analyzed with a Coulter XL-MCL single laser flow cytometer (Beckman Coulter, Inc.). Mean live bacteria count was not different among treatments ($6.75, 4.77, 4.97 \times 10^{11} \pm 0.53 \times 10^{11}$ cells/mL; $P = 0.10$) for HC, MC and LC, but YC addition increased number of viable bacteria in all treatments ($P < 0.01$). There was also a ration by YC interaction with greatest differences in the HC diet ($P = 0.01$). Total live bacteria counts decreased after feeding ($P < 0.01$) and began to increase 4 h after feeding. We conclude that feeding different ratios of F:C did not change total viable bacteria population, but YC increased this count in all 3 diets in this experiment.

Key Words: Viable Bacteria Count, Flow Cytometry, Yeast Culture

T265 Updates to the Cornell Net Carbohydrate and Protein System: Effects of changes in feed digestion rates and passage rate assignments on metabolizable energy and protein predictions. E. B. Recktenwald*, D. A. Ross, T. R. Overton, L. E. Chase, P. Huhtanen, and M. E. Van Amburgh, *Cornell University, Ithaca, NY.*

Evaluations of the Cornell Net Carbohydrate and Protein System (CNCPS) v6 were made with data from individually fed lactating dairy cows from three independent studies. As implemented, CNCPSv6 accounted for a similar proportion of the variation (86%) in first limiting (ME or MP) milk production as CNCPSv5 but with a lower bias (Tylutki et al. 2007). Further evaluations of observed data from cows fed more MP limiting diets demonstrated large biases in the MP allowable milk (up to 9 kg/d) and this was investigated. Pool sizes and rates of carbohydrate digestion were updated based on the data of Lanzas et al. (2007). In CNCPS v6, NDF degradation rates were linked to NDIN rates to based on the available data on pool degradation characteristics. The soluble protein pools sizes and rates were also evaluated and modified based on the available literature data on protein degradation and flow out of the rumen. For example, the protein A pool rates were decreased from 10,000%/h (Sniffen et al. 1992) to 200%/h. Further, the standardized precipitation method (Licitra et al. 1996) underestimated the peptide content of many forages; thus modifications to the NPN pool were made based on the available feed chemical data. Finally, within the structure of the model the soluble pools (both carbohydrate and protein) were linked to the liquid passage rate equations; they were previously linked to the solids passage rates. Data from 141 observations from individual cows and from means of independent studies were used to re-evaluate CNCPSv6 after these modifications; improvements were demonstrated in ME and MP allowable milk predictions (Table 1).

Table 1.

Prediction	CNCPS Version	Mean prediction	Mean prediction bias	RSMPE	Residual error	Obs vs pred slope
MP	6.0	37.04	-2.57	5.52	4.88	0.73
MP	6.1	41.34	1.66	5.21	4.94	0.74
ME	6.0	44.97	5.35	7.84	5.73	0.66
ME	6.1	44.76	5.08	7.60	5.66	0.67
Most limiting	6.0	36.91	-2.70	5.49	4.77	0.74
Most limiting	6.1	40.60	0.92	4.70	4.61	0.77

Key Words: CNCPS, Metabolizable Protein, Modeling

T266 Dynamics of ruminal fiber digestion of corn milling co-products. L. O. Tedeschi¹, P. J. Kononoff², K. Karges³, and M. L. Gibson³, ¹Texas A&M University, College Station, ²University of Nebraska, Lincoln, ³Dakota Gold Research Association, Sioux Falls, SD.

The corn-ethanol dry milling industry is a major producer of feedstuffs, namely distillers dried grains plus solubles (DDGS). This industry has also produced new feeds that differ in chemical composition and possibly nutrient availability. The objective of this study was to evaluate the dynamics of ruminal fiber digestion of several co-products. Thirty samples of four corn milling co-products were evaluated in this study:

DDGS, high protein DDGS (HP-DDGS), bran (BRAN), and dehydrated germ (GERM). Alfalfa hay (HAY) was used as a standard feed in the in vitro fermentation dynamics analysis. Neutral detergent residue (without sodium sulfite; NDR) averaged 32.9, 34.8, 21.9, 33.5 % for DDGS, HP-DDGS, BRAN and GERM respectively. The CP and ether extract averaged 30.8 and 11.2 %, 44.6 and 4.18 %, 15.3 and 9.49 %, and 17.4 and 17.4% for DDGS, HP-DDGS, BRAN and GERM, respectively. The feeds were fermented in vitro for a 48 h period. Gas production was measured using a computerized system and data was fitted to an exponential model to compute the fractional degradation rate (kd). Statistical analyses were performed using the random coefficients model assuming an incomplete block design. The TDN for each feed was predicted using a summative equation with the kd of NDR. The kd of NDR and defatted fiber residue (DFR) were significantly different ($P < 0.05$) for DDGS, HP-DDGS, BRAN and GERM, and was estimated to be 6.88 and 8.44 %/h, 11.8 and 11.7%/h, 6.14 and 8.52%/h, 7.24 and 9.14%/h, respectively. Robust regressions were developed to compute kd of NDR using standard chemical analysis. The results suggested that the proportion of fiber digested in the rumen were affected by degree of sample processing and fat removal. Although tabular values for the rate of NDF digestion in the CPM-Dairy model are generally indicative of many feed co-products, these results suggest that the digestion rates of fiber may vary greatly across different types of co-products. Furthermore, the use of model simulations in this study demonstrated that observed differences in fermentability and chemical composition result in differences in the supply of TDN for lactating dairy cows.

Key Words: Fiber, Co-Products, Rumen

T267 Please see abstract 57.

T295 Use of the mobile nylon bag method to determine phosphorus disappearance in common dairy cattle ration ingredients. N. M. Cherry*¹, B. D. Lambert^{1,2}, and J. P. Muir¹, ¹Texas AgriLife Research, Stephenville, TX, ²Tarleton State University, Stephenville, TX.

Phosphorus (P) excretion in manure and has become a major problem facing dairy producers in much of the United States. Excess P released into the environment may pollute surface waters leading to eutrophication and excess algal growth. One approach to reducing P excretion is to avoid excess dietary P. Data regarding P availability in feedstuffs is limited and more precise ways of measuring P availability in the digestive tract are needed. In this experiment the mobile nylon bag method was used to determine the disappearance of dry matter (DM) and P in ground corn, corn silage, alfalfa hay, coastal bermudagrass hay, and Tifton-85 bermudagrass hay in steers after ruminal (24 hrs), ruminal + pepsin/HCL (rumen + PH), and ruminal + pepsin/HCL + intestinal (rumen + PH + I) incubation. Ruminal degradation of both P and DM differed ($P < 0.05$) between feedstuffs, and by site of incubation. DM total-tract (rumen + PH + I) availability for ground corn, corn silage, alfalfa hay, coastal bermudagrass hay, and Tifton-85 bermudagrass hay were 90.35, 51.89, 41.66, 69.04, 71.79% respectively. Total tract (rumen + PH + I) P availability for ground corn, corn silage, alfalfa hay, coastal bermudagrass hay, and Tifton-85 bermudagrass hay were 99.22, 92.22, 94.81, 84.55, and 85.36%, respectively. The variability in the availability in P (~15%) indicates that inclusion of a P availability coefficient in ration balancing software could have a measurable impact on subsequent P excretion from dairy cattle. More data concerning P availability as affected by feed ingredient or plant species, maturity and quality are needed to more accurately define P availability in dairy cattle feeds.

Key Words: Phosphorus, Mobile Nylon Bag

Small Ruminant: Goats

T268 Evaluation of the FAMACHA(R) system, fecal egg counts, hematocrits and weight of sheep and goats associated with parasitism fed varying levels of herbs and protein/energy grain. H. A. Swartz*¹, A. Stewart¹, D. Sommerer¹, F. Wulff¹, and M. Ellersieck², ¹Lincoln University, Jefferson City, MO, ²University of Missouri, Columbia.

A study was conducted to determine the effects of feeding various levels of protein/energy grain in an herbal mixture to Katahdin (K) hair sheep (n=39), Dorset(D) wool sheep (n=36) and Boer (B) goats (n=52), evaluating the FAMACHA[®] system for anemia compared to the red blood cell volume (hematocrit). The FAMACHA[®] system has been shown to be a useful tool in sheep in identifying clinical anemia associated with parasitism. However, the application of FAMACHA[®] to goats has not been evaluated. The FAMACHA[®] system has a scale based on the color of the ocular conjunctiva; 1-2 red and healthy, 3 borderline and 4-5 pale pink to white indicating anemia. The herbs consisted of 40.5% wormwood (*Artemisia absinthium*). Treatment groups were Dorsets, 1) control, 2) .11 gm/hd herbs plus .227kg/hd 14% protein/corn based diet daily (grain), 3) .11 gm/hd herbs weekly plus .227 kg/hd grain weekly. Katahdin sheep received 4) control, 5) 5.5 gm/hd herbs weekly and .113 kg of grain daily, 6) 5.5 gm/hd herbs plus .113 kg/hd grain weekly. Boer goats were fed 7) .113 kg/hd grain weekly 8) 5.5 gm/hd herbs plus .227 kg/hd grain daily and 9) 5.5 gm/hd herbs plus .113 kg/hd grain daily. Fecal egg counts (FEC), hematocrits (HEM), FAMACHA[®] (FAM) readings and weight (WT) were collected at the beginning of the project in all treatments and every four weeks. Data were analyzed in the SAS system for Pearson correlation coefficients and MIXED procedure in all treatments. The correlations of FEC to HCT ($r = -.37$), FEC to FAM ($r = .27$), HCT to FAM, ($r = -.27$) & HCT to WT ($r = .43$) with the K & D, significantly related ($P < .05$). The FAM to HCT in the Boer goats was not applicable showing no relationship in differences. There were no significant differences in treatment groups of K, D & B. The daily feeding of grain compared to the weekly feeding in sheep and goats and increase in feed from .113 to .227 in D and one group of B showed no significant differences in treatments. The FAM readings were effective in the sheep but not in the meat goats in HCT.

Key Words: FAMACHA, Deworming, Herbs

T269 The effect of garlic on *Haemonchus contortus* infection in goats. Z. Wang*, E. Loetz, A. L. Goetsch, S. P. Hart, and T. Sahl, American Institute for Goat Research, Langston University, Langston, OK.

Garlic has been used in some countries as an ingredient in deworming remedies for humans and animals for many years. The study reported here determined the efficacy of garlic for treatment of *H. contortus* infection and effect on immune responses in goats. Twelve Spanish wethers (1.5 yr, 35 ± 1.5 kg BW) naturally infected with *H. contortus* were allocated to two groups of six each and housed individually. Goats were fed hay-based diets (ME = 8.7 MJ/kg DM; CP = 10%) without or with 2% of garlic powder. The diets were offered for 4 wk at a maintenance level of intake. The initial mean fecal egg counts (FEC) were $4,983 \pm 1,973/g$ (range of 1,125 to 13,652/g) for the Control group and $8,654 \pm 3,548/g$ (range of 2,050 to 22,225/g) for the Garlic group. There was not a time x treatment interaction in FEC ($P > 0.05$). With initial FEC as a covariate, the garlic treatment reduced FEC (geometric mean:

$7,872 \pm 38.6/g$ for Control and $699 \pm 38.4/g$ for Garlic, respectively; $P < 0.001$) during the experimental period. Serum concentrations of IgA, IgE, and IgG on d 0, 14, and 28 were not affected ($P > 0.05$) by garlic intake. The BW of goats did not change during the experiment and was not affected by treatment ($P > 0.05$). These data suggest that the decline in FEC may be attributable to cell mediated immunity rather than a humoral immune reaction or direct garlic toxicity to the parasites. The results demonstrate that garlic is a potent anthelmintic herb and warrant more work to elucidate the mechanism.

Key Words: Goats, Garlic, *Haemonchus*

T270 Efficacy of wormwoods (*Artemisia* spp.) as an anthelmintic in goats. S. P. Hart*¹, J. F. S. Ferreira², and Z. Wang¹, ¹American Institute for Goat Research, Langston University, Langston, OK, ²Appalachian Farming Systems Research Center, USDA-ARS, Beaver, WV.

Gastrointestinal nematodes (GIN) are the greatest health problem in goat production and control of GIN has become difficult due to development of anthelmintic resistance. Therefore, there is a need to investigate plant materials with potential anthelmintic activity. The objective of this study was to investigate the efficacy of two wormwood species against GIN in goats. A native wormwood (*Artemisia ludoviciana*) was harvested at the mature stage and whole plants were air-dried and fed to goats (B). *Artemisia annua* was cultivated and harvested at the late vegetative stage and air-dried; leaves were stripped from the stalks, dried at 45°C in a forced-air oven and crushed (L). Dry open Boer and Boer cross does (average BW = 42.3 kg) adapted to Calan headgates were used in this study. Does were housed in a barn and fed a control diet, 0.45 kg of a grain supplement (13% CP and 75% TDN) and 0.9 kg of a low quality hay (7% CP and 68% NDF) for a 7-d adaption period. Goats were randomly assigned to treatments. Seven does received the control diet throughout the study. Four animals received 0.34 kg B, 0.34 kg grain supplement, and 0.68 kg hay for 4 d and then received the control diet for the remainder of the study. Six animals were fed 0.45 kg L, 0.45 kg supplement, and 0.45 kg hay for 6 d and then received the control diet for the rest of the study. Fecal samples were taken for two consecutive days prior to feeding treatment diets and then on alternate days for 14 d. Fecal egg counts (FEC) were conducted by the McMaster procedure. The FEC were log transformed prior to statistical analysis. There was a significant time (pre-treatment vs post treatment) by treatment interaction ($P < 0.002$). Control FEC increased from 1,266/g to 1,673/g whereas B FEC decreased from 3,998/g to 2,979/g. Conversely, FEC for L was unchanged (2,510/g vs 2,419/g). The apparent anthelmintic activity of *Artemisia ludoviciana* merits further investigation, especially at a younger stage of maturity.

Key Words: Anthelmintic, Gastrointestinal Nematodes, Alternative Dewormer

T271 Influence of sericea lespedeza pellets on gastrointestinal parasite fecal egg counts in goats. N. C. Whitley*¹, T. H. Terrill², J. E. Miller³, J. M. Burke⁴, and M. C. Gooden¹, ¹University of Maryland Eastern Shore, Princess Anne, ²Fort Valley State University, Fort Valley, GA, ³Louisiana State University, Baton Rouge, ⁴USDA-ARS-DBSFR, Booneville, AR.

The objective of the experiment was to determine the influence of sericea lespedeza pellets (SLP) on gastrointestinal parasite fecal egg counts (FEC) in goats. Naturally infected, mixed sex Boer crossbred goat kids were used at 22.5 ± 0.74 kg body weight. Animals housed on pasture and being supplemented at approximately 2% BW concentrate daily were removed from pasture at an average FEC of 2468 ± 302 epg. Goats were placed in individual pens with concrete-slatted or expanded metal flooring with goats allotted to treatments of 0 (CON), 20, 40, or 60% SLP (20SLP, 40SLP, 60SLP) to account for sex, body weight, pasture FEC and flooring type with 13, 10, 9 and 13 goats per treatment, respectively. Diets were mixed to be isonitrogenous and isocaloric, and included alfalfa pellets to provide a pelleted legume forage control. Blood samples for packed cell volume (PCV; packed red blood cell level/serum level $\times 100\%$) and fecal samples for FEC (using the Modified McMasters technique) were collected on d-1, 7, 14, 21 and 28. Larval culture for speciation was conducted on fecal samples collected on d 28 of the study. Statistical analysis was conducted using the MIXED procedure of SAS for repeated measures and Pearson Product Moment correlations were conducted using the CORR procedure of SAS. In this study, PCV and FEC were negatively related ($r = -0.37$; $P < 0.0001$) as were FEC and body weight ($r = -0.20$; $P < 0.004$). Mean PCV and FEC were not influenced by treatment, averaging $27 \pm 1.5\%$ for CON, $33 \pm 1.8\%$ for 20SLP, $33 \pm 1.7\%$ for 40SLP and $31 \pm 2.2\%$ for 60SLP. The FEC averaged 2690 ± 483 epg for CON, 1406 ± 551 epg for 20SLP, 1517 ± 529 epg for 40SLP and 1266 ± 690 epg for 60SLP diets. Larval speciation through fecal culture indicated that at the end of the study, *Haemonchus contortus* larva were 43, 39, 35 and 31% of the sample for CON, 20SLP, 40SLP and 60SLP, respectively. So, overall larval cultures and PCV indicated a modest to low infestation level of *H. contortus*, which might have been selectively reduced by SLP. However, more research is needed to determine the influence of SLP on gastrointestinal nematodes in goats.

Key Words: Parasites, Tannin, FEC

T272 Effect of somatic cell count in goat milk on yield and sensory quality of semi-hard cheese. S. S. Chen^{1,2}, L. Zhang^{1,3}, B. Bah¹, and S. S. Zeng*¹, ¹American Institute for Goat Research, Langston University, Langston, OK, ²College of Food Science & Nutritional Engineering, China Agricultural University, Beijing, China, ³Northeast Agricultural Research Center of China, Changchun, China.

This study investigated the effect of somatic cell count (SCC) in goat milk on yield and sensory quality of semi-hard cheese. Thirty kilograms of goat milk with SCC levels of 410,000 (Low), 770,000 (Medium), and 1,250,000 cells/ml (High) was obtained from the Alpine herd of the American Institute for Goat Research for the manufacture of semi-hard cheese in the Langston University dairy processing pilot plant for two consecutive weeks at three stages of lactation. Cheese milk prior to cheesemaking was analyzed for SCC, total solid (TS), protein, and fat in the Langston Dairy Herd Improvement (DHI) laboratory. Cheese yield was recorded on day 1 and cheese samples on days 1, 60 and 120 of aging were analyzed for scores of total sensory, flavor, and body/texture, and contents of moisture, protein, and fat. Results indicated that there were no significant differences ($P > 0.05$) in cheese yield among milk with different SCC levels. However, goat milk with high SCC resulted in significantly lower ($P < 0.05$) scores of total sensory and body/texture than milk with low or medium SCC, although no difference was observed in flavor score. A higher ($P < 0.05$) cheese yield was obtained from goat milk in early lactation (April) than in mid- (July) or

late lactation (October) probably because of a higher total solids content in early lactation milk. Aging for 60 days or more improved ($P < 0.05$) scores of total sensory, flavor, and body/texture in cheese as expected. It is concluded that SCC in goat milk did not affect the yield of semi-hard cheese but high SCC resulted in inferior sensory quality.

Key Words: Somatic Cell Count, Goat Milk, Cheese

T273 Replacement of coastcross hay by soybean hulls in lactating dairy goat diets. R. S. Gentil*, C. Q. Mendes, I. Susin, A. V. Pires, G. H. Rodrigues, F. S. Urano, E. M. Ferreira, R. C. Amaral, and M. F. Ribeiro, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, SP, Brazil.*

Soybean hulls (SH) can be used to replace either grain or forage in diets for lactating dairy ruminants. Most of research has been directed towards dairy cows, while for lactating goats there is little information about the effects of SH on intake, milk yield and composition. Thirty-six lactating Saanen goats (45 ± 8 DIM) were assigned to a complete randomized block design (according to milk production, DIM and number of lactation) to determine the effects of replacing coastcross hay neutral detergent fiber (NDF) by soybean hulls NDF on dry matter intake (DMI) and milk yield and composition. Goats were housed individually in a tie stall for a period of 8 weeks. Does were fed a 50:50 (concentrate:roughage ratio) TMR with 15% crude protein and with similar amount of NDF. Soybean hulls replaced hay by 0%, 33%, 67% or 100% on a DM basis, corresponding to the experimental treatments OSH, 33SH, 67SH and 100SH, respectively. Does were milked twice a day and milk samples were saved in-bromo-2-nitropropane-1-3-diol to determine composition by infrared absorbance. There was a linear decrease in daily milk production (2.76, 2.48, 2.58 and 2.05 kg), 3.5% fat-corrected milk (2.93, 2.54, 2.42 and 2.05 kg), lactose (4.51, 4.44, 4.38 and 4.33%) and total solids (12.45, 12.14, 11.60 and 11.63%) for OSH, 33SH, 67SH and 100SH, respectively, when SH were added to the diet. However, milk fat (3.86, 3.63, 3.23 and 3.56%) and milk protein concentration (2.99, 3.03, 2.94 and 2.85%) were similar ($P > 0.05$) among treatments. There was a quadratic response ($P < 0.01$) on daily DMI (2.18, 2.70, 2.46 and 1.89 kg) and feed efficiency (1.33, 0.93, 0.98 and 1.10 3.5% FCM.DMI-1) when SH replaced coastcross hay in the diet. These data suggest that partial replacement of coastcross hay by SH improves DMI. However, there was no beneficial effect on milk production and composition.

Key Words: Co-Products, Fiber, Saanen

T274 Classification tree analysis of grazing behavior in goats. T. A. Gipson*, A. R. Askar, A. Beker, R. Puchala, A. Asmare, G. D. Detweiler, and A. L. Goetsch, *American Institute for Goat Research, Langston University, Langston, OK.*

Electronic monitoring equipment may allow for characterization of grazing behavior without potential effects of human visual observation. Translating equipment output into specific activities, however, is challenging. Therefore, this study was conducted to develop means of predicting grazing behavior based on visual observation from output of currently available electronic monitoring systems. There were 1,538 5-min observations of grazing activity (G = grazing; RL = resting, lying; RS = resting, standing; W = walking) at two locations collected by four

observers on 28 goats over 4-d periods. There were 390, 627, 478, and 43 observations for G, RL, RS, and W, respectively. Goats were fitted with GPS collars (GPS 3300, Lotek, Newmarket, Ontario, Canada) to ascertain distance between consecutive GPS fixes. Collars were equipped with left-right (X-activity), forward-backward (Y-activity), and head-down motion sensors. A leg activity/position sensing system (IceTag, IceRobotics, Midlothian, Scotland, UK) was employed to determine stepping, standing, and lying. Classification tree analysis was conducted using CART[®] software. A decision tree, which is a diagram representing a classification system, with a minimum relative cost criterion of 0.560 yielded 18 terminal nodes. Prediction success rate for G was 70.3% (i.e., 274, 35, 48, and 33 G observations were classified into G, RL, RS, and W terminal nodes, respectively). Success rate for RL was 74.0% (57, 87, and 19 RL observations classified as G, RS, and W, respectively). Success rate for RS was 48.5% (93, 106, and 47 RS observations classified as G, RL, and W, respectively). Success rate for W was 83.7% (5, 1, and 1 W observations classified as G, RL, and RS, respectively). Output from currently available electronic monitoring equipment systems can be used to predict grazing behavior of goats based on visual observation; however, prediction success rate is less than optimal. Other potential monitoring equipment should be evaluated to improve success rate.

Key Words: Goats, Grazing, Predictive Model

T275 Integration of meat goat production into pine silvopasture.

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Little is understood about how meat goat production can be included as a value added product to high value saw log production in pine silvopasture. Understanding animal-plant interactions in these systems is key to their sustainable management. The objectives were to determine the optimum stocking rates of Boer cross wethers goats on recently thinned and pruned loblolly pine plantation. Three stocking rates (SR) at 0.50 animal unit equivalent (AUE)/ha (low), 0.75 AUE/ha (medium), and 1.0 AUE/ha (high) (equivalent to 10, 15, and 20 goats/ha, respectively) were evaluated in a randomized complete block design at the Federation of Southern Cooperatives, Epes, AL. Goats were weighed at 30 d intervals over a 90-d period to determine ADG. Available plant biomass quality and quantity were determined before and after the grazing period. Blood samples were collected to assess blood urea nitrogen (BUN). The ADG were higher ($P < 0.05$) for the low SR compared to the medium and high SR while no differences were observed ($P > 0.05$) between the latter two treatments. The BUN concentrations were not different among treatments during the first 30 days ($P > 0.10$), but as the season progressed, goats on higher SR tended to have higher BUN values ($P < 0.08$), particularly at d 60 and 90. At the start of the trial, average plant biomass was 1071, 862, and 1033 kg DM/ha for low, medium, and high SR, respectively. Corresponding values at the end of the trial were 1445, 560 and 813 kg DM/ha. The control paddocks contained an average of 1014 kg DM before and 1852 kg DM at the end of the trial. Biomass DM declined at a faster rate on plots with higher SR; percentage changes were +82.8, +35.0, -35.1, and -21.3 for the control, low SR, medium SR, and high SR, respectively. Nutrient composition of plant biomass, measured as CP, NDF, ADF and acid detergent lignin did not differ ($P > 0.05$) among treatments. Because the study year occurred during a drought year, further studies are required in average or above average precipitation years.

Key Words: Goats, Silvopasture, Stocking Rate

T276 Mineral requirements for growth of Moxoto goats grazing in the semi-arid region of Brazil. M. J. Araújo¹, A. N. Medeiros¹, S. Gonzaga Neto¹, R. G. Costa¹, I. A. M. A. Teixeira^{*2}, K. T. Resende², C. A. T. Marques¹, G. M. P. Melo², and S. F. Souza¹, ¹Universidade Federal da Paraíba/UFPB, Areia, PB, Brazil, ²Universidade Estadual Paulista/UNESP, Jaboticabal, SP, Brazil.

Indigenous goats play an important role for the semi-arid region of Northeastern Brazil as a biological resource with great genetic variability. In addition, they are a source of animal protein of high biological value available to people of low income. However, there is a lack of information about these animals; mainly regarding their nutritional requirements. Therefore, the objective of this study was to determine net mineral requirements for growth of thirty-six male Moxoto goat kids (15.69 ± 0.78 kg initial BW), grazing in the semi-arid region of Brazil. Four kids were slaughtered at the beginning of the experiment (baseline group, 15.37 ± 0.30 kg BW) and the remainder (n = 32) were allocated randomly to one of the four levels of supplementation (treatment groups: 0, 0.5, 1.0 and 1.5% BW). There were eight kids per treatment. When the animals in the 1.5% BW treatment group reached 25 kg BW, the animals in all treatment groups were slaughtered. The individual whole empty body was weighed, ground, mixed and sampled for chemical analyses. The body composition (g/kg empty body weight; EBW) ranged from 10.80 to 11.50 g Ca; 7.86 to 8.74 g P; 0.37 to 0.42 g Mg; 1.57 to 1.61 g Na and 1.58 to 1.74 g K, for Moxoto kids between 15 and 25 kg BW. The net mineral requirements (g/kg empty body weight gain; EWG) were determined by comparative slaughter technique which ranged from 9.53 to 10.65 g Ca; 7.41 to 8.65 g P; 0.36 to 0.43 g Mg; 1.31 to 1.41 g Na and 1.47 to 1.70 g K for animals with BW ranging from 15 to 25 kg. In conclusion, our study indicated that indigenous goats grazing in the semi-arid region of Brazil have different mineral requirements from those values recommended by international committees for dairy and meat goats.

Key Words: Body Composition, Caatinga, Indigenous Goats

T277 Mineral requirements of Saanen growing kids. K. T. Resende^{*1}, D. Oliveira¹, I. A. M. A. Teixeira¹, A. N. Medeiros², and A. C. D. Ferreira³, ¹Universidade Estadual Paulista/Unesp, Jaboticabal, SP, Brazil, ²Universidade Federal da Paraíba, Areia, PB, Brazil, ³Universidade Federal do Sergipe, Aracaju, SE, Brazil.

The aim of this study was to determine the calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na) and potassium (K) requirements for growth of 20 Saanen intact male kids (5.30 ± 0.34 kg of initial BW). The kids were fed for ad libitum intake, and were slaughtered when they reached an average BW of 5.30 ± 0.14 kg (n = 6), 12.90 ± 0.32 kg (n = 6), and 21.03 ± 0.36 kg (n = 8) kg. Individual body components (head plus feet, hide, internal organs plus blood, and carcass) were weighed, ground, mixed, and samples were taken to chemical analyses. A completely randomized design was used with 3 treatments (slaughter weight). The allometric equations used to estimate the relationship between calcium, phosphorus, magnesium, sodium and potassium contents on the empty body and empty body weight (EBW) presented good data adjustment (R^2 ranged from 0.92 to 0.98). Whereas the proportions of Ca, P, Mg, Na and K in the empty body ranged from 9.91 to 10.85 g Ca/kg of EBW; 8.75 to 8.99 g P/kg of EBW; 0.78 to 0.65 g Mg/kg of EBW; 2.01 to 1.09 g Na/kg of EBW and from 2.71 a 1.62 g K/kg of EBW at 5 and 20 kg of BW, respectively. The net requirements for gain of BW ranged from 903 to 988 mg Ca/day/100 g, from 759 to

779 mg P/day/100 g, from 56 to 47 mg Mg/day/100g; from 84 to 46 mg Na/day/100g, from 132 to 79 mg K/dia/100g BW, for Saanen kids at 5 and 20 kg BW. Our results suggest that the mineral requirement for growing dairy goats raised under tropical conditions differ from the established recommendations.

Key Words: Body Composition, Goat, Major Mineral

T278 Effects of induced copper deficiency with added molybdenum on health and immune responses of male goat kids. S. Solaiman, S. Roper, K. Beguesse*, G. Reddy, N. Gurung, and K. Copedge, *Tuskegee University, Tuskegee, AL.*

Eighteen male goat kids (BW = 25.6 +/- 1.04 kg) were randomly assigned to three treatment groups. Groups (1) received grain mix (GM) with no added molybdenum (Mo), (2) received GM with 5 ppm additional Mo, and (3) received GM with 10 ppm additional Mo. Animals were housed individually and fed a 50:50 GM: bermudagrass hay twice daily for 12 wks. Blood was collected every 4 wks to determine blood metabolites and complete blood count. Parasite load was measured through egg counts per g of feces (FEC). Vital signs and body condition scores were recorded every 4 wks. Humoral immunity was evaluated through injection of chicken ovalbumin on wk 10 to measure IgG antibody titer. Cell-mediated immunity was measured via sub-dermal injection of phytohemagglutinin on wk 12, and post measurement of lymphocyte proliferation via caliper measurement of skin folds. Animals were slaughtered and liver and kidney samples were analyzed for copper content. Vital signs and body condition scores were not affected by treatments; however, rumen contraction tended to be lower in goats receiving 5 ppm added Mo (quadratic, $P = 0.07$). There was no difference in FEC between treatment groups. Blood serum chemistry did not change except for creatine decreased (linear, $P = 0.005$), alkaline phosphatase increased (linear, $P = 0.002$), and gamma-glutamyl transferase tended to increase (linear, $P = 0.07$) as Mo increased in the diets. Creatinine kinase tended to be higher (quadratic, $P = 0.1$) in goats receiving 5 ppm added Mo. Serum copper did not change, liver copper decreased (linear, $P = 0.003$) and kidney copper increased (linear, $P = 0.0001$) as Mo increased in the diets. Red blood cells decreased (linear, $P = 0.02$) and white blood cells were higher (quadratic, $P = 0.01$) in goats receiving 5 ppm Mo with no difference in differential counts. Immune response measured by skin thickness, was lower after 24 hours (linear, $P = 0.007$) and 48 hours (linear, $P = 0.01$) as level of Mo increased in the diets. Antibody titer decreased ($P = 0.04$) with added 10 ppm Mo in the diet. Goats on 5 or 10 ppm added Mo had no apparent copper deficiency symptoms, except lowered immune responses.

Key Words: Copper-Molybdenum, Goats, Immune Response

T279 Effects of synchronizing the release of energy and nitrogen in the rumen on nitrogenous flow at the duodenum of cashmere goats. D. P. Bu^{2,1}, D. X. Lu^{*2}, W. Cui⁴, J. Loo³, and J. Q. Wang¹, ¹Chinese Academy of Agricultural Sciences, Beijing, P. R. China, ²Inner Mongolia Agricultural Science And Technology, Hohhot, P. R. China, ³University of Illinois, Urbana, ⁴Ningxia University, Yinchun, P. R. China.

Twelve cashmere goats with a cannula in rumen and proximal duodenum were used in a 2 x 2 factorial design to examine the effects of

synchronizing (S) the release of energy and nitrogen in the rumen as well as feeding frequency (F) on nitrogenous flow at the duodenum. All diets were isonitrogenous and isoenergetic but differed in their synchrony index (SI). To calculate SI, based on previous results from our laboratory, we set optimum microbial protein synthesis at 23g rumen-digestible-nitrogen (RDN)/kg digestible organic matter (DOM). Calculated SI (0 to 1.0) was 0.92, 0.84, 0.82, or 0.56 for the greater S diet fed 4 x d (GSF4), lower S diet fed 4 x d (LSF4), greater S fed twice per d (GSF2), or lower S fed twice per d (LSF2), respectively. Goats receiving LSF4 or GSF4 were fed at 0600, 1200, 1800, and 2400 h. Goats receiving LSF2 or GSF2 were fed at 0600 and 1800 h. Flow of DM at the duodenum was estimated using Co-EDTA as indigestible marker, during the last 6 d of each experimental period. Duodenal digesta was collected every 6 h/d during the last 6 d of each experimental period and pooled within each animal. Nitrogen intake averaged 11.9, 11.3, 11.6 and 11.0 g/d in GSF4, LSF4, GSF2 and LSF2 ($P > 0.05$), respectively. Flow of total-N at duodenum was 13.8, 11.4, 14.9 and 10.6 g/d ($P > 0.05$), separately. Microbial-N flow was greater when goats were fed either greater-S diets (3.2 vs. 2.1 g/d; $P < 0.05$) or at a greater frequency (3.0 vs 2.3 g/d; $P < 0.01$). Duodenal flow of non-ammonia N (NAN) tended to be greater (2.1 vs 2.72 g/d; $P = 0.09$) in animals fed lower-S diet compared with greater-S diets. There was a linear correlation between flow of microbial-N and rumen SI ($R^2 = 0.87$; $n = 12$). Overall, these results indicated that synchronizing the rate of supply of RDN and DOM in the rumen increased the efficiency of microbial protein synthesis and microbial protein flow to the duodenum. We conclude that flow of microbial-N might be improved by increasing rumen SI.

Key Words: Rumen Fermentation, Synchronization, Feeding Frequency

T280 Effects of protein and energy supplementation on *in situ* disappearance of low-quality Coastal Bermudagrass hay in goats. M. S. Reinhard^{*1}, B. D. Lambert^{1,2}, J. P. Muir², and R. Harp¹, ¹Tarleton State University, Stephenville, TX, ²Texas AgriLife Research, Stephenville, TX.

Cattle grazing forages with crude protein (CP) of 6% or less often need protein supplementation to maximize ruminal forage utilization. Because of the selective foraging ability of goats, it is not known if goats consuming low CP forages have a similar need for supplemental protein and/or energy. The purpose of this study is to determine the digestibility of low-quality forages with protein and energy supplements in goats. Four mature ruminally cannulated goats were used in a 4 x 4 Latin square design experiment. Treatments consisted of either casein (0.122% BW), corn starch (0.15% BW), or dextrose (0.15% BW) administered daily into the rumen, compared to a hay-only control. Goats had *ad libitum* access to Coastal Bermudagrass (CB) hay (5.8% CP) and clean drinking water at all times during the experiment. Each period consisted of 14 days for treatment adaptation followed by 7 days incubation of *in situ* bags. *In situ* hay samples were analyzed for dry matter disappearance after 0, 2, 4, 8, 16, 24, 48, and 72 hours of ruminal incubation. Dry matter disappearance was not affected by any of the treatments in this experiment. More research is needed to define the effects of protein and energy supplements on ruminal forage degradation in goats.

Key Words: Goat, Protein, Energy

T281 Energy requirements for maintenance and growth of Boer crossbred kids. I. A. M. A. Teixeira¹, K. T. Resende¹, J. M. Pereira Filho², R. C. Canesin¹, and T. T. Berchielli¹, ¹Universidade Estadual Paulista/Unesp, Jaboticabal, SP, Brazil, ²Universidade Federal de Campina Grande, Patos, PB, Brazil.

Two experiments were conducted to determine the energy requirement for maintenance and growth of 64 ½ Boer ½ Saanen crossbred, intact male kids (5 and 15 kg of initial BW for experiment 1 and 2, respectively). In the first experiment, the baseline group was 6 randomly selected kids, averaging 5.6 ± 0.8 kg of BW. An intermediate group consisted of 6 randomly selected kids, fed for ad libitum intake, that were slaughtered when they reached an average BW of 10.0 ± 0.4 kg. The remaining kids (n = 18) were randomly allocated to one of 3 levels of DMI (ad libitum and restricted to 70% or 40% of the ad libitum intake) within 6 slaughter groups. Kids were slaughtered when the ad libitum treatment kid reached 15 kg of BW. In the second experiment, the baseline group was composed by 7 kids, averaging 15.3 ± 0.3 kg of BW. An intermediate group consisted of 6 kids, fed for ad libitum intake, that were slaughtered when they reached an average BW of 20.4 ± 0.7 kg. The remaining kids (n = 21) were randomly allocated to one of 3 levels of DMI, similar to the first experiment, within 7 slaughter groups. Kids were slaughtered when the ad libitum treatment kid reached 25 kg of BW. Individual empty bodies were weighed, ground, mixed, and samples were taken to chemical analyses. For young animals (experiment 1) the calculated NE and ME requirements for maintenance were 50.0 and 76.2 kcal/kg^{0.75} of empty BW (EBW), respectively, and the partial efficiency of use of ME for NE was 0.66. On the other hand, older kids presented greater requirements, whereas the daily maintenance requirement were 101.0 kcal NE/kg^{0.75} of EBW and 181.1 kcal ME/kg^{0.75} of EBW and lower partial efficiency of use of ME for NE of 0.56. Net energy requirement for growth ranged from 1.7 to 2.2 Mcal/kg of EBW gain at 5 and 25 kg of BW. These results suggest that meat goats present energy requirement different from the established recommendations. (Sponsored by FAPESP, 04/06626–0).

Key Words: Body Composition, Goat, Nutritional Requirement

T282 Effects of acclimatization on energy expenditure by meat goats. A. K. Patra, R. Puchala, G. Anicut, T. A. Gipson, T. Sahl, and A. L. Goetsch*, *American Institute for Goat Research, Langston University, Langston, OK.*

Seven Spanish and seven Boer yearling wethers were used to assess relationships between energy expenditure (EE) and temperature (Temp), relative humidity (Hum), and temperature-humidity index (THI). The two breed groups were confined separately in 8 x 6 m pens in an enclosed facility with a concrete floor without cooling. Only enough heat was provided to prevent damage to waterers and water lines from excessive freezing. Thus, the intent was to have minimal Temp and Hum control and to incur fluctuations corresponding to outside conditions. Energy expenditure was determined over 2-d periods 13 times during a 1-yr period based on EE:heart rate (HR) measured at 13-wk intervals. Climate variables were averaged over 2, 4, 6, and 8 wk preceding EE measurement. Wethers were fed for the maintenance energy requirement (ME_m). Mean, minimum, and maximum values during the 2 wk preceding EE determination were 19.9, 7.9, and 31.8°C for Temp and 53.6, 36.1, and 62.5% Hum, respectively. Neither Temp nor THI were correlated with or had significant effects in regression equations to predict the difference between EE at measurement times and the 1-yr mean (EE_{diff}).

Conversely, Hum was correlated (P < 0.01) with EE_{diff}. When the 13 HR measurement times were assigned to Cool and Warm periods, EE_{diff} was affected (P < 0.01) by a genotype x period interaction. Nonetheless, the effect of Hum in models including genotype, period, and genotype x period was significant for 2, 4, 6, and 8 weeks (P < 0.01). The R² of linear regressions of EE_{diff} against Hum were slightly greater for 2 and 4 vs 6 and 8 wk (0.11, 0.10, 0.08, and 0.07, respectively); regression coefficients for 2 and 4 wk were 1.265 and 1.163 kJ/kg BW^{0.75} per 1% Hum, respectively. With a median Hum of 50%, average regression coefficient of 1.2 kJ/kg BW^{0.75} per 1% HUM, and average ME_m of 390 kJ/kg BW^{0.75}, predicted ME_m is 374 and 406 kJ/kg BW^{0.75} at minimum and maximum Hum, respectively. In conclusion, without extremes eliciting cold or heat stress, Hum appears to have a slight effect on ME_m of meat goats in both cool and warm periods of the year.

Key Words: Goats, Energy, Acclimatization

T283 Effect of length of grower/finisher ration supplementation on chevon production and net return from crossbred meat goats. M. Lema*, S. Kebe, C. Pierfax, and N. Adefope, *Tennessee State University, Nashville.*

Forty weaned crossbred kids were blocked by body weight and genotype and divided into four treatment groups. Each treatment group was replicated in two 0.4 ha choice chicory paddocks with 5 kids per paddock and supplemented with identical total amount of commercial grower/finisher goat ration over variable lengths of time (0 (control), 45, 90 or 135 days). While total grower/finisher ration cost and consumption (27.5, 30.1 and 27.1 kg for the 45, 90 and 135 day supplemented groups, respectively) did not differ statistically, total live weight gain (0.77, 4.95, 6.43 and 7.23 kg, respectively) and net return over feed cost (2.13, 3.44, 6.46 and 9.87 dollars, respectively) increased linearly (P < 0.05) from 0 to 135 days of supplementation indicating that when unpaid family labor is utilized, supplementation of weaned meat goats with the same total quantity of grower ration over a longer duration is economically beneficial than over a shorter duration. When labor cost was factored into the equation, supplementation over a longer period resulted in negative net returns (-1.06, -2.54 and -3.63 dollars for the 45, 90 and 135 day supplemented groups versus +3.13 dollars for the non-supplemented group) making the non supplemented group economically beneficial than the other three supplemented groups. Boneless retail cuts from the leg, loin, shoulder and rack were highest (P < 0.05) for the 135 days supplemented group while the non-supplemented control and those supplemented for 45 and 90 days were not different. No significant difference was observed in back fat thickness, loin eye area and kidney pelvic and heart fat among treatments.

Key Words: Meat Goat, Length of Supplementation, Net Return

T284 Pelleted soybean hulls or cottonseed and corn as supplements for weanling Boer-cross wethers grazing bermudagrass pastures. M. H. Poore*, J.-M. Luginbuhl, H. M. Glennon, A. D. Shaeffer, and H. A. Deihl, *North Carolina State University, Raleigh.*

A trial was conducted over two years to determine the influence of supplementation with pelleted soybean hulls (SBH) or whole cottonseed plus corn (WCS) on post-weaning growth and carcass characteristics of Boer-cross wether kids (initial BW 21.2 kg). Kids were born mid-

February to mid-March, and weaned in mid-May at 10 to 14 weeks of age. During the weaning period kids were fed grass hay and 1% of BW as a mixed pelleted concentrate. Kids were divided into 3 BW blocks and assigned from within blocks to make 9 groups (3 wethers and 3 does per group in yr 1, and 4 wethers and 2 does in yr 2). Kids were placed on 9 bermudagrass pastures arranged in 3 blocks of 3 pastures each in mid-June. Pastures averaged 0.067 ha of Tifton-44 Bermudagrass (0.075 ha in yr 1 and 0.058 ha in yr 2), and each pasture had an adjacent equal sized pasture of Coastal Bermudagrass as a potential emergency expansion area. Each pasture was divided into 5 paddocks and kids were rotated to a fresh paddock each 3 to 5 d. Pastures were clipped behind the kids as necessary to maintain forage quality. After 2 wk adaptation to the pastures, kids were allotted to three supplement treatments; 1) minerals only (MIN), 2) minerals plus 1% BW SBH, or 3) minerals plus 1% BW of a mix of 65% corn, 33% whole cottonseed, and 2% limestone. In yr 1 all kids remained on the original Tifton-44 pastures for 70 d after treatments were initiated, but in yr 2 pastures were doubled to include all the Coastal Bermudagrass area early in the trial due to dry weather. In yr 2 all doe kids were also removed after 28 d, and the trial was ended after 56 d. Average forage mass was 3606 kg/ha in yr 1 and 1945 kg/ha in yr 2. At the termination of the trial all wethers were harvested. Carcass grade was determined on a scale where 1 to 1.9 = Prime and 2.0 to 2.9 = Choice. Supplementation at 1% BW improved post-weaning growth and carcass characteristics of kids grazing bermudagrass pasture, while supplement type had little influence on growth or carcass characteristics.

Table 1. Influence of supplements on meat goat growth and carcass

Item	MIN	SBH	WCS	SEM	Contrast 1	Contrast 2
ADG, g/d	49.5	87.5	88.7	3.0	0.01	ns
Carcass wt, kg	10.53	12.54	12.74	0.15	0.01	ns
Dressing %	43.3	47.2	47.5	0.58	0.01	ns
Carcass grade	2.63	2.27	2.25	0.07	0.01	ns
Pelvic fat, g	91.6	195.5	221.0	13.1	0.01	0.20
Fat cover, mm	1.39	2.36	3.18	0.31	0.01	0.10
Loineye area, sq cm	7.70	9.73	9.28	0.36	0.01	ns

Contrast 1 = P value for MIN vs. Supplements. Contrast 2 = P value for SBH vs. WCS

Key Words: Meat Goats, Supplements, Bermudagrass

T285 Influence of dietary condensed tannins in meat goats on fatty acid composition of carcasses. J. Lee*, G. Kannan, B. Kouakou, D. Moore, and T. Terrill, *Fort Valley State University, Fort Valley, GA.*

Sericea lespedeza hay decreases nematode infections in goats, although the effect of its high condensed tannin (CT) content on carcass quality has not been adequately studied. Twenty Boer × Spanish meat goats (6 mo of age; BW = 19.2 ± 0.74 kg) were used to determine the effect a high CT diet on fatty acid profiles of tissue samples from different carcass sites. Goats were assigned randomly to pens (5 goats/pen), and each pen was allotted to one of two dietary treatments of 75% hay: sericea hay (SER; high in CT) or Bermuda grass hay (BER; n = 10 goats/treatment) plus a 25% corn-based supplement (18 % CP) consisting predominantly of corn and soybean meal for 14 wk. At the end

of the feeding trial, goats were slaughtered using standard procedures. The *Longissimus dorsi* (LD) muscle, intermuscular, subcutaneous, and kidney fats were obtained from each carcass. Total lipid from each fat depot sample was extracted by the chloroform (0.013% BHT)-methanol method. Extracted lipids were prepared for the fatty acid methyl esters (FAME) and then analyzed by gas chromatography. Palmitic (16:0), stearic (18:0), oleic (18:1n9), and linoleic (18:2n6) acids were the four major fatty acids in the LD muscles and intermuscular fats from goats fed either SER or BER diet. The subcutaneous and kidney fats mainly consisted of myristic (14:0), 16:0, C18:0, and C18:1n9 acids. No significant differences were found in the four major fatty acids on the site of fat depots between SER and BER groups. However, compared with goats fed the BER diet, goats fed the SER diet had lower ($P < 0.05$) concentrations of *trans*-7-hexadecenoic (16:1t) and margaric (17:0) acids in LD muscles; a higher ($P < 0.05$) concentration of linolenic (18:3n3) acid in intermuscular fat; higher ($P < 0.05$) concentrations of C18:2n6 and 11-eicosenoic (C20:1n9) acids in subcutaneous fat; and a higher ($P < 0.05$) concentration of C20:1n9, but a lower ($P < 0.05$) concentration of C17:0 in kidney fat. The results indicated that a diet high in condensed tannins may not influence the major fatty acids in the different fat depot sites in meat goats.

Key Words: Goats, *Sericea lespedeza*, Fatty Acid Profile

T286 Effects of long term feed restriction and monensin on growth, feed efficiency and body measurements in Anglo Nubian does. P. Turiello*, V. Coniglio, S. Posadas, M. Chaves, L. Godio, and G. Cufre de Lenardón, *Universidad Nacional de Río Cuarto, Río Cuarto, Córdoba, Argentina.*

Periods of feed restriction results from seasonal deficits of food. The experiment evaluated effects of long term feed restriction and monensin on liveweight gain, BCS, and body measurements to test usefulness of monensin to ameliorate feed restriction. Nineteen weaned Anglo Nubian does (BW 11.9±1.6 kg) were randomly assigned to control (fed ad libitum; n = 5) (C), restricted (78% of C per unit BW; n = 7) (R) and R + 12.5 mg/head/d of monensin (n = 7) (M). A 247-d trial used a 70:30 ground mixture of alfalfa hay:corn grain; ME of the diets was 2.4 Mcal/kg DM and CP was 16 %. Minerals and vitamins were supplemented. Urea was added to restricted diets to equalize CP intake to that of C. Individual feed intake was recorded daily, does were weighed weekly, body measurements and BCS (0-5) were recorded every 28 days. Data analysis was by ANOVA for a completely randomized design; when the F-test was significant, differences between means were determined by Tukey's-test. Average daily DMI was greater in C (.65 vs. .37 and .34 kg/d M and R, respectively) ($P < 0.001$). BW at termination differed among treatments ($P < 0.001$). BW of goats fed ad libitum was higher than M and R (29±1.7). Whereas M does also had greater BW than R (18±0.9 vs. 15±1.0 kg, respectively). Average daily gain was highest for C ($P < 0.01$), whereas M also had higher ADG than R (67±4, 25 ± 4 vs. 12±5 g/d, resp.). Score for BC was highest for C, 3.9, and M had greater BCS than R, 2.2 vs. 1.4 respectively ($P < 0.05$). F: G ratios were 9.7, 15.4 and 26.9. Withers height, chest girth and hip height were greater in does with heavier weight (C > M > R; $P < 0.01$). Monensin lessened the effects of long term restriction, demonstrating its potential to be used with restricted feeding to improve performance.

Key Words: Feed Restriction, Monensin, Goat

Teaching/Undergraduate and Graduate Education: Teaching in the Animal Sciences

T287 Use of an informal taste panel to teach students concepts related to beef palatability. J. A. Daniel*¹ and T. D. Pringle², ¹Berry College, Mount Berry, GA, ²University of Georgia, Athens.

As a lab experience, students (n = 31) enrolled in Introduction to Agriculture (ANS 105; a general education science course for non-science majors) at Berry College participated in an informal taste panel. Students received no classroom instruction in beef palatability assessment prior to this lab. At the beginning of the lab, students completed a quiz (pre-quiz) consisting of 12 questions. Ten of the questions were designed to test the students' knowledge of different attributes of beef quality, and two of the questions were designed to assess students' steak preferences. A rating sheet was then distributed to the students and they moved to a desk with apple juice and crackers. Students were presented with the following bite sized samples (approximately 2x2x2 cm cubes) for evaluation: an infraspinatus steak cooked to 66°C, 71°C, or 82°C, a longissimus steak aged for 1, 7 or 21 days, and a low, medium, and high choice longissimus steak. All longissimus steaks were cooked to 71°C. The longissimus steaks aged for 1, 7 or 21 days were all obtained from the same animal, choice infraspinatus steaks were purchased from a local grocery store, and all steaks were stored frozen until the day prior to the experiment. Students were asked to take a bite of cracker and drink of apple juice between each sample. After completion of the taste panel, evaluation sheets were collected and results and beef palatability attributes were discussed with the class. Students then completed the previously mentioned quiz (post-quiz). Scores on the 10 questions designed to test students' knowledge of different attributes of beef quality were improved ($58.5 \pm 0.2\%$ on the pre-quiz vs $82.8 \pm 0.2\%$ on the post-quiz; $P < 0.0001$). For the 2 questions accessing students' steak preference, one addressed preferred degree of doneness and the second asked students to choose a steak based on USDA Quality Grade, weight, cut, aging, and degree of doneness. Interestingly, 24 of the 31 students changed one or more of their answers for these questions, and 10 students changed their preferred degree of doneness following the taste panel. These results suggest an informal taste panel is an effective means of teaching students beef palatability attributes.

Key Words: Beef, Taste Panel, Teaching

T288 Student demographic profile for Mississippi State University riding courses. M. Nicodemus*, *Mississippi State University, Mississippi State.*

Management of a riding herd for University riding courses is costly, and yet, the popularity of such courses attracts new students to equine programs. Laboratory fees attached to these courses have assisted in paying for associated management fees, but this approach requires offering of courses that attracts large student enrollment. In preparation for recent expansion of the equine courses offered at Mississippi State University, students (n = 44) enrolled in riding courses were asked to fill out a researcher-developed, 16-item survey instrument with questions focusing on student academic history and horse background. Eighty-three % of students were majors outside of the Animal & Dairy Sciences department with the largest number of these students coming from the biology department (17%) followed by the business department (13%). Fifty-two % of the students were seniors and were taking the course as a free elective (78%). While these riding courses were open to all levels of riding, 39% of students had ridden a limited number of

times (1-5 times) followed by 35% of students having ridden between 6-30 times. Majority of students (57%) had never taken a formal riding lesson nor had they ever had any experience in training a horse (74%). Eighty-three % of the students were not current horse owners and 48% had never owned a horse. Forty-eight % of students had only ridden in trail rides for recreational purposes with 47% of students riding mostly stock-type breeds (Quarter Horse, Paint Horse, Appaloosa). While the majority of students (57%) were not planning on a career in the equine industry, 65% planned on owning their own horse in the future. Forty-three % of students planned on taking another University riding course and of those students 86% were students with limited riding experience (ridden 1-5 times). Results from this survey suggest riding courses geared more towards less experienced riders with the focus more on recreational riding will attract more student enrollment. Plans for the equine curriculum are to offer an additional introductory riding course in the upcoming semester.

Key Words: Equine Curriculum, Riding Courses, Undergraduate Teaching

T289 Developing an internet-based course on milk and dairy products. A. D. Fogleman*, C. R. Summers, H. J. Hickman, L. G. Turner, and J. C. Allen, *North Carolina State University, Raleigh.*

With fewer dairy farms and processing plants in NC and the Southeastern States, students and citizens have less opportunity to become familiar with the dairy industry, technology, safety, and regulations required to bring milk and dairy products to the table. New distance education technology provided an opportunity to bring a new course titled "Milk and Dairy Products", delivered entirely by Internet, to our students and others around the country. Two graduate teaching assistants, with guidance from two faculty and a technician, developed a course outline, investigated available literature and requested that the library purchase needed reference material. Lecture outlines, text and illustrations were developed in PowerPoint™ and reviewed by the team. An audio track of the lecture content was attached to each PowerPoint™ presentation using LecShare Pro™. The program created higher quality and smaller virtual lecture files than traditional video-taping. Other videos gave a virtual guided tour of the NCSU dairy farm and dairy processing pilot plant. Homework and quizzes accompany the 15 weekly course units. Background reading assignments were posted on the library's electronic reserve system, saving the students the need for a textbook purchase. The course is available to the campus and to individuals around the country through distance.ncsu.edu. The course is able to take advantage of the diverse experience and knowledge of dairy products of two faculty, and combine the perspective of a team of developers to make a consistent and uniform presentation of course content. Students enrolled had little prior knowledge or experience in dairy processing, but are very excited by their overview of the course outline and website. Increasing the number of students and citizens who have a sound knowledge of milk and dairy processing methods will help the dairy industry assure the public of the need for land preservation for agriculture, of the safety of the dairy food supply, and dispel misinformation about the healthfulness and nutritional importance of milk consumption. Students in this course will be more interested in employment in the dairy industry.

Key Words: Teaching, Milk Processing, Distance Education

T290 Species preference of incoming animal science freshmen at North Carolina State University. J. A. Moore*, W. L. Flowers, and R. L. McCraw, *North Carolina State University, Raleigh.*

Understanding student interests is important when assessing and updating curricula and courses. Incoming freshmen (12 years of data) answered a survey at orientation to indicate their first and second choices for species preference. Species were companion animal (comp), horse, beef, dairy, small ruminant (SR), and other. Data were blocked by year (1996-1999, 2000-2003, 2004-2007) in order to evaluate changes over time. The number of students annually taking the survey for the three blocks was 88^a, 93^a, and 124^b, respectively ($P < 0.02$); there was a 95% response rate for the past 6 years, but numbers of actual incoming Animal Science majors prior to 2002 are not available because students did not have to declare a major prior to attending. The percentage of students indicating pre-vet as their career choice was 75^a, 81^{a,b}, and 85^b for the three blocks, respectively ($P < 0.02$). There was no block by species interaction for first or second choices ($P > 0.51$), indicating a consistent response over the 12 year period. In Table 1, means within a row that do not share a superscript differ ($P < .05$). The data show consistent interest in companion animals as first choice and horses as second choice over the 12 year period, and livestock species accounted for just 10% of first choice responses and 23% of second choice responses. Students who chose "other" were asked to specify, and responses commonly included exotic animals, marine animals, and reptiles. These data help us understand the interests of our incoming students as we work to keep our curricula and courses current.

Table 1. Species preference of incoming freshmen (percentage of respondents)

	Comp	Horse	Beef	Dairy	SR	Swine	Other	SEM
1st, 96-99	52.5 ^a	31.5 ^b	7.0 ^c	2.0 ^d	0.5 ^d	1.8 ^d	4.8 ^{c,d}	1.8
1st, 00-03	53.8 ^a	29.8 ^b	5.3 ^{c,d}	2.5 ^d	0.8 ^d	0.5 ^d	7.8 ^c	1.8
1st, 04-07	53.3 ^a	30.5 ^b	7.0 ^c	1.5 ^d	1.5 ^d	0.8 ^d	5.5 ^{c,d}	1.8
2nd, 96-99	28.3 ^b	43.3 ^a	7.3 ^c	8.3 ^c	4.3 ^{c,d}	1.0 ^d	7.5 ^c	1.9
2nd, 00-03	30.3 ^b	37.5 ^a	6.8 ^{c,d}	7.3 ^{c,d}	6.3 ^{c,d}	2.3 ^d	9.5 ^c	1.9
2nd, 04-07	25.0 ^b	39.8 ^a	7.3 ^{c,d}	8.8 ^c	6.3 ^{c,d}	3.0 ^d	10.5 ^c	1.9
1st, 12 yr	53.1 ^a	30.6 ^b	6.4 ^c	2.0 ^d	0.9 ^d	1.0 ^d	6.0 ^c	1.0
2nd, 12 yr	27.8 ^b	40.2 ^a	7.1 ^{c,d}	8.1 ^{c,d}	5.6 ^d	2.1 ^e	9.2 ^c	1.1

Key Words: Undergraduate, Students, Livestock

T291 Changes in species preference reported by animal science graduating seniors at North Carolina State University. J. A. Moore*, W. L. Flowers, and R. L. McCraw, *North Carolina State University, Raleigh.*

Understanding changes in student interests over time assists in the evaluation of our curricula, courses, and extracurricular opportunities. Graduating seniors (5 years of data) were asked what their first and second choice species had been upon arrival and at graduation (average = 22% external transfer students). Species were companion animal (comp), horse, beef, dairy, small ruminant (SR), and other. An average of 45% of graduating seniors (42 of 94 per year) completed the survey. In Table 1, means within a row that do not share a superscript differ ($P < .05$), and "Leaving minus arrival" is the sum of "leaving" first plus second choice minus sum of "arriving" first plus second choice (a positive number indicates a shift in preference toward that species

while a student was enrolled as an undergraduate). The data show a shift in preference away from companion animals and horses toward livestock and "other" animals, but the top two first choice preferences remained companion animals and horses. Graduates indicated that livestock accounted for 15% of first choice preferences on arrival and 27% of first choice preferences upon graduation. The data indicate that experiences while enrolled as undergraduates have an impact on student species preference.

Table 1. Species preference reported by graduating seniors

	Comp	Horse	Beef	Dairy	SR	Swine	Other	SEM
1st (%), arrival	46.6 ^a	35.2 ^b	8.0 ^c	4.4 ^{c,d}	0.6 ^d	2.2 ^{c,d}	3.0 ^{c,d}	2.2
2nd (%), arrival	30.0 ^a	20.0 ^b	12.8 ^c	11.8 ^c	9.0 ^c	8.2 ^c	8.0 ^c	2.5
1st (%), leaving	29.4 ^a	31.6 ^a	8.8 ^{b,c}	7.4 ^c	2.2 ^c	9.0 ^{b,c}	11.2 ^b	2.5
2nd (%), leaving	27.6 ^a	13.4 ^{b,c}	15.6 ^{b,c}	19.6 ^b	10.0 ^{c,d}	8.6 ^{c,d}	5.6 ^d	2.6
1st + 2nd, arrival	76.6 ^a	55.2 ^b	20.8 ^c	16.2 ^{c,d}	9.6 ^d	10.4 ^d	11.0 ^d	2.8
1st + 2nd, leaving	57.0 ^a	45.0 ^b	24.4 ^c	27.0 ^c	12.2 ^d	17.6 ^{c,d}	16.8 ^{c,d}	3.8
Leaving minus arrival	-19.6 ^c	-10.2 ^b	3.6 ^a	10.8 ^a	2.6 ^a	7.2 ^a	5.8 ^a	3.1

Key Words: Undergraduate, Students, Livestock

T292 Equine internships: Factors that predict success. K. Bennett-Wimbush*, *Ohio State Agricultural Technical Institute, Wooster.*

Traditional employee screening processes usually are based on academic performance, however, there can be a dichotomy between academic achievement and employee job performance. This study examined the records from 140 equine industry internships from students enrolled in an Associate of Applied Science program from 1999 to 2006. Employers evaluated employees on thirteen criteria including: punctuality; willingness/learn; dependability; work quality; acceptance of constructive criticism; personal appearance; cooperation w/co-workers; productivity; professionalism; supervisor acceptance; customer acceptance; technical knowledge and overall performance using a Likert scale of 1-5 (1=poor, 2=fair, 3=average, 4=good, 5=excellent). Pearson's correlation analysis was performed between employer evaluation and employee salary (0=no pay, 1=below minimum wage (mw), 2=mw, 3=above mw, 4=50% above mw); cumulative grade point average (gpa) at the time of the internship; practicum gpa and graduation status. The cumulative gpa at the time of the internship was not different between students who graduated (2.88 ± 0.49) compared to students who did not graduate (2.47 ± 0.58) so data was combined for analysis. The average intern earned minimum wage. Those areas that were scored the lowest by employers were work speed (4.3 ± 0.77) and technical knowledge (4.2 ± 0.76) while cooperation w/co-workers and acceptance by supervisors were evaluated the highest (4.6 ± 0.55). Quality of work was positively correlated ($p < 0.05$, $r = 0.16$) with both cumulative gpa and salary. Technical knowledge was positively correlated ($p < 0.01$, $r = 0.20$) with salary. Based on this data, academic success may not be the best predictor of employee performance and students with a higher degree of technical skills may receive higher starting salaries.

Key Words: Internships, Equine

T293 Technical note: Equine gastrointestinal tract preservation techniques to enhance teaching effectiveness. B. T. Gutierrez* and J. S. Pendergraft, *Sul Ross State University, Alpine, TX.*

When the decision was made to euthanize a Quarter Horse mare suffering from chronic colic, students from the Department of Animal Science preserved the gastrointestinal tract (GIT) organs and tissues for use as a teaching tool. The specimens were removed from the horse within 1 h of death, separated into sections (stomach, small intestine, cecum, large colons, and small colon) and immediately cleaned with water. Digesta was flushed continuously from the GIT sections with water until the exiting water was clear. The fresh specimens were trimmed of any excess tissues and then filled with and submerged in a 10% formalin solution for 5 d. The GIT were then removed and rinsed with water and allowed to air dry for 2 h. Each section of the GIT were individually dried with forced air. The external portions of the GIT were allowed to remain moist to prevent tearing. The dried internal sections were filled with expanding polyurethane foam. The foam was administered throughout the GIT and then each end of the tracts were sealed. The GIT were positioned and orientated as in situ and the foam was allowed to expand and cure for 1 d. Excess foam, external fat, and other unwanted tissues were removed from the GIT. A clear coat of polyurethane was applied to the outside of the tract and allowed to dry for 1 d. This process was repeated three times. This method of GIT preservation resulted in a durable light weight specimen that has no unpleasant odor and is reasonably resistant to handling. The impact from the project will be the continual enhance of the educational experiences of future animal science students by the use of this visual learning tool.

Key Words: Gastrointestinal, Anatomy, Equine

T294 Impact of a herpes (EHV-1) outbreak on incoming equestrian students, horse numbers and outside generated revenue at The University of Findlay. E. D. Bonnette*, F. D. McCarthy, and R. Koehler, *The University of Findlay, Findlay, OH.*

In January 2003, a neurologic strain of the Equine Rhinopneumonitis (EHV-1) virus infected the majority of the horses at one of The University of Findlay horse farms. Over a five week period, roughly 80% of the 140 horses housed at the university's English equestrian facility showed clinical symptoms and fourteen of those horses were ultimately euthanized. The farm was put on a self-imposed quarantine, while access to the university's western equestrian facilities was severely limited. Once the causative agent was identified and the affected horses treated, policies were implemented to reduce the likelihood of another outbreak of this kind. Because of the significance of this event in the equestrian world, publicity regarding this outbreak was intense and created concerns that incoming fall equestrian students, retention of existing students and outside owned horses for the training programs might be adversely affected. Significant income generating events were potentially at risk with a negative public perception of the facility and programs. Data obtained from various university sources were summarized for the academic years 2003 - 2007. Total number of equestrian majors over the five year period following the outbreak indicated a linear increase in students at the end of each academic year. During that same period, applications and acceptance of outside-owned horses trained by equestrian students remained relatively consistent to those before the outbreak. The most notable adverse effect was to the non-academic revenue being generated by non-university organizations utilizing either equestrian facility. Gross revenue for the first fiscal year following the outbreak was reduced by nearly 50% and has shown a steady increase to overtake the pre-outbreak levels. From the data, The University of Findlay has apparently seen no long-term detrimental effects to student enrollment, incoming outside owned horse numbers or total outside revenues in the five years after the initial outbreak event.

Key Words: Horse, EHV-1

SYMPOSIA AND ORAL SESSIONS

Animal Health I

1 Obesity in horses: An equine metabolic syndrome? P. J. Johnson*, V. K. Ganjam, and N. T. Messer, *University of Missouri, Columbia.*

Similar to the situation in human society, obesity is common in domesticated equids. Broad parallels exist between causative factors with relevance to both species. Horses develop obesity when they are fed rations that exceed nutritional requirements under management systems that fail to provide substantive physical inactivity. Obese humans often develop insulin resistance (IR), hypertension, atherogenic dyslipidemia, chronic inflammation, and a tendency to a procoagulative state. This constellation of clinical disorders has been termed the “metabolic syndrome” and its presence signifies high risk for many potentially fatal conditions including cardiovascular diseases (atherosclerosis, myocardial infarction, stroke), diabetes mellitus, liver disease, cancer, neurodegenerative disease, and polycystic ovarian disease. An “equine metabolic syndrome” (EMS) has been described in which obesity and IR are risk factors for laminitis (“founder”). Laminitis is a painful, crippling affliction of the equine digit (hoof), which often necessitates euthanasia for severely affected individuals. The extent to which other aspects of the human syndrome may or may not play a role in EMS is less certain, controversial, and the subject of substantial current investigation.

Horses and (especially) ponies evolved as a thrifty species. Health was assured by the persistent physical mobility associated with seeking out native prairie grassland species and the evasion of predators. Horses and ponies tended to migrate over considerable distances to obtain sufficient food for survival. Evolutionary forces ensured that the modern horse was thoroughly adapted to the available grassland forage species that grew abundantly in their domain. The impositions of the needs of human management have been such that domesticated horses are (usually) fed rations that differ greatly from those anticipated by evolutionary selection. Coupled with enforced physical confinement and the elimination of predators, modern horses commonly develop obesity and the attendant endocrinopathic health consequences.

Key Words: Horse, Obesity, Metabolic Syndrome

2 Steers grazing toxic *Neotyphodium coenophialum*-infected forages have increased hepatic gluconeogenic capacity. K. R. Brown*¹, J. L. Klotz², J. R. Strickland², L. P. Bush¹, J. A. Boling¹, and J. C. Matthews¹, ¹*University of Kentucky, Lexington,* ²*Forage-Animal Production Research Unit, USDA-ARS, Lexington, KY.*

Impaired growth performance and clinical parameters constituting summer slump in cattle grazing toxic endophyte-infected tall fescue are well documented. To test the hypothesis that fescue toxicity affects carbon chain and amino acid N metabolism in the liver of cattle grazing this forage, 19 Angus steers were randomly assigned to graze either a low-endophyte (LE; 6.8% infection) mixed grass-tall fescue pasture (n = 9; BW = 266 ± 10.9 kg; 5.7 ha) or a high-endophyte (HE; 62.8 % infection) tall fescue pasture (n = 10; BW = 267 ± 14.5 kg; 5.7 ha) for 89-105 d. Pasture samples were collected on d 37, 59, 88 and 109, pooled, and analyzed for alkaloid content. Blood was collected on d 85 for serum prolactin (PRL) analysis and steers then killed over a 17-d period, with treatment animals equally distributed over d of kill. HE pasture samples contained (µg/g) 24 and 38 times more (P < 0.01) ergovaline (0.322) and lysergic acid (0.065), respectively, than did LE pastures. Serum PRL of HE steers was (P < 0.01) 10% (3.60 ng/mL) that of LE steers. Whereas liver alanine transaminase content did not differ, aspartate transaminase (AST) and cytosolic phosphoenolpyruvate carboxykinase (PEPCK-C) content was 56% and 90% greater (P < 0.01), respectively, in HE steers. In contrast, hepatic content of glutamate synthetase, glutamate dehydrogenase, and 3 transport proteins responsible for high-affinity aspartate/glutamate uptake in the liver did not differ. Together, the increased hepatic content of AST and PEPCK-C of HE steers indicates that increased alkaloid challenge, depressed serum PRL, or both, induces a greater capacity for liver gluconeogenesis, met in part through an increased expression of proteins that metabolize aspartate carbons to oxaloacetate and oxaloacetate to phosphoenolpyruvate.

Key Words: Endophyte, Gluconeogenesis, Liver

3 Grazing endophyte-infected tall fescue alters serotonin receptor-induced contractility of bovine lateral saphenous veins.

J. L. Klotz*¹, K. R. Brown², Y. Xue², J. C. Matthews², J. A. Boling², L. P. Bush², and J. R. Strickland¹, ¹USDA-ARS, FAPRU, Lexington, KY, ²University of Kentucky, Lexington.

Concurrent with grazing of endophyte-infected tall fescue is the consumption of toxic alkaloids that negatively affect cardiovascular function and result in fescue toxicosis. Vascular effects of ergopeptine alkaloids are mediated by stimulation of various biogenic amine receptors yet to be fully characterized. The objective was to evaluate the effect of grazing 2 levels of toxic endophyte-infected tall fescue on the vasoconstrictive activities of (\pm)-1-(2,5-dimethoxy-4-iodophenyl)-2-aminopropane hydrochloride (DOI), BW 723C86 (BW), CGS-12066A (CGS), and 5-carboxamidotryptamine hemithanolate maleate (5CT), agonists for 5-hydroxytryptamine (HT)_{2A, 2B}, 5-HT_{1B} and 5-HT₇ receptors, respectively. Segments (2-3 cm) of the cranial branch of the lateral saphenous vein were collected at time of slaughter from steers follow-

ing a 114 to 127-d grazing period of either a low endophyte-infected (LE) mixed grass pasture (10% infection; n=8; BW=333 \pm 10 kg) or a high endophyte-infected (HE) tall fescue pasture (92% infection; n=8; BW=311 \pm 9 kg). Veins were sliced into 2-3 mm sections and suspended in a myograph chamber containing 5 mL of oxygenated Krebs-Henseleit buffer (95% O₂/5%CO₂; pH=7.4; 37°C) and allowed to equilibrate at 1 g of tension for 90 min. Increasing concentrations of DOI, BW, CGS, and 5CT were administered every 15 min. Data were normalized (%) to the contractile response induced by a reference dose of norepinephrine (1x10⁻⁴ M) and data for each treatment were analyzed for effects of concentration and endophyte level. Maximal contractile intensities achieved with DOI were decreased 35% ($P < 0.05$) in steers grazing HE pastures, whereas those achieved with 5CT were increased 37% ($P < 0.05$). The contractile response to CGS did not differ between pasture groups and there was an absence of contractile response to BW in both groups. Grazing HE pastures alters vascular responses which may be mediated through modified serotonin receptor activities.

Key Words: Bovine, Fescue, Serotonin

Symposium: Beef Species: The Evolution of Beef Cattle Genetic Evaluation

4 Milestones in beef cattle genetic evaluation. L. L. Benyshek*, *University of Georgia, Athens.*

The first national beef sire evaluation summary was published in 1971. Since 1971 beef breeds that have serious genetic improvement programs have adopted this genetic evaluation technology. Today it is rare when a bull is offered for sale without Expected Progeny Differences. Initially, application of methodology was limited by hardware and software constraints. The current genetic evaluation summaries show that the industry has taken genetic evaluation seriously with more traits than producers can assimilate into breeding program. This has spawned an effort in decision making software including selection indexes. The advent of DNA technology for beef cattle has begun to blossom with the sequencing of the beef genome. Genetic evaluation began in the 1930's with research in performance testing. In the 1940's large regional research programs were funded leading to state beef cattle improvement associations in the 1950's. In the late 1950's some breed registry associations began to formalize the collection of performance data. In 1968, a major milestone was achieved with the establishment of the Beef Improvement Federation which standardized the collection and analysis of data. In 1972 C. R. Henderson presented an invited ASAS paper that formalized his mixed model procedures providing best linear unbiased predictions (BLUP) of breeding value. Established breeds produced estimated breeding values; however, mixed model procedures were first applied only to designed progeny tests. With the advent of increased artificial insemination the data structure evolved to warrant national sire evaluation using BLUP in the 1970's. In the 1980's animal model procedures began to evolve particularly after the first genetic prediction conference in 1983 where the reduced animal model was elucidated. In 1984 the reduced animal model was applied to field data for four breeds resulting in the first published evaluations using the technology. In the years following, the animal model became the standard for genetic evaluation. Currently, researchers continue to look at improved models leading to across breed evaluations and the incorporation of genomic information in the procedures.

Key Words: Beef, Genetic Evaluation, Mixed Model

5 Producing and using genetic evaluations in today's beef industry. D. Garrick*, *Iowa State University, Ames.*

Genetic change is a straightforward consequence of selection. Genetic improvement is more difficult to achieve because it requires the cumulative value of favorable changes to exceed the costs incurred by unfavorable changes, data collection and recording and infrastructural investments. The principal technology that has been available to assist breeders make informed selection decisions has been the expected progeny difference or EPD. The nature and scope of EPDs has grown enormously over the last few decades, to encompass a large array of easily measured attributes. Breed Associations have acted individually in the production of EPDs, gaining scientific and servicing support from land-grant Universities, principally, Colorado State, Cornell, Georgia and Iowa State Universities. This approach is now structurally, financially and technologically challenged, unable to meet current or future demands of industry. Bull buyers are now demanding across-breed EPDs including crossbred or composite bulls, most commonly Angus derived. The Breed Association data systems are not well structured to unambiguously record crossbred animals or any external pure-bred

parents. The land-grant service providers are keen to pass on their subsidized servicing roles in favor of software licensing and research support. The advent of small panels of molecular test information has created challenges with new kinds of data that have not been able to be harnessed by Breed Associations. This will likely get worse with the adoption of high-density SNP marker panels. Finally, in contrast to other industries, beef cattle EPDs have failed to move to properly reflect economic rather than just productive characteristics of alternative bulls. These challenges must be addressed if the beef industry is to retain its competitiveness, nationally and internationally.

Key Words: Genetic Evaluation, Selection, Beef Cattle

6 DNA technology: Estimation of genetic merit from large DNA marker panels. R. L. Fernando*¹ and C. Stricker², ¹*Iowa State University, Ames,* ²*Applied Genetics Network, Davos, Switzerland.*

Given trait and marker data on a sufficient number of individuals, the effects of all markers can be estimated accurately and used for genetic evaluation of future candidates using only marker genotypes. In practice, however, the number of marker effects in the model is much greater than the number individuals with trait phenotypes. Several strategies have been proposed to overcome this problem. One strategy includes markers in the model as random effects with a constant variance for all markers. We will show that as the number of independent markers increases, this approach converges to pedigree based BLUP, which does not use any marker information. As markers on a chromosome are not independent, even though the accuracy drops with the number of markers included in the model, this approach gets higher accuracies than pedigree based BLUP. Better results are obtained, however, when locus-specific variances are estimated from the data. We used computer simulated data to investigate the relationship between the accuracy of prediction and the number of markers included in the model for a Bayesian method that uses a zero-inflated inverse chi-square prior for the locus-specific variances. A genome of 30 chromosomes, each 1 Morgan in length, was simulated. Random mating in a population with an effective size of 100 for 1000 generations was used to generate linkage disequilibrium. Marker effects were estimated with trait phenotypes and marker genotypes on 2120 animals. The estimated effects were used to predict the breeding value of 2000 animals in the following generation. Accuracy of prediction was quantified by the square of the correlation between the predicted and true breeding values. Accuracies were obtained with 3,000, 30,000 and 60,000 markers in the model from four replications of the simulation. The mean values of the accuracies were 0.82, 0.88, and 0.88 for the three marker densities. This Bayesian method seems to be well suited for estimation of genetic merit from large DNA marker panels.

Key Words: Whole-Genome Analysis, Genomic Selection, Marker Assisted Selection

7 Integrating genetic evaluations with DNA technologies for the ultimate selection tool. R. J. Tempelman*¹ and S. D. Kachman², ¹*Michigan State University, East Lansing,* ²*University of Nebraska, Lincoln.*

Various genomics companies have recognized the value of marker assisted selection for beef cattle improvement by marketing estimated molecular values (EMV) based on genetic markers as determined from tissue samples submitted by participating breeders for animals of interest. These EMV are typically based on dozens or hundreds of markers whose individual effects have been estimated from reference populations as based on extensive records on a large number of phenotypes on thousands of cattle. Only the EMV, as the sum of these estimated effects, and not the marker genotypes themselves, are generally reported back to the breeder. We will address how EMV can be integrated with existing phenotypic and pedigree data, as currently used to provide expected progeny differences (EPD), to enhance the accuracy of national beef cattle genetic evaluation. Attention will be drawn to computational issues, improvements in accuracy of EPD and its concomitant potential

for earlier selection, potential ascertainment bias, and selection for traits that are not extensively recorded. These assessments will be based on various assumptions on how well the EMV correlate with the true genetic merit. The drawbacks from not having individual marker genotype information will be directed towards issues that are particularly relevant for beef cattle production, such as multibreed genetic evaluation, genotype by environment interaction, multiple trait selection, multi-sire pastures, and selection for uniformity. Whole genome selection based on emerging high throughput single nucleotide polymorphism (SNP) chips appears to offer substantial promise in addressing some of these limitations.

Key Words: Genetic Markers, Expected Progeny Differences, Genome Selection

Breeding and Genetics: Current Issues in Dairy Cattle Breeding

8 Improved accuracy of computer programs that optimize breeding and replacement decisions for dairy cattle. A. De Vries*, *University of Florida, Gainesville.*

Objective was to improve the accuracy of computer programs that optimize breeding and replacement decisions for individual cows to support economic decision making. Most recently published optimization programs characterize cows by a limited number of discrete states, a combination of (at least) parity, level of milk production, stage of lactation, and pregnancy status. The number of states is necessarily limited to make computations feasible. Consequently, cows may not be well represented by a state and the program's decisions may be significantly different from optimal. For example, a small number of lactation curves (for example Wood's curves) are typically used depending on parity and level of milk production. In practice, every cow has a unique lactation curve. A significant improvement in accuracy of prediction of cow performance can be obtained when the states for the current lactations of the cows currently in the herd are separated from the states for their next lactation and replacement heifers. The states for cows currently in the herd can then be dramatically increased with few extra computations. These adjustments allow for much more accurate predictions of individual cow performance in the current lactation than previously available. Predicted cow performance for the remainder of the lactation can be updated daily. Consequently, optimized breeding and culling decisions are more accurate. To illustrate, 400 cows from the University of Florida dairy research herd were used. Individual lactation curves were predicted by Best Prediction. The resulting 400 lactation curves predicted milk yields in the remainder of the lactation better than the few standard Wood's curves in traditional programs. Optimal breeding and culling decisions were frequently different. The program currently runs as an add-on to existing dairy herd information systems using automated data exchange. The proposed improvement in accuracy is an important step towards more realistic computerized decision support on dairy farms.

Key Words: Optimization, Breeding, Replacement

9 Genetic analysis of profitability of Canadian Holstein cows. J. Bohmanova*¹, J. Jamrozik¹, K. Hand², D. Lazenby², and F. Miglior^{3,4}, ¹*CGIL, University of Guelph, Guelph, ON, Canada*, ²*CanWest DHI, Guelph, ON, Canada*, ³*Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada*, ⁴*Canadian Dairy Network, Guelph, ON, Canada.*

Profitability functions, developed by Dairy Herd Improvement (DHI) in Canada, are widely used by Canadian farmers to evaluate profitability of their cows. Profit of a cow is defined as the difference between revenues and expenses. Revenues are functions of total amount of fat, protein and other solids, adjusted for amount of fluid in milk. Expenses are calculated as sum of overhead, maintenance feed, marginal feed and quota opportunity costs. Costs associated with fertility and health are not considered due to unavailability of data. The aim of this study was to estimate variance components and breeding values (EBV) for profit in the first 3 lactations and to calculate correlations between EBV for profit and other traits currently evaluated in Canada. Multi-trait (MT) and random regression models (RRM) were applied. The four traits

estimated in MT were rearing costs and daily profits in first, second and third lactation. In the RRM analysis, profit was assumed to be a continuous trait, defined as function of age. The rearing cost was evaluated as a correlated trait with the same effects as in MT. Variance components were estimated by Gibbs sampling using a sub-sample of data consisting of records from 68,434 cows. Breeding values were estimated for 3,329,689 animals. In MT, heritability of rearing cost and daily profit in first, second and third lactation were 0.22, 0.28, 0.28 and 0.43, respectively. Rearing cost was lowly and negatively correlated (-0.18) with daily profit in first and uncorrelated with profit in later parities. In RRM, heritability of rearing cost was 0.36. Heritability of profit increased with age and ranged between 0.32 and 0.45. Medium and negative correlations were found between rearing cost and profit across all three lactations. Profit EBV were highly correlated with EBV for production traits (0.85), moderately with Lifetime Profit Index and negatively correlated with fertility, longevity and daughter calf survival. No correlations were found between EBV for conformation traits and profit, except for angularity and bone quality.

Key Words: Profitability, Rearing Cost, Random Regression Model

10 Alternatives for evaluating daughter performance of progeny-test bulls between official evaluations. H. D. Norman*¹, J. R. Wright¹, and K. A. Weigel², ¹*Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD*, ²*University of Wisconsin, Madison.*

In August 2007, USDA changed from calculating official genetic evaluations quarterly to triannually to coincide with the schedule for international evaluations. Industry cooperators requested that unofficial interim evaluations be initiated between official evaluations for progeny-test (PT) bulls to offset part of the delay in receiving information due to the schedule change. To determine whether interim evaluations could provide accurate information for semen collection and storage (banking) for bulls of potentially superior genetic merit, interim evaluations were calculated with the current USDA animal model system and 4 data subsets of milk yield records from daughters of Holstein PT bulls with official August 2006 evaluations: 1) most recent 12 mo of calvings from cooperator herds with ≥ 1 PT daughter, 2) most recent 18 mo of calvings from herds with ≥ 1 PT daughter, 3) most recent 12 mo of calvings from herds with ≥ 5 PT daughters, and 4) most recent 18 mo of calvings from herds with ≥ 5 PT daughters. Interim evaluations from each data subset were compared with previous and subsequent official USDA evaluations. Correlations between interim and official evaluations were high (0.95 to 0.98 for bulls of interest) for all 4 subsets, which indicated that interim evaluations could provide valuable information between official evaluations. Correlations were highest when data were included from the most recent 18 mo of calvings from herds with ≥ 1 PT daughter. Interim evaluations had a higher reliability than that of previous official evaluations for almost all PT bulls that added daughters and had a lower reliability for almost all non-PT bulls. The Council on Dairy Cattle Breeding and dairy records processing centers supported June, September, and November interim evaluation with release limited to PT bulls with ≥ 10 daughters and an increase in reliability since the most recent official sire evaluation.

Key Words: Interim Evaluation, Genetic Evaluation, Progeny Test

11 Comparison of herds that currently supply young bulls to progeny testing programs with large commercial herds that could serve as dedicated suppliers. A. D. Coburn*^{1,2}, K. A. Weigel¹, S. A. Schnell², and G. Abdel-Azim², ¹University of Wisconsin, Madison, ²Genex Cooperative Inc, Shawano, WI.

Young dairy bulls for artificial insemination (AI) programs have traditionally been provided by seed stock producers. However, the number of seed stock herds has decreased due to changing dynamics of the dairy industry, including increases in average herd size, changes in business priorities, and attrition of stereotypical registered Holstein herds. Our objective was to compare the genetic profiles of herds that supply young AI sires at present with those of large commercial herds that might serve as dedicated suppliers of young sires to specific AI organizations in the future. A total of 693 current supplier herds were identified; these were the herd of record for the dam of a Holstein bull sampled by a major AI stud from 2005 to 2007. In addition, 976 large commercial herds were identified; these had more than 300 Holstein cows that contributed to the most recent routine national genetic evaluation. Frequency of 3X milking was greater in large commercial herds (55%) than in current supplier herds (19%). Among testing plans, DHIR was most common in current supplier herds (73%), whereas DHI-AP was most common among large commercial herds (71%). Mean lactation yield was higher in large commercial herds than in current supplier herds for milk (11,408 kg vs. 11,012 kg), fat (416 kg vs. 414 kg), and protein (348 kg vs. 339 kg), whereas mean lactation somatic cell score (SCS) was lower (2.69 vs. 2.74). Among large commercial herds, 208 herds had mean milk yield > 12,273 kg; 173 herds had mean fat yield > 455 kg; 273 herds had mean protein yield > 364 kg; 207 herds had mean SCS < 2.40; 238 had data collection rating (DCR) for milk > 90%, and 492 had DCR for components > 90%. Mean predicted transmitting abilities (PTA) were similar for current supplier herds and large commercial herds, although the range was less for commercial herds. Current supplier herds had a greater percentage of cows designated with elite status, but the total number of cows with elite status was similar for both groups of herds.

Key Words: Progeny Testing, Dairy, Artificial Insemination

12 Genetic analysis of Canadian dairy cows milked by an automatic milking system. M. Nixon*¹, J. Bohmanova¹, J. Jamrozik¹, L. R. Schaeffer¹, G. Mason¹, J. Rodenburg², F. Miglior^{3,4}, and K. Hand⁵, ¹University of Guelph, Guelph, ON, Canada, ²Ontario Ministry of Food, Agriculture and Rural Affairs, Woodstock, ON, Canada, ³Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada, ⁴Canadian Dairy Network, Guelph, ON, Canada, ⁵CanWest DHI, Guelph, ON, Canada.

Twice a day milking is currently the most often used milking schedule in Canadian dairy cattle. However, with the use of an automatic milking system (AMS), dairy cows can be milked more frequently. One of the major drawbacks of an AMS are cows that attend the milking system less than twice a day, and therefore have to be manually brought (or fetched) to the AMS by the farmer. The objective of this study was to examine milking intervals of the fetched dairy cow and to estimate genetic parameters for milking frequency of dairy cows milked in an AMS. The data collected was 166,712 daily records of 1,786 primiparous cows from 14 farms in Ontario and Quebec. Majority of cows visited milking robot 2 (47%) or 3 (37%) times a day. A two-trait random regression model was used for estimation of (co)variance components for 24-h milk yield and milking frequency. The model included fixed effect of herd x test-date, fixed regression on days in milk nested within season and random

regression for additive genetic and permanent environmental effects. Both fixed and random regressions were fitted by Legendre polynomials of order four. The variance components were estimated using restricted maximum likelihood. Heritabilities for the daily milking frequency and daily milk yield ranged between 0.06 and 0.19 and 0.20 and 0.39, respectively. Genetic correlations between daily milk yield and daily milking frequency were highest at the peak of lactation (0.86) and lowest in mid-lactation (0.45). Further investigation is needed into later parities and estimating breeding values for milking frequency.

Key Words: Dairy Cattle, Automatic Milking System, Heritability

13 Impact of selection for decreased somatic cell score on productive life and culling for mastitis. H. D. Norman*, R. H. Miller, and J. R. Wright, *Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD.*

Impact of continued selection for decreased somatic cell score (SCS) was examined to determine if such selection produced cows with difficulty responding to bacteria within the mammary gland as expressed by greater mastitis susceptibility and shorter productive life (PL). Holstein artificial-insemination bulls with a predicted transmitting ability (PTA) for SCS based on ≥ 35 daughters were grouped by quintile based on PTA SCS. Then 25 cow groups were formed based on sire and maternal grandsire (MGS) quintiles. Cows had birth dates from 1993 through 1999 and calving dates from 1995 through 2005. Cows that changed herds or had unreported lactations for their first 5 parities were excluded as were herds with <5 cows. Data were available from 2,556,402 cows in 27,167 herds. Mean cow PL was 27.1 mo; time opportunity was a restricting factor. Mean PTA SCS was 3.26 for sires and 3.25 for MGS for the cow group with highest sire and MGS quintiles and 2.77 and 2.76 for the group with lowest sire and MGS quintiles. Least squares difference in PL was examined on a within-herd basis with cow birth year in the model. Cows from the lowest sire-MGS quintile group had 3.2 mo longer PL than those from the highest sire-MGS quintile group and were less likely to be culled for mastitis (9 versus 13%) based on reported reason for record termination. Advantage for cows with a sire or MGS with lower PTA SCS was nearly linear across groups within MGS or sire quintile, respectively. Difference in PL between cow groups with highest and lowest sire quintiles for PTA SCS ranged from 2.0 to 2.4 mo; corresponding difference for MGS quintiles ranged from 0.8 to 1.2 mo. Because each month of additional PTA PL is valued at \$29 in the current USDA lifetime net merit index, a 200-cow herd from the lowest sire-MGS group for PTA SCS would be worth nearly \$6,000 more annually than a 200-cow herd from the highest sire-MGS group without considering any additional income or expense associated directly with SCS. Selection for decreased SCS across generations is expected to produce cows that are less likely to be culled for mastitis.

Key Words: Somatic Cell Score, Productive Life, Mastitis

14 Derivation of factors to estimate daily yield from single milkings for Holsteins milked two or three times daily. M. M. Schutz*¹, J. M. Bewley¹, and H. D. Norman², ¹Purdue University, West Lafayette, IN, ²USDA-ARS, Beltsville, MD.

The objective was to derive factors to predict daily yield when milk weights are recorded once when cows are milked twice (2x) or once or

twice when cows are milked thrice (3x) per d. Data were from herds enrolled in Dairy Herd Improvement and automatically recording milking weights and times. Following edits, 83,690 daily records of 1842 first lactation cows and 143,670 records of 2957 later lactation cows in 5 2x herds and 41,657 records of 779 first lactation cows and 84,131 records of 1999 later lactation cows in 4 3x herds remained. Factors currently in use to adjust single milking yields for milking interval (MINT) were applied. Also, 3 methods were compared to estimate factors or equations to predict daily yield. Factors were estimated as the ratio of the sum of daily milk to the sum of partial milk within a parity-MINT class (24 intervals in 2 parities) [Method 1] or as the sum of the ratios of daily milk to partial daily yield for each cow-day divided by the number of cow-days within parity-MINT class [Method 2]. Resulting factors from both methods were smoothed, applied to data, and residuals were regressed on days in milk (DIM). Regression equations (n=168) were also developed within parity-MINT-DIM classes (2x7x12) [Method 3] to simultaneously account for MINT and DIM. Separate factors and equations were derived for each milking in 2x or 3x herds. Method 3 resulted in consistently stronger correlations between estimated and actual yields and smallest root mean squared error (rMSE) for all milkings and parities. For 2x herds, Method 3 resulted in rMSE of 2.3, 3.0, 2.6, and 3.4 kg for AM milkings for Parity 1 and 2 and PM milkings for parity 1 and 2, respectively; compared to rMSE of 2.6, 3.2, 4.1, and 4.8 kg from current factors for the same milkings and parities. Likewise for 3x herds, Method 3 had smallest rMSE, while Method 1 had rMSE similar to those from current factors. Work is ongoing to determine whether equations from Method 3 will allow accurate estimation of daily yield when applied to other herds and traits fat, protein, and somatic cell score.

Key Words: Milking Interval, Adjustment Factor, Milking Frequency

15 Genetic correlation of live weight with price and calves' commercial values. R. Dal Zotto*, M. Cassandro, M. Penasa, M. De Marchi, and G. Bittante, *University of Padova, Legnaro, Padova, Italy.*

Aim of this study was to estimate heritabilities and genetic correlation of live weight and commercial values of Brown Swiss calves. A total of 23,911 individual live weight (kg) and commercial value (Euro/kg and Euro/calf) of Brown Swiss calves were recorded by Kovieh, the wholesale cattle organization of Bolzano province (Italy), from January 2003 to December 2007. Data were derived by 239 weekly auctions of calves sold at age from 7 to 50 days, with a live weight from 30 to 110 kg, and with a commercial value from 1.0 to 5.0 Euro/kg. Only calves with registered breed of sire and dam have been considered. Age at auction (24 ± 8 d) has been classified into three classes, (young, intermediate and old). (Co)variance components were estimated with a multiple-trait animal model based on Restricted Maximum Likelihood (REML) procedure using VCE package (Groeneveld, 1998). The pedigree file included all animals with at least a phenotypic record on one trait and all known ancestors of animals with phenotypic record. For all traits a linear model was used considering the following fixed effects: herd of birth (3116 levels), auction test-day (239 levels), age (3 levels). Animal and residual effects were considered as random and assumed to be independents. Heritabilities were 0.364 ± 0.015 for live weight (kg), 0.112 ± 0.036 for price commercial value (Euro/kg) and 0.175 ± 0.023 for calves commercial value (Euro/calf). Genetic correlations between live weight and price and between liveweight and calf commercial value were 0.046 ± 0.096 and 0.707 ± 0.047 , respectively. Genetic correlation between price and calves commercial values was, as expected, high and equal to 0.734 ± 0.041 .

These estimates of (co)variance components should provide the parameters for breeding value estimation of Brown Swiss bulls for these beef traits useful as additional information to increase the breed profit.

Key Words: Genetic Parameters, Commercial Values, Dairy Calves

16 Relationship between milk production and female fertility traits in Holsteins. A. Sewalem*^{1,2}, G. Kistemaker², and F. Miglior^{1,2}, ¹*Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Sherbrooke, Quebec, Canada,* ²*Canadian Dairy Network, Guelph, ON, Canada.*

Milk production and reproductive traits are major factors with respect to overall efficiency and profitability of the dairy industry. Various reports indicated that breeding for increased production in dairy cattle has negative side effects on health and fertility traits. The aim of this study was to assess the relationship between production trait and selected female fertility traits. Data consisted of Canadian test day and breeding records of the Holstein breed with first calving occurring between 1997 and 2007. A total of 15,000 records randomly selected herd were used for genetic parameter estimations. Traits studied were calving to first service (CTFS), first service to conception (FSTC) and test day milk yield close to 90 DIM (TD90M). The data included only records of first parity cows. The mean CTFS, FSTC and TD90M were 89.35 ± 33.86 , 31.39 ± 44.78 and 30.24 ± 61.73 , respectively. The genetic correlation between CTFS and TD90M was 0.29 and between FSTC and TD90M was 0.12, showing that cows with high milk production at time of first insemination tended to have longer intervals of CTFS and FSTC.

Key Words: Reproductive Traits, Production, Canadian Dairy Breeds

17 Genetic correlations between conception rates and test-day milk yields using a threshold-linear random-regression model. S. Tsuruta*¹, I. Misztal¹, C. Huang¹, and T. J. Lawlor², ¹*University of Georgia, Athens,* ²*Holstein Association USA Inc., Brattleboro, VT.*

The objective of this study was to estimate genetic correlations between conception rates (CR) and test-day milk (TDM) yields for different DIM. The data included 245,214 first parity service records of 102,929 first-parity cows born in NY between 1999 and 2003. The CR was defined as the outcome of a single insemination. CR and TDM were analyzed by using a bivariate model with herd-year, age, AI status, service month, cubic regressions on DIM using Legendre polynomials as fixed effects, herd \times sire interaction, sire additive genetic and permanent environment with cubic random regressions on DIM, service sire, and residual as random effects. Variance components were estimated using a Bayesian method via Gibbs sampling. Farms were categorized into small (≤ 50 cows) and large operations. Larger herds produced more test-day milk (33.7kg, 30.4kg), have lower CR (31%, 36%), start breeding earlier (77 d, 94 d to first service), and have fewer days open (137 d, 145 d). A more stressful relationship between CR and DIM was observed during the higher production periods of the lactation curve for large herds. For large herds, the genetic correlation between CR and TDM was 0.4 at DIM=50, dropped to 0 at DIM=90, was -0.55 at DIM=155, and rose to 0 at DIM=240. For small herds, the correlation was 0.1 at DIM=50, dropped to 0 at DIM=70, was -0.2 at DIM=120, and rose to 0 at DIM=240. For large (small) herds, the average correlation across

DIM between CR and TDM was -0.2 (-0.1). The average heritability estimate for CR was 2.4% (5.3%). The chi-square test showed that the frequencies of service records were significantly different during a week for 60% of large herds and for 11% of small herds, suggesting more timed AI services in large herds. Large herds may be more advantageous for identifying bulls with superior fertility, but small herds may be more advantageous for identifying bulls that sire more fertile daughters.

Key Words: Conception Rate, Test-Day Milk, Threshold-Linear Model

18 Study on genetic parameters of conception rate and heat detection/expression. C. Huang*¹, I. Misztal¹, S. Tsuruta¹, and T. J. Lawlor², ¹University of Georgia, Athens, ²Holstein Association USA Inc., Brattleboro, VT.

The purpose of this study was to indirectly estimate genetic parameters of heat detection/expression (HDE). Days open (DO) is a composite trait with many components, including conception rate (CR) and HDE. An insemination outcome (IO) is mainly influenced by CR. A genetic correlation between DO and IO contains information about the genetic correlation between the HD/E and CR. Field data were obtained from DRMS, Raleigh, NC, and included milk and service records on 109,278

cows in first lactation from 2,952 herds in NY from 1999 to 2003. A bivariate sire model included DIM, season, milk yield, age, AI status as fixed effects, herd-year, service sire, additive genetic, and permanent environment as random effects. Because of a single record per animal in DO, estimability required that the residual variance for DO be fixed. The data were split by herd size (≤ 50 , ≥ 100); tests indicated that many larger farms use timed AI while few small ones do. The genetic correlation between DO and IO was 0.991 with small herds and 0.996 with large herds. A data set for DO and IO was simulated assuming a range of genetic correlations between CR and HDE. For a range of 0.1-0.9, the genetic correlations between DO and IO were all ≥ 0.99 . Subsequent studies looked at correlations of IO and HDE. In simulated data, records analyzed for HDE existed until the insemination resulted in conception. In field data, HDE was estimated as $1/[(DO-df+21)/21 \times ns]$, where df is days at first insemination, and ns is number of services. With the field data set, the genetic correlations between HDE and IO were 0.996 with small herds and 0.994 with large herds. With the simulated data set, these correlations were 0.992, 0.984, and 0.538 when the simulated genetic correlations between HDE and CR were 0.9, 0.5, and 0.1, respectively. Heat detection as present in DO is censored, and very high genetic correlations between DO and IO are estimated even if the true correlations between HDE and CR are low.

Key Words: Conception Rate, Days Open, Heat Detection/Expression

Dairy Foods: Dairy Food Chemistry and Microbiology

19 ADSA Pioneer: Milk quality - Developments in testing and grading of raw milk. W. S. LaGrange*, Iowa State University, Ames.

Milk testing was initiated due to consumer pressure to have wholesome uniform products. Initially, the buyer smelled and sometime tasted the milk. When the Babcock test came along milk richness or fat content could be standardized. Older milk could be determined from titration and alcohol tests. Then keeping quality tests such as Methylene blue and Resazurin became important to manufacturers. A lot of time was spent in identifying spoilage and pathogenic organism in raw milk. As technology became available rapid and sophisticated tests became the standard of the milk industry. In the developed world many tests are determined prior to the milk being unloaded at the manufacturing plant.

20 Transglutaminase polymerization of a modified whey protein ingredient. D. A. Clare* and C. R. Daubert, North Carolina State University, Raleigh.

Transglutaminase promotes protein crosslinking reactions through an acyl transferase mechanism involving protein-bound glutaminy residues and primary amines including the ϵ -amino group of lysine residues in soy, myosin, gluten, oat globulin, peanuts, casein and whey. In this study, a modified whey protein concentrate (mWPC) was prepared to varying protein concentrations, 5.6% - 10% or 8% - 14.3% solids (w/w), in deionized water, pH 8.0, and crosslinked with microbial transglutaminase (TGase) at an enzyme/substrate ratio of \sim 5 units of activity/g mWPC. Test mWPC dispersions, prepared in the presence and absence of 10 mM dithiothreitol (DTT), were then incubated with the enzyme for various time intervals at 40°C. Representative samples were analyzed with respect to their (a) SDS-PAGE banding profile, (b) degree of crosslinking as determined by OPA assays, (c) apparent viscosity measurements, (d) gelation parameters, and (e) emulsion properties.

SDS-PAGE results showed that polymer formation occurred in all experimental mWPC dispersions treated with TGase, even those devoid of dithiothreitol (DTT); however, the rate of the reaction was slower. For example, quantitative OPA analyses revealed \sim 30% cross-linking in whey protein samples containing 10mM DTT after a 3h treatment period compared to 15% polymerization in equivalent solutions prepared under non-reducing conditions. These finding were attributed, in part, to maintenance of the redox status of the active cysteine residue found in the enzymatic catalytic site.

Pseudoplasticity was observed in all shear rheological experiments. Furthermore, the apparent viscosity and gel strength of TGase-mWPC dispersions was slightly lower than non-treated controls while the gelling temperature was raised. Notably, both the viscosity and stability of emulsions, prepared with these dispersions, were significantly improved. Scanning electron microscopy revealed a larger pore size in mTGase crosslinked mWPC samples, attributed to polymer formation. Ultimately, these approaches may provide novel whey-based food ingredients with unique functional characteristics for expanded application within the world marketplace.

Key Words: Whey Proteins, Transglutaminase, Functionality

21 Production of conjugated linoleic acid in milk by lactic acid bacteria. A. J. Pandit*, S. K. Anand, K. F. Kalscheur, and A. N. Hassan, South Dakota State University, Brookings.

Geometrical and positional isomers of conjugated linoleic acid (CLA) have several reported health benefits. Dairy products like cheese are increasingly being viewed as a possible dietary source of CLA. Increasing CLA level in these products could help bridge the gap between daily CLA requirement and effective dietary intake. This study was undertaken to evaluate CLA production and their isomeric distribution in milk during fermentation by lactic acid bacteria (LAB). A total of 155 cultures of LAB, including 46 cultures from the Dairy Science Department's culture collection, 68 isolates from retail cheeses, and 41 raw milk isolates were screened for CLA production. Cultures were individually inoculated in milk at 2% levels and incubated for 4 h at 37°C. Fat was extracted from milks at the end of incubation and the butyl esters were analyzed by gas chromatography. Control milks had an average CLA content of 0.41 ± 0.10 gm/100 gm of fatty acids (FA). The 13 cultures (7 *Lactococcus* and 6 *Lactobacillus*) from the Department collection produced CLA values ranging from 0.43 ± 0.03 to 0.63 ± 0.14 gm CLA/100 gm FA in milk. A higher CLA level was produced by five isolates from retail cheeses (4 *Lactococcus* and 1 *Lactobacillus*). The highest CLA production by one of the *Lactococcus* strains was 1.12 ± 0.35 gm/100 gm FA. The remaining 4 isolates (3 *Lactococcus* and 1 *Lactobacillus*) produced 0.87 ± 0.22 , 0.63 ± 0.16 , 0.56 ± 0.15 , 0.62 ± 0.10 gm CLA/100 gm FA, respectively. These cultures increased mainly the cis-9, trans-11 isomer and also produced 3 to 5 unidentified CLA isomers. On an average, cis-9, trans-11 represented 62.62%, and trans-10, cis-12 represented 17.77% of the total CLA. This study shows that lactic acid bacteria can increase levels of CLA in fermented milk and possibly be used for making dairy products enriched with CLA.

Key Words: Conjugated Linoleic Acid, Lactic Acid Bacteria, Milk

22 Immuno-stimulatory AT oligodeoxynucleotide from *Lactobacillus gasseri* requires a specific self-stabilized structure. T. Shimosato*¹, M. Tohno², T. Sato³, Y. Kawai², T. Saito², and H. Kitazawa², ¹Shinshu University, Minamiminowa, Nagano, Japan, ²Tohoku University, Sendai, Miyagi, Japan, ³Yokohama City University, Yokohama, Kanagawa, Japan.

Some probiotics (*live microorganisms which when administered in adequate amounts confer a health benefit on the host*) enhance the secretion of anti-inflammatory cytokines by innate immune cells. We have been studying immuno-stimulatory DNA from probiotics as an immuno-active factor in probiotics. Recently, we found an immuno-stimulatory AT oligodeoxynucleotide (ODN) containing a unique core sequence (5'-ATTTTAA-3') in *L. gasseri* genomic DNA. Interestingly, although the AT-ODN does not contain any CpG sequences, it exerts mitogenic activity and augments Th1 type immune responses via Toll-like receptor (TLR) 9. We then identified 280 different AT-ODNs in *L. gasseri* genomic DNA, and mitogenicity and NF- κ B reporting assays showed that 13 of these 280 AT-ODNs were strongly immuno-stimulatory in the TLR9 transfectant. Of these, AT-ODNs LGAT-145

and LGAT-243 were the most potent. LGAT-243 had the greatest activity and was more potent in the induction of Th1 type cytokines than the swine prototype, ODN D25. We further found that a six-base secondary loop structure containing a self-stabilized 5'-C...G-3' stem sequence is important for induction of the potent immuno-stimulatory activity. The present study identified novel strong immuno-stimulatory AT-ODNs in the genomic DNA of probiotics. Moreover, these results are the first to demonstrate that AT-ODNs with a specific loop and stem structure are important for immuno-stimulatory activity. Finally, the data shows that TLR9 is a receptor for not only CpG but also for AT ODNs. These findings may help our understanding of intestinal immuno-regulation mediated by probiotic DNA through TLR9, for the development of new probiotic foods.

Key Words: AT-ODN, *Lactobacillus gasseri*, TLR9

23 Complete genome sequence and comparative genome microarray of *Lactobacillus casei* provides evidence for genome expansion and reveals significant intraspecies differences. H Cai^{*1}, J. R. Broadbent², and J. L. Steele¹, ¹University of Wisconsin, Madison, ²Utah State University, Logan.

Lactobacillus casei are industrially important lactic acid bacteria (LAB) that have been primarily used as probiotics and specialty cultures for cheese flavor development. They have remarkable ecological adaptability to diverse habitats. The genome sequence of *L. casei* ATCC334 had been analyzed. It contained a 2,895,264-bp chromosome and a 29,061-bp plasmid with a GC% of 46.6 and 42.2, respectively. A total of 2,951 ORFs was predicted. Several unique features of the genome supported the hypothesis that the genome had been expanded for versatile adaptation to diverse ecological niches: (i) a correlation was observed between the relatively high GC% of the genome and versatile adaptability of LAB, (ii) relatively low numbers of rRNA and tRNA genes relative to genome size likely indicated presence of large amount of unessential genes; and (iii) significantly higher number (~3.25% of total ORFs) and larger diversity of transposases (11 families) suggested the key role of transposases in genome expansion and horizontal gene transfer of the species. Additionally, the genome contained relatively high number of transcriptional regulators (>4% of total ORFs) and transporters. About 361 secreted proteins, 19 glycosyltransferases and several mucus- and fibronectin-binding proteins were identified. About 28 peptidases and homologs for PrtP and PrtM were predicted. Comparative genome microarray between ATCC334 (a cheese isolate) and a silage isolate 12A revealed ~14.4% of the genes that are present in ATCC334 are missing in 12A, most of which are transposase- and bacteriophage- associated genes or genomic regions. Loci involved in sugar transport, metabolic enzymes and transcriptional regulators also differ. Collectively, the genomic features of *L. casei* provided evidence for genome expansion that may have facilitated its diverse ecological adaptability. Significant gene content differences were identified between the cheese and silage isolates, which may underlie the ecological adaptation of these strains to their specific ecological niches.

Key Words: *Lactobacillus casei*, Genome Sequence, Adaptation

24 Effect of feeding pasture and long chain omega-3 fatty acid

(LCn-3FA) supplements on the composition and oxidative stability of milk & butter. M. C. Rose^{*1}, H. P. V. Rupasinghe¹, S. M. Budge², K. Glover¹, and A. H. Fredeen¹, ¹Nova Scotia Agricultural College, Truro, NS, Canada, ²Dalhousie University, Halifax, NS, Canada.

Enriching milk with LCn-3FA, namely docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), to improve its nutritional profile may also increase rate of lipid oxidation and the production of off-flavors. Antioxidant content of forage may ameliorate the effect, but antioxidant content of forages is reduced by ensiling. The objective of this experiment was to determine the effect of feeding LCn-3FA and forage type with different anti-oxidant potential on the oxidative stability of milk. Eight mid-lactation Holstein cows (BW 612.5 ± 9.49kg; BCS 2.71 ± 0.03 out of 5; milk yield 16.83 ± 0.56kg) were used to evaluate four treatments: pasture (with concentrate fed twice daily at milking according to milk yield 1:4 w/w) or total mixed ration (TMR containing ensiled forage and 11.06 kg concentrate DM per cow daily) with or without a supplement of rumen-protected LCn-3FA. Cows were assigned randomly to treatment in two 4x4 Latin squares with 28 d periods. Milk was collected on days 27 and 28. No significant differences (P>0.05) in gross milk composition among the treatments were observed, which averaged 4.11 ± 0.23% fat; 3.10 ± 0.09% protein; 4.69 ± 0.03% lactose. Butter was made by centrifugation at 15,000 x g for 15 min at 4°C. Oxidation of raw milk and butter was determined using the Thiobarbituric Acid Reactive Substances (TBARS) method. TBAR absorbance at 530nm was significantly higher (P=0.02) in milk and butter of cows fed TMR supplemented with LCn-3FA compared with those fed pasture and LCn-3FA. These results indicate that a pasture-based diet may improve the shelf life of milk and butter enriched with LCn-3FA.

Key Words: Long Chain Omega-3 Fatty Acids, Lipid Oxidation, Forage

25 The protective effect of processed cheese against hyperlipidemia in rats. M. H. Abd El-Salam* and D. A. Mohamed, National Research Centre, Cairo, Giza, Egypt.

The effects of ingestion of processed cheeses containing different types of fats on plasma lipid profile and lipid peroxidation of hypercholesterolemic rats were studied. The study included three types of processed cheeses; the first two contained vegetable oils and the third contained milk fat only. Five groups of rats (8 animals each) were fed balanced diet (normal control), hypercholesterolemic diet (control) and hypercholesterolemic diet containing one of the tested processed cheeses respectively for 8 wks. The body weight and food intake were recorded and gain in body weight and food efficiency ratio were calculated. Blood analysis was carried out at the end of the experiment for total lipids and cholesterol, LDL, HDL, triglycerides (Tg) and plasma malondialdehyde (MDA). Feeding the different processed cheeses with hypercholesterolemic diet showed variable reductions in the plasma lipids except HDL which was increased as compared to control. The highest reduction was observed in group that received processed cheese containing milk fat only. Also, this group showed significant reduction in lipid peroxidation as measured by MDA. These results reflect the potential beneficial effects of consumption of processed cheese containing milk fat only towards cardiovascular diseases.

Key Words: Processed Cheese, Hypercholesterolemia, CLA

26 Antimicrobial activity of dried spearmint and its extracts for use as soft cheese preservatives. M. Foda¹, M. El-Sayed*¹, M. E-Mogazy¹, A. Hassan², and N. Rasmy², ¹*National Research Center, Cairo, Egypt*, ²*Faculty of Agriculture, Cairo, Egypt*.

Spearmint which is common herb in the Mediterranean region was evaluated (dried or its extracts) as inhibitor factor against the growth of four strains of bacteria, four strains of yeast and four strains of moulds, using filter paper disc agar diffusion technique. Obtained results showed that water and ethanolic extracts had no inhibitory effect on all strains under test except the moderate activity of ethanolic extract against Gram positive bacteria (*Bacillus cereus* and *Staphylococcus aureus*). Essential oil was the strongest antimicrobial inhibitor, so, its antifungal activity and minimum inhibitory concentration (MIC) were examined. To evaluate the antimicrobial activity of spearmint, two types of UF-soft cheese were prepared using different concentrations of dried spearmint and its essential oil. Spearmint essential oil showed significant reduction on counts of total bacteria, proteolytic bacteria and psychrotrophic bacteria compared with control samples. Moulds and yeasts were totally inhibited by using the essential oil.

Key Words: Soft Cheese, Antimicrobial Activity, Spearmint

27 Is Levowitz–Weber the appropriate confirmatory stain for direct microscopic somatic cell counting of ovine milk? K. H. Petersson*¹, L. Connor¹, C. S. Petersson-Wolfe², and K. A. Rego¹, ¹*University of Rhode Island, Kingston*, ²*Virginia Polytechnic Institute and State University, Blacksburg*.

The stain approved for regulatory use in bovine and ovine milk is the non-specific methylene blue based Levowitz–Weber (L–W) stain in

contrast to the approved stain for goat milk, the DNA specific Pyronin–Y–Methyl Green (PMG) stain. Due to the presence of cytoplasmic particles in ovine milk the use of the L–W stain has the potential to artificially elevate the MSCC, particularly in late lactation. The objective of the current study was to compare the MSCC of sheep (n=42) over an entire lactation using 3 different counting methods: 1.) Direct Microscopic Somatic Cell Count (DMSCC) with L–W stain, 2.) DMSCC with PMG stain, and 3.) MSCC using the automated Fossomatic cell counter (FOSS). All staining procedures were conducted in accordance with U.S. regulatory procedures. Composite milk samples were collected from Friesian ewes (1–7 yr of age) within 2 wk of lambing and then monthly thereafter throughout the entire lactation. Each milk sample was divided into 2 aliquots. The DMSCC staining procedures (L–W and PMG) were conducted on one aliquot within 48 h of sample collection. The second aliquot was bronopol–preserved and Fossomatic cell counting began within 72 h of sample collection. The same bronopol–preserved sample was tested for fat, protein, milk urea nitrogen and total solids content. Sample collection began in October 2007 and will continue until May 2008. Descriptive statistics on the preliminary data have been summarized. To date, all study animals have been sampled from lambing through 90 days in milk. The average MSCC for L–W, PMG and FOSS were $98 \pm 9 \times 10^3$ (Mean \pm SEM), $72 \pm 7 \times 10^3$ and $345 \pm 40 \times 10^3$ cells/ml, respectively. Preliminary statistical analyses suggest significant interactions between the counting method and milk components fat, protein and total solids, as well as month of lactation. Additionally, milk urea nitrogen level appears to have a significant negative association with MSCC. A full statistical analysis will be examined following the completion of data collection in May 2008.

Key Words: Ovine Milk, Somatic Cell Count, Staining Procedure

Symposium: ESS Program: Horse Genome Toolbox for Animal Science Applications

28 Exploiting the public genome databases for equine science. L. C. Skow*, *Texas A&M University, College Station.*

Improved technologies developed during and consequent to the human genome project have resulted in the complete genome sequences of more than a thousand species of microbes and eucaryotes, including 25 species of mammals and 10 non-mammalian vertebrate species. These vast sources of publicly available data represent invaluable potential information for inquiry at all levels of biological processes. This presentation will provide an introductory overview to on-line genome databases, gene mining tools and genome annotation resources as a prelude to the following speakers who will speak to specific genome resources and tools recently developed for equine science based on the horse genome sequence. Emphasis will be on functional genomics applications.

Key Words: Equine, Genome Tools, Functional Genomics

29 Identification of genes for health and performance traits in horses through whole genome analysis. J. Mickelson*, *University of Minnesota, St Paul.*

An extraordinary and sustained effort by the equine genome research community, and the excellent downstream potential of the horse as a biomedical model, played a significant role in the selection of the horse for full genome sequencing and genome structure analysis by the National Human Genome Research Institute. As a result, we are now extremely well-positioned to address our long-term research goals, which can briefly be summarized as identifying genes and pathways associated with normal health, disease, performance, growth, development, fertility, and disease resistance in horses. With focused research investments we can now expect advances in our understanding of equine biology, improvement in health, performance and well being, as well as the development of equine models of significant human health concerns.

The equine research community now has the technology to rapidly genotype tens of thousands of single nucleotide polymorphism (SNP) DNA markers on a single horse for less than \$300. These whole genome SNP chips can, in principle, allow the identification of genes having a major influence on traits of interest provided that a sufficient population of well phenotyped horses can be acquired. In this presentation the principles, practice, and limitations to such whole genome scans to identify the chromosomal location of genes contributing to a trait, and the means to find the specific genes and alleles that may be responsible, will be presented.

Key Words: Equine Genetics, Equine Genome, SNP Marker

30 Transcriptional profiling for gene expression analyses of equine samples. J. N. MacLeod*, *University of Kentucky, Lexington.*

Analyses of gene expression are widely performed in experimental biology to investigate cell and tissue function, cellular differentiation,

disease pathogenesis, and the molecular mechanisms of different therapies. The basic premise is that valuable insight about a tissue or cell type can be obtained from studying qualitative and quantitative changes in the patterns of gene expression. Several laboratory techniques are used routinely to evaluate gene expression on a transcriptional level. Selection of a specific procedure is usually dependent on the experimental objectives, amount of sample available for analysis, investigator preferences and resources, and cost considerations. One challenge in quantitative analyses of gene expression can be trying to select the individual genes that will be most interesting and biologically relevant to study. Transcriptional profiling enables scientists to initially make a broad assessment of the approximately 22,000 genes in the mammalian genome. Using cDNA and oligonucleotide microarrays, expression across large subsets of genes and even the entire genome can be evaluated in a single experiment. These screening procedures often enable a more informed decision to be made on which individual genes, or groups of functionally related genes, should be most interesting to focus on at greater detail in subsequent experiments. Essentially, the scientist can evaluate the "forest" before making a decision on which individual "trees" should be investigated further. This presentation will overview transcriptional profiling concepts and microarray platforms, concentrating on procedures that are currently being used to profile gene expression in equine RNA samples. Emergent technologies based on "next generation sequencing" and mRNA resequencing will be discussed.

Key Words: Equine, Transcriptional Profiling, Microarray

31 Let the genome give your project a leg-up: Real-time qPCR strategies in equine research. S. Brooks*, *Cornell University, Ithaca, NY.*

Sequencing of the equine genome has opened-up a multitude of possibilities in research techniques for equine scientists. During the last 100 years great discoveries have been made using antibodies, histochemistry, biochemistry and population or quantitative statistics. Unfortunately, reagents needed for traditional assay methods, like antibodies, are not as readily available in the horse as they are in other species. Furthermore, the methods often require special expertise. In some cases, Real-Time qPCR can offer a convenient alternative. With a genome sequence literally at our fingertips we can now design primers and probes for virtually any target in record speed. As the complexity of gene regulation is unraveled, use of gene expression studies has likewise expanded. Real-Time qPCR, using mRNA as a template, can measure changes in gene expression for proteins of interest faster and more accurately than ELISA or western plot can for the protein itself. Additionally, purified nucleic acids and more easily acquired and stored than fresh tissue or protein. In addition to gene expression Real-Time platforms are currently being used for genotyping, quantification of copy-number variants, mutation scanning, mirco and siRNA detection, DNA-methylation analysis and finally, coming full circle, in immuno-qPCR, which can improve sensitivity up to 1000-fold over traditional ELISA.

Key Words: Horse, Genome, Real Time qPCR

Extension Education: Symposium: Has the Land Grant College Left the Farm?

32 Why there is less applied agricultural research conducted at land grant colleges. R. L. Plain*, *University of Missouri, Columbia.*

Over the past 20 years, there has been a steady shift in the type of research conducted by colleges of agriculture at land grant universities, away from applied research and toward basic research. There are two primary reasons for this shift. First, formula funds available through USDA have held constant, more or less, for much of this period. Thus, the purchasing power of these federal dollars has shrunk by the rate of inflation. This has forced researchers to increasingly rely on competitive grants for funding. By their nature, competitive grants tend to be more oriented to basic research. The second reason for the shift away from applied research relates to changes that have taken place in agriculture. Farms have gotten much bigger. For land grant universities to do many types of applied research, they need facilities and equipment comparable to those used by producers. This is particularly a problem for applied livestock research, where replicating the production systems used by modern swine and dairy farms can be quite costly.

Key Words: Research, Land Grant, Funding

33 What I did when I had an extension/research appointment and what I do now: How times have changed. R. L. Nebel*, *Select Sires Inc., Plain City, OH.*

For 22 yrs I had an extension/research appointment first at North Carolina State University and then Virginia Tech. My appointment and performance expectations changed from 100% extension to 75% extension 25% research. Additionally, for 16 yrs I taught an applied reproductive management class in the associate degree program and during my last 5 yrs I taught a senior level physiology of reproduction class. Extension focus at the county level switched to specialized multi-county or regional area dairy agents of which there are currently three. I was the major advisor to fifteen MS students with most doing large field studies to obtain data to answer their thesis objectives. Funding for applied field studies in the area of reproduction of dairy cattle was and still is difficult to obtain. In 2005, I started my present position as senior reproductive and herd management specialist at Select Sires Inc. My primary responsibility is to elevate the reproductive expertise of all Select Sires member cooperatives and international distributor personnel and develop programs to ensure Select Sires is the recognized industry leader in applied reproductive management programs at the producer level. To conduct workshops on basic AI training, advanced AI training, herd management evaluation, synchronization and heat detection protocols, herd record analysis using on-farm records and the RePRO Analysis™ program, and on-farm consulting with dairy producers and their employees on reproductive and herd management issues. The objective of my presentation is to compare and contrast my career paths as a reproductive specialist in academia and now in the AI industry.

Key Words: Extension Education, Applied Reproduction, AI Industry

34 Serving the beef industry by re-defining your comfort zone. M. Siemens*, *Cargill Meat Solutions, Wichita, KS.*

In planning a career everyone makes decisions how best to obtain the desired outcomes, including the sort of job one wants to do until they retire. Dr. Siemens earned a Ph.D. in ruminant nutrition with the objective of finding a job supporting the beef industry through a university extension position. Such a position was obtained. After 10 years in academia an opportunity arose which allowed Dr. Siemens to seek new challenges outside of academia, so he left his university position for one in industry. Seeking the ability to have a broader impact Dr. Siemens found himself in industry working in animal welfare, beef procurement, swine procurement, beef/pork/turkey marketing, process verification, beef/pork/turkey retailer/foodservice support, biotechnology and other industry issues. Not too much on the pure ruminant nutrition side of the business anymore, and all areas where Dr. Siemens had limited formal training. To be successful and valuable to the livestock industries Dr. Siemens has had to re-define his comfort zone from ruminant nutrition to a variety of subject matters where expertise was needed. This has required him to obtain knowledge and information from a variety of sources and to find ways to generate new knowledge when gaps existed. Sources have included university extension, but also other academics as well as colleagues in industry. Generation of new knowledge within industry has proven invaluable to him as a source of continuing professional development. The new knowledge is neither peer reviewed nor shared widely (i.e. in scientific journals), which is different than that generated through the Land Grant system. It is, nonetheless, extremely valuable to those with access to it.

Key Words: Extension, Production Research, Industry

35 A transition from extension-research to industry swine genetics. W. O. Herring*, *Smithfield Premium Genetics Group, Rose Hill, NC.*

Much like the way of poultry, over the last 15 years, swine production has shifted to an integrated, contract production model. Today, the top 20 pork producers in the U.S. account for approximately half of the sow herd inventory. All of those top 20 producers currently have employees that are licensed veterinarians, nutritionists, physiologists and/or geneticists. Because of more homogenous production systems, scientists at these companies provide the technical assistance directly to growers where in the past that assistance was provided by Extension. These scientists can also focus on problems that improve production and reduce costs associated with those businesses. Their research is either generated internally, or they seek out those research programs at universities or other technology companies with whom they can collaborate to answer specific questions. If university research programs lose touch with the specific needs of these livestock producers, their research programs may not provide a benefit to improving livestock food production. A more specific example in livestock genetic improvement is emerging. Over the past fifteen years, research funding in genetics has shifted away from quantitative genetics to almost completely molecular strategies. However, we have struggled to come up with sweeping examples of how molecular-based genetic improvement has significantly improved livestock production over the last decade. While this has brought in

large grant dollars with attractive overhead for universities, it in turn has yielded a shortage of qualified, young scientists adequately trained with state-of-the-art quantitative genetics skills. While some have argued that nearly all of the needed research has been done utilizing quantitative strategies for livestock improvement, we have much research underway with our datasets for problems that have not yet been addressed in the literature. With a continually shifting U.S. livestock production paradigm, those businesses, researchers, universities and policy makers will have to openly communicate to maintain appropriate research priorities.

Key Words: Extension, Swine, Genetics

36 Why our farm is supporting MS research programs for the University of Illinois. B. F. Wolter*, *The Maschhoffs Inc., Carlyle, IL.*

For over a century, the Land Grant Extension System has created and disseminated knowledge throughout agricultural industries. The utilization of such knowledge has resulted in significant improvement in the biological efficiency of animal production systems. Arguably, Extension's applied science-based research is an important catalyst to increasing animal performance through development of management strategies on the basis of quantified improvements in genetic makeup of animals, facility design, animal health, and nutritional programs

among other factors. Such factors differ among modern animal production systems; therefore, specific research programs focused on system level improvement of biological output are increasingly necessary. The importance of observing science-based principles in study design, analysis, interpretation of results, and a systems-based approach to implementation remains constant among the changes in animal production. Moreover, a multi-disciplined approach involving the use of scientific results found in literature, as well as careful observations made by trained scientists within practical animal environments proves effective for providing incremental improvements in biological efficiency. Ultimately, this approach enhances profitability of animal production systems in competitive business climates. To that end, the Maschhoffs collaborated with the University of Illinois over the last decade to apply such an approach; the efforts resulted in science-based animal management strategies that increase its competitiveness within the pig production sector. Moreover, future scientists and managers are trained collaboratively through the research-based program, and these individuals are likely candidates for providing the leadership to the future of the pig industry. The Maschhoffs experience suggests careful consideration of the objectives in both private industry and public Land Grant Institutions, on behalf of the collaborative parties can provide a closer alignment of interests leading to definitions for the program. Resulting programs may provide for a long-term model for innovating today's animal production sector.

Key Words: Extension, Research

Symposium: Forages and Pastures: Fiber Fermentation: Influence of Supplemental Nonstructural Carbohydrates

37 Factors affecting activity of cellulolytic microbes in the rumen. P. J. Weimer*^{1,2}, ¹USDA-ARS, Madison, WI, ²University of Wisconsin, Madison.

Ruminant diets that contain high levels of readily fermentable carbohydrates often display reduced fiber digestibility, but separating direct from indirect effects has proven difficult. Laboratory culture studies have revealed that the most widely studied ruminal fibrolytic bacteria cannot use starches, and while often capable of using simple sugars, cannot compete effectively for these with typical saccharolytic ruminal bacteria. Glucose and cellobiose are known to inhibit cellulase enzymes *in vitro*, but their effect *in vivo* appears to be reduced by their low concentrations and by the fact that polysaccharide hydrolase enzyme complexes of the fibrolytic bacteria are cell-bound and somewhat protected from the bulk rumen liquid phase. At high sugar concentrations *in vitro*, rapid sugar fermentation appears to lengthen lag time before initiation of fiber digestion, without necessarily reducing digestion rate. Low ruminal pH (<5.9) inhibits growth of the most well-studied ruminal fibrolytic bacteria, but studies with mixed ruminal microflora *in vitro* suggest that cellulose degradation continues at substantially lower pH, apparently due to cellulose hydrolysis by cellulase complexes of nongrowing fibrolytic bacteria, coupled with rapid consumption of the released sugars by more acid-tolerant, noncellulolytic bacteria. Cellulose hydrolysis decreases rapidly at pH values < 5.3, apparently due to loss of adherence to cellulose fibers by the fibrolytic bacteria. Unlike starches, pectin does not appear to reduce fiber digestibility, in part because it is degradable by some fibrolytic bacteria, and because its fermentation does not result in dramatic declines in ruminal pH. Available data suggest that complex interactions among the microflora modulate the effects of concentrates on fiber digestion. Moreover, recently developed molecular techniques for characterizing bacterial populations suggest that most ruminal bacterial species have eluded isolation in pure culture, introducing the possibility that additional species may contribute to ruminal fiber digestion.

Key Words: Cellulose, Fiber Digestion, Rumen

38 The source and degradability of dietary starch influences forage and fiber utilization by lactating dairy cows. D. P. Casper*, D. Schauff, D. Kleinschmit, D. Jones, E. Lanka, and G. Ayangbile, *Agri-King, Inc., Fulton, IL.*

Milk production by the modern lactating dairy cow is often limited by the intake and supply of nutrients through digestion and absorption in both the rumen and intestine. Optimal nutrient intake and supply is achieved through ration formulation and orchestration of forages, feeds, and feeding management on the farm to maximize digestion and absorption. The lactating dairy cow is well adapted to use forages to meet these nutrient requirements. However, the range in forage quality and subsequent ruminal fiber digestion can be quite dramatic based on forage types, environmental conditions, varieties, harvest management, etc. Ultimately, it is the rate and extent of ruminal fiber digestion of the forage that will determine the maximum nutrient supply by the ration to the lactating dairy cow. Starch sources are used in the ration to supply the difference between the nutrient requirements of the cow

and the nutrients supplied by the forages. However, the rate and extent of starch digestion of these sources can negatively or positively influence ruminal fiber digestion. The objective of this presentation will be to discuss the interactions between the rate and extent of various starch sources (corn, barley, wheat, etc.) and their interaction on ruminal fiber digestion from various forage sources to meet the nutrient requirements for milk production. For example, our work with summarizing the data from the USDA-ARS Energy Metabolism Unit Database demonstrates that lactating dairy cows exhibiting symptoms of ruminal acidosis (inverted fat and protein ratios) caused by excessive ruminal starch digestion resulted in significant reductions in ruminal fiber digestion when fed different forage sources. These reductions in ruminal fiber digestibility also lead to a lower supply of nutrients, milk production, milk components and feed efficiency by the lactating dairy cow.

Key Words: Forages, Starch, Digestibility

39 Manipulation of rumen microflora to improve ruminant production. R. J. Forster*, K. A. Beauchemin, and S. Ohene-Adjei, *Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.*

The addition of large quantities of non-structural carbohydrates to the diet of ruminants has often been associated with increased risks for ruminal acidosis and decreased activity of cellulolytic bacteria. Previously, the commonly accepted scenario for the occurrence of rumen acidosis was the overgrowth of lactic acid producing *Streptococcus bovis* and a decrease in lactate-utilizing bacteria. The subsequent accumulation of lactic acid and drop in rumen pH would then adversely affect the acid sensitive cellulolytic bacteria. However, recent studies utilizing molecular techniques to quantify rumen bacterial populations have not supported the theory that *S. bovis* always increases dramatically when starch is supplemented to cattle. Furthermore, lactic acid does not necessarily accumulate in rumen fluid of animals experiencing rumen acidosis. The inoculation of lactate-utilizing bacteria into the rumen before the onset of increased starch supplementation has had some success in establishing these bacteria before natural populations can increase. Recent studies of the microbial diversity of the rumen have shown that most of the rumen bacteria have not been cultivated and that even coherent phylogenetic groups can vary widely in their functional attributes. This presents challenges for the interpretation of results based on the characterization and enumeration of a few cultivated strains. It has also been found that populations of bacteria traditionally thought to be dominant in the rumen of cattle (such as the *Prevotella* and *Butyrivibrio* groups) may not always be present in significant numbers. To fully understand how the rumen microflora can be manipulated to ameliorate the effects of excess starch on fiber fermentation, we must obtain a thorough knowledge of the bacteria present under different dietary regimens and how they respond to dietary stress. Molecular techniques are being developed and are helping to better understand the dynamics of rumen microbial populations and how they may be manipulated to improve animal production.

Key Words: Rumen Ecology, Acidosis, *Prevotella*

Graduate Student Paper Competition: ADSA Dairy Foods

40 Effects of sucrose on the foaming and interfacial properties of whey protein isolate and egg white protein mixtures. X. Yang^{*1,2}, T. K. Berry^{1,2}, and E. A. Foegeding^{1,2}, ¹North Carolina State University, Raleigh, ²Southeast Dairy Foods Research Center, Raleigh, NC.

Whey proteins form wet foams with properties similar to egg white but lack stability when incorporated in an angel food cake. Sucrose is a major component of cakes; however, its effects on foaming, interfacial and baking properties have not been investigated. In this work, 12.8% (w/v) sucrose (the amount found in angel food cake foams) was added to 10% (w/v) protein solutions. The effects of sucrose on the foaming and interfacial properties of egg white protein (EWP), whey protein isolate (WPI), and mixtures of the two were evaluated. Two types of WPI (one based on ion-exchange separation and the other on membrane filtration) and five EWP/WPI ratios were investigated. Physical properties of foams (drainage 1/2 life and yield stress) and dynamic viscosity of pre-foam solutions were measured. Interfacial rheology was determined by a pending drop method. Normal and no sucrose angel food cakes were prepared and evaluated for volume and structure.

Addition of sucrose caused a 79% increase in drainage 1/2 life of EWP foams, whereas drainage 1/2 life of WPI and EWP-WPI mixtures were increased by no more than 32%. Sucrose significantly ($p < 0.05$) increased dynamic viscosities of all protein solutions but only increased the interfacial dilational elastic modulus of EWP, suggesting that the improved interfacial elasticity of EWP effectively slowed down foam drainage. The yield stress values and interfacial dilational elastic moduli of WPI and EWP-WPI mixtures were decreased with sucrose addition, with a positive relationship established between yield stress and interfacial dilational elastic modulus. The presence of sucrose increased angel food cake volume when EWP proportion was higher than 50%, but showed no improvement in the coarse structure of EWP-WPI mixed cakes. These results indicated that sucrose increased foam stability, interfacial elasticity, and angel food cake volume when combined with egg white. This was not observed in whey proteins and EWP-WPI mixed systems, suggesting that one functional difference between whey and egg white proteins is how they interact with sucrose.

Key Words: Whey Proteins, Sucrose, Foam

41 Rheological and chemopreventive properties of milk fermented with exopolysaccharide-producing lactic cultures. D. H. Purohit^{*}, A. N. Hassan, E. Bhatia, and C. Dwivedi, *South Dakota State University, Brookings.*

The objectives of this research were to evaluate the rheological and chemopreventive properties of milk fermented with different exopolysaccharide (EPS)-producing lactic cultures. Reconstituted (11% wt/vol) skim milk was fermented with single strains of EPS-producing and non-producing cultures. They collected on the surface of undisturbed fermented milk samples and after cutting was measured. All EPS-producing cultures reduced the amount of whey present on the surface of the undisturbed samples, while only three out of five strains reduced syneresis measured after cutting. All EPS-producing cultures except a strain of *Lactobacillus delbrueckii* ssp. *bulgaricus* reduced viscoelastic moduli in fermented milk. In the chemoprevention study, 140 male Fisher rats were divided into 7 groups of 20 each. Rats in 6 groups were fed diets supplemented with fermented milks made with single strains of EPS-producing and non-producing cultures, while rats in

group 7 (control) were fed a diet supplemented with milk acidified with glucono- δ -lactone (GDL). All rats were injected with azoxymethane (15 mg/kg, subcutaneous) at weeks 7 and 8 of age to induce tumors in the gastrointestinal tract and fed their respective diets ad libitum throughout the study. After 30 weeks of initiation, rats were anesthetized with ether, intestinal tissues were isolated, washed with normal saline, and number and size of tumors were recorded in the colon and small intestine. Rats fed diets supplemented with fermented milk made with two EPS-positive and one EPS-negative strains significantly lowered colon tumor incidence and colon tumor multiplicity. Cyclooxygenase-2 (COX-2) enzyme activity (enzyme implicated in colon tumor development) was significantly lower in colon tissue of rats fed diets containing milk fermented with four EPS-producing and one non-EPS-producing cultures than that in rats fed diet supplemented with GDL acidified milk. Differences in the chemopreventive effects among EPS-positive cultures could be due to variations in the type of EPS or other metabolites.

Key Words: Fermented Milk, Rheology, Chemoprevention

42 Effect of different types of emulsifiers on the functional properties of low-fat process cheese. E. M. Salim^{*1}, S. Govindasamy-Lucey², M. E. Johnson², and J. A. Lucey¹, ¹University of Wisconsin, Madison, ²Wisconsin Center for Dairy Research, Madison, WI.

In this study, the impact of different types of emulsifiers (EM) on the textural and rheological properties of low-fat process cheese (LPC) was investigated. After a preliminary screening of 9 different types of EM, small lab-scale LPC were prepared from fat-free cheese base (that was made by direct acidification of skim milk to pH 5.6 using citric acid), and the addition of 5 different EM at 4% level; citric acid esters (CAE), diacetyl tartaric acid esters of monoglycerides (DATEM) (Anionic), N-cetyl-N,N,N trimethylammonium bromide (CTAB) (Cationic), distilled monoglycerides (DM), and mono-diglycerides (MD) (Non-ionic). No citrate or phosphate-based salts were used for LPC manufacture. Control nonfat process cheese was made without any EM. Moisture content and pH of LPC were kept constant at 63.0% and 5.5, respectively. Texture profile analysis was used to determine adhesiveness and hardness at 40 and 80% compression levels (CL). Meltability was measured by UW Melt-Profiler as the degree of flow (DOF). Small amplitude oscillatory rheometry determined storage modulus (G' or stiffness) and loss tangent (LT; a meltability indicator) during heating from 5 to 85°C. LPC with EM were softer than control at 40% CL but harder than control (except for DATEM and CTAB) at 80% CL. LPC made with DATEM and CTAB had similar properties except that DATEM exhibited fracture during compression while CTAB cheese was sticky. LPC with DM, MD, and CAE were generally similar and had higher DOF than control. The only major difference between these cheeses was that MD had similar G' values at 8°C to control whereas DM and CAE had higher G' values. The addition of all types of EM produced cheeses with lower maximum LT and higher G' values at 85°C relative to control cheese. These results demonstrate that different types of EM can be used to modify both low temperature properties (hardness, fracture) and high temperature properties (melt, flow) of LPC, which would be useful for various applications like slices, blocks and shreds. These LPC cheeses are currently being scaled-up to further investigate their physicochemical properties.

Key Words: Low-Fat Process Cheese, Emulsifiers, Functionality

43 Manufacture and characterization of whey protein concentrate from microfiltration of milk. H. S. Somni* and V. V. Mistry, *South Dakota State University, Brookings.*

Whey protein concentrates (WPCs) are widely used in the dairy industry due to their nutritive and functional properties. There is a high degree of variability in composition, functional, and sensory properties of WPCs. Commercial WPCs can also develop stale flavor due to the presence of lipid and protein impurities. These attributes limit the extent of their use in the food industry. Whey proteins from microfiltration (MF) permeate are unique; they have not been subjected to cheese making process, are in native state, its composition is similar to cheese whey, practically free of bacteria and impurities of fat and protein. Such whey proteins have the potential of providing useful applications in various products. Raw skim milk was microfiltered at 50-55°C to separate whey protein (MWP). MWP was further concentrated by UF and spray drying to obtain MWP concentrate (MWPC). At no stage were any of the fractions in the stream pasteurized or diafiltered. The average composition (4 replicates) of MWPC powder was; 49% protein, 4.5% ash, 0.6% fat and 6.1% moisture. The functional properties of the product were compared with two commercial WPCs (samples A and B) at pH 7. The minimum concentration to gel at 80°C/30 min for all the samples was 8% protein. For emulsion stability, 33% fat emulsion was prepared in 100 ml of 2% protein solution and the fat content in bottom 50 ml was measured after 2 hrs. The stability was expressed as percent ratio of fat in bottom layer to total fat. The emulsion stability was 61.4, 68.2 and 62.1% respectively, for MWPC, sample A and sample B. The foaming properties were expressed as % overrun and foam stability. The average overrun for NPWC and sample A was 963.1 and 486.8 respectively. Only 44% foam collapsed after 30 min whereas for sample A the foam collapsed in less than 5 min. For sample B the foam was very unstable to measure even overrun

Key Words: Whey Protein Concentrate, Functional Properties

44 Transport of glucose by *Bifidobacterium animalis* ssp. *lactis* occurs via facilitated diffusion. E. P. Briczinski*, A. T. Phillips, and R. F. Roberts, *The Pennsylvania State University, University Park.*

Bifidobacterium animalis ssp. *lactis* strains are often studied as potential probiotics. Colonization by and survival of probiotics in the large intestine depend on utilization of fermentable carbohydrates not absorbed or metabolized by the host. Although carbohydrate utilization is critical to bifidobacterial activity in the gut, relatively little is known about carbohydrate transport in this genus. While most strains of bifidobacteria are able to ferment glucose, glucose non-fermenting strains (GNF) have been reported. The objective of this research was to develop an understanding of the difference in glucose utilization between strains that grow on glucose compared to GNF strains. Two closely related strains of *B. animalis* ssp. *lactis*, DSMZ 10140 (type strain) and RB 4825 (obtained from a commercial starter culture manufacturer), were compared. DSMZ 10140 (glucose-positive) and RB 4825 (glucose-negative) were indistinguishable using nucleic acid-based techniques (PFGE, RAPD-PCR, gene sequencing). A low-affinity facilitated diffusion glucose transporter was identified in DSMZ 10140 by performing uptake assays with D-[U-¹⁴C] glucose. Based on kinetic analyses, mean values for K_t and V_{max} were 14.8±3.4 mM and 0.13±0.03 μmole/min/mg cell protein, respectively. When competitor carbohydrates were included in uptake assays, stereospecificity was exhibited, with greater competition by methyl-β-glucoside than methyl-α-glucoside. There was no inhibition

of glucose uptake by sodium fluoride, iodoacetic acid, sodium arsenate, sodium azide, 2,4-dinitrophenol, monensin, or valinomycin, which often block active transport; however, significant inhibition (>30%) was observed with phloretin, an inhibitor of facilitated diffusion of glucose. Glucose uptake by four additional commercial strains of *B. animalis* ssp. *lactis* was also inhibited by phloretin, indicating the activity of facilitated diffusion glucose transporters. The glucose transporters characterized in this work are the first identified in *B. animalis* ssp. *lactis* and the first identified facilitated diffusion transporters of glucose in actinobacteria.

Key Words: *Bifidobacterium animalis* ssp. *lactis*, Probiotics, Glucose Transport

45 Characterizing stress responses of bifidobacteria strains of industrial importance. A. K. Abdalla*^{1,2}, M. A. Mohran¹, S. C. Ingham², J. R. Broadbent³, and J. L. Steele², ¹Assiut University, Assiut, Egypt, ²University of Wisconsin, Madison, ³Utah State University, Logan.

Delivery of probiotic bifidobacteria in foods would benefit from the development of technologies to enhance their survival in foods and during gastric passage. This research aims to better understand how bifidobacteria respond to stress and identify potential strategies to enhance their survival. Intrinsic resistance to acid (HCl) for three strains each of *Bifidobacterium animalis* ssp. *lactis* and *Bifidobacterium longum* were screened at pHs ranging from 2.0 to 6.5. In general, *B. lactis* strains had a higher intrinsic acid resistance than *B. longum*. For example, while no significant reduction in viability of the *B. lactis* strains was observed after 2h at pH 3.5, the *B. longum* strains decreased by 3 log₁₀ CFU/mL. Also, strain to strain variations were observed within the same species. For example reductions of 1.5, 1 and 3 log₁₀ CFU/mL in viable numbers of *B. lactis* strains RH-1, DSM 10140 and D 2908 was observed after 2h at pH 2.0, respectively. For all of the strains examined, conditions to induce an acid tolerance response (ATR) have been identified. Observed increases in survival during acid challenge after ATR induction ranged from 0.5 to 2 log₁₀ CFU/mL. Additionally, intrinsic resistance to NaCl has been examined with the *B. lactis* strains examined. No significant reductions in viability were observed after 20h in NaCl concentrations up to 12% (W/V). These results indicate the importance of both strain selection and culture treatments for enhancing the survival of bifidobacteria in foods and during gastric passage.

Key Words: *Bifidobacterium*, Acid Resistance, Salt Resistance

46 Growth substrates for nonstarter lactic acid bacteria. Biochemistry and transcriptional profile of *Lactobacillus casei* ATCC 334 in a Cheddar cheese model system. M. Budinich*¹, I. Diaz-Muniz¹, H. Cai¹, V. Smeianov¹, J. Broadbent², and J. Steele¹, ¹University of Wisconsin, Madison, ²Utah State University, Logan.

Cheese ripening is a dynamic, poorly understood process that is essential for development of cheese flavor and requires non-starter lactic acid bacteria (NSLAB). The energy sources utilized for growth by NSLAB are unknown. However, potential energy sources include simple carbohydrates, citrate, nucleic acids, glycopeptides and phosphopeptides. *Lactobacillus casei* is the typical dominant species of NSLAB present

in ripening cheddar cheese. Cheddar cheese extract (CCE) was used as a model system medium to examine the growth substrates present in Cheddar cheese at 2, 6 and 8 month of ripening. A decrease in both growth rate and maximum cell density of *Lb. casei* ATCC 334, a cheese isolate, indicate that substrates are being consumed and or changing during ripening process. Analysis of volatiles by SPME GC/MS indicated the appearance of several potential cheese flavor compounds. The completed genome of *Lb. casei* ATCC 334 permitted us to observe global gene expression patterns during fermentation of 2 month old CCE and identified 42 genes differentially expressed related to energy and metabolism. A putative pathway to derive energy from nucleic acid degradation was proposed and tested in chemically defined media. *Lb. casei* ATCC 334 was able to grow on milk derived glycopeptides and glycolipids and on *Lc. lactis* spp. *cremoris* SK11 derived nucleic acids but not on cheese derived phosphopeptides. Single carbohydrate studies showed that the ability to ferment carbohydrates also depends on the composition of the media and prior history of the bacterium

Key Words: Growth Substrates for NSLAB, Cheese Model System, Transcriptional Profile of *Lactobacillus casei* ATCC 334

47 Production of conjugated linoleic acid in cheese slurry by lactic acid bacteria. A. J. Pandit*, S. K. Anand, A. N. Hassan, and K. F. Kalscheur, *South Dakota State University, Brookings.*

Certain lactic acid bacteria (LAB) produce conjugated linoleic acid (CLA) from linoleic acid. Such CLA producing LAB, when used in cheese manufacture, can possibly increase CLA. Previous studies conducted in our laboratory have screened and identified CLA producing LAB. In the present investigation a slurry method was used to screen these CLA producing LAB for their suitability in cheese manufacturing with higher CLA levels. Cheese slurry (60% moisture, pH 6.6) from Cheddar curd was steamed, cooled to room temperature, inoculated in duplicates with respective cultures, and incubated for 5 day at 37°C. Treatments used were: 1) 4b cheese isolate (CI) (*Lactococcus* isolated from Cheddar cheese), 2) 4b + *Lb. helveticus* (ATCC 15807), 3) 4b + CI (*Lactobacillus* isolated from Cheddar cheese), 4) 850 + *Lb. helveticus*, 5) 850 + CI (*Lactobacillus*), and 6) CLA negative commercial starter culture (850, control). Cheese slurries were analyzed on day 0, 1, 3, and 5 for pH, Free fatty acids (FFA), bacterial counts on M17 and MRS, and CLA content. The CLA content of slurries before inoculation was 0.73 gm/100 gm fatty acids (FA). On day 1, CLA values of 0.94, 0.82, 0.78, 0.79, 0.73, and 0.74 gm/100 gm FA were observed in treatments 1, 2, 3, 4, 5, and 6, respectively. Maximum CLA content was observed in treatments 1 (0.99 gm/100 gm FA) and 2 (0.855 gm/100 gm FA) after 3 d of incubation. The CLA in treatment 1 (1.10 gm/100 gm FA) after 5 d of incubation was higher ($p < 0.05$) than that in the control (0.73 gm/100 gm FA). Counts on M17 agar declined from 10^{10} cfu/ml (d 1) to 10^7 cfu/ml (d 5), while counts on MRS agar increased from 10^7 cfu/ml (d 1) to 10^8 cfu/ml (d 5). None of the slurries were rancid after 5 d of incubation. This study provides useful information on the feasibility of some CLA-producing starter culture in cheese manufacture. It was also useful in anticipating the behavior of different CLA producing cultures during ripening.

Key Words: Cheese Slurry, Conjugated Linoleic Acid, Lactic Acid Bacteria

48 Profiling flavor related biochemical changes in cheddar cheese during ripening using infrared spectroscopy. A. Subramanian*, J. Harper, and L. Rodriguez-Saona, *The Ohio State University, Columbus.*

Composition and flavor quality of Cheddar cheese, which influence the consumer acceptance, price and food processing application, develop during the ripening process. However, ripening is not well understood due to the heterogeneous nature of cheese. Profiling cheese ripening by means of few selected variables can save time and money for the cheesemaker. Mid infrared (MIR) spectroscopy is an attractive technology for rapid, sensitive, and high-throughput analysis of food components. Preliminary results have shown that MIR could classify Cheddar cheese based on flavor quality. The objective of this research was to use MIR to further the understanding on biochemical changes during ripening and their influence on flavor.

Twelve different Cheddar cheese samples were ripened for a period of 73 days. Samples were collected on days 7, 15, 30, 45 and 73 during ripening and analyzed for organic acid and amino acid content using liquid and gas chromatography, respectively. For MIR analysis the samples were treated using organic solvents and the extracts were scanned between 4000-700 wavenumbers. The spectra of samples were matched with the composition and quality data to develop multivariate statistical regression and classification models. The spectra correlated well (r -value > 0.95) with the flavor quality as well as the changes in organic and amino acid levels. Furthermore, age of the cheese could also be predicted within a standard error of 1.6 days. Some of the prominent infrared marker bands that were responsible for the correlation were 1411 (amino acids), 1710-1450 (fatty acids), and 1200-1050 cm^{-1} (organic acids). Interestingly, greatest change in composition of cheeses was observed between the days 15 and 30. This could be valuable information for prediction of cheese flavor quality early in the ripening process. Early identification of flavor quality will assist in controlling ripening parameters, and deciding the marketability and application of cheese. FT-IR spectroscopy shows great promise as a rapid, simple and cost-effective analytical and quality control tool for monitoring and understanding cheese ripening.

Key Words: Cheddar Cheese, Flavor, Infrared Spectroscopy

49 Sensory evaluation of reduced fat cheddar cheese fortified with omega-3 fatty acids for oxidized, rancid and fishy flavor attributes.

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Omega-3 fatty acids reduce inflammation and help prevent risk factors associated with certain diseases. However, because the body cannot synthesize them they must come from diet. Therefore, interest in fortifying cheddar cheese with omega-3 fatty acids exists, but there is concern that doing so may have detrimental effects on the flavor of the final cheese product.

Fifty percent reduced fat cheddar cheese was manufactured to contain 16, 32 (typical fortification level), and 64 mg docosahexaenoic/eicosapentaenoic acids (DHA/EPA) per 28-g serving (in triplicate). This was accomplished by comminuting to particles about 2 mm in diameter, adding an encapsulated fish oil powder, pressing to form a cheese block overnight, and storing at 8 °C. Control cheese contained no fish oil. Samples were rated on a five-point categorical scale (No, Slight,

Moderate, Strong, and Extremely Strong Flavor) by 11 trained panelists for oxidized, rancid, and fishy flavor attributes at 1, 7, 30 and 90 d. For analysis, numerical values of 0 to 4 were assigned respectively. Omega-3 fatty acid fortification caused no change in oxidized ($p = 0.08$) or rancid flavor ($p = 0.35$). Mean oxidized flavor scores were from 0.2 to 0.4 throughout 90 d for all cheeses. Rancid flavor increased during storage ($p < 0.0001$) with mean scores of 0.4 at d 1 and 0.9 at d 90 (score of 1 = "Slight Flavor"). Fishy flavor increased with level of DHA/EPA fortification ($p < 0.0001$), but decreased during storage ($p < 0.0001$). At d 1, average fishy flavor scores for control, and the fortified cheeses

were 0.2, 0.3, 0.8, and 1.2 respectively. By 30 d these had decreased to 0.1, 0.1, 0.2, 1.0, and by 90 d to 0.0, 0.0, 0.2, 0.5 leaving the 64 mg DHA/EPA sample with fishy flavor significantly different from control. Thus, cheddar cheese can be fortified with up to 32 mg DHA/EPA per serving using an encapsulated fish oil without causing an increase in oxidized, rancid or fishy flavors provided the cheese is stored for 30 d because initial fishy flavor diminishes during storage.

Key Words: Omega-3 Fatty Acids, Cheese, Flavor

Graduate Student Paper Competition: ADSA Production Division

50 Osteopontin immunoreactivity in peripheral blood mononuclear cells, ileum, and ileocecal lymph node of dairy cows naturally infected with *Mycobacterium avium* subsp. *paratuberculosis*. E. L. Karcher^{*1}, C. S. Johnson¹, J. P. Bannantine², D. C. Beitz¹, and J. R. Stabel², ¹Iowa State University, Ames, ²USDA-ARS, National Animal Disease Center, Ames, IA.

Osteopontin (Opn), a highly acidic glycoprotein, plays a role in initiating the innate immune response to mycobacterial infections by promoting cellular adhesion and recruitment of inflammatory cells from the peripheral blood. The formation of granulomas at the site of *Mycobacterium avium* subsp. *paratuberculosis* (MAP) infection is critical for the early control of infection. The objective of this experiment was to identify Opn in peripheral blood mononuclear cells (PBMCs), ileum and ileocecal lymph node (ICN) of dairy cows naturally infected with MAP and to compare the frequency and intensity of staining between noninfected healthy controls, subclinical, and clinical cows. For analysis of peripheral blood, PBMCs were isolated weekly from naturally infected periparturient dairy cows 3 weeks prior to calving through 4 weeks postpartum. Western blot detected Opn protein bands at 24-, 37-, 50-, and 62-kDa in the PBMC lysates of all animals. The densities of the 24-, 37-, and 62-kDa proteins varied extensively between cows and the variation did not seem to be related to infection group. Immunohistochemical analysis was used to determine the location and expression of Opn in the ileum and ICN. The frequency and intensity of staining also was reported. Confirmation of the acid-fast bacilli in the tissue sections was achieved by the Ziehl-Neelsen method. Within the ileum, macrophages, lymphocytes, and plasma cells stained positive for Opn. Clinical cows expressed Opn at a greater frequency in the lamina propria. Control and subclinical cows did not have areas of granulomatous inflammation, but cells staining for Opn were equally intense for the three groups. Osteopontin expression in the ICN was not affected by MAP infection. Results of this study confirm for the first time Opn localization in the peripheral blood and in the intestinal tract of MAP-infected cows and differences in Opn expression at the site of infection.

Key Words: Osteopontin, *Mycobacterium avium* subsp. *paratuberculosis*

51 Effect of linoleic acid and dietary vitamin E supplementation on sustained conjugated linoleic acid production in milk fat from dairy cows. A. M. O'Donnell^{*}, N. S. Mittelman, J. L. Capper, and D. E. Bauman, Cornell University, Ithaca, NY.

Conjugated linoleic acid (*cis*-9, *trans*-11 18:2, CLA), a bioactive fatty acid (FA) found in milk and dairy products, has potential human health benefits due to its anticarcinogenic and antiatherogenic properties. Milk fat CLA concentrations can be markedly increased by dietary manipulation; however, high levels of CLA are difficult to sustain as rumen biohydrogenation shifts and milk fat depression (MFD) is induced. The objective of the present study was to feed a typical Northeastern corn based-diet and investigate whether vitamin E and soybean oil supplementation would sustain an enhanced milk fat CLA content while avoiding MFD. Holstein cows (n = 48) were assigned to a randomized complete block design for 28 d and received one of four treatments: 1) control (C), 2) 10,000 IU/d vitamin E (E), 3) 2.5% soybean oil (Oil), and 4) 10,000 IU/d vitamin E plus 2.5% soybean oil (Oil/E). A 2 wk

pre-treatment control diet served as the covariate. Milk fat percent was reduced by both high oil diets (3.52, 3.55, 2.94, and 2.98% for C, E, Oil, and Oil/E, respectively). However, milk yield was increased by the Oil/E diet, therefore milk fat yield was lowest in cows fed the Oil diet (1.35, 1.35, 1.06, and 1.25 kg/d for C, E, Oil, and Oil/E). Milk protein percent was higher for cows fed the Oil diet (3.06, 3.06, 3.29 and 3.03% for C, E, Oil and Oil/E), implying that nutrient partitioning was altered in response to the reduction in milk fat. Milk fat concentration of CLA more than doubled in cows fed the oil diets, with concurrent increases in *trans*-10 18:1 and *trans*-11 18:1 FA. Moreover, milk fat from cows fed the two oil diets had 31.0% less *de novo* synthesized FA and 33.7% more long chain preformed FA. In conclusion, dietary supplements of soybean oil caused a reduction in milk fat percent and a shift in fatty acid composition characteristic of MFD. Dietary vitamin E did not overcome the oil-induced reduction in milk fat percent or changes in FA profile, but partially mitigated the reduction in fat yield by increasing milk yield.

Key Words: Conjugated Linoleic Acid, Milk Fat, Vitamin E

52 CD4⁺ and CD8⁺ T cell response in neonatal calves fed *Morinda citrifolia* (Noni). V. J. Brooks^{*1}, R. G. Godbee², S. F. Peek¹, and B. J. Darien¹, ¹University Wisconsin, Madison, ²University Nevada, Reno.

Developmental immaturity of the immune system renders neonatal calves vulnerable to high rates of morbidity and mortality. Ingesting colostrum containing maternal immunoglobulins, leukocytes and cytokines is critical in ensuring calf health and survival. Juice made from the *Morinda citrifolia* fruit (noni) reportedly has immune enhancing effects, including anti-inflammatory activity and inhibition of tumorigenesis. The objective of this study was to evaluate the immune modulating effects of feeding neonatal calves noni puree by measuring lymphocyte proliferation and CD25 expression on CD4⁺, CD8⁺ and $\gamma\delta$ T cells. Eighteen newborn Holstein bull calves were acquired in pairs from local dairies. All calves received 4.0 L of pooled colostrum by 12 h of age and were confirmed to have adequate passive transfer (>1200 mg/dL IgG). The calves were divided into two groups. Group 1 was comprised of control calves, while Group 2 received 30 mL of noni puree twice daily in milk replacer. Day 0 samples were obtained between 36 and 48 h of age and before the first feeding of puree. Peripheral blood mononuclear cells were collected and isolated from each calf on days 0, 3, 7, and 14. To measure lymphocyte proliferation, a mitogen induced Lymphocyte Blastogenesis Test (LBT) was performed. Mitogen induced activation of CD4⁺, CD8⁺ and $\gamma\delta$ T cells was evaluated by the up-regulation of the IL-2 receptor, CD25, on these cells with two-color flow cytometry. For both tests concanavalin A (ConA) and phytohemagglutinin were used as global mitogens. Results showed a significant increase in CD25 expression on CD8⁺ T cells in noni puree fed calves on day 3 of the study or approximately 5 days postpartum. Similarly, CD25 expression on CD4⁺ T cells was also higher in noni puree fed calves on day 3. Both findings were in response to ConA stimulation, whereas the LBT did not show a significant difference between the two groups in their response to either mitogen. The precise mechanism and impact on long term health are not explained by the current study and are important areas deserving further study.

Key Words: *Morinda citrifolia*, Calves, Immunomodulation

53 Effects of alfalfa inclusion rate on productivity of lactating dairy cattle fed wet corn gluten feed based diets. C. R. Mullins^{*1}, K. N. Grigsby², and B. J. Bradford¹, ¹*Kansas State University, Manhattan*, ²*Cargill, Inc., Blair, NE*.

An experiment was conducted to evaluate the effects of varying alfalfa inclusion rate in diets containing 31% (DM basis) wet corn gluten feed product (Sweet Bran, Cargill, Inc.). Eighty primiparous and multiparous Holstein cows averaging 178 ± 90 DIM (mean \pm SD) were randomly assigned to one of four sequences in a 4×4 Latin Square with 28-day periods. Treatments were diets containing 0, 7, 14, and 21% alfalfa on a dry matter basis, with corn silage, corn grain, soybean meal, expeller soybean meal, and mineral supplements varying across diets to maintain uniform nutrient densities. Diets were formulated for similar crude protein, neutral detergent fiber, and non-fiber carbohydrate concentrations. Feed intake, milk production, body weight, and body condition score were monitored, and linear and quadratic effects of increasing alfalfa inclusion rate were assessed using mixed model analysis. As the inclusion rate of alfalfa increased, dry matter intake increased linearly ($P = 0.05$; 26.7, 27.3, 27.4, and 27.5 kg/d for 0, 7, 14, and 21% alfalfa, respectively), and solids-corrected milk ($P = 0.07$; 29.9, 30.2, 30.8, and 30.5 kg/d) and energy-corrected milk production ($P = 0.09$; 32.9, 33.3, 33.8, and 33.6 kg/d) tended to increase linearly. Body weight gain decreased linearly ($P = 0.02$; 22.9, 18.0, 11.2, and 9.5 kg/28 d) with increasing alfalfa inclusion rate. Although increasing the inclusion rate of alfalfa increased the proportion of large particles in diets, treatments had no effect on milk fat yield or concentration. Feeding more alfalfa (up to 21% of DM) tended to increase milk yield while decreasing body weight gain, suggesting that metabolizable energy utilization shifted from body weight gain to milk production in these treatments. However, removing alfalfa from the diet had only minor effects on productivity.

Key Words: Dairy Nutrition, Byproduct, Forages

54 Diet does not affect putative mammary epithelial stem cells in pre-weaned Holstein heifers. K. M. Daniels^{*1}, A. V. Capuco², R. E. James¹, M. L. McGilliard¹, and R. M. Akers¹, ¹*Virginia Polytechnic Institute and State University, Blacksburg*, ²*USDA-Agricultural Research Service, Beltsville, MD*.

Overfeeding prepubertal heifers can impair mammary epithelial growth and development, processes that depend on stem cells. We evaluated effects of milk replacer (MR) composition on putative bovine mammary epithelial stem cell populations using a 5-bromo-2-deoxyuridine (BrdU; a thymidine analog) label retention method. Stem cells retain BrdU over time through selective segregation of labeled template DNA strands during mitosis, whereas the label is diluted in non-stem daughter cells. Twenty-four newborn heifers were fed one of four MR diets ($n=6$ /diet): CON (20% CP, 21% fat MR fed at 441 g DM/d), HPLF (28% CP, 20% fat MR fed at 951 g DM/d), HPHF (27% CP, 28% fat MR fed at 951 g DM/d), and HPHF+ (27% CP, 28% fat MR fed at 1431 g DM/d). Calves were fed twice daily; water and starter (20% CP, 1.43% fat) were offered free choice. At 30 d of age heifers were given 5 mg BrdU per kg BW daily for 4 d. Heifers were euthanized 29 d later. Mammary tissue was collected from two peripheral and two cisternal parenchymal regions in the left front quarter. Histological sections were prepared and processed for dual-label immunofluorescent detection of Ki67 and BrdU. Digital images were obtained at 40x magnification from 10 regions per slide. Labeled cells were counted manually and total number of epithelial cells determined using image analysis software. Diet had

no effect on percentage of labeled mammary epithelial cells, nor was there a diet by region interaction. Percentage of BrdU-labeled epithelial cells was largest in cisternal regions of the gland ($2.39 \pm 0.44\%$) and decreased toward the periphery ($0.73 \pm 0.45\%$). The opposite was true for Ki67-labeled epithelial cells (8.97 ± 0.81 vs. $10.88 \pm 0.77\%$). This is consistent with decreased proliferation and increased cell cycle arrest in cisternal regions. In peripheral regions, percentage of BrdU-labeled epithelial cells averaged $0.12 \pm 0.11\%$. These data provide no evidence that putative mammary epithelial stem cells are affected by protein and fat differences in MR fed to pre-weaned calves.

Key Words: Heifer, Mammary, Stem Cell

55 Gene expression for enzymes involved with volatile fatty acid and glucose metabolism are affected by the dietary forage-to-concentrate ratio. G. B. Penner^{*1}, M. Taniguchi¹, L. L. Guan¹, K. A. Beauchemin², and M. Oba¹, ¹*University of Alberta, Edmonton, Alberta, Canada*, ²*Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada*.

The objectives of this study were to determine the effects of the dietary forage-to-concentrate ratio on in vivo volatile fatty acid (VFA) clearance, and the expression of genes related to ruminal absorption and metabolism of VFA and glucose. Twelve ruminally cannulated dry Holstein cull cows were fed either a control diet (HF) or a diet to pre-dispose cattle to a high VFA load (LF), which contained 92% and 36% forage on a DM basis, respectively. After a 28-d diet adaptation period, ruminal pH, ruminal VFA concentrations, and in vivo VFA clearance were measured. Cows were subsequently euthanized and ruminal tissue (ventral sac) was harvested for gene expression analysis using quantitative real-time PCR. Mean ruminal pH was 0.45 pH units lower (6.03 vs. 6.48 ; $P < 0.01$) and total VFA concentration was 25 mM higher (138 vs. 113 mM; $P < 0.01$) for the LF compared to the HF treatment. The fractional liquid passage, VFA clearance, and VFA absorption rates were not different between treatments and averaged 8.3 ± 0.8 , 21.5 ± 0.9 , and $13.2 \pm 1.0\%/h$, respectively. With respect to butyrate metabolism, the LF treatment had a 1.34 ± 0.12 fold greater expression of β -hydroxybutyrate dehydrogenase ($P = 0.04$) and tended to have a 1.72 ± 0.35 fold greater expression of acyl CoA synthetase ($P = 0.09$). However, the expression of hydroxymethylglutaryl CoA synthase tended to be reduced (0.83 ± 0.07 fold; $P = 0.06$) for the LF relative to the HF treatment. Furthermore, the expression of hexokinase tended ($P = 0.08$) to be increased by 1.30 ± 0.13 fold but sodium glucose linked transporter and pyruvate dehydrogenase were decreased by 0.44 ± 0.11 ($P < 0.01$) and 0.70 ± 0.11 ($P = 0.04$) fold for the LF treatment relative to the HF treatment. These data indicate that the VFA load does not affect the rate of VFA absorption in vivo but may affect the pathway of butyrate metabolism and the utilization of glucose as an energy source.

Key Words: Real-Time PCR, VFA Metabolism, VFA Absorption

56 Lactation performance and amino acid utilization of cows fed increasing amounts of de-oiled dried distillers grains with solubles. K. Mjoun^{*1}, K. F. Kalscheur¹, A. R. Hippen¹, D. J. Schingoethe¹, and D. E. Little², ¹*South Dakota State University, Brookings*, ²*DairyNet Inc., Brookings, SD*.

As the ethanol industry continues to grow, innovative products are emerging; deoiled dried distillers grain with solubles (dDGS), a low fat (3.7% Ether Extract) product, is an example of this evolution. The effects of feeding increasing quantities of dDGS on lactation performance and amino acid utilization were evaluated with 23 multiparous and 19 primiparous Holstein cows in a randomized complete block design for 8-wk including a 2-wk covariate period. The dDGS were included in diets at 0, 10, 20, and 30% of the diet on a DM basis. Increasing dDGS in diets tended to affect DMI in a quadratic manner ($P = 0.09$), such that cows fed the 20% dDGS had the greatest DMI (24.4 kg/d) and those fed the 30% dDGS had the least (22.1 kg/d). Milk production (34.9 kg/d) was not affected by the inclusion of dDGS. Milk fat percentage tended to increase linearly ($P = 0.09$) from 3.21 to 3.64% as dDGS increased in the diets. Similarly, milk fat yield tended to increase linearly from 1.09 to 1.29 kg/d as dDGS increased from 0 to 30% of the diet. Milk protein percentage (2.98, 3.08, 3.11, and 2.98%) and milk protein yield (1.02, 1.08, 1.10, and 1.03 kg/d) responded in a quadratic manner ($P < 0.01$). Milk urea N decreased linearly ($P < 0.01$) from 15.5 to 13.1 mg/dL. The efficiency of N utilization for milk protein synthesis was not affected by including dDGS and averaged 25.9%. The efficiency of milk production (ECM/DMI) increased linearly ($P < 0.05$) with increasing dDGS in the diet. Arterial Lys decreased linearly (66.0, 57.6, 51.9, 44.8 $\mu\text{M/L}$; $P < 0.01$) whereas arterial Met increased linearly (16.5, 17.9, 22.5, 29.3 $\mu\text{M/L}$). Arteriovenous difference of Lys linearly decreased (42.6, 37.1, 36.6, 32.5 $\mu\text{M/L}$) while that of Met was unaffected. The extraction of Lys by the mammary gland increased linearly (64.3, 64.4, 70.7, 72.2%) while that of Met decreased linearly (71.6, 57.5, 50.8, 42.7%). These results indicate that addition of up to 30% of dDGS in mid-lactation diet supported lactation performance similarly to that of a control diet based on soybean products.

Key Words: De-Oiled Dried Distillers Grains with Solubles, Dairy Cow, Amino Acids

57 Development of a mechanistic model to predict feed intake in domestic and wild ruminants of various physiological states. T. Hackmann* and J. N. Spain, *University of Missouri, Columbia.*

Understanding the regulation of feed intake is important in nutritional management of domestic and wild ruminants. A mechanistic model of ruminant feed intake and digestion was formulated to investigate hypotheses of intake regulation and to serve as a predictive tool. The model is a compartmental model and represents fluxes of nutrients across pools in the reticulorumen, small intestine, and large intestine. Similar to a model published by D.S. Fisher, predicted intake is the level of intake that reaches an optimum balance among chemostatic, distention, and protein feedbacks. Unlike in previous models, the chemostatic setpoint is varied with the energetic demands of the animal in order to investigate how intake is affected by these demands, which vary with species, body weight, physiological state, and level and stage of production. Data from 15 studies that report ad libitum DMI of all-forage diets were used to compare model-predicted DMI with actual DMI for animals of a range of physiological states (gestation, lactation, growth, and no production), levels and stages of production, body weight (16 to 907 kg), and species (14 bovids, 4 cervids, and 1 giraffid). The coefficient of determination (R^2) between actual and predicted DMI was 0.701 and 0.910 when DMI was expressed as percentage of BW and kg/d, respectively ($n = 158$). For domestic species (cow, sheep, goat) alone, agreement was higher, with values of R^2 of 0.718 and 0.954 when DMI was expressed as percentage of BW and kg/d, respectively ($n = 107$). The good agreement between predicted and actual DMI and other considerations support the hypotheses of intake regulation embodied in the model, namely that energetic demands of the animal regulate intake. The model shows promise as a predictive tool for application to domestic and wild ruminant species and awaits further development to model non-all-forage diets.

Key Words: Intake, Model, Ruminant

Graduate Student Paper Competition: ADSA Southern Branch

58 Effect of milk replacer composition on growth and rumen development of neonatal Holstein calves. A. J. Bridges*, C. C. Williams, C. F. Hutchison, J. M. Laborde, A. N. Howard, and C. Leonardi, *Louisiana State University, Baton Rouge.*

A study was conducted to determine effects of different fat and protein levels in commercial milk replacers on the growth performance and rumen development of neonatal Holstein calves. Fifty-three calves (23 male; 30 female) were assigned to one of three dietary treatments which included 3 milk replacers (20%CP: 20% fat; 25%CP:15% fat; 28%CP: 20% fat) fed once per day at 10% of birth weight through weaning on day 42. Calves were offered a 20% CP calf starter and water free choice beginning on day 5. All calves were weaned on day 42. Body weights were measured at birth and weekly through weaning. Additionally, hip height, wither height, and body length were measured weekly. Feed intake and fecal scores were recorded daily. Beginning on day 7 and continuing weekly through weaning, blood samples were collected prior to morning feeding for analysis of IGF-I and on days 14, 28, 42, and 56 for PUN and beta-hydroxybutyrate concentrations. On days 28, 56 and 84 rumen fluid was collected for analysis of pH and short chain VFAs to evaluate possible differences in rumen development. Calves fed 28:20 milk replacer had greater ($P < 0.01$) average daily gain, starter intake, PUN, and beta-hydroxybutyrate concentrations when compared to the other treatments. Also, a treatment by week interaction was observed ($P < 0.01$) for starter intake, with calves on 28:20 milk replacer increasing after week 3 and maintaining the greater starter intake through week 8. No differences were observed ($P > 0.05$) in fecal scores among any treatments. Average weekly wither height and body length were greater ($P < 0.05$) in calves fed 28:20 milk replacer. There were no effects ($P > 0.05$) of treatment on IGF-I concentrations, rumen pH, or concentrations of VFA. Acetate and propionate, as a percent of total VFA, tended ($P < 0.10$) to be greater in calves fed 28:20 milk replacer. These data indicate that increasing the dietary protein content of milk replacer without reducing fat content improved growth in young dairy calves without compromising health or rumen development.

Key Words: Milk Replacer, Growth, Rumen Development

59 Effects of ThermalCare-D[®] on efficiency and production of lactating dairy cows during hot weather. J. Boyd*¹, J. W. West¹, J. Bernard¹, and S. Block², ¹*University of Georgia, Tifton*, ²*ADM Research, Decatur, IN.*

A trial was conducted to evaluate effects of ThermalCare-D[®] v1(T1), ThermalCare-D[®] v2(T2), and ThermalCare-D[®] v1 with glycerol(T1G) on milk yield, efficiency of yield, and nutrient digestibility in hot weather. Thermal Care D[®] is comprised of proprietary additives selected for the potential ability to improve physiological response to heat stress. Forty-eight Holstein cows averaging 183 DIM and 43.9 kg/d of milk were used. The study was conducted June to Aug. 2007. Cows were fed a common diet during a 2 wk standardization period, blocked into groups of 4 based on parity, milk yield, and ECM and randomly assigned within block to one of 4 treatments for 8 wks. Experimental design was a randomized complete block. Diets were corn silage based and balanced to be iso-caloric and iso-nitrogenous. No effects on DMI, milk yield,

or energy corrected milk ($P < 0.53$) were noted. Yet, multiparous cows offered T2 and primiparous cows on T1G treatments showed similar milk yield which was greater than cows fed C or T1 diets ($P < 0.02$). An increase ($P < 0.01$) in milk yield was observed for primiparous versus multiparous cows on T1G. Decreased ($P < 0.02$) milk fat percentage was observed for T1 versus C while T2 and T1G had numerically lower fat percentage versus C. An increase in NE balance by week was observed for T1G (42.2 Mcal/d) compared to C, T1, and T2 (22.8, 20.6, and 36.1 Mcal/d, respectively). Cows fed T1G had numerically the greatest weekly weight gain compared with other treatments. No effect on respiratory rate, skin temperature, body temperature or concentrations of serum glucose, urea N, or non-esterified fatty acid was noted. Cows offered Thermal Care-D[®] treatments tended ($P < 0.13$) to increase DMI versus C when digestibility measurements were recorded. Cows fed T1 and T2 exhibited ($P < 0.05$) improved digestion of DM, NDF and ADF compared with C or T1G. Results suggest ThermalCare-D[®] may improve feed DMI and nutrient digestion by cows during hot weather. The addition of glycerol to ThermalCare-D[®] v1 was more beneficial to primiparous cows than multiparous cows.

Key Words: Heat Stress, ThermalCare, Glycerol

60 Effect of starch and casein infusions in the abomasum of lactating dairy cows. A.G. Rius*¹, J. A. D. R. N. Appuhamy¹, D. Kirovski², J. Cyriac¹, and M.D. Hanigan¹, ¹*Virginia Polytechnic Institute and State University, Blacksburg*, ²*University of Belgrade, Belgrade, Serbia.*

The objective of this study was to evaluate the effects of abomasally infusions of starch, casein or the combination of both on milk and protein yields in lactating cows fed restricted diet. We hypothesized that abomasal infusions of starch plus casein could maintain milk and protein yields when cows were fed 70% of requirements for protein and energy. Six primiparous mid-lactation ruminally cannulated Holstein cows were randomly assigned to treatments using a replicated incomplete 4x4 Latin-square design. All animals received the same diet (17.6 % CP and 1.58 Mcal NEI) throughout the study. Beginning on d 13 of each period, cows were restricted to 70% of ad libitum intake and abomasally infused for 36 h with starch (S; 3 kg/d), casein (C; 1.3 kg/d) the combination (S+C) or water (W) using peristaltic pumps. On d 14, milk samples were collected. Milk yield and components were analyzed using the Proc Mixed procedure of SAS to test main effects and differences among treatments. Milk yields were not significantly affected by treatments ($P < 0.55$) and the LSM were 1.23, 1.02, 1.01, 1.05 kg/h for C+S, W, S and C respectively (SEM=0.11). Milk protein yields were also not significantly affected by treatments ($P < 0.36$) with LSM of 39, 29, 30 and 33 g/h for C+S, W, S and C respectively (SEM=3.6). As expected, MUN (milk urea nitrogen) was significantly affected by treatment ($P < 0.05$) and the LSM were 13.43, 10.57, 8.58, 15.17 mg/dl for C+S, W, S and C respectively (SEM= 0.69). Although it was not significant the MUN difference between C+S and C was 1.74 ($P < 0.09$; SEM=0.92) and the difference for W and S was 1.99 mg/dl ($P < 0.06$; SEM<0.92). Other milk components were not significantly affected by treatments. In conclusion the MUN results indicate that nitrogen can be used more efficiently if starch absorption is enhanced.

Key Words: Cow, Casein, Starch

Symposium: Meat Science and Muscle Biology: Meat Quality: Regulation of Intramuscular Fat Deposition

61 The value of marbling in consumer acceptance of beef. L. R. Corah*, *Certified Angus Beef LLC, Wooster, OH.*

In 1925, the USDA implemented the quality grading system to address consumer confusion related to meat quality. Since that original role, marbling has become an important component of meat quality in both the domestic and global marketplace. Most research studies have shown that as marbling levels increase, the overall consumer acceptability increases. The triad of flavor, tenderness, and juiciness are considered by most scientists to be the key components of eating satisfaction. Although the magnitude will vary by study, marbling contributes to each of these three attributes. Recent research at Texas Tech University shows that tenderness is important, but flavor is two and a half times as important in overall consumer acceptability of beef. In the past eight years, cattle markets have started to reflect these consumer preferences as the Choice-Select and Premium Choice-Low Choice spreads have widened from historical levels of \$2-4/cwt to \$10-12/cwt in the last three years. A recent Cattle-Fax analysis suggests that the impact of Premium Choice and Prime adds \$500 million plus annually of added value to the producer.

Key Words: Marbling, Consumer Acceptance, Beef

62 Renewing the interest on marbling in pork products. C. M. Schultz Kaster*, R. C. Johnson, and J. O. Matthews, *Farmland Foods Inc., Kansas City, MO.*

This presentation will describe some of the current information on the impact of marbling in pork. The pork industry has dramatically changed its definitions of quality over the past twenty years progressing from weight to leanness to muscle quality and more recently to measure of palatability. Marbling is a means for a visual assessment of perceived product quality, and already has consumer meaning due to its use with quality grades in the beef industry. However, marbling had been allowed to diminish in pork as pigs were made leaner. The contribution of marbling to palatability has been debated particularly as it relates to tenderness. Color and pH are both key indicators of quality, and are widely used for selection in the pork industry. Marbling has emerged as a means to differentiate high end product, particularly for the foodservice industry driven by celebrated chefs and menu nomenclature. Ideal amounts of marbling are still being determined, and may vary depending on the market, and increasing marbling may come with negative effects like steatosis in ham muscles, increased fat content for nutritional labeling, and negative consumer perceptions of too much fat. Increasing marbling may come at a cost that impacts production or genetic costs depending on the level desired. Demand for this product is still being determined directly by retail outlets offering a higher tier of pork, or by chefs using it on menus on a limited basis. The possibility exists that increase marbling in all pork may indirectly increase demand if it contributes to the improvement of palatability in the general pork population.

Key Words: Pork, Marbling, Quality

63 Cellular regulation of intramuscular adipose tissue deposition and composition. S. B. Smith*¹, H. Kawachi², C. B. Choi³, C. W. Choi⁴, and J. E. Sawyer¹, ¹Texas A&M University, College Station, ²Kyoto University, Kyoto, Sakyo-ku, Japan, ³Yeungnam University, Gyeongsan, Korea, ⁴National Institute of Animal Science, Suwon, Korea.

It is well documented that grain feeding stimulates adipogenesis in beef cattle, whereas pasture feeding depresses the development of adipose tissues, including intramuscular (i.m.) adipose tissue. Production practices that depress adipogenesis also limit the synthesis of monounsaturated fatty acids (MUFA). Insulin stimulates glucose incorporation into fatty acids *in vitro* in s.c. and i.m. adipose tissues of long-fed cattle fed a high-concentrate diet, but has no effect on adipose tissues of long-fed cattle fed a hay-based diet. Marbling scores and s.c. adipose tissue MUFA are depressed by hay feeding, even when cattle are raised to the same BW endpoint. Conversely, the accumulation of i.m. adipose tissue in beef cattle is enhanced by feeding supplemental vitamin C and zinc, and is depressed by supplemental vitamin A. In preadipocyte cultures, vitamins A and D both decrease glycerol-3-phosphate dehydrogenase (GPDH) activity, an index of adipocyte differentiation, whereas incubation of bovine preadipocytes with L-ascorbic acid-2-phosphate increases GPDH activity. Exposing bovine preadipocytes to zinc also stimulates adipogenesis, putatively by inhibiting nitric oxide (NO) production. However, incubation of bovine preadipocytes with arginine, a biological precursor of NO, strongly promotes differentiation in concert with increased expression of stearoyl-CoA desaturase (SCD). This suggests that the effect of either arginine or zinc on adipogenesis is independent of NO synthesis in bovine preadipocytes. Enhanced expression of SCD is associated with a greater accumulation of MUFA both in bovine preadipocyte cultures and during development in growing steers. In bovine preadipocytes, *trans*-10, *cis*-12 conjugated linoleic acid (t10,c12 CLA) strongly depresses adipocyte differentiation and SCD gene expression, thereby reducing MUFA concentrations. This suggests that any production practice that elevates t10,c12 CLA in bovine adipose tissue will reduce i.m. adipose tissue development, in concert with a depressed accumulation of MUFA.

Key Words: Adipose Tissue, Fatty Acid, Growth

64 Nutritional regulation of intramuscular fat deposition. J. S. Drouillard* and C. D. Reinhardt, *Kansas State University, Manhattan.*

Demand for high-value, well-marbled beef products has spawned interest in nutritional strategies that increase marbling. USDA statistics for yield and quality grades reported during the last 10 years reveal an alarming trend for production of fatter carcasses with less marbling. Escalation of feed prices, particularly energy sources, has pushed production costs to unprecedented levels, suggesting that feeding to fatter compositional endpoints may become cost prohibitive. This forces beef producers to seek alternative means of affecting beef quality while feeding to lean, efficient endpoints. There is evidence to suggest that rigorous grain processing methods, such as flaking, decrease marbling scores relative to overall fat deposition and retail yield. Roughages, which are essential for maintaining digestive health, are costly relative to nutrient density.

Some studies suggest that low roughage levels lead to fatter carcasses with less marbling. Feeding fats and oils has, until recently, been practiced widely by feedlots, particularly in the Southern Plains. Though low levels can enhance carcass quality, levels often determined necessary to optimize efficiency (3-4%) may reduce marbling accretion relative to other body fat depots. Similarly, distiller's grains can enhance carcass quality when fed at low levels, while higher levels can have deleterious consequences for marbling, or at least can have a negative impact on the ratio of marbling to external fat deposition. Ruminant degradability and concentration of dietary protein also can influence marbling deposition. Higher levels of dietary protein have consistently increased quality grade of cattle fed diets consisting of flaked, rolled, or ensiled grains. This may have implications for diets containing distiller's grains, as the protein has low to moderate ruminal degradability. Methyl donor compounds, including choline and betaine, have improved marbling in several experiments, though results have been variable. Radical changes in ingredient and nutrient price relationships may force producers to re-evaluate diet composition as it relates to marbling.

Key Words: Beef, Marbling, Nutrition

65 Genetic regulation of intramuscular fat deposition. D. W. Moser*, *Kansas State University, Manhattan.*

Like most carcass traits, marbling score and percent intramuscular fat are highly heritable, and should respond well to selection. Significant breed differences exist in both beef and swine, but within-breed variation is

also great. In swine, long term selection for lean growth has decreased marbling. The Angus beef breed has recently shown an increasing genetic trend for marbling, but most other beef breeds have shown little or no change in the past few decades. Direct measurement of marbling requires harvest of the animal, so producers practice selection on genetic predictions generated from progeny test data and ultrasound measurements of sires and progeny, as well as genetic marker tests. Progeny testing is the most accurate, but requires the greatest amount of time, and usually, the most expense. Automated grading of carcasses and electronic animal identification may allow greater volumes and quality of carcass data to be collected for use in genetic evaluation. Ultrasound measurement of intramuscular fat in live cattle has been used successfully in cattle for many years, and has gained wider use in swine. Serum leptin has also been suggested for use as a selection criterion to increase marbling. Genetic tests for marbling have been developed for both species. In beef, tests for thyroglobulin gene mutations for use in predicting marbling score and quality grade have been marketed since 2000, but validation studies of these tests generally show modest effects. Other genes, such as leptin, have also been suggested as having effects on marbling, and for most commercial genetic marbling tests, the underlying genes are unknown or not publicly revealed. In swine, the *rendement napole* gene has been shown to affect marbling. Most swine breeding companies have proprietary marker tests for a variety of production and meat quality traits. The most promising opportunities for increased rate of genetic change for intramuscular fat in both species lie with genetic analyses that combine carcass data, ultrasound measures of live animals, and test results from large panels of genetic markers.

Key Words: Intramuscular Fat, Marbling, Selection

Symposium: Nonruminant Nutrition: Mineral Absorption: What is Known?

66 Transporters in the absorption and utilization of Zn and Cu. G. M. Hill* and J. E. Link, *Michigan State University, East Lansing.*

Before the discovery and elucidation of transporters, mammals were thought to co-transport Cu or Zn as an anionic complex such as binding with an amino acid as a chelate or a receptor such as transferrin. In 1995, the first mammalian transporter gene, ZnT1, was identified. However, it is now thought that two protein families are involved in Zn transport. The ZnT family reduces intracellular Zn by aiding in efflux from the cell or promoting the influx into intracellular vesicles. As noted by Cousins et al., (2006) the mechanism of ZnT transport against a Zn concentration gradient is unknown. However, only the ZnT1 transporter appears to be located at the plasma membrane. It has been shown to respond in tissues in a variety of manners to Zn reduction and supplementation. Our laboratory (Martinez et al., 2004) have found ZnT1 and metallothionein to work in concert during pharmacological Zn supplementation. The second protein family, Zip proteins, provide Zn transport from extracellular fluid or intracellular vesicles into the cytoplasm and has not been identified in a livestock species. Like Zn, no good indicator of status has been identified for Cu. However, the recent identification of Cu transporters and chaperones give researchers the opportunity to understand the regulation of Cu-trafficking where the proteins are modified by post-translational mechanisms. Two Cu transporters, Ctr1 and Ctr3, mediate high affinity Cu uptake. Murr1, a small cytoplasmic protein, has been identified in human hepatic tissue, but its role in Cu metabolism is unknown. The discovery of Cu chaperones that are involved in facilitating Cu absorption into proteins may provide an excellent status indicator. It has been shown that the protein of the Cu chaperone for Cu/Zn superoxide dismutase (CCS) is increased in tissue of Cu deficient rats induced when moderately high Zn diets were fed. We have recently found CCS in the young pig. It is essential that these new molecular findings be utilized to evaluate bioavailability and nutritional needs of Cu and Zn in livestock.

Key Words: Cu, Zn, Transport Proteins

67 Absorption and metabolism of iron and manganese. J. W. Spears* and S. L. Hansen, *North Carolina State University, Raleigh.*

This presentation will discuss our current understanding of iron (Fe) and manganese (Mn) metabolism. Iron metabolism and its biochemical functions are closely linked to the ability of Fe to undergo oxidation and reduction. Prior to absorption, ferric Fe (Fe^{+3}) must first be reduced to ferrous Fe (Fe^{+2}) by dietary reducing agents or reductases that reside on the duodenal apical membrane. Divalent Fe is then transported into enterocytes by divalent metal transporter 1 (DMT1). Absorbed Fe is exported from the enterocyte by ferroportin 1 (FPN) and immediately oxidized via hephaestin, a copper-dependent ferroxidase. Iron is then transported in the blood in the Fe^{+3} form bound to transferrin. Transferrin receptors on tissues allow for the uptake of transferrin-bound Fe by cells. Whole body Fe homeostasis is controlled at the level of intestinal absorption, due to limited ability to excrete absorbed Fe. Cellular Fe concentrations are controlled by Fe regulatory proteins in the cytosol that bind to iron responsive elements located on the mRNA of proteins involved in Fe absorption (DMT1, FPN), uptake (transferrin receptor), and storage (ferritin). The same DMT1 protein that transports Fe^{+2} into

the intestine also transports Mn^{+2} . Based on limited research with pigs less than 1% of dietary Mn is absorbed. Absorbed Mn is transported to the liver bound to albumin and α -2-macroglobulins. Biliary excretion of Mn from the liver plays an important role in Mn homeostasis. Manganese leaving the liver is transported bound to transferrin; however, the number of transferrin binding sites occupied by Mn is very low relative to Fe. In summary, the last decade has provided incredible amounts of information about absorption and metabolism of Fe, but several steps involved in absorption and metabolism of Mn remain to be elucidated.

Key Words: Iron, Manganese, Metabolism

68 Active phosphate absorption: What do we know and is it important? J. S. Radcliffe*, *Purdue University, West Lafayette, IN.*

Phosphorus has probably been the most researched mineral over the last decade. However, research has focused primarily on enhancement of P digestibility, with very little emphasis on the mechanisms of absorption. When abundant in the diet, P, in the form of phosphate is absorbed passively via a paracellular route. However, as phosphate concentrations in digesta decrease, phosphate can be absorbed through an active, sodium dependent route. Historically, diets have been over-formulated with P, and therefore the passive absorption route dominates. However, as the concentration of P in swine diets have been lowered to reduce excretion, active absorption may be more important. Furthermore, most experiments evaluating phytase contain a negative control treatment, where dietary P concentrations are often 0.1-0.2 %-units below the requirement, which will result in an increased active transport of phosphate. To optimize dietary P utilization it is necessary to better understand active phosphate absorption, and how this transport system is regulated. Active phosphate absorption occurs through the sodium phosphate co-transporter, NaPi2b. Data from rodents, and more recently from swine, have demonstrated that as the concentration of P in the diet is decreased, active phosphate absorption is increased. This increase is the result of an increased translocation of NaPi2b from a subapical pool to the brush border membrane. Gene expression data is mixed, with the majority of experiments reporting no change in NaPi2b mRNA. The response to decreasing dietary P concentrations has been observed in as little as 3 d in pigs. Active phosphate absorption has been reported to be responsive to serum vitamin D concentrations in rodents, but not to dietary vitamin D concentrations in rodents or swine. Ultimately a better understanding of active phosphate absorption will result in improved diet formulation that will enhance P absorption and retention.

Key Words: Phosphate, Absorption, Phosphorus

69 Intestinal calcium absorption: Mechanisms learned from transgenic and knockout mice. J. C. Fleet*, *Purdue University, West Lafayette, IN.*

Although the role of calcium (Ca) in bone health has been well appreciated for nearly a century, in the last decade the use of transgenic and knockout mice has revealed many things about the mechanisms by which this essential nutrient enters the body. Ca crosses the intestinal barrier

using both a paracellular/diffusional pathway that responds solely to the luminal content of Ca and by a transcellular pathway that is active and saturable. While passive diffusion occurs throughout the intestine and accounts for 65-75% of the Ca that enters the body, the active, saturable component is thought to be limited to the proximal small intestine. The hormonally active form of vitamin D (1,25 dihydroxyvitamin D or 1,25 D) is the primary regulator of intestinal Ca absorption. Deletion of the vitamin D receptor (VDR) in mice reveals that the loss of intestinal Ca absorption is the primary defect responsible for disruption of Ca metabolism in these mice. Transgenic recovery of VDR into either the

proximal small intestine or throughout the intestine suggest that there vitamin D-regulated Ca absorption is also present in the lower bowel. Recently the facilitated diffusion of transcellular Ca absorption has been challenged by knockout mouse studies. Deletion of the apical membrane transporter gene (TRPV6) or of the gene for the putative Ca ferry protein calbindin D9k, have a minimal impact of basal or vitamin D regulated intestinal Ca absorption. New work will be necessary to fully understand the mechanism of transcellular, intestinal Ca absorption.

Key Words: Calcium, Vitamin D, Absorption

Physiology and Endocrinology: Nutrition and Growth, Reproductive and Lactational Performance

70 Adipose triglyceride lipase is a novel lipase in dairy cattle. D. Elkins* and D. Spurlock, *Iowa State University, Ames.*

Dairy cattle undergo negative energy balance during early lactation when increased energy requirements are not offset by energy intake. As a result, cows in negative energy balance mobilize adipose tissue to help meet their energy requirements. Excessive mobilization of adipose tissue has been associated with reproductive and health problems. Traditionally, phosphorylation of hormone-sensitive lipase (HSL) by protein kinase A has been viewed as the rate-limiting step of lipolysis. More recently, adipose triglyceride lipase (ATGL) has been identified as an additional lipase capable of hydrolyzing triglycerides to diglycerides. The objective of this research was to determine if ATGL is expressed in adipose tissue of lactating dairy cows, and to determine if its expression differs with stage of lactation. Adipose tissue was biopsied from 10 early [5-14 DIM] and 10 mid [176-206 DIM] lactation multiparous Holstein cows. Semi-quantitative western blots were used to evaluate HSL, phosphorylated HSL, and ATGL protein using commercially available antibodies. Blood samples were collected for analysis of lipolytic indicators, nonesterified fatty acid (NEFA) and glycerol. As expected, glycerol and NEFA were significantly greater in early compared to mid lactation cows ($P < 0.0001$), confirming a significant difference in lipolytic activity between stages. Expression of phosphorylated HSL, but not total HSL, was significantly greater in early compared to mid lactation cows ($P = 0.001$). Additionally, phosphorylated HSL was highly correlated with NEFA ($r = .66$; $P = 0.03$) and glycerol ($r = .77$; $P = 0.006$). ATGL protein was detected in adipose tissue of early and mid lactation cows, and its expression was significantly greater in mid compared to early lactation cows ($P = 0.002$). ATGL expression was not significantly correlated with NEFA or glycerol. These results confirm that ATGL is expressed, but likely makes a small relative contribution to lipolysis in early lactation cows. Increased expression of ATGL in mid lactation may indicate a more significant role for ATGL in basal lipolysis during positive energy balance.

Key Words: Dairy, Lipase, Adipose

71 Peripartal changes of adiponectin, adiponectin receptor 1, adiponectin receptor 2, leptin and leptin receptor mRNA expression in subcutaneous adipose tissue of dairy cows. A. Lemor, M. Mielenz*, A. Hosseini, and H. Sauerwein*, *University of Bonn, Germany.*

The transition from pregnancy to lactation is of critical importance for health, production, and profitability of the dairy cow. Within the homeostatic regulation of the adaptation to the metabolic changes involved, the adipocytokine adiponectin is attracting increasing interest due to its role in lipid metabolism, insulin resistance and glucose homeostasis. Data on the expression of adiponectin and its receptors, adiponectin receptor 1 (AdipoR1) and adiponectin receptor 2 (AdipoR2) as well as comparisons with the leptin system are mainly limited to monogastric species, whereas for ruminants corresponding data are lacking. We therefore aimed to characterize the mRNA expression for these adipokines and their receptors during the transition period in sc adipose tissue in dairy cows.

Biopsies from sc fat were taken at the tail head from 10 dairy cows (Holstein-Frisian) first between 13 - 2 d antepartum (AP) and second between 20 - 23 d postpartum (PP). Total mRNA was extracted and

purified by spin columns. The mRNA expression of adiponectin, AdipoR1, AdipoR2, leptin and leptin receptor (obRb) was quantified by real-time RT-PCR. Leptin protein was measured via ELISA in blood samples collected at the biopsy dates. Data were analysed by Wilcoxon Matched-Pairs Signed-Ranks Test and Spearman Rank Order Correlation (SPSS).

For adiponectin mRNA time-related changes were not detectable, whereas for AdipoR1 and AdipoR2 the PP expression was reduced ($P \leq 0.05$) to 57% of the AP values. Serum leptin was decreased ($P \leq 0.05$) PP, the analogous decrease in leptin mRNA did not reach the level of significance; obRb mRNA expression was 2.6-fold higher ($P \leq 0.05$) PP compared to AP. Positive correlations between AdipoR1 and AdipoR2 ($r = 0.82$, $P \leq 0.05$) were observed.

Our results indicate that the local effects of adiponectin and leptin in fat may differ between pregnancy and early lactation whereby the difference seems to be mediated at the receptor level rather than at the level of the ligand.

Key Words: Adiponectin, Leptin, Transition Cow

72 Propionate effects on the mRNA expression of adiponectin in two adipose depots and its receptors AdipoR1 and AdipoR2 in liver, skeletal muscle and adipose tissue of goats. M. Mielenz*, C. Seybold, A. Lemor, and H. Sauerwein, *University of Bonn, Germany.*

Adiponectin, an adipocyte-derived hormone, is an insulin sensitizing agent in monogastric mammals. In contrast to man, less information is available concerning the importance of the adiponectin system in ruminants. Propionate increases insulin secretion in ruminants but also acts directly through short chain fatty acid (SCFA) sensitive receptors (GPR41/43) in monogastrics. Here we characterize the effects of iv infused propionate on adiponectin and its receptors AdipoR1 and AdipoR2 in goats. Castrated male goats (Deutsche-Edelziege, 10 to 12 mo old) were allocated to infusions through jugular catheters after an over-night fast. They received propionate infusions (96 $\mu\text{mol/kg/min}$, pH 7.4; $n = 4$) or NaCl-solution of the equivalent Na-concentration ($n = 5$). Infusions were carried out for 260 min. The mRNAs for adiponectin, AdipoR1 and AdipoR2 were quantified by real-time RT-PCR after euthanasia in perirenal and subcutaneous adipose tissue. The receptor mRNAs were also tested in liver and semitendinosus muscle. Data analysis showed no effect of propionate on adiponectin mRNA in both adipose tissues. AdipoR1 and AdipoR2 tended to increase in subcutaneous ($P = 0.087$ and $P = 0.092$, respectively) but not in perirenal adipose tissue after propionate infusion. In liver, AdipoR1 increased ($P = 0.01$) and AdipoR2 tended to increase ($P = 0.068$) by stimulation with propionate. No effect was observed in skeletal muscle.

There was no effect on adiponectin mRNA in adipose tissue, at least in the small number of animals examined. With the exception of muscle, the mRNAs for both receptors were up-regulated in the different tissues analyzed. This effect might have been mediated by a general increase in energy intake, by insulin effects and/or signal transduction through SCFA sensitive receptors. The relevance of the propionate effects on the adiponectin system in ruminants has to be clarified in the future, as well as the role of the SCFA sensitive receptors in ruminants.

Key Words: Adiponectin, Propionate, Goat

73 Effect of ghrelin or obestatin continuously infused to dairy cows on grazing and ruminating behaviour and plasma hormone and metabolite concentrations. J. R. Roche*¹, A. J. Sheahan¹, D. P. Berry², L. Chagas¹, D. Blache³, and J. Kay¹, ¹DairyNZ, Hamilton, New Zealand, ²Teagasc Moorepark, Fermoy, Ireland, ³University of Western Australia, Perth, Australia.

Fifty-one cows were randomly allocated to one of three groups; a control and cows continuously infused with either 0.74 $\mu\text{mol/d}$ of ghrelin or obestatin sc. Infusions began 20 DIM and treatments continued for 8 wk. During wk 6 and 8, cows were observed over four 24-hr periods and grazing behaviour noted every 10 min. During wk 7, blood samples were collected every 4 h over 2 d, with the bleeding schedule staggered by 2 h on d 2 to ensure a blood sample was collected every 2 h of the 24 h period. Where necessary, data were transformed to be normally distributed. The effect of treatment on grazing behaviour and the concentration of blood metabolites and hormones was determined using mixed models, with cow included as a repeated effect. The concentration of metabolites varied with time. Ghrelin-infused cows had greater ($P < 0.01$) plasma growth hormone concentrations than either control or obestatin cows, consistent with ghrelin's role as a growth hormone secretagogue. However, this difference was only evident during a long period of ingestive inactivity between midnight and 0800 h, suggesting a possible role for ghrelin in growth hormone secretion during periods of negative energy balance. Leptin concentrations were greater ($P < 0.001$) in ghrelin than obestatin cows, with control cows intermediate. In comparison, NEFA concentrations increased ($P < 0.001$) from control to ghrelin to obestatin, although the effect is of little biological significance (0.09, 0.10, and 0.11 mmol/L, respectively). Plasma ghrelin concentrations were not affected by treatment, but plasma glucose was less in ghrelin- and obestatin-infused cows than control cows. Treatments did not affect time spent grazing or ruminating, although the length of the first grazing bout was longer in ghrelin and obestatin cows between the am and pm milking. Research is required to confirm or deny the role of ghrelin or obestatin in the feeding behaviour of grazing dairy cows.

Key Words: Ghrelin, Obestatin, Grazing Behavior

74 Evaluation of insulin-like growth factor-I and temperament as selection tools in Brahman heifers. L. C. Caldwell*^{1,3}, R. O. Dittmar III^{1,3}, T. D. A. Forbes², T. H. Welsh Jr.¹, and R. D. Randel³, ¹Texas AgriLife Research, College Station, TX, ²Texas AgriLife Research and Extension Center, Uvalde, TX, ³Texas AgriLife Research and Extension Center, Overton, TX.

In an effort to detect feed efficient beef cattle, researchers are exploring the use of insulin-like growth factor-I (IGF-I) concentrations and temperament scoring as tools for selection. Studies have revealed that temperament can affect ADG. Reports from Johnston et al. (2002) suggest that concentrations of IGF-I may be associated with the prediction of residual feed intake (RFI) in beef cattle. However, when tested in Brangus females, Lancaster et al. (2007) failed to find a correlation between IGF-I concentration and RFI. The purpose of this study was to assess the relationship of IGF-I concentrations and temperament with RFI and ADG in Brahman heifers. Using a Calan gate system, 3 separate Brahman heifer calf crops from 2004 ($n = 31$; 16-19 mo), 2005 ($n = 50$; 10.5-13.5 mo) and 2006 ($n = 56$; 5-8 mo) were limit fed a complete ration at 2.2% BW in 70-d feeding trails. Performance and feed intake

data were collected throughout the trials to determine feed efficiency. Temperament, determined by exit velocity and pen score, was evaluated at weaning. IGF-I concentrations were determined by RIA from samples collected on d 0 and 70. Correlations between IGF-I and RFI were weak ranging from $r = -0.064$ to 0.222 ($P > 0.05$). Temperament had no significant effect ($P > 0.05$) on RFI. The 2004 heifers categorized by temperament as calm, moderate or excitable showed mean RFI of 0.029 ± 0.08 , -0.178 ± 0.16 and 0.111 ± 0.09 , respectively. Year 2005 heifers averaged -0.001 ± 0.01 , -0.004 ± 0.01 and -0.007 ± 0.01 . The 2006 heifers averaged -0.002 ± 0.02 , -0.018 ± 0.02 and 0.021 ± 0.02 . Weak correlations were seen between IGF-I and ADG ($r = -0.056$ to 0.311) ($P > 0.05$). Correlations between ADG and temperament were significant. The 2004 heifers categorized by temperament had ADG of 0.678 ± 0.05 , 0.628 ± 0.04 and 0.647 ± 0.04 ($P = 0.07$), respectively. Year 2005 heifers averaged 0.88 ± 0.05 , 0.745 ± 0.03 and 0.791 ± 0.04 ($P = 0.07$). The 2006 heifers averaged 0.579 ± 0.03 , 0.606 ± 0.03 and 0.481 ± 0.04 ($P = 0.03$). These results suggest that IGF-I concentration is unrelated to RFI; however, temperament may be associated with ADG in Brahman heifers.

Key Words: IGF-I, Residual Feed Intake, Brahman

75 Variation in metabolic regulation in the liver of dairy cows during the dry period and in early lactation. H. A. van Dorland*¹, S. Richter¹, I. Morel², and R. M. Bruckmaier¹, ¹Veterinary Physiology, Vetsuisse Faculty, University of Bern, Bern, Switzerland, ²Agroscope Liebefeld-Posieux (ALP), Posieux, Switzerland.

The metabolic status and simultaneously the hepatic regulation during the dry period, after partum, and in early lactation were studied in dairy cows. Liver biopsies were obtained from 28 cows in wk 10 antepartum (a.p.), and on d 1, and in weeks 4 and 14 postpartum (p.p.). Blood samples were collected every two wk during this period. Liver samples were analyzed for mRNA expression levels of hepatic factors of the carbohydrate-, lipid metabolism, and citric acid cycle (PEPCKc, PEPCKm, PC, ACSL, CPT 1A, CPT 2, ACADVL, HMGCS1, HMGCS2, PPAR α , PPAR γ , SREBF1, ACLY, and CS). Blood plasma was assayed for concentrations of glucose, BHBA, NEFA, cholesterol, triglycerides, insulin, IGF-1, T3, and T4. For evaluation, cows were divided into 2 groups based on the plasma concentration of β -hydroxybutyric acid (BHBA) at four weeks p.p. (group H, BHBA > 0.75 mmol/L; group L, BHBA < 0.75 mmol/L, respectively). In both groups, plasma parameters followed a pattern usually observed in dairy cows. However, changes were moderate and the energy balance in cows turned positive in week 7 p.p. Significant group effects were found in week 10 a.p., when plasma concentration of triglycerides was higher in L than in H, and in week 4 p.p., when plasma concentration of glucose and IGF-1 was lower in H than in L. Similarly, moderate changes in mRNA expression of hepatic factors between the different time-points were observed. One significant group difference was found in week 10 a.p., when a higher relative expression of mRNA of PEPCKc was observed in H than in L. Significant Spearman Rank Correlation Coefficients between the variables were not similar at each time-point and were not similar between the groups at each time-point, suggesting that metabolic regulation differs between cows. Conclusive, metabolic regulation in dairy cows is obviously a dynamic system, and differs between cows at different metabolic stages related to milk production.

Key Words: Metabolism, Liver, Gene Expression

76 Mild metabolic acidosis in sheep alters renal and skeletal muscle expression, but not liver, of amino acid enzymes and transporters. Y. Xue^{*1}, S. F. Liao¹, S. Greenwood², B. W. McBride², J. A. Boling¹, and J. C. Matthews¹, ¹University of Kentucky, Lexington, ²University of Guelph, Guelph, ON, Canada.

In metabolic acidotic rodents and humans, the altered expression of glutamine (Gln), glutamate (Glu), and alanine (Ala) metabolizing enzymes and transporters by the kidney, skeletal muscle, and liver is important to maintain blood acid-base balance. To test the hypothesis that mild metabolic acidosis (acidosis) induces an analogous response in sheep, the relative content of mRNA, protein, or mRNA and protein, for 6 metabolizing enzymes and 5 plasma membrane transporters of Gln/Ala/Glu was determined by real-time PCR and immunoblot analyses in homogenates of kidney, skeletal muscle, and liver of control (n = 5) vs acidotic (n = 5) sheep (Las et al., 2007, *J. Anim. Sci.* 85:2222). In kidney, where Gln use is increased in acidotic rodents, SN1 (Gln transporter) mRNA content was 790% greater ($P=0.05$), whereas Gln synthetase protein and mRNA was 56 ($P=0.01$) and 43% ($P=0.04$) lower, respectively, in acidotic sheep. In contrast, no change in phosphoenolpyruvate carboxykinase (protein and mRNA), renal glutaminase (mRNA), or Glu dehydrogenase (protein) was found, although their expression is highly increased in acidotic rodents. In skeletal muscle, a net releaser of Gln and net user of Ala in acidotic sheep, the protein content of aspartate transaminase was 101% greater ($P=0.03$) while Glu dehydrogenase tended to be ($P=0.11$) 33% greater in acidotic sheep. However, no change in the content of Ala transaminase protein, SNAT2 (Ala,Gln transporter) mRNA, or 3 Glu/aspartate transport proteins was found. In acidotic rodents, the liver is a net releaser of Gln. However, the mRNA or protein content of any enzyme or transporter did not differ in control vs acidotic sheep. These results indicate that the potential for aspartate and Glu use by skeletal muscle, and Gln absorption by the kidneys, is increased in mildly acidotic sheep, whereas liver capacity for Gln, Ala, and Glu metabolism remains constant.

Key Words: Acidosis, Amino Acid Metabolism, Sheep

77 Effects of prepartum 2,4-thiazolidinedione on metabolism and performance of transition dairy cows. K. L. Smith*, W. R. Butler, and T. R. Overton, *Cornell University, Ithaca, NY.*

Thiazolidinediones (TZD) are potent, synthetic ligands for peroxisome proliferator activated receptor-gamma (PPAR- γ) that reduced plasma concentrations of NEFA and increased dry matter intake (DMI) during the peripartum period in a previous experiment. Data from Holstein cows (n = 31) entering second or greater lactation were used to determine whether late prepartum administration of TZD would affect periparturient metabolism and milk production. Cows were administered 0, 2.0, or 4.0 mg TZD/kg BW by intrajugular infusion once daily beginning 21 d before expected parturition until parturition. Plasma samples were collected daily from 22 d before expected parturition through 21 d postpartum and twice per week from wk 4 through 9 postpartum. With increasing doses of TZD prepartum, plasma NEFA concentrations decreased linearly during the peripartum ($P = 0.01$) and postpartum ($P = 0.02$) periods (d -7 to d +7; 268, 246, 193 \pm 22 μ Eq/L and d 0 to d +21;

342, 296, 224 \pm 35 μ Eq/L, respectively). Postpartum liver triglyceride content was decreased linearly (11.0, 9.1, 4.7 \pm 1.9%; $P = 0.02$) and glycogen content increased linearly (2.16, 2.26, 2.75 \pm 0.19%; $P = 0.02$) with prepartum TZD administration. Peripartum DMI (16.2, 17.6, 17.6 \pm 0.5 kg/d) was increased linearly ($P = 0.04$) by TZD administration. Cows administered TZD prepartum had increased ($P = 0.001$) postpartum BCS (wk 1 through 9). Yields of 3.5% fat-corrected milk were affected quadratically ($P = 0.04$) by prepartum TZD administration (52.4, 54.1, 47.0 \pm 1.8 kg/d). Generally, cows administered 4.0 mg TZD/kg BW had the lowest ($P < 0.10$) milk component yields. Prepartum TZD administration linearly decreased ($P = 0.03$) the number of days to first ovulation (28.9, 25.0, 18.1 \pm 3.6 d) and increased ($P = 0.05$) the number of cows ovulating on or by d 21 postpartum. These results indicate that prepartum administration of TZD improves metabolic health and DMI of periparturient dairy cows, decreases reliance on body fat reserves, and may promote return of ovarian function during early lactation.

Key Words: Transition Cow, Thiazolidinedione, PPAR- γ

78 Glutamine synthetase is up-regulated in the liver of old beef cows by estradiol implants. E. D. Miles^{*1}, B. W. McBride², K. R. Brown¹, K. K. Schillo¹, J. A. Boling¹, and J. C. Matthews¹, ¹University of Kentucky, Lexington, ²University of Guelph, Guelph, ON, Canada.

Previous research in our laboratory has shown that old beef cows have reduced hepatic expression of glutamine synthetase (GS) and alanine transaminase (ALT), two enzymes in the liver that are critical for optimal N recycling. This experiment was conducted to characterize the effect of supplemental estrogen on these two proteins and other indicators of hepatic glutamate metabolic capacity. Fourteen old (> 10 yr) non-pregnant beef cows were housed in a dry lot with ad libitum access to alfalfa hay and water for 28 d. On d 1 of the study, cows received (n = 7/group) either a sham (Control) or CompuDose (25.7 mg estradiol; Elanco Animal Health) implant. On d 14 and 28, jugular blood and liver biopsy samples were collected. The effects of estrogen treatment (TRT), time after implant (DAY), and their interaction (TRT \times DAY) were assessed by ANOVA, using the repeated measures option of PROC MIXED (SAS). Plasma estrogen concentration of implanted cows (5.07 pg/mL) was 222 % more ($P = 0.01$) than for control cows (1.5 pg/mL). Plasma ammonia, and serum urea N levels, aspartate transaminase (AST), and ALT concentrations were not affected ($P \geq 0.21$). Immunoblot analyses were performed to quantify the relative liver content of GS, ALT, AST, glutamate dehydrogenase (GDH), and two System X-AG transporters (GLT-1 and EAAC1). For GS protein content, TRT ($P = 0.01$), DAY ($P = 0.03$), and TRT \times DAY ($P = 0.03$) effects were observed. Specifically, GS content was increased 350% by d 14 ($P = 0.002$) and 200% by d 28 ($P = 0.05$). In contrast, the protein content of ALT ($P \geq 0.37$), AST ($P \geq 0.71$), GDH ($P \geq 0.21$), GLT-1 ($P \geq 0.43$), or EAAC1 ($P \geq 0.19$) was not affected by estrogen implant. Hepatic content of GTRAP3-18, an inhibitor of EAAC1 activity, also was not altered ($P \geq 0.36$). These results indicate that the hepatic expression of GS in old beef cows is sensitive to stimulation by supplemental estrogen, whereas expression of other proteins that support hepatic glutamate metabolism is not.

Key Words: Aging, Estrogen, Nitrogen Metabolism

Production, Management and the Environment: Measuring and Evaluating Environmental Stress

79 Dairy cows and the environment: Were we better off 83 years ago? A. D. Garcia*¹ and J. G. Linn², ¹*South Dakota State University, Brookings*, ²*University of Minnesota, St. Paul*.

Concerns on the environmental impact of dairy cattle have increased recently. There's been unsubstantiated speculation that current emissions from dairy cows are far worse than in the past. This paper compares the environmental impact of dairy cows early in the 1920's with those in 2007.

In 1924 there were 12 million more dairy cows in the U.S. than in 2007. In spite of this, yearly milk production was 43.7 million kg less as production per cow was 1,892 kg per lactation (NASS). According to Hopkins (JDS 2:208), of 595 farms surveyed 62% grazed their cows 6 months of the year. Grazed and confined cows were fed a yearly average of 1 Ton of silage, 1.9 Ton of forage, and 1 Ton of grain DM.

In the 1920's the U.S. dairy herd was more breed diverse, with the first true-type for Holsteins not developed until 1922. Haecker et al. (Minn. Agr. Exp. Sta. Bul. 140, 79 p.), used 454 kg as a cow's average body weight with feeding standards aimed to maintain it. Cows were thus fed on average 3,541 kg of dry feed, produced 1,898 kg of milk yearly, with a feed efficiency of 0.52 kg milk/kg feed. Using the Ellis et al. (JDS 90:3456) model to predict methane emissions based on daily DM intake, a dairy cow in the 1920's consuming 9.7 kg would emit 11.1 MJ of methane/d.

In 2007, there were 9.15 million dairy cows in the US producing on average 9,196 kg of milk yearly. A national summary on feed amounts and types being used on today's dairy farms is not available. Assuming an efficiency of 1.5 kg milk/kg feed DM and a DM intake of 12.7 kg/d for 60 days dry, the average daily DM intake over 365 days for a dairy cow in 2007 would be about 18.9 kg/d. Using the Ellis et al. model, the average cow emitted 18.5 MJ methane/d. This is a methane emission of 0.73 MJ/kg milk compared to 2.14 MJ/kg milk for cows in the 1920's. The reduction of 12 million dairy cows since 1924 results in total methane emissions reduction of 68.4 million MJ/d, or 39% less methane from dairy cows today than in 1920's. In addition, feed efficiency has increased three-fold over the last 8 decades.

Key Words: Methane, Dairy, Environment

80 Impact of using feedline soakers in combination with Korral Kools® to cool early lactation cows housed in desert style barns. J. F. Smith*¹, B. J. Bradford¹, A. Oddy², J. P. Harner¹, and M. J. Brouk¹, ¹*Kansas State University, Manhattan*, ²*NADA Al-Othman, Al Ahsa, Saudi Arabia*.

An experiment was conducted at a dairy located in Saudi Arabia in September 2007 to evaluate the impact of feedline soakers, in combination with Korral Kools®, on the body temperature of early lactation cows. Feedline soakers were installed in two pens of cows. The feedline soakers were set to come on at a barn temperature of 21°C with a soaking frequency of 5 min (36 s on and 264 s off). Korral Kools® were spaced every 6 m over the resting area and were operated, with the fans coming on at a barn temperature of 27°C and the water at 30°C. Feedline soakers were alternately turned on and off for 24 h periods over 4 d. Hourly ambient temperature, humidity and temperature-humidity index (THI)

were collected from a weather station located on the dairy. Vaginal temperatures of 7 primiparous (53 d in milk, 41.2 kg/d milk production) and 6 multiparous cows (28 d in milk, 48.1 kg/d milk production, 2.8 lactations), located in separate groups, were collected every 5 min using data loggers (HOBO U12) attached to a blank CIDR. Vaginal temperature data was analyzed with a mixed model including fixed effects of pen, treatment, day within treatment, time of day, and treatment by time of day interaction, and the random effect of cow within pen. Repeated measures over time were modeled with a variance component covariance structure, and denominator degrees of freedom were estimated using the Kenward-Roger method. Ambient temperature during the trial was 29.7°C (range: 21.7 to 38.5°C), relative humidity was 44.4% (16 to 85%) and THI was 75.6 (68 to 82). Feedline soakers significantly decreased mean 24-h vaginal temperatures from 38.98 to 38.80°C ($P < 0.001$). Treatment by time interaction was also significant ($P < 0.001$), with greatest treatment effects during peak heat stress; feedline soakers reduced vaginal temperatures from 39.72 to 39.42°C at 2400 h and from 39.32 to 38.98°C at 500 h. Additional research is needed to determine how to operate the Korral Kool® system with feedline soakers.

Key Words: Heat Stress, Dairy Cattle, Cooling

81 Impact of using evaporative pads and fans in combination with feedline soakers to reduce heat stress of prepartum cows. J. F. Smith*, B. J. Bradford, J. P. Harner, and M. J. Brouk, *Kansas State University, Manhattan*.

An experiment was conducted at the KSU dairy in August 2007 to evaluate the impact of evaporative pads and fans, in combination with feedline soakers, on the body temperature of prepartum cows. To complete this trial, an addition was constructed to the maternity barn to incorporate the use of evaporative pads and fans to cool the bedded pack area. Evaporative pads were alternately turned on and off for 24 h periods over 4 days. When the pads were on, water was circulated through the evaporative pads from 830 h to 230 h. The fans pulling air through the evaporative pads were operated anytime the barn temperature was above 21°C. The feedline soakers were set to come on at a barn temperature of 21°C with a soaking frequency of 15 min (5 min on and 10 min off). Logging devices collected ambient temperature and relative humidity data at 15-min intervals. Vaginal temperatures of 8 cows located in the same group were collected every 5 min using data loggers (HOBO U12) attached to a blank CIDR. Vaginal temperature data was analyzed with a mixed model including fixed effects of treatment, time of day, and treatment by time of day interaction, and the random effects of cow and day within treatment. Repeated measures were modeled with a variance component covariance structure, and denominator degrees of freedom were estimated using the Kenward-Roger method. Evaporative cooling significantly decreased mean 24-h barn temperature by 3.8°C and temperature-humidity index (THI) by 2.3 units. The greatest differences in barn temperature and THI occurred at 1700 h, when temperature was reduced by 6.8°C and THI by 3.1 units. Evaporative cooling significantly decreased mean 24-h vaginal temperatures from 38.95 to 38.79°C ($P < 0.001$). The treatment by time interaction was also significant ($P < 0.001$), with the greatest treatment effects during peak heat stress times (39.2 vs. 38.9°C at 1500 h, 39.3 vs. 39.1°C at 2300 h for pads off and

on, respectively). Evaporative cooling in combination with feedline soakers can be used to reduce body temperatures of prepartum cows experiencing heat stress.

Key Words: Heat Stress, Dairy Cattle, Transition Period

82 Differences in thermoregulatory ability between slick and normal-haired lactating Holstein cows in response to acute heat stress. S. Dikmen^{*1,2}, E. Alava², E. Pontes³, J. M. Fear², B. Y. Dikmen⁴, T. A. Olson², and P. J. Hansen², ¹University of Uludag, Bursa, Turkey, ²University of Florida, Gainesville, FL, USA, ³Universidade de São Paulo, São Paulo, Brazil, ⁴University of Uludag, Keles Vocational School, Keles, Bursa, Turkey.

The slick gene is a major dominant gene in cattle that controls hair growth. The aim of this study was to determine whether slick-haired Holsteins are better able to regulate vaginal (VT) and skin temperature (ST), respiration rate (RR) and sweating rate (SR) than normal-haired Holsteins during exposure to an acute increase in heat stress. Lactating slick and normal-haired cows were kept in one of two environments: an indoor environment (n=10) with fans and evaporative cooling and an outdoor environment (n=10) only with shade cloth. VT, RR, ST and SR were measured at 1200, 1500, 1800 and 2100 h and blood samples were collected for plasma cortisol concentrations. Cows in the outdoor environment had higher VT, ST, SR and RR than cows in the indoor environment (P<0.001). VT was lower (P=0.05) in slick-haired animals in both environments. The least-squares means \pm SEM for VT at 1200, 1500, 1800 and 2100 h were 39.4 \pm 0.1 vs 39.9 \pm 0.1, 39.7 \pm 0.1 vs 40.0 \pm 0.1, 39.8 \pm 0.1 vs 40.3 \pm 0.1, 39.4 \pm 0.1 vs 40.0 \pm 0.1 $^{\circ}$ C for slick vs normal, respectively, in the outdoor environment and 38.8 \pm 0.1 vs 39.0 \pm 0.1, 38.5 \pm 0.1 vs 38.9 \pm 0.1, 38.8 \pm 0.1 vs 39.0 \pm 0.1, 38.5 \pm 0.1 vs 38.9 \pm 0.1 $^{\circ}$ C for slick vs normal in the indoor environment. SR tended to be higher for slick-haired cows in both environments (P=0.07). The least-squares means \pm SEM for SR at 1200, 1500, 1800 and 2100 h were 113.6 \pm 6.5 vs 88.6 \pm 6.5, 93.5 \pm 6.5 vs 75.2 \pm 6.5, 90.2 \pm 6.5 vs 82.0 \pm 6.5, 25.1 \pm 6.5 vs 24.7 \pm 6.5 g/hm² for slick vs normal, respectively, in the outdoor environment and 70.4 \pm 6.5 vs 60.1 \pm 6.5, 52.7 \pm 6.5 vs 37.3 \pm 6.5, 47.7 \pm 6.5 vs 55.2 \pm 6.5, 14.5 \pm 6.5 vs 16.8 \pm 6.5 g/hm² for slick vs normal in the indoor environment. RR was lower for slick-haired cows in both environments (P<0.05). There was no difference in ST between hair type and cortisol concentrations were not affected by environment or hair type. Results indicate that slick-haired cows can regulate their body temperature more effectively than normal cows during heat stress. The superior thermotolerance of the slick-haired cows is likely to reflect increased heat loss via conduction and convection as well as increased SR.

Key Words: Heat Stress, Holstein, Slick Hair Gene

83 Development of models for predicting management practices and conditions that alleviate heat stress in large commercial dairy farms. J. M. Schefers^{*}, K. A. Weigel, and N. B. Cook, University of Wisconsin, Madison.

During the summer of 2007, 29 dairy herds in the Alta Advantage[®] progeny testing program were selected to participate in a heat stress study to determine the importance of different types of heat abatement systems and facility designs for alleviating heat stress in lactating dairy cows.

For each herd, intravaginal temperatures were recorded from lactating cows using a continuous temperature logging device (HOBO[®]) attached to a blank intravaginal insert (CIDR). The observational period was 39 hr, and temperatures ($^{\circ}$ Celsius) were recorded at 2-min intervals. The temperature data loggers were inserted in 7 to 8 early lactation cows per herd. Ambient temperature ($^{\circ}$ Celsius) and relative humidity were collected at 2-min intervals over the same 39-hr period as the temperature data loggers in the freestall barns on each dairy. Overall, 16 variables related to facilities and heat abatement systems were considered in this study. Mean intravaginal cow temperature was calculated for each lactating cow from the temperature data logging devices over the 39-hr observational period. Mean intravaginal cow temperature was used to calculate the mean herd temperature for each herd participating in the study. Mean temperature humidity index (THI) was the most significant predictor (P<0.01) of mean herd temperature for herds that participated in the heat stress study. As THI increases, mean herd temperature also increases. Also, mean herd temperature was significantly higher (P<0.05) for dairy herds that had a north-south (NS) orientated barn than herds with barns orientated in the east-west (EW) direction. Least squares means were 38.97 $^{\circ}$ C and 38.84 $^{\circ}$ C for the NS orientated barns and EW orientated barns, respectively. Furthermore, the holding pen was identified as a major risk area for heat stress. Airflow in cubic feet per minute per cow (cfm/cow) and stocking densities in the holding area were both found to be significant at P<0.05. As the airflow rate in cfm/cow increased, there was a significant decrease in mean herd temperature and as stocking densities increased, cows got hotter.

Key Words: Heat Stress, Dairy Cattle, Environment

84 Is the temperature–humidity index (THI) the best indicator of heat stress in lactating dairy cows in a subtropical environment? S. Dikmen^{*1,2} and P. J. Hansen², ¹University of Uludag, Faculty of Veterinary Medicine, Bursa, Turkey, ²University of Florida, Gainesville.

Several temperature–humidity indexes (THI) have been developed to estimate the degree of thermal stress experienced by mammals. THI's are based on formulae that include meteorological variables related to air temperature and humidity. Many of these were originally derived for species other than cattle and many were not derived by performing regression analysis to estimate the optimal weighting of temperature and humidity. The objective of this study was to develop an equation using meteorological variables that best predicted rectal temperature of lactating cows in a subtropical environment and compare the accuracy of prediction of rectal temperature of this equation to that obtained using dry bulb temperature (DBT), 7 different THIs, and DBT or THI in combination with other meteorological variables. Rectal temperature was measured between 1500 and 1700 h in 1280 lactating Holstein cows in north central Florida. Dry bulb temperature, relative humidity (RH), black globe temperature (BGT), dew point, and wind speed were recorded at each cow's location. Data were recorded from August to December 2007. Regression analysis to predict rectal temperature was performed using various models that included parity, stage of lactation, farm, milk yield, the meteorological variables mentioned above as well as seven separate THIs. Stepwise regression analyses were performed to identify equations with highest coefficient of determination (r²) for predicting rectal temperature. The r² using DBT (0.407) was similar to that for models using THI (r² between 0.420 and 0.425) or BGT (r²=0.389). The r² for equations using DBT could be improved by adding RH (r²=0.428) or RH and RH² (r²=0.437) to the model. In conclusion, DBT is nearly as good a predictor of body temperature of lactating

Holsteins in a subtropical environment as THI and inclusion of RH in the model results in r^2 as good as THI.

Key Words: Heat Stress, Temperature–Humidity Index

85 Evaluation of accuracy and variation of ThermoChron® iButtons®. S. M. Garey*, T. H. Friend, and B. H. Carter, *Texas A&M University, College Station.*

The ThermoChron iButton DS1921H temperature logger has been useful in a wide range of biological studies. The objective of this study was to determine if the accuracy or variability of these devices change as they age or when they are used over a range of temperatures. Individual iButtons were grouped into new (4000 to 6000, $n=11$) and old (32000 to 35000, $n=12$) categories by number of lifetime readings. The iButtons were exposed for 1 h to 20°C, 30°C, 38°C and 44°C in a thermostatically controlled water bath in ascending order, and the temperature treatments were subsequently replicated in descending order. After the iButtons stabilized at each temperature, 60 readings at 1-min intervals per iButton were evaluated for accuracy against a calibrated certified thermometer (accuracy $0.1 \pm 0.05^\circ\text{C}$) by calculating the average mean of the differences at each reading. The variation of each iButton was then compared using the standard deviation of those differences. The effect of age on deviation from the certified thermometer was determined using independent t -tests. Overall, the new iButtons were more accurate ($P < 0.01$), differing from the certified thermometer by -0.26°C , while the old iButtons differed by -0.46°C . Additionally, new iButtons had a tendency ($P < 0.05$) to be less variable with a mean SD of 0.07°C , versus 0.09°C for old iButtons. The performance of the iButtons in different temperatures was analyzed using paired t -tests with a Bonferroni correction. As the temperature increased, the accuracy of the iButtons improved ($P < 0.01$) with average differences of -0.41°C at 20°C, -0.40°C at 30°C, -0.36°C at 38°C and -0.31°C at 44°C. These results suggest that data collected with these devices, regardless of age, should be individually corrected to a standard reference for cross-study comparison. Alternatively, a correction to a group mean by allowing the iButtons to equilibrate in a temperature range similar to that in which it will be used will improve within-study comparisons.

Key Words: ThermoChron, iButton, Temperature

86 Addition of skin temperature to whole body temperature measures improves relationship to Temperature Humidity Index under moderate climatic conditions. R. B. Zimbelman*, J. B. Wheelock, M. D. O'Brien, J. Muumba, A. Alex, R. P. Rhoads, L. H. Baumgard, and R. J. Collier, *University of Arizona, Tucson.*

The Temperature Humidity Index originally developed by Thom (1958) and extended to cattle by Berry and colleagues (1964) is used to estimate cooling requirements of dairy cattle. However, correlation of THI to measurements of core body temperature is not adequate. Our objective was to determine if incorporation of skin surface temperature to mean body temperature measures would improve Pearson Correlation Coefficients between THI and physiological measures of heat stress. During a three-month span, three groups of cows ($n=12$) were housed in the environmental chambers at the University of Arizona for a total of 22 days. Each group experienced a total of three environments where THI was at a minimum of 49, maximum of 79 and an average 62.9. We uti-

lized NRC 1971 THI calculation $(0.18 \times \text{Tdb} + 32) \times (0.55 - (0.0055 \times \text{RH}) \times (1.8 \times \text{Tdb} - 26))$ for estimate of environmental heat load. Physiological measures of heat strain included respiration rate (RR/min), infrared surface temperature (ST, °C), rectal temperature (RT, °C), heart rate (HR/min), and evaporative heat loss (EVHL, g/m²). Mean body temperature (BT, °C) was calculated using the formula $\text{BT} = (0.33 \times \text{ST} + 0.67 \times \text{RT})$. Respiration rates, ST, RT, EVHL, and HR were routinely collected 4 times per day and hourly for 24 hours once biweekly for a total of 2096 measures. Correlations of these measures to THI were as follows: THI and RR ($r=0.63$; $P < 0.0001$), THI and RT ($r=0.42$; $P < 0.0001$), THI and SR ($r=0.64$; $P < 0.0001$), THI and ST ($r=0.86$; $P < 0.0001$), THI and BT ($r=0.85$; $P < 0.0001$), and THI and HR ($r = -0.45$; $P < 0.05$). Correlations between BT and RR ($r=0.48$; $P < 0.0001$), BT and SR ($r=0.69$; $P < 0.0001$), BT and RT ($r = 0.63$; $P < 0.0001$). We conclude that under moderate climatic THI conditions investigated addition of ST to BT improved the correlation of BT to THI over RT alone. In addition, the correlation of RR, ST, and BT are improved over RT alone implying that ST has a greater effect on RR than RT.

Key Words: Temperature Humidity Index, Skin Temperature, Body Temperature

87 Facility characteristics of U.S. dairy operations and their impact on cow health and productivity. J. E. Lombard*¹, C. B. Tucker², M. A. G. von Keyserlingk³, and C. A. Kopral¹, ¹USDA:APHIS:VS:Centers for Epidemiology and Animal Health, Fort Collins, CO, ²University of California, Davis, CA, ³Animal Welfare Program, University of British Columbia, Vancouver, BC, Canada.

Assessments and questionnaires were administered to evaluate cow health, productivity and facility characteristics on 491 dairy operations in the top 17 dairy states as part of the USDA's National Animal Health Monitoring System's Dairy 2007 study. The objectives of this portion of the study were to quantify characteristics of cow housing and how these features correspond with cow health and productivity on U.S. dairy operations. Data were collected from March through August 2007. The percentage of operations assessed by housing types were tiestall (39.0%), stanchion (13.0%), freestall (38.4%), drylot (5.0%) and other multiple animal areas (4.6%). Stanchion barns were the oldest with the mean building year of 1949 compared to freestall housing with a mean building year of 1989. Mean stall widths were widest for tiestalls (1.2 m) compared to stanchions or freestalls (both 1.1 m). In general, freestall operations had more bedding than tiestall and stanchion operations. Overall disease incidence, including hypocalcemia and displaced abomasum, was lowest on drylot operations compared to other housing systems. Operations with stanchion housing had lower cow removal rates compared to tiestall and freestall operations and a lower percentage of deaths compared to freestall operations. Rolling herd average milk production was higher for operations with tiestall (9647 kg) or freestall (9706 kg) housing compared to stanchion (7966 kg) or drylot (8065 kg) facilities. Facilities constructed in the last 20 years, such as freestall housing, have placed greater emphasis on cow comfort and may be associated with increased health and production compared to older facilities. However, results of this study indicate that freestall facilities are not associated with improved health compared to other housing systems, suggesting that further improvements in facility design and management must be identified.

Key Words: Housing, Health, Productivity

88 The effects of supplementing a dietary novel yeast culture on body temperature indices, production and metabolism in heat-stressed lactating cows. G. Shwartz¹, J. B. Wheelock¹, L. L. Hernandez¹, M. D. O'Brien¹, K. A. Dawson², M. J. VanBaale¹, R. P. Rhoads¹, R. B. Zimelman¹, and L. H. Baumgard^{*1}, ¹University of Arizona, Tucson, ²Alltech Inc., Nicholasville, KY.

Multiparous, lactating Holstein cows (n= 23; 120±30 DIM, 690±67 kg BW) housed in climatic chambers were randomly assigned to 1 of 2 dietary treatments (TRT): a diet containing Yea-Sacc[®] HD (a formulated yeast culture for heat stress, n=12, 10 g/d) or control diet (n=11). The trial length was 28d and consisted of a 7d thermal-neutral acclimation period (18°C, 20% humidity) followed by 21d of heat stress (HS; cyclical daily temps ranging from 29.4 to 37.8°C and 20% humidity). Cows were individually fed a TMR consisting primarily of alfalfa hay and steam flaked corn. During acclimation, yeast supplementation had no effect on temperature or production variables. During HS, TRT had no effect on rump temperature, respiration rate, or sweating rates. Tail head (39.52 vs 39.24°C) and shoulder (39.59 vs 39.31°C) temperatures tended (P<0.08) to be higher for controls. Controls had increased (P<0.05) rectal temperature at 1200 and 1800 h (40.29 vs 40.02°C; 40.35 vs 40.12°C, respectively), and tended to be higher (39.48 vs 39.26°C; P=0.05) at 0600 h compared to yeast fed cows. There was no TRT effect on BW loss (58 kg) during HS. Although DMI decreased (29%) during HS, there was no TRT effect on intake. HS progressively decreased milk yield, reaching a nadir (33%) on the 3rd week, but TRT had no effect on milk yield (28.16 kg), 3.5% FCM (29.05 kg) or ECM (28.14 kg). Although TRT had no effect on milk composition, HS decreased (P< 0.05) protein (7%) and lactose (5%), but did not alter fat levels. HS cows were in negative EBAL (-1.0 Mcal/d), but TRT had no effect on EBAL or feed efficiency (1.71). Independent of TRT, HS decreased plasma glucose (11%), but neither TRT nor HS altered basal NEFA levels. PUN was increased (≥45%) and also tended to be lower in yeast-fed cows (13.5 vs 14.6 mg/dL; P<0.10). Despite yeast-fed cows having reduced body temperatures and PUN concentrations, production parameters were not improved during HS.

Key Words: Heat Stress, Yeast Culture

89 Effects of nutrition and feeding management on production, health and culling by organically-managed dairy herds in south-eastern Pennsylvania. K. Griswold^{*1}, H. Karreman², S. Dinh¹, and J. High³, ¹Penn State Cooperative Extension, University Park, PA, ²Penn Dutch Cow Care, Gap, PA, ³Lancaster DHIA, Manheim, PA.

The effects of nutrition and feeding management on production, health, and culling were examined using a combination of survey and DHIA data. Initially, 38 organically-managed (OM) herds using Lancaster DHIA services were recruited for the study, but only 29 herds returned completed surveys. The survey consisted of 308 questions concerning herd demographics, milk quality, health, reproduction, nutrition, and young stock. Monthly DHIA 202 report data from 2006 for each herd were used for the study. Data were analyzed using PROC MIXED and PROC REG within SAS. The supplemental forage model included the fixed effects of feeding haylage (HYL), baleage (BL), alfalfa hay (AH), mixed-grass hay (MGH), and corn silage (CS). The supplemental grain model included the fixed effects of feeding shelled corn (SC), high-moisture shelled corn (HMSC), ear corn (EC), high-moisture ear corn (HMEC), oats (OA), speltz (SP), soybean meal (SBM), and a grain mix (GM). LS means with standard errors are presented in the table below.

The results indicate that herds feeding BL produced less milk with greater milk fat % and protein % compared to herds not feeding BL. Corn silage supplemented herds produced more milk than herds not receiving corn silage. Regression analysis revealed no significant (P > 0.05) relationship between level of CS supplementation and milk yield. Feeding oats significantly increased milk fat %, but milk fat yield (kg per cow per year) was not affected (P = 0.91). All other supplements examined had no effects on milk yield and components (P > 0.10). Both herd cull rate % and death loss % were not affected (P > 0.10) by supplemental forage or grain choices. These results suggest that supplemental forage choice has more potential impact on milk production and components in OM dairy herds than supplemental grain choice. Supplementation of forage to enhance milk yield does not deleteriously affect culling and death loss in OM dairy herds.

Table 1. Effects of supplemental feeds on milk production in organically-managed dairy herds

Supplement	Milk yield, kg/cow/year		P
	Yes	No	
Corn Silage	7,837 ±341	6,501 ±479	0.0007
Baleage	6,594 ±481	7,745 ±364	0.008
Ear Corn	7,346 ±577	7,171 ±909	NS
Oats	7,035 ±1,033	7,482 ±1,020	NS
	Milk Fat %		
Supplement	Yes	No	P
Corn Silage	3.84 ±0.08	3.88 ±0.12	NS
Baleage	3.97 ±0.12	3.75 ±0.09	0.038
Ear Corn	3.63 ±0.17	3.90 ±0.12	0.084
Oats	3.87 ±0.14	3.65 ±0.14	0.037
	Milk Protein %		
Supplement	Yes	No	P
Corn Silage	3.06 ±0.06	3.11 ±0.08	NS
Baleage	3.18 ±0.08	3.00 ±0.06	0.01
Ear Corn	3.02 ±0.12	3.17 ±0.09	NS
Oats	3.15 ±0.10	3.05 ±0.10	NS

Key Words: Organic, Milk Yield, Nutrition

90 Identification of efficient sets of artificial insemination reproductive management programs: A stochastic dominance analysis. N. J. Olynk^{*} and C. A. Wolf, Michigan State University, Lansing.

Reproductive success is critical to the financial success of the dairy farm. Several reproductive management technologies have been developed to aid in effective and efficient reproductive management. Farm managers have heterogeneous risk preferences. The riskiness of a program's outcome (i.e., range of potential conception or heat detection rates) and the risk preferences of the farm manager will affect technology adoption decisions. Further, on-farm costs and goals will affect the reproductive program chosen. The objective of this research was to identify optimal programs for farms with a given set of characteristics (e.g., manager characteristics, on-farm costs, goals). Stochastic dominance, a method to rank risky alternatives without specific information on decision maker preferences, was utilized to determine efficient sets of programs for farm managers with given risk preferences and for various on-farm cost scenarios. First degree stochastic dominance (FSD) identified the

efficient programs for decision makers who simply prefer 'more to less', or in this case prefer the program with lower total cost. Second degree stochastic dominance (SSD) compared programs based on relative riskiness, and identified the efficient programs for decision makers who prefer 'more to less' at a diminishing rate – and therefore are risk averse. Prior reproductive study results were used to parameterize the analysis of reproductive technologies including visual heat detection, Ovsynch, and Cosynch. No FSD was identified which highlights that no single

reproductive program was preferred by all managers. SSD of Ovsynch over Cosynch was identified under given scenarios, indicating that risk averse managers would prefer Ovsynch over Cosynch. By identifying efficient sets of reproductive programs we can make better technology adoption recommendations to dairy farm operators and further understand why farms adopt specific reproductive technologies.

Key Words: Reproductive Management, Decision Support, Stochastic Dominance

Ruminant Nutrition: Forages

91 Optimizing forage use in total mixed rations for lactating cows. R. Kowsar¹, G. R. Ghorbani¹, M. Alikhani¹, M. Khorvash¹, and A. Nikkhah^{2,3}, ¹Isfahan University of Technology, Isfahan, Iran, ²Zanjan University, Zanjan, Iran, ³University of Illinois, Urbana.

The principal objective was to determine the effects of partial replacement of short-length alfalfa hay (AH, peNDF>8 mm = 14%) with corn silage (CS, peNDF>8 mm = 45%) in yellow grease supplemented total mixed rations on feed intake, chewing activity, rumen fermentation, and productivity of lactating cows. Four multiparous (138 ± 3 days in milk) and four primiparous (115 ± 10 days in milk) Holstein cows were used in a replicated 4 × 4 Latin square design study with four 21-d periods. Each period had 14-d of adaptation. Treatments were diets (dry matter based) with 1) 40% alfalfa hay (ALF), 2) 24% alfalfa hay + 16% corn silage (CS40), 3) 20% alfalfa hay + 20% corn silage (CS50), and 4) 16% alfalfa hay + 24% corn silage (CS60). All diets contained 2% yellow grease. Cows had greater ($P < 0.05$) intakes of net energy, neutral detergent fiber, and physically effective fiber when CS replaced 40, 50, and 60% of short AH. Replacing short AH with CS lengthened daily eating and chewing times in all cows, and increased rumen pH at 4-h post-feeding in multiparous cows ($P < 0.05$) but did not affect it in primiparous cows. Apparent total tract digestibility coefficients for dry matter, organic matter and crude protein were not different among ALF, CS40 and CS50 fed cows but were lower ($P < 0.05$) in the CS60 fed cows (71, 72, 71%) than in the ALF group (75, 77, 76%). Energy corrected milk yield was greater ($P < 0.05$) in CS40 (33.8 kg) and CS60 (34.0 kg) groups than in the ALF group (31.9 kg). Milk protein yield was increased ($P < 0.05$) when CS replaced 40, 50, and 60% of AH. Milk lactose was higher only in the CS60 fed cows, but milk lactose yield was greater in CS50 and CS60 fed cows, compared to the ALF fed cows. Milk percent and yield of fat and total solids and changes in body condition score did not differ among treatments. Therefore, partial replacement of short-length AH with CS enhanced diet palatability, stimulated energy and physically effective fiber intakes, and increased milk protein yield.

Key Words: Alfalfa Hay, Corn Silage, Yellow Grease

92 Fenugreek as forage for dairy cows 1. Effect on productivity. A. W. Alemu* and L. Doepel, *University of Alberta, Edmonton, AB, Canada.*

Fenugreek (*Trigonella foenum-graecum L.*) is a novel forage crop to Canada that is being studied as an alternative forage to alfalfa for dairy cows. The objective of this study was to evaluate the effect of fenugreek haylage relative to alfalfa haylage on productivity of dairy cows. Six 2nd lactation Holstein cows (56 ± 8 DIM) fitted with ruminal cannula were used in a replicated 3x3 Latin square design with 18 d periods, the last 7 d being used for collection. A TMR consisting of 40% haylage, 10% barley silage and 50% concentrate on a DM basis was fed once daily. The haylage component constituted the dietary treatments: 1) AAFC F70 fenugreek (F70), 2) CDC Quatro fenugreek (QUAT) and 3) Alfalfa (ALF). Apparent total tract digestibility of the diets was determined by feeding chromic oxide at 21 g/d as an indigestible marker. Data were analyzed using orthogonal contrasts of alfalfa vs. fenugreek (FEN) and F70 vs. QUAT. DMI, milk yield, and milk protein and lactose yields

were higher ($P < 0.05$) for cows fed ALF than FEN, whereas milk fat yield and percent were unaffected by treatment. Milk urea N (MUN) was lower in the ALF fed cows than the fenugreek fed cows ($P = 0.003$). Total-tract digestibility of DM (77.4%), CP (78.3%), NDF (63.5%) and ADF (59.5%) was unaffected by treatment. Our results suggest that although the digestibility of the fenugreek diets was equivalent to that of the alfalfa diet, fenugreek haylage has a lower feeding value than alfalfa for lactating dairy cows due in part to lower DMI, resulting in lower milk yield. As such, it may not be a suitable alternative to alfalfa haylage.

Table 1.

	Treatment				Contrasts	
	F70	QUAT	ALF	SEM	ALF vs. FEN	F70 vs. QUAT
DMI, kg/d	16.8	18.7	22.9	0.7	<0.001	0.10
Milk yield, kg/d	31.8	32.4	39.1	1.9	<0.001	0.63
Milk fat, %	2.64	2.66	2.43	0.2	0.11	0.85
Milk fat, g/d	837	862	943	70.5	0.17	0.73
Milk protein, %	2.83	2.85	3.04	0.1	<0.001	0.48
Milk protein, g/d	908	923	1188	46.5	<0.001	0.75
Milk lactose, %	4.58	4.59	4.66	0.04	0.02	0.52
Milk lactose, g/d	1473	1490	1827	83.9	<0.001	0.80
MUN, mg/dl	16.3	15.9	13.9	0.8	0.003	0.52
Total tract digestibility						
DM	77.6	76.0	78.6	1.9	0.40	0.53
CP	78.0	77.7	79.1	1.8	0.49	0.87
NDF	67.3	62.1	61.2	3.2	0.27	0.18

Key Words: Fenugreek, Milk Production, Apparent Digestibility

93 Brown midrib corn silage fed during the transition period can result in a persistent increase in production. W. C. Stone¹, L. E. Chase¹, T. R. Overton¹, J. L. Lukas¹, and K. E. Nestor², ¹Cornell University, Ithaca, NY, ²Mycogen Seeds, Wooster, OH.

Holstein cows (n = 66) entering second or greater lactation were used to determine whether feeding Brown Midrib (BMR; Mycogen F2F444) or conventional (a mixture of varieties) corn silage (CS) would improve performance and metabolism. Cows were fed diets that differed in source of CS from 3 wk precalving until 3 wk postcalving. Diets were formulated to keep all parameters the same with the exception of NDF digestibility. The NDF-d (30 h) for conventional and BMR silages averaged 56.8 and 73.8%, respectively. Prepartum rations contained about 47% CS, 18% wheat straw, 7% alfalfa haylage (AH), and 28% concentrate (DM basis). Postpartum rations contained about 40% CS, 15% AH, 1% straw, and 44% concentrate. All cows were fed a separate ration containing only conventional CS as the CS source from wk 4 to 15. Cows were housed in tiestalls and had milk weights (3X/d) and DMI recorded daily and milk composition measured weekly. Blood samples collected weekly during the transition period were analyzed for NEFA and BHBA. Cows fed BMR had higher DMI during the 2 wk period before calving and 3 wk period postcalving. Yields of milk, fat-corrected milk (FCM), and solids were increased for the first 15 wk of

lactation period for cows fed rations containing BMR. Concentrations of peripartur NEFA and postpartur BHBA were not affected by treatment. Feeding BMR CS during the transition period resulted in increased milk and milk solids yield during the first 15 wk of lactation.

Table 1. Effects of BMR or conventional corn silage on cow performance

	Control	BMR	SE	P value
Prepartur DMI, d -21 to -1, kg/d	13.8	14.6	0.38	0.14
Prepartur DMI, d -14 to -1, kg/d	13.2	14.3	0.35	0.03
Postpartur DMI, d 0 to 21, kg/d	18.2	20.2	0.41	0.001
Milk, kg/d	43.1	45.4	0.9	0.07
3.5% FCM, kg/d	45.1	48.1	1.1	0.07
Fat, %	3.85	3.90	0.07	0.66
True protein, %	3.06	3.01	0.11	0.72
Milk solids, kg/d	5.32	5.67	0.10	0.02

All production results are averages for the first 15 wk of lactation.

Key Words: Brown Midrib, Corn Silage, Transition Period

94 Production response of lactating cows to combinations of BMR corn silage and Tifton 85 bermudagrass hay. J. J. Castro*, N. A. Mullis, and J. K. Bernard, *University of Georgia, Athens.*

The effect of feeding combinations of forages with improved NDF digestibility on performance was evaluated in an 8-wk randomized design trial. Treatments were arranged as a 2 x 2 factorial to include silage from either normal (NCS) or brown midrib silage (BMR) with or without Tifton 85 (T85) bermudagrass hay. Experimental diets contained 50% forage with 3 to 5 % of DM provided by ryegrass silage. Treatments were 1) NCS; 2) BMR; 3) NCS plus T85; and 4) BMR plus T85. Diets were formulated to be isocaloric and isonitrogenous but differed in NDF concentrations: 30, 31, 34, and 34% of DM for treatments 1 through 4, respectively. Forty Holstein cows averaging 82 ± 19 DIM, 41.6 ± 8.9 kg/d milk, and 3.2 ± 0.2 % fat were assigned randomly to treatments at the end of 2 wk standardization period. Mean DMI, milk yield, fat and protein percentage and ECM yield during the trial were 24.7, 40.6, 3.12, 2.94, and 38.8; 26.4, 41.0, 3.31, 2.86, and 40.0; 24.7, 38.1, 3.65, 2.87, and 38.8; and 25.6 kg/d, 39.8 kg/d, 3.35 %, 2.85 %, and 39.0 kg/d for treatments 1, 2, 3, and 4, respectively. Cows fed diets with BMR had higher ($P < 0.01$) DMI than those fed NCS. Milk yield was lower ($P < 0.05$) but fat percentage was higher ($P < 0.05$) when cows were fed diets with T85 hay compared with those that did not receive T85. No differences were observed in milk protein concentrations or yield of fat, protein, or ECM among treatments. Blood glucose was higher ($P < 0.05$) in cows consuming diets with BMR than with NCS and averaged 64.2, 69.7, 67.2, and 68.7 mg/dl for treatments 1, 2, 3, and 4, respectively. An interaction ($P < 0.05$) between corn silage type and T85 was observed for plasma urea concentrations because of higher concentrations with BMR than NCS diet when T85 was added; (15.7, 13.7, 16.3, and 18.0 mg/100 ml for treatments 1, 2, 3, and 4, respectively). The results of this trial indicate that including T85 at 10 % of DM in diets based on normal or BMR plus ryegrass silage can maintain acceptable DMI and overall performance.

Key Words: Forage Evaluation, NDF, Tifton 85

95 Effect of wheat forage maturity and preservation method on dietary passage kinetics and DM digestibility of mixed diets fed to growing beef calves. P. Beck*, F. Nacer, B. Stewart, D. Shockey, M. Morgan, and S. Gunter, *University of Arkansas Division of Agriculture, Hope.*

Wheat (*Triticum aestivum* L.) forage was harvested at the boot or hard dough stage of maturity, preserved as hay or silage, and fed in total mixed diets (80:20 concentrate:forage ratio, DM basis) in order to measure the effect of maturity at harvest and preservation method on particulate passage rate and apparent DM digestibility. Six 1.2-ha wheat fields were harvested at either boot or dough stage of maturity and either ensiled or stored as hay. Hay or silage was incorporated into 14.5% CP diets using soybean hulls, corn, and cottonseed meal as primary concentrate sources. Beef calves (n=16, BW=187 ± 9.4 kg) were individually fed 2.0% of BW diets for 15 d in a completely randomized design with a 2 x 2 factorial arrangement of treatments. Calves received a pulse dose of 2.5 g YbCl₃ and fecal samples were collected at 6, 12, 24, 36, 48, 60, 72, and 96-h post dosing. Extraction of Yb was completed using an EDTA procedure and analyzed with Inductively Coupled Plasma spectrometry. Fecal Yb excretion curves were analyzed by nonlinear regression procedures of SAS using a one-compartment model (Marquardt method). Ruminant particulate passage rate (PPR) was determined by rate of ruminal mixing x 0.59635, mean ruminal retention time was calculated by 1/PPR, and fecal output was determined by Yb dose/K0. Acid detergent insoluble ash (ADIA) was used as an internal marker to determine diet DM digestibility. Data were analyzed using the GLM procedure of SAS using animal as the experimental unit. Ruminant PPR, RRT, fecal output, and diet DM digestibility averaged 4.6%/h, 22.7 h, 3.7g/kg BW, and 81.6%, respectively and were not affected ($P \geq 0.15$) by forage maturity, preservation method, or the interaction. This study indicates that maturity of wheat forage at harvest and preservation method has no effect on kinetics of dietary passage or digestibility when fed as 20% of a total mixed diet.

Key Words: Digestibility, Passage Rate, *Triticum aestivum* L.

96 Effect of maturity and preservation method of wheat forage on the performance of growing beef calves fed mixed diets. M. Morgan*, P. Beck, F. Nacer, B. Stewart, D. Shockey, and S. Gunter, *University of Arkansas, Division of Agriculture, Hope.*

Wheat (*Triticum aestivum* L.) forage was harvested at the boot or hard dough stage of maturity, preserved as hay or round-bale silage, and fed to growing calves in total mixed diets to determine the effects of maturity at harvest and preservation method on animal performance. Six 1.2-ha wheat fields were cut using a disc mower at either the boot or dough stage of maturity. One-half of each field was either round baled within 24 h and ensiled or baled as hay. Fresh cut forage contained 24 and 57% DM, 15 and 8% CP, and 19 and 23% NFC, for boot and dough harvest, respectively. After 3 months of storage, boot cut silage contained 22, 17, and 18% DM, CP, and NFC, respectively; while hay contained 91, 15, 5.5% DM, CP, and NFC. Dough cut silage contained 47, 10, and 18% DM, CP, and NFC, respectively; while hay contained 91, 9, 22% DM, CP, and NFC. The hays or silages were incorporated into 14.5% CP diets at 20% (DM basis) using soybean hulls, corn, and cottonseed meal as the concentrate sources. Growing beef calves (n=84, BW=229 ±

6.0 kg) were randomly assigned to the 4 diets and fed at 3% (DM basis) of BW for 63 d in a 2 x 2 factorial arrangement with 3 pens/treatment. Animal performance data were analyzed as a completely randomized design using the mixed procedure of SAS. Forage yield, feed intake and G:F was analyzed using the GLM procedure of SAS. Forage yield at the dough harvest was greater ($P < 0.01$) than at boot harvest (2,781 vs. 6,259 \pm 246 kg/ha, respectively). Average daily gain (1.20 \pm 0.05 kg), DMI (7.4 \pm 0.15 kg), and feed efficiency (0.16 \pm 0.01) were unaffected ($P \geq 0.55$) by maturity at harvest, preservation method, or their interaction. The results indicate that forage maturity at harvest and preservation method has no affect on animal performance of growing beef steers when fed at 20% of mixed diets.

Key Words: Cattle, Hay, Silage

97 Comparison of grazing stockpiled tall fescue versus feeding hay or hay plus supplement to beef cows in late gestation and early lactation. A. M. Meyer*, R. L. Kallenbach, and M. S. Kerley, *University of Missouri, Columbia.*

Ninety-three beef cows (avg BW = 624.5 \pm 11.7 kg, avg BCS = 5.0 \pm 0.1) were allocated by BW, BCS, age, and calving date to 1 of 3 treatments (3 replicates each): grass hay fed to cows on dormant, previously grazed pastures (HAY), grass hay with supplementation (1.1 kg corn and 0.9 kg DDGS•cow⁻¹•d⁻¹) to meet predicted NRC requirements (HS), and strip-grazed non-endophyte infected stockpiled tall fescue pasture (STF). The trial was conducted from mid December to late March and split into 2 periods: from initiation to 1 wk precalving (P1, d 1 to 68) and from precalving until conclusion (P2, d 69 to 103). Average nutrient composition of STF was better than that of hay (11.8% vs. 8.0% CP, 67.2% vs. 74.2% NDF). Stockpiled pastures had an average yield of 2,691 kg DM/ha and average utilization rate of 60.6%. Hay offered did not differ ($P > 0.05$) between HAY and HS (12.4 vs. 11.8 kg•cow⁻¹•d⁻¹, respectively). During P1, HAY cows lost BW while HS and STF cows gained BW (-9.7 vs. 21.1 and 14.5 kg, respectively; $P < 0.05$), despite having similar BCS and ultrasonic back fat (BF) thickness. Although no differences were observed in BW or BF during P2, HAY cows lost more BCS ($P < 0.05$) than HS and STF cows (-0.6 vs. -0.2 and -0.1, respectively). Over the entire trial, HAY cows lost more ($P < 0.05$) BW, BCS, and BF than HS and STF cows (BW: -85.0 vs. -49.3 and -52.0 kg, BCS: -0.9 vs. -0.3 and -0.2, BF: -0.53 vs. -0.33 and -0.28 cm). No differences ($P > 0.05$) were observed for cow BW changes post-trial through weaning, pregnancy rates, or calf birth and weaning weights.

Post-trial, HAY cows gained more ($P < 0.10$) BCS than HS (0.7 vs. 0.3), and HAY ($P < 0.05$), and HS ($P < 0.10$) gained BCS compared to a loss in STF cows (-0.1) through weaning. Results of this study indicate that grazing STF is a viable option for wintering spring-calving beef cows. Because typical grass hay used is often of lower quality than STF, cows fed hay require supplementation to achieve similar performance to that observed while grazing STF.

Key Words: Beef Cows, Stockpiled Tall Fescue, Supplementation

98 Associative effects of leguminous (C3; Lucerne) and nonleguminous (C4; Corn & sorghum) fodders on In-situ digestion kinetics of fiber. M. Yaqoob*¹, J. I. Sultan², A. Javed², and P. Akhtar³, ¹*Department of Livestock Management, University of Agriculture, Faisalabad, Punjab, Pakistan,* ²*Institute of Animal Nutrition and Feed Technology, University of Agriculture, Faisalabad, Punjab, Pakistan,* ³*Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Punjab, Pakistan.*

An in sacco Nylon Bag study was conducted to evaluate the associative effects of leguminous (C3; Lucerne) and nonleguminous (C4; corn & sorghum) fodders. Lucerne was replaced at the rate of 15, 30 and 45% with corn and sorghum fodders respectively. The respective fodder samples were filled in each Nylon bag (10g) and incubated in the rumen of fistulated buffalo calf at 0, 0.5, 1, 2, 4, 6, 10, 12, 24, 36, 48 and 72 hours respectively. The bags were suspended in reverse order so that all the bags were pulled out together. The data regarding lag time rate of disappearance and extent of digestion were analyzed using analysis of variance techniques. Lucerne substitution increased ($P < 0.05$) the in sacco DM and NDF digestibility (48h) of corn and sorghum with maximum value at 30% replacement level. However, a declining trend was observed with the higher substitution level. A similar trend was noticed in rate of disappearance of DM and NDF of corn and sorghum. Lucerne substitution decreased the ($P < 0.05$) the lag time for DM and NDF disappearance in sacco upto 30% replacement level for both nonleguminous fodders however, an increasing trend was observed at 45%, substitution level. The extent of in sacco DM and NDF digestion was unaffected ($P < 0.05$) by Lucerne substitution. A positive associative effect was observed by replacing the Lucerne (C3) with corn and sorghum (C4) fodders, which was maximum at 30% Lucerne replacement.

Key Words: Lucerne, Sorghum, Lag Time

Ruminant Nutrition: Minerals and Vitamins

99 Impact of copper deficiency in the presence or absence of high dietary manganese on iron status of cattle. S. L. Hansen* and J. W. Spears, *North Carolina State University, Raleigh.*

Iron (Fe) and copper (Cu) metabolism are closely intertwined, and a deficiency of Cu may lead to a secondary Fe deficiency. The impact of a severe Cu deficiency on proteins involved in Fe metabolism in the bovine has not been studied. Therefore, a 493 day study was conducted to determine the effect of a severe long-term Cu deficiency on Fe metabolism in beef cattle. Twenty-one Angus calves were born to cows receiving one of the following treatments: 1) adequate Cu (+Cu), 2) Cu deficient (-Cu), and 3) Cu deficient plus 500 mg Mn/kg DM (-Cu+Mn). Following weaning, calves remained on the same treatment as their dam through growing (basal diet analyzed 7 mg Cu/kg) and finishing (analyzed 3 mg Cu/kg) phases. Plasma Fe concentrations were positively correlated ($P < 0.01$; $R^2 = 0.49$) with plasma Cu concentrations. Reciprocally, there was a negative relationship ($P < 0.01$; $R^2 = -0.31$) between liver Cu and Fe concentrations. This relationship is likely explained by lower ($P < 0.01$) ceruloplasmin activity in -Cu. vs. +Cu calves. Based on Western blotting of duodenal mucosal scrapings collected at harvest, concentrations of hephaestin (Hp), a Cu-dependent ferroxidase, were greater ($P = 0.01$) in -Cu+Mn compared to -Cu calves. Similarly, concentrations of the Fe export protein ferroportin (FPN) tended ($P = 0.07$) to be higher in -Cu+Mn vs. -Cu calves, likely due to lowered Fe status of -Cu+Mn calves. However, concentrations of divalent metal transporter 1 (DMT1), a protein responsible for import of Fe, Mn and Cu into cells, were lower ($P = 0.04$) in -Cu+Mn calves vs. -Cu calves. Concentrations of Hp, FPN and DMT1 did not differ ($P > 0.1$) between +Cu and -Cu calves. In summary, while Fe status of calves was impacted by changes in Cu status, Cu deficiency alone did not impact duodenal concentrations of proteins important in Fe metabolism. However, excessive dietary Mn appeared to regulate DMT1, and this regulation was able to override low body Fe signals.

Key Words: Cattle, Copper, Iron

100 The effects of trace mineral source on performance and health of newly received steers and the impact of cobalt concentration on performance and lipid metabolism in finishing steers. J. S. Schutz*¹, E. D. Sharman¹, J. J. Wagner¹, C. K. Larson², N. E. Davis¹, and T. E. Engle¹, ¹Colorado State University, Fort Collins, ²Zinpro Corporation, Eden Prairie, MN.

Two hundred and sixteen Angus cross steers purchased from salebarns (230 kg \pm 3.6) were utilized to determine the impact of trace mineral source and concentration on performance, tissue metabolites, and lipid metabolism. Treatments during the 27 d receiving phase consisted of: 1) Inorganic trace mineral (INORG; 125 mg Cu from CuSO₄; 360 mg Zn from ZnSO₄; 200 mg Mn from MnSO₄; and 12.5 mg Co from CoCO₃ h₂O) and 2) Organic trace mineral (ORG; iso-amounts of Cu, Zn, Mn as amino acid complexes, and Co glucoheptonate). On d 0 and 27, blood samples were collected from three steers per pen. On d 28, steers were transitioned to a high concentrate finishing diet containing different concentrations of Co. Treatments during the finishing

phase consisted of: 1) Control (no supplemental Co); 2) 0.10 mg Co/kg DM from cobalt glucoheptonate; 3) 1.0 mg Co/kg DM from cobalt glucoheptonate. The same three steers per pen were bled on d 27, 84, and 224 of the finishing phase. During the receiving phase, red blood cell superoxide dismutase activity was higher ($P < 0.03$) for ORG vs. INORG supplemented steers. During the finishing phase, overall ADG tended ($P < 0.06$) to be higher for steers receiving 1.0 mg Co/kg DM (1.65, 1.62, 1.71 kg \pm 0.03 for control, 0.10 mg Co/kg DM, 1.0 mg Co/kg DM treatments, respectively). Steers receiving 1.0 mg Co/kg DM had higher YG ($P < 0.04$; 2.53, 2.29, 2.73 \pm 0.11 for control, 0.10 mg Co/kg DM, 1.0 mg Co/kg DM treatments, respectively) and back fat thickness ($P < 0.04$; 1.54, 1.39, 1.71 cm \pm 0.08 for control, 0.10 mg Co/kg DM, 1.0 mg Co/kg DM treatments, respectively) than steers receiving 0.10 mg Co/kg DM. Serum, liver, and longissimus muscle B12 concentrations increased ($P < 0.04$) as dietary Co concentration increased.

Key Words: Cattle, Cobalt, Trace Mineral

101 The effect of ZinMet® brand zinc methionine on feedyard performance and carcass merit in crossbred yearling steers. J. J. Wagner¹, J. J. Wagner*¹, T. E. Engle¹, and G. Walker², ¹Colorado State University, Fort Collins, ²Global Animal Products, Amarillo, TX.

One hundred forty four crossbred yearling steers were utilized in a randomized block study to evaluate ZinMet® brand zinc methionine as a source of supplemental zinc for yearling feedlot steers. Treatments examined included: Control, 100 mg/kg DM supplemental zinc from zinc sulfate; and, ZinMet®, 40 mg/kg DM supplemental zinc from ZinMet® brand zinc methionine and 60 mg/kg DM supplemental zinc from zinc sulfate. There was a trend for increased live weight at d35 ($P = 0.07$) and d70 ($P < 0.18$) for steers fed ZinMet® as compared with steers fed the control trace minerals. Finished weight was similar for control and ZinMet® treatments (569.5 and 574.3 kg, respectively). The largest difference ($P < 0.05$) in average daily gain between treatments was observed for day 1 through 35 of the study (1.96 versus 1.63 kg/hd/d for the ZinMet® and control treatments, respectively). Average daily gains from day 1 through harvest were similar between treatments. Treatment was not a significant source of variation for dry matter intake (DMI). The greatest difference in DMI between treatments (0.16 kg per day, $P < 0.14$) occurred from day 1 through 34. Treatment had no effect on feed to gain or gain to feed ratio d1 through slaughter. The largest difference between treatments for feed to gain ($P < 0.17$) or gain to feed ($P < 0.16$) occurred from day 1 through 34. Treatment was not a significant source of variation describing recovered net energy for maintenance (NEm) or recovery of net energy for gain (NEg). Carcass weight, dressing percentage, yield grade, and quality grade were similar for control and ZinMet® treatments. Liver abscess rate was not different for the control and ZinMet® treatments. These data indicate that overall feedlot performance and carcass merit were similar for yearling steers fed ZinMet® brand zinc methionine or zinc sulfate as sources of supplemental zinc. Steers fed ZinMet® brand zinc methionine achieved greater ADG, DMI, and feed efficiency from d1-34 as compared with control steers.

Key Words: Zinc, Zinc Methionine, Organic Trace Minerals

102 Effect of trace mineral source on lactation performance, claw integrity and fertility of dairy cattle. J. L. Siciliano-Jones¹, M. T. Socha^{*2}, D. J. Tomlinson², and J. M. DeFrain², ¹*FARME Institute, Homer, NY*, ²*Zinpro Corporation, Eden Prairie, MN*.

Two hundred fifty multiparous and primiparous cows were assigned to a study at approximately 70 d prepartum to determine the effect of trace mineral source on lactation performance, claw integrity and fertility. Cows received treatments from 3 wk prepartum through wk 35 postpartum. Treatments consisted of 1) Sulfate, all supplemental Zn, Mn, Cu and Co provided in sulfate form; and 2) CTM, where 360 mg Zn, 200 mg Mn, 125 mg Cu and 12 mg Co supplied daily by sulfate minerals were replaced with similar amounts of minerals supplied by Availa^{®4} (Zinpro Corporation). Individuals involved with daily animal care and/or data recording were blinded to treatment assignments. Cows from all treatments were housed in common pens and treatments were dispensed to cows via a computerized feeder. All claws of cows were examined prior to treatment administration and at 16 and 36 wk postpartum by personnel trained in identifying claw lesions. Cows fed the CTM diet tended to produce more ($P \leq 0.10$) milk and energy-corrected milk than cows fed the Sulfate diet. Cows fed the CTM diet also produced more ($P \leq 0.05$) milk protein and solids (fat + protein) than cows fed the Sulfate diet. Replacing Sulfate minerals with those supplied by CTM decreased ($P \leq 0.05$) incidence of sole ulcers at wk 36 postpartum, and tended to decrease ($P \leq 0.10$) incidence of interdigital dermatitis at wk 16 and 36 postpartum. Severity of heel erosion tended to be less ($P \leq 0.10$) for cows fed CTM than cows receiving the Sulfate diet. Despite first service conception rates tending to be greater ($P \leq 0.10$) for cows fed the Sulfate diet, there was no effect of treatment on the rate at which cows became pregnant. A greater percentage of cows fed the Sulfate diet tended ($P \leq 0.10$) to be culled from the herd prior to wk 36 postpartum than cows fed the CTM diet. Replacing Sulfate minerals with CTM resulted in improved lactation performance and claw integrity.

Key Words: Trace Mineral, Dairy Cattle, Claw Lesion

103 Effect of nano selenium and organic zinc supplementation on lactation performance and milk selenium and zinc concentrations in dairy cows. W. Wen-Xuan^{*1}, X. Xian-Lin¹, Z. Yun-Guo², and W. Heng-Jin¹, ¹*Guizhou University, Guiyang, Guizhou Province, P. R. China*, ²*Xifeng Agricultural Bureau, Xifeng, Guizhou province, P. R. China*.

Both selenium and zinc are essential trace elements, and their deficiency has been to be associated with insufficient performance in dairy cows. In this study, twenty-seven clinically healthy multiparous Holstein cows in middle lactation (DIM=180) were randomly allocated to three blocks of 9 cows to examine the effects of nano selenium and organic zinc supplementation on lactation performance and milk selenium and zinc concentrations. Animals were fed one of three following diets: conventional diet (control), conventional diet and nano selenium (0.5mg/kg DM) (Treatment 1, T1); and conventional diet and nano selenium (0.5mg/kg DM) and organic zinc (37.8mg/kg DM) (Treatment 2, T2). There were no significant difference ($P > 0.05$) for the 10-day prefeeding data of dry matter intake (DMI); milk production and compositions of fat, and protein; and milk selenium and zinc concentrations in three blocks. The DMI in cows fed diet T1 tended to decrease compared with those on diet control (16.0 vs. 13.2; $P < 0.1$), but not for diet T1 (14.4; $P > 0.05$). Cows receiving diet control also produced increased milk

production relative to cows fed diet T1 and T2 (28.07 : 25.44 : 25.12; $P < 0.1$). There were no significant difference for milk fat (3.69 : 4.06 : 4.02; $P > 0.05$) and milk protein (2.98 : 2.95 : 3.02; $P > 0.05$) among three dietary treatments. Addition of nano selenium (T1 and T2) had no effect on milk selenium concentration (0.024 : 0.027 : 0.026; $P > 0.05$); however, zinc supplementation resulted in significant higher milk zinc level than diets control and T1 (3.80 : 4.00 : 9.00; $P < 0.05$). It is suggested, from the above-mentioned parameters, that organic zinc supplementation in the diet is beneficial for increase of milk zinc concentration; whereas the palatability should be improved due to the reduced DMI in the current study.

Key Words: Nano Selenium, Organic Zinc, Dairy Cows

104 The influence of calf Se status on glutathione peroxidase-1 and glutathione peroxidase-3 activities, and liver GPx-1 messenger RNA. G. Lum^{*}, J. Rowntree, K. Bondioli, M. McCarter, L. Southern, and C. Williams, *LSU Agricultural Center, Baton Rouge, LA*.

The purpose of this research was to determine the influence of dietary Se on erythrocyte glutathione peroxidase (GPx-1) and plasma glutathione peroxidase (GPx-3) activities and relative liver GPx mRNA levels in growing Holstein bull calves. Calves ($n = 14$) were started 28 d after birth on either a Se adequate (0.15 ppm Se) or deficient (0.01 ppm Se) diet until 180 d of age. Blood samples were taken from each calf at trial initiation, every 28 days, and at experiment end for determination of GPx-1 and GPx-3 activity. Four calves from each treatment were euthanized at d 180 of age for determination of liver GPx-1 relative mRNA level. Feed intake and average daily gain were not affected by Se level. The GPx-1 activity was greater for Se adequate than Se deficient calves ($P < 0.001$) but not until d 84 of age. The GPx-3 activity was more variable than that of GPx-1, and GPx-3 activity of the Se adequate group was only greater than that of the Se deficient group ($P < 0.05$) on d 180 of age. N-fold differences were calculated for relative GPx-1 mRNA levels between groups. There was a 50% decrease in GPx-1 mRNA for Se-deficient calves ($P < 0.05$) compared with Se-adequate calves. Regression analysis was performed on the data to determine the relationship between the various response variables. There was only a moderate relationship ($r^2=0.579$) between the n-fold difference in GPx-1 mRNA transcript levels and GPx-1 activity at d 180 of age, despite a correlation coefficient of 0.76. The relationship between the n-fold difference in GPx-1 mRNA and GPx-3 activity at d 180 of age was much stronger ($r^2=0.8087$), with a correlation coefficient of 0.899, which was unexpected, as GPx-3 is generally considered a more variable response and therefore a short-term indicator of Se status. In our trial, GPx-1 activity reflected diet Se concentration earlier than GPx-3. Although GPx-1 mRNA was positively correlated to both enzyme activities, n-fold differences on the transcript level were most associated with GPx-3 activity.

Key Words: GPx-1, mRNA, Selenium

105 Selenium partitioning between body compartments in lactating dairy goats supplemented with various sources and levels of Se. G. Caja^{*1}, C. Flores¹, A. Salama¹, and G. Bertin², ¹*Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain*, ²*Alltech France, Levallois-Perret, France*.

Four concentrates supplemented with different Se sources (SS, sodium selenite; SP, Sel-Plex[®] selenized *Saccharomyces cerevisiae* CNCM I-3060) and Se levels (control, 0.039; SS, 0.418; SP-1, 0.423; SP-2, 0.548 mg/kg DM), were fed to 4 balanced groups of Murciano-Granadina dairy goats (7 goats/group) from early- (35 DIM) to mid-lactation (147 DIM). Ration consisted of concentrate (0.72 kg DM/d) and a Se deficient forage mixture offered ad libitum (65% chopped tall fescue hay and 35% alfalfa hay pellets) to each goat group. Forage intake measured daily (1.33 ± 0.01 kg DM/d; 0.087 mg Se/kg DM) and FCM-3.5% yield (1.76 ± 0.13 L/d) recorded weekly did not vary between goat groups. Supplementation of dietary Se dramatically increased ($P < 0.001$) the Se content in all compartments studied in a dose dependent manner. Increase in Se contents were faster in plasma and milk, peaking at wk 6 to 8 from the start of supplementation. Passage from feed to milk and hooves was related to casein and keratin contents and was more efficient, for the same Se daily dose, when the selenized yeast form (SP) was used. Se speciation indicated dramatic increases in selenomethionine and selenocysteine, which were greater in milk with SP diets ($P < 0.001$). Dietary Se correlated exponentially ($R^2 = 0.78$) with Se in milk. Content of Se in hair was more than twice the Se content in hooves, but no differences between hair and hooves were found when SS and SP were compared at the same dose. Regarding the negative control group, Se content in hair decreased during the experiment from 500 to 450 ng/g which may be useful as reference value when Se is under the requirements in red and black coated goats. In conclusion, organic Se was more effective than inorganic Se for increasing Se content in the different compartments of lactating dairy goats, indicating a greater bioavailability of Se from selenized *Saccharomyces cerevisiae* CNCM I-3060 and the possibility of producing Se enriched goat milk and cheeses as functional foods.

Table 1. Partitioning of Se according to dietary source and dose in lactating goats

Se, ng/g	Control	SS	SP-1	SP-2	SEM	P
Whole blood	155 ^c	329 ^b	313 ^b	391 ^a	13	0.001
Plasma	51 ^c	123 ^{ab}	113 ^b	132 ^a	5	0.001
Milk	9.2 ^d	13.8 ^c	19.5 ^b	39.7 ^a	0.9	0.001
Hair	482 ^c	730 ^b	699 ^b	900 ^a	39	0.001
Hooves	204 ^d	313 ^c	394 ^{ab}	350 ^{bc}	25	0.001

a, b, c, d $P < 0.05$

Key Words: Selenium, Micromineral, Dairy Goats

106 Effectiveness of potassium bicarbonate to increase dietary cation-anion difference in early lactation cows. R. White¹, J. Harrison¹, R. Kincaid², E. Block³, and N. St. Pierre⁴, ¹Washington State University, Puyallup, ²Washington State University, Pullman, ³Church and Dwight, Princeton, NJ, ⁴The Ohio State University, Columbus.

Thirty Holstein cows (15 per treatment) were used in a continuous design lactation study to evaluate the effectiveness of potassium bicarbonate as a cation to increase dietary DCAD from ~ 25 to 42. The study was conducted from mid August to mid December. Cows were fed individually via Calan[®] feeding gates one of two treatment diets formulated to be equal in all nutrients except potassium. The potassium level of the control diet was ~ 1.2% of DM and increased to ~ 1.8% of DM using potassium carbonate (DCAD Plus[®], Church & Dwight, Princeton, NJ) for the DCAD+ treatment. Diets consisted of (%DM): alfalfa hay (13.4), corn silage (12.1), blue grass straw (8.6), corn distillers grains with

solubles (10.3), whole cottonseed (6.2), and grain-mix (49.4). Cows were assigned at random to one of the two dietary treatments at ~ 15 DIM and continued through ~ 105 DIM. Production data and composition were analyzed as a mixed model with the fixed effects of treatment, week, and their interactions, and the random effect of cows within treatment, using an AR(1) correlation structure for the errors. Linear and quadratic orthogonal polynomial contrasts were used, and weekly means were compared with the slice option of the MIXED procedure (SAS V9.1) when one of the polynomial degree was significant. The treatment x week quadratic effect was significant ($P < 0.0002$) for milk production indicating that the milk production curves were significantly different between the two treatments. Significant differences ($P < 0.065$) in milk production were noted at weeks 5, 6, 7, and 8 of the study. Milk production was 43.9, 43.2, 44.2, and 42.2 kg/d for DCAD+ treatment, and 40.5, 39.7, 40.2, and 39.2 kg/d for control treatment, at weeks 5, 6, 7, and 8 of the study, respectively. Milk fat % was significantly different ($P < 0.05$) and was 4.31 for DCAD+ and 3.96 for control. Milk true protein % was significantly ($P < 0.05$) different and was 2.79 for DCAD+ and 2.96 for control. Results indicate that potassium bicarbonate can be used to effectively increase DCAD in early lactation cows with a resulting increase in milk production and milk fat percent.

Key Words: Dairy, DCAD, Potassium Bicarbonate

107 Phosphorus excretion in lactating cows fed diets supplemented with fat. Z. Wu*, J. D. Ferguson, and D. W. Rensburg, *University of Pennsylvania, Kennett Square.*

The effect of supplemental fat on P utilization in dairy cows was determined using the following 4 dietary treatments formed in a 2×2 factorial arrangement: low P, low fat (LPLF); low P, high fat (LPHF); high P, low fat (HPLF); and high P, high fat (HPHF). The P content of the diet was 0.34 or 0.43%, and the fat content 3.0 or 5.4%. The levels were varied by adding monosodium phosphate and soybean oil to LPLF that contained no supplemental P or fat. Soy oil was top-dressed onto the TMR. Two thirds of the diet was provided by corn silage and grass silage for all treatments. Forty mid-lactation (172 ± 32 DIM) Holsteins (16 primiparous) were used among the 4 treatments for 5 wk following a 2-wk covariate period; however, one primiparous cow in HPLF was culled during trial for reasons unrelated to treatments. Dietary P amount did not affect lactation performance, whereas increasing dietary fat reduced milk fat content. Increasing dietary P increased fecal P concentration, whereas supplementation of the diet with fat tended to reduce fecal P content. Consistent with the 2001 NRC, 0.34% dietary P appeared adequate for mid-lactation cows milking 30 kg/d, and increasing the level may increase fecal P excretion; supplemental fat may reduce P excretion. (Research was supported in part by Pennsylvania Department of Agriculture)

Table 1.

Item	LPLF	LPHF	HPLF	HPHF	SEM	P ¹	F ¹	P x F ¹
DMI, kg/d ²	20.5	20.5	20.2	19.7
Milk, kg/d	29.8	30.0	30.0	28.5	1.0	0.75	0.51	0.49
Fat, %	3.83	3.21	4.04	3.03	0.17	0.17	0.01	0.73
Fat, kg/d	1.133	0.866	1.076	0.832	0.065	0.49	0.01	0.86
Protein, %	3.08	3.21	3.06	3.24	0.08	0.98	0.08	0.74
Protein, kg/d	0.922	0.972	0.830	0.913	0.047	0.12	0.17	0.74
Fecal P, %	0.80	0.79	1.08	0.95	0.03	0.01	0.08	0.11

¹P values for the effect of P, fat, and their interaction. ²Group-fed average.

Key Words: Phosphorus Excretion, Fat Supplementation, Milk Fat

108 Effect of feeding rumen-protected niacin on core body temperature and milk production in lactating Holstein dairy cows during summer heat stress. R. B. Zimbleman*, R. J. Collier, and T. R. Bilby, *University of Arizona, Tucson.*

Niacin has been shown to increase resistance to thermal stress in cattle by increasing whole body evaporative heat loss and cellular heat shock response to thermal stress in vitro. As raw niacin is extensively degraded in the rumen, this study utilized encapsulated niacin (NIASHURE[®]) to determine effects on body temperature, milk yield and composition. A total of 400 lactating primiparous and multiparous Holstein cows were randomly assigned to a switchback design (two 30d periods) of either control (C, no niacin n=200) or rumen-protected niacin (RPN, cows supplemented with 12g/d/cow of encapsulated niacin, n=200). Groups were balanced for DIM (166 +/- 11), milk yield, and parity prior to start of the study which was conducted from August 7th thru October 7th, 2007 on a commercial dairy in Arizona. Milk yields were recorded 3X daily and a monthly milk sample was collected for milk components. Vaginal temperatures were collected using thermochron iButtons (MAXIM Integrated Products Inc., Sunnyvale, CA) temperature loggers attached to an intravaginal device and inserted into a random sub-sample of cows (n=16) from each pen (n=2) with similar DIM, milk yields, and parity for 7 d. Body core temperatures were decreased for the RPN group during periods of peak thermal load from 1300 to 1600 h (P<0.01). Milk fat and protein percent was elevated in the RPN versus C groups (3.65 vs. 3.38 and 3.09 vs. 3.05 %, respectively; P<0.01). Subsequently both fat- and energy-corrected milk was greater for cows in the RPN group compared with cows in the C group (39.7 vs. 38.2 and 39.6 vs. 38.4 kg, respectively; P<0.01). In addition, both fat- and energy-corrected milk was increased in multiparous compared to primiparous cows (40.7 vs. 37.2 and 40.7 vs. 37.3 kg; P<0.01). However, groups did not differ in milk yield or DMI. In conclusion, supplementing lactating cows with rumen-protected niacin during summer heat stress reduced core body

temperature and increased both fat and protein percent, in turn, elevating fat- and energy-corrected milk yields.

Key Words: Niacin, Heat Stress, Dairy Cattle

109 Biological activity of vitamin E in dairy cows. S. K. Jensen*, *University of Aarhus, Tjele, Denmark.*

α -Tocopherol (α -toc) demonstrate the highest vitamin E activity, and is available both as natural RRR- α -toc isolated from plant sources, and as a synthetic racemic mixture of all eight possible stereoisomers α -all-rac- α -toc. The increased use of vegetable oil for technical purposes increase the possibility for isolating different natural by-products from the oil residue, including tocopherols. Assessing the correct biological activity in form of bioavailability and biopotency is a great challenge, due to difficulties by measuring clinical endpoints in larger animals than rats and poultry. Due to the lack of good biological markers for bioactivities, bioavailability is often used as one of the surrogate markers for bioactivities. Therefore, analysis of the individual stereoisomers of α -tocopherol, is an important tool in order to quantify relative bioavailability of the individual stereoisomers. I.m. injection of 2.5 g all-rac- α -toc acetate into 4 dairy cows produced a rapid increase in plasma concentration of α -toc, and for all stereoisomers maximal concentration (Cmax) was achieved 1 day after injection, with a total α -toc concentration of 16.9±0.8 μ g/ml plasma. The highest Cmax was obtained by RRR- α -toc in plasma, followed by the sum of the four 2S stereoisomers, leaving the three synthetic 2R-stereoisomers with the lowest Cmax (P<0.001). The relative bioavailability in plasma of the 2R stereoisomers was significant higher than the 2S stereoisomers (P<0.001). Expressed in terms of relative availability the average availability of 2S- α -toc is six times lower than RRR- α -toc. In milk the absolute secretion of the individual stereoisomers varied from 0.67 % of the injected amount for the 2S stereoisomers over 6.5 % on average for the three synthetic 2R stereoisomers to 16.3% for RRR- α -toc. A calculation of total α -toc secretion into the milk after a single injection of 2.5 g all-rac- α -toc acetate gave an average secretion of 6.4±0.9% (mean ± SD) of injected amount.

Key Words: Natural Vitamin E, Stereoisomers, Bioavailability

ADSA-SAD (Student Affiliate Division) Undergraduate Competition: Dairy Foods

110 Conjugated linoleic acids and their effect on dairy marketing. R. M. Haines*, B. A. Corl, and D. R. Winston, *Virginia Polytechnic Institute and State University, Blacksburg.*

Conjugated linoleic acids (CLA) are 18 carbon fatty acids with two conjugated double bonds. Several CLA isomers exist in ruminant food products; the placement and type of double bonds help determine the chemical properties and health benefits associated with that isomer. Of these CLA isomers, *cis-9, trans-11* is most important, exhibiting cancer fighting properties when found in high enough tissue concentrations. Specifically *cis-9, trans-11* prevents and reduces the incidence of malignant mammary tumors in both rodents and more recently in human studies. Milk products are the leading source of *cis-9, trans-11* CLA in the diet as this isomer comprises 90% of the CLA in milk fat. While supplements are available to supply higher levels of CLA in the body, dairy products are a better source of the compound. Specifically, consumption of milk products produces higher *cis-9, trans-11* tissue concentrations than chemically prepared supplements because dairy products contain vaccenic acid, a precursor to the *cis-9, trans-11* isomer. Vaccenic acid can be used to synthesize CLA in body tissues as demonstrated in cows, rodents, swine and humans. Dairy products also produce higher tissue concentrations of *cis-9, trans-11* because this isomer is in higher concentrations in milk fat than in supplements. While *cis-9, trans-11* comprises 90% of CLA in milk fat; the average supplement is only 44.81% *cis-9, trans-11* isomers. The *trans-10, cis-12* isomer is found in commercial supplements in roughly equal quantities to *cis-9, trans-11* CLA. *Trans-10, cis-12* has been linked to hyperinsulinemia and insulin resistance in rodents which makes future research necessary to investigate the safety of this isomer. Additionally, high-CLA milk products are acceptable to consumers, with taste panels identifying no significant difference in color, taste, or overall quality when compared to traditional milk. Because of this lack of sensory difference and health benefits associated with consumption of high-CLA dairy products, consumers expressed a willingness to pay generous price premiums for high-CLA milk products that could provide opportunities to expand milk marketing and increase revenue for the dairy industry.

Key Words: Conjugated Linoleic Acid

111 Probiotics: For life. S. Quarles*, *Clemson University, Clemson, SC.*

Dairy product consumption transforms with the landscape of the U.S. population. Consumer standards, wants, and needs are ever changing. Recent commercialization identifies a growing consumer demand; probiotics. Easy enough for the manufacturers, as these microscopic flora have been part of the dairy industry for centuries. What has caused this new attraction to these beneficial products? Knowledge. With all the information available it is easy to see why these products are a good investment; given society is growing more health conscious. According to a conference held by the National Center for Complimentary and Alternative Medicine (NCCAM), specific aims for probiotics include treatment of intestinal irregularities and the prevention of certain infections of the female reproductive tract, cancer recurrence, and atopic dermatitis in children. Microorganisms are naturally found in the human gut and most are beneficial for the digestive process; however, some may have detrimental effects on the human system. Diarrhea is a common

ailment caused by viral or bacterial infections and can be exacerbated by the use of antibiotics. Research has found the most beneficial bacterial strains are those of *Lactobacillus* which remedy digestive disturbances and are known to maintain a healthy environment in the female reproductive system. Lactose intolerance, a condition involving low levels of lactase, can be eased by the ingestion of probiotics which aid in the body's digestion of lactose. A correctly operating digestive system will benefit the immune system by providing vitamins and minerals allowing probiotics to concurrently boost immune defenses. By incorporating probiotics into their products, dairy manufacturers have a chance to boost sales and improve the consumer image of dairy products. According to market reports, the probiotic's sector is expected to increase in the coming years with yogurt and yogurt beverages being the biggest contenders. Continuing education will solidify this growth. Product innovation is a key factor in increasing market share, says the author of the Frost and Sullivan report on the U.S. probiotics market; a market that will continue to expand for probiotics are for a healthy life.

Key Words: Probiotics, Dairy, Foods

112 No spoon required: The changing face of yogurt. A. J. Koons*, *Pennsylvania State University, University Park.*

Drinkable yogurt is one of the fastest growing food segments in the world. This product is defined as a dairy-based yogurt in a liquid form, usually containing fruit or fruit flavoring. According to Nielsen market research, annual sales of drinkable yogurt from 2005 to 2006 rose 18.4%, with a 2006 value of \$7.76 billion. Drinkable yogurts offer many health benefits that may enhance both digestive and immune functions. The Dannon Company surveyed 565 physicians throughout the nation and found that doctors who regularly discuss nutrition with patients recommended consuming yogurt with live and active cultures. Many studies have demonstrated the health benefits of probiotics found in yogurts and other fermented milk products. Additionally, drinkable yogurts often contain the prebiotic inulin, a natural dietary fiber, which enhances calcium absorption and stimulates the growth of probiotic organisms. Yogurt preferences differ by consumer age and other factors. A study conducted by the University of Helsinki compared the importance of sensory properties of yogurt-type snack foods between the young and elderly. When evaluating the importance of taste, texture, and aroma, the elderly subjects gave taste a 46% importance rating compared to younger subjects who only assigned it an 8% rating. Aroma was the most significant factor in both age groups but was much more important for the younger subjects who rated its importance at 80%. A North Carolina State University study showed that preferences among strawberry drinkable yogurts differed due to ethnicity; however, it was not the sole reason affecting the choice of product. Color, sweetness, aroma, perceived health benefits, and other factors influenced consumer preference. Researchers at Washington State showed that yogurt products provide satiety. They found liquid yogurts and conventional yogurts reduce hunger and increase fullness when compared to fruit drinks and dairy fruit drinks. The popularity of drinkable yogurts should continue to increase as new products are introduced to target specific audiences in the marketplace.

Key Words: Drinkable Yogurt, Probiotic, Prebiotic

113 More than what meets the eye: Labeling of milk. A. L. Pitre*, *Louisiana State University, Baton Rouge.*

Labeling of milk has always been important in the industry; however, over the past few years, it has become somewhat of an enemy to our dairy producers. Labels are extremely important for the saleability of milk and its products. Farmers want the consumer to be informed and want their products to be marketed as to not mislead the consumer. They want the consumer to be able to make an educated healthy choice that is safe for all. Several problems arise in this feat. For example, some companies use what is known as “absence labeling”. In absence labeling, such phrases as “antibiotic free” or “hormone free” appear on the label. This is often found with companies who try to distinguish themselves from others. These “inaccurate” labels have caused a huge uproar in our industry. Some of the labels have little to no scientific research to prove or support what they are trying to sell. Producers that are selling “hormone free” milk are claiming that their milk is bST-free but what about the amount of bGH that naturally occurs in the cow? Even if cows are not injected, a small amount of growth hormone is present in all milk, including organic milk. For more than twenty years, this specific claim has been studied extensively. There are no indications that milk used from treated and non-treated cows is compositionally different. Producers work extremely hard at keeping all food items as safe and healthy as possible. Producers strive to inform the public that all milk is safe and antibiotic free. It is their main goal to produce safe, high quality milk by caring for their cows in order to create a wholesome product. All producers are mandated by the state and federal government and must meet certain standards and pass rigorous inspections. We want all consumers to know that milk is safe and ‘does a body good’. DRINK MORE MILK!!!

Key Words: Milk, Labeling, Food Safety

114 Use of whey proteins in food products. M. Welper*, *Iowa State University, Ames.*

Whey protein is comprised of four main types of protein: β -Lactoglobulin, α -Lactoglobulin, bovine serum albumin, and Immunoglobulin G. They can be extracted from raw milk in a variety of ways, including micro-filtration, ultra-filtration, and ionization. Whey proteins are often added to foods as a binding agent, egg replacement, or as a functional ingredient in products such as ice cream and milk replacer. In addition to these traditional uses, nutrition experts are now investigating the use of whey protein in dietetic and health foods, as well as a key ingredient in infant formulas. Recent research has shown that, when used along with a healthy diet and exercise, whey proteins may have a positive affect on muscle mass, bone density, cardiovascular health, and immunity; also reducing/preventing symptoms of hypertension and type II diabetes. One of the main reasons for these beneficial characteristics may be the protein’s ability to enhance absorption, transportation, and synthesis of several key nutrients, like calcium, in the body’s digestive system. Whey protein also contains a broad array of essential amino acids and immunoglobulins; both of which are critical components in the diets of many teens and adults. The novel uses of whey proteins will not only provide a highly nutritional and versatile food additive but also additional revenue for today’s dairy producers.

Key Words: Whey Protein

Animal Health II

115 Wildlife threat for disease transmission to domestic livestock. S. C. Olsen*, *National Animal Disease Center, Ames, IA.*

The role of wildlife as reservoirs for emerging or re-emerging diseases in domestic livestock has increased in importance over the last decade. Although this review will primarily focus on diseases issues in the United States, disease issues related to the interface between wildlife and domestic livestock are being increasingly recognized worldwide. Pathogens transmitted between wildlife and domestic livestock include viruses, bacteria, and protozoa, which in many instances are zoonotic. For some diseases, wildlife were initially infected from domestic livestock, whereas in others, the disease was most likely endemic in wildlife hosts. Examples of cattle diseases transmitted from wildlife include: brucellosis, tuberculosis, Johne's disease, bovine viral diarrhoea, and neoplasia. Examples in swine, include brucellosis, pseudorabies, influenza, and exotic viruses. Rabies, West Nile, and equine protozoa myelitis (*Sarcocystis neurona*) are examples of diseases transmitted from wildlife to horses. In poultry, influenza and Newcastle's disease are examples. Changes in livestock housing and husbandry practices have influenced transmission of diseases from wildlife. Disease transmission has also been impacted by human recreational activities, changes in land use and demography, and changes in wildlife populations and their behaviour. Current knowledge would suggest that reservoirs of disease in wildlife will continue to impact domestic livestock. New vaccines, diagnostics, treatments, and changes in husbandry/management will be necessary to minimize the economic impact of wildlife diseases on domestic livestock.

Key Words: Disease, Transmission, Wildlife

116 Providing veterinary healthcare to underserved counties in Pennsylvania through credentialed veterinary technicians. D. W. Rensburg*, D. T. Galligan, and J. D. Ferguson, *University of Pennsylvania School of Veterinary Medicine, Kennett Square.*

Providing healthcare and preventative medicine to food animals is critical to maintaining food safety, national biosecurity and farm sustainability. Based on 2006 data obtained from the AVMA and AABP seven Pennsylvania counties (10%) have farms in dairy or beef production without a resident veterinarian in food supply veterinary medicine (FSVM). Based on a profile of Pennsylvania farm size and expected expenditures to bovine veterinarians, counties with at least one FSVM practitioner had a mean veterinary healthcare expenditure of \$1.2 million, \$274,421 per food animal veterinarian. Counties with no FSVM practitioners were assumed to have little or no veterinary service but based on dairy and beef animal numbers, had a potential mean veterinary healthcare expenditure of \$220,729; this represents approximately 80% of the expected expenditures needed to support a veterinarian. Counties with FSVM veterinarians had a mean value of 6,515 total cattle (6,220 beef and 2029 dairy) per vet; counties without FSVM practitioners had on average 7,329 total cattle including 5,757 beef and 1,571 dairy cattle. However, the density of veterinary expenditures was substantially lower in counties without FSVM practitioners (\$383/sq. mile) compared to counties with FSVM veterinarians (\$1,877/sq. mile). This may account for the disparity in veterinary service since veterinarians wishing to

engage in bovine practice would have to travel farther between farms, thereby diluting earnings at each farm. Credentialed veterinary technicians could expand the range of current neighboring practices or be remotely supervised by their veterinary employers in satellite practices. This provides veterinary practices the opportunity to increase the number of farms served and thereby increase their market for high profit margin services or products. Additionally, it provides a cost-effective solution that will ensure Pennsylvania's dairy and beef producers have access to the veterinary healthcare resources required to remain sustainable.

Key Words: Veterinary Technician, Veterinary Shortage, Rural Veterinary Service

117 A Bootstrap method for the estimation of reference intervals of biochemical parameters. C. Dimauro*¹, P. Bonelli², P. Nicolussi², N. P. P. Macciotta¹, and G. Pulina³, ¹*Dipartimento di Scienze Zootecniche University of Sassari, Sassari, Italy,* ²*Istituto Zooprofilattico Sperimentale per la Sardegna, Sassari, Italy,* ³*AGRIS Sardegna, Sassari, Italy.*

Reference intervals are largely used in veterinary medicine being a fundamental element for making clinical diagnosis on animals. The International Federation of Clinical Chemistry (IFCC) recommends the use of both parametric and non-parametric methods to estimate reference intervals. For both methods, the necessary condition is that a sample of at least 120 apparently healthy individuals has to be used. In this paper we suggest a method based on bootstrap procedure to reduce, without losing accuracy, the minimum number of requested apparently healthy individuals to discover reference intervals for biochemical parameters. Bootstrapping is a computer intensive resampling method that allows to estimate the population mean and its standard error (SE). Reference intervals for biochemical parameters are then calculated as $(m \pm 2s) \pm 1.96 \sqrt{(s^2(1/n + 2/(n-1)))}$, where m is the bootstrap mean, n is the sample size and $s = SE \cdot \sqrt{n}$ where SE is the bootstrap standard error. Reference intervals were calculated using a decreasing sample size on a dataset of 14 biochemical parameters measured on 120 apparently healthy Sarda dairy sheep. An example of estimated reference intervals for alanine aminotransferase (ALT) and aspartate aminotransferase (AST) using this approach is shown in table 1. Results suggested that the limits of reference intervals were efficiently estimated until a minimum sample of around 60 animals and began to diverge below this limit.

Table 1: Bootstrap reference intervals and 95% CI (in brackets) for ALT and AST for decreasing sample size in dairy sheep

Sample size	ALT(U/L)		AST(U/L)	
	Reference limits		Reference limits	
	Lower	Upper	Lower	Upper
120	9.4 (7-12)	37.7 (35-40)	63.3(52-75)	212.8(201-224)
80	9.4 (7-12)	37.6 (35-40)	62.7(48-77)	214.8(200-229)
70	9.2 (6-12)	37.7 (35-41)	62.4(47-79)	213.8(198-229)
60	9.2 (6-12)	37.5 (34-41)	63.1(47-80)	211.4(195-228)
50	8.9 (5-13)	38.1 (35-44)	61.4(43-80)	213.0(195-231)

Key Words: Reference, Interval, Bootstrap

Graduate Student Paper Competition: ADSA-ASAS Northeast Section

118 Feeding heat-treated colostrum increases IgG absorption in neonatal dairy calves. J. A. Elizondo-Salazar*, A. J. Heinrichs, R. F. Roberts, and M. R. Long, *The Pennsylvania State University, University Park.*

Newborn Holstein heifer calves were studied to compare absorption of immunoglobulins G, total serum protein levels, and T cells from unheated or heat-treated colostrum. First milking colostrum with > 50 g IgG/L (measured by colostrometer) was collected from Holstein cows and frozen at -20°C until a total of 106 L were accumulated. Once collected, colostrum was thawed at 4°C and pooled in a commercial batch pasteurizer to create a uniform batch. Colostrum was thoroughly mixed at 4°C for about 20 min. 53 L of colostrum were transferred into 1.89 L containers and frozen at -20°C until needed for feeding. The remaining 53 L were heated at 60°C for 30 min, transferred into 1.89 L containers, and then frozen at -20°C until needed for feeding. A total of 28 calves weighing ≥ 35 kg at birth were systematically enrolled into 1 of the 2 treatment groups. Calves were separated from their dams at birth before suckling occurred. Before feeding colostrum, a jugular blood sample was collected from each calf. For the first feeding, 3.8 L of colostrum were bottle fed by 1 to 2 h of age. To ensure that all calves received an equal amount of colostrum, an esophageal feeder was used in calves with reduced appetite. For the second and third feeding, pasteurized whole milk at 5% of birth BW was fed. For the remaining time, calves were fed milk replacer (20% CP, 20% fat) at 10% of birth BW in 2 daily feedings until wk 5. Then it was reduced to only a.m feeding until weaning at 6 wks of age. Blood samples were collected, at 24 and 48 h of age and at wk 1 to 6. Serum from samples was used to measure IgG levels, total serum protein and T cells. Calves fed heat-treated colostrum had significantly greater IgG₁ and total IgG concentrations compared with calves fed unheated colostrum. There was no effect of treatment on total serum protein or T cells.

Table 1. Total serum protein and IgG levels.

Age	Total Serum		Protein (g/L)		IgG ₁ (g/L)		IgG ₂ (g/L)	
	Heated	Unheated	Heated	Unheated	Heated	Unheated	Heated	Unheated
24 h	5.6	5.5	21.5 ^a	18.6 ^b	1.1	1.0		
48 h	5.7	5.6	21.2 ^a	18.4 ^b	1.1	1.0		
1 wk	5.6	5.5	20.5 ^a	17.9 ^b	1.1	0.9		
2 wk	5.6	5.5	19.6 ^a	17.1 ^b	1.1	0.9		
3 wk	5.4	5.3	18.2 ^a	15.9 ^b	1.0	0.9		
4 wk	5.2	5.1	16.6 ^a	14.4 ^b	0.9	0.8		
5 wk	5.0	5.0	14.6 ^a	12.6 ^b	0.8	0.8		
6 wk	4.7	4.7	12.3 ^a	10.5 ^b	0.7	0.8		

P < 0.05

Key Words: Colostrum, Immunoglobulin, Passive Transfer of Immunity

119 Mammary and liver lipogenic gene expression in lactating mice fed diets supplemented with trans-18:1 isomers or t10c12 CLA. A. K. G. Kadegowda*¹, E. E. Connor², B. B. Teter¹, J. Sampugna¹, L. S. Piperova¹, and R. A. Erdman¹, ¹University of Maryland, College Park, ²USDA-ARS, Beltsville, MD.

The coordinated suppression of lipogenic pathways during milk fat depression (MFD) has suggested the involvement of a global regulator of lipogenic gene expression. Recent studies (Peterson et al., 2004; Harvatine et al., 2006) have implicated SREBP1 as the central regulator of fatty acid (FA) synthesis. The objective of this study was to examine the effects of trans-18:1 isomers or t10c12 CLA on mammary and liver lipogenic gene expression in lactating mice. Thirty lactating C57Bl6J mice were randomly assigned (n=5) to 6 diets supplemented with one of the following isomers t-7-, t-9-, t-11-18:1, t10c12-CLA (CLA) or PHVO (partially hydrogenated vegetable oil) from d6 to d10 postpartum (PP). Milk, mammary and liver samples were collected on d10 PP. Expression of genes involved in de novo FA synthesis (ACACA, FASN), desaturation (SCD1, SCD2), triacylglycerol (TG) synthesis (AGPAT), FA uptake (LPL), transcriptional regulation (SREBP1, ChREBP, INSIG1, SCAP, MLX, THRSP) and nuclear receptor signaling (PPARA, PPARG, LXRA, RXR) were tested by qPCR. Milk fat percentage was decreased by CLA (44%; *P*<0.001), t-7-18:1 (27%; *P*<0.001) and PHVO (23%; *P*<0.001), compared to Control. In the mammary gland, CLA decreased (*P*<0.001) the genes related to de novo FA and TG synthesis and desaturation, and genes involved in transcriptional regulation including SREBP1, ChREBP, PPARA and THRSP (*P*<0.05). PHVO and t-7-18:1 decreased the expression of AGPAT, SCD1 and THRSP (*P*<0.05). Similar to CLA, PHVO decreased SREBP1 and PPARA (*P*<0.05), while t-7 up-regulated SCAP and MLX (*P*<0.05). The measured genes were not altered by t-9- or t-11-18:1 in mammary gland. In liver, AGPAT was down regulated (*P*<0.05) with MFD, while expression of other lipogenic genes was not altered. Opposite to mammary gland, CLA up-regulated SREBP1 and PPARA (*P*<0.05) and decreased PPARG (*P*<0.05). The results showed that, in addition to SREBP1, other transcriptional regulators could be involved in milk fat synthesis.

Key Words: Lactating Mice, Trans Fatty Acids, Gene Expression

120 Photoperiod regulates diurnal expression patterns of genes related to immune function in PBMC of heifers. L. E. Lord*, X. S. Revelo, and T. B. McFadden, *University of Vermont, Burlington.*

Photoperiod can be manipulated to enhance efficiency of animal production. Skeletal long day photoperiods (SLD) involve exposure to brief pulses of light during photosensitive periods to mimic long day photoperiods (LD). Thus, SLD could be used to alter photoperiod while minimizing energy costs. We hypothesized that exposure to SLD would elicit changes in gene expression similar to those under exposure to LD. Holstein heifers were exposed to short day photoperiod (SD; 9 h light: 15 h dark; 9L: 15D, n=10) for 3 wk, followed by LD (15L: 9D, n=5) or SLD (2L: 11D: 2L: 9D, n=5) for 4 wk to test for effects on gene expression in peripheral blood mononuclear cells (PBMC). Blood was collected at 0600, 1200, 1900 and 2400h on the last day of treatments. PBMC were isolated to quantify expression of major histocompatibility complex Class I (MHC), indoleamine 2,3-dioxygenase (IDO), and long form prolactin receptor (PRLr) genes, which are photoperiod-responsive and play a role in immune function. Under SD, expression of IDO and PRLr varied during the day (*P*<0.02). Expression of all 3 genes showed significant (*P*<0.07) diurnal variation during exposure to LD or SLD, however expression patterns differed markedly from SD. Expression of MHC and IDO did not differ (*P*>0.16) between LD and SLD treatments

whereas expression of PRLr tended to be lower in SLD compared to LD ($P = 0.09$). These data demonstrate diurnal variation in expression of these 3 genes in PBMC. The similarity of gene expression profiles on SLD or LD suggest that skeletal photoperiods could be used to alter immune function in heifers.

Table 1. Effects of photoperiod and time of day on gene expression in PBMC

		Treatment Means				P-value
		0600h	1200h	1900h	2400h	Time
MHC	LD	0.73 ^a	0.82 ^a	1.55 ^b	0.62 ^a	0.004 ¹
	SLD	1.20 ^a	0.68 ^b	1.30 ^a	0.45 ^b	
	SD	0.67 ^a	1.05 ^b	0.83 ^{ab}	0.79 ^{ab}	0.11
IDO	LD	0.73 ^a	0.75 ^a	1.24 ^b	0.83 ^{ab}	0.007 ¹
	SLD	0.99 ^a	1.16 ^a	1.74 ^b	1.08 ^a	
	SD	1.61 ^a	1.36 ^{ac}	1.01 ^{bc}	0.71 ^b	0.019
PRLr	LD	1.16 ^a	0.98 ^{ab}	0.65 ^b	0.93 ^a	0.07 ¹
	SLD	0.57 ^a	0.65 ^a	0.54 ^a	1.03 ^b	
	SD	0.12 ^a	0.44 ^b	0.52 ^b	0.18 ^a	0.0002

^{a, b, c} Means within a row differ ($P \leq 0.05$); ¹Main effect of time across LD and SLD treatments.

Key Words: Photoperiod, Gene Expression, Immune Function

121 Colicin E1 and EDTA have additive antimicrobial effects against *Escherichia coli* isolates in bovine milk. J. M. Scudder^{*1}, C. H. Stahl², and M. R. Waldron¹, ¹University of Vermont, Burlington, ²North Carolina State University, Raleigh.

Colicins are antimicrobial proteins produced by some strains of *E. coli* that are lethal against other strains of *E. coli* and species of bacteria. Milk components, such as calcium and magnesium have been shown to inhibit the activity of antimicrobial peptides; however, the addition of EDTA displaces these cations and destroys the casein micelles. The objective of the current study was to determine the efficacy of purified colicin E1 (ColE1), EDTA, and a ColE1/EDTA combination against a variety of mastitis-causing bacterial strains in several media. A factorial arrangement of treatments was used to test ColE1 and EDTA at concentrations of 0, 100 and 250 μ g/ml and 0, 10 and 20mM respectively, in media, whole, and skim milk. Antimicrobial activity of the treatments was determined after quantification of bacteria at several incubation time-points by serial dilution and direct plating. ColE1 did not inhibit the growth of *Klebsiella pneumoniae*, *Staphylococcus aureus*, or *Streptococcus uberis* in Luria-Bertani media (LB) at a concentration of 250 μ g/ml ($P > 0.50$), eliminating further investigation of antimicrobial effects against those microbes. The antimicrobial effects of ColE1 were similar against both *E. coli* 25922 and *E. coli* P4:O32; thus, the results for these *E. coli* strains were pooled prior to statistical analysis. When *E. coli* were incubated in LB, combinations of ColE1 \geq 100 μ g/ml and EDTA \geq 10mM resulted in killing and complete growth inhibition ($P = 0.02$). In whole milk, combinations of ColE1 \geq 100 μ g/ml and 20mM EDTA resulted in killing and complete growth inhibition of *E. coli* ($P < 0.01$). In skim milk, *E. coli* growth was completely inhibited by 4 hours when 250 μ g/ml ColE1 and 20mM EDTA were added to the growth cultures ($P = 0.02$). Taken together, these results show that

a ColE1/EDTA combination is effective at both killing and inhibiting growth of *E. coli* in bovine milk.

Key Words: Colicin, Antimicrobial, EDTA

122 Skeletal muscle satellite cells do not spontaneously adopt adipogenic fates. J. D. Starkey^{*}, M. Yamamoto, S. Yamamoto, and D. J. Goldhamer, University of Connecticut, Storrs.

Muscle satellite cells are known to play key roles in the growth and maintenance of skeletal muscle tissue. Accumulation of intramuscular adipose tissue is commonly observed in aged and dystrophic skeletal muscle and its abundance is a key factor in determining meat quality. The myogenic regulatory factor, *MyoD*, is involved in embryonic myogenic lineage commitment and is expressed in satellite cell precursors. Recent reports indicate that skeletal muscle satellite cells have the capacity to adopt adipogenic phenotypes in culture. We investigated the myogenic commitment state of skeletal muscle satellite cells in mice using novel Cre/loxP recombination lineage tracing technology. To facilitate the permanent labeling of the vast majority of satellite cells, we developed mice with *Cre recombinase* knocked into the *MyoD* locus (*MyoD^{Cre}*) and crossed them with Cre-dependent reporter mice (*R26R^{EYFP}*) to generate offspring carrying both alleles. Cells from these mice that have expressed the *MyoD* locus constitutively express *enhanced yellow fluorescent protein* (EYFP) from the Cre-recombined reporter locus. Single *extensor digitorum longus* myofibers were isolated from adult *MyoD^{Cre/+};R26R^{EYFP/+}* mice and cultured for 14 d followed by immunocytochemistry to detect labeled (EYFP+) cells. The adipogenic cells observed in single myofiber cultures from adult mice were not labeled, indicating that they had never expressed *MyoD* and were thus most likely not of satellite cell origin. Clonal analysis of individual satellite cells from *MyoD^{Cre/+};R26R^{EYFP/+}* mice revealed that Cre/loxP-labeled cells did not spontaneously differentiate into lipid-filled adipocytes. We did, however, observe lipid accumulation in EYFP+ satellite cell cultures following exposure to 100 μ M γ -linolenic acid for 10 d. These results indicate skeletal muscle satellite cells are committed to myogenesis and do not readily differentiate into lipid-filled adipocytes without exposure to potent adipogenesis-inducing agents.

Key Words: Skeletal Muscle, Satellite Cell, Adipocyte

123 Presence of mammary epithelium modulates expression of growth-regulating genes in stroma of bovine mammary gland. J. G. Titus^{*}, S. B. Simpson, and T. B. McFadden, University of Vermont, Burlington.

The mammary fat pad acts as a paracrine regulator of mammary growth; however, the specific action of this developmental regulation is not completely understood. We hypothesized that epithelial-stromal interaction modulates stromal expression of estrogen- and growth hormone-responsive genes known to regulate mammogenesis. An epithelium-free mammary fat pad was prepared in one gland of each of 20 Friesian calves at 1 mo of age. At 18 mo of age, heifers were assigned to one of four treatments: control (C), estrogen (E), growth hormone (GH) or estrogen plus growth hormone (GE). Heifers in E and GE groups were injected s.c. with estrogen (0.1 mg/kg BW). Heifers in GH and GE groups were injected i.m. with recombinant bovine somatotropin (Posilac[®], 500mg).

Heifers in the C group received no hormone. Heifers were slaughtered 24 h after hormone treatment and stromal tissue was collected from both the epithelium-free (**CFP**) and intact fat pads (**MFP**). Total RNA was isolated from tissues and qualitative PCR was performed to determine expression of five genes in cDNA pooled from each fat pad group. Expression of estrogen receptor (**ER**)- α , transforming growth factor (**TGF**)- β and epidermal growth factor receptor (**EGFR**) mRNA was greater in MFP than CFP (10, 6 and 2 fold difference, respectively). TGF- α and progesterone receptor (**PR**) expression was similar in CFP and MFP. Quantitative real-time PCR was used to measure the rela-

tive expression of ER α and PR in the stroma. Expression of ER α was reduced in CFP relative to MFP ($P < 0.05$), however there was no effect of hormone treatment nor was there an interaction between hormone treatment and tissue type ($P > 0.05$). Neither presence of epithelium nor hormone treatment affected PR expression ($P > 0.05$). We conclude that the presence of epithelium directly affects the stromal expression of several genes involved in regulation of mammary development.

Key Words: Epithelium-Free Fat Pad, Gene Expression, Mammo-genesis

ADSA-SAD (Student Affiliate Division) Undergraduate Competition: Dairy Production

124 WITHDRAWN.

125 Nutrigenomics: A new direction for the dairy industry. D. G. Wilson*, *Pennsylvania State University, University Park.*

Nutrigenomics, the study of how specific dietary nutrients influence gene expression, is a new and exciting science that shows promise of improving efficiency in many areas from milk production to reproduction. Extracting RNA for microarray analyses both before and after a ration change can indicate which genes are up-regulated, or “turned on,” and which are down-regulated, or “turned off,” when new nutrients are added to the diet. In this process, fluid RNA is placed on a computer chip, treated with a special dye, and exposed to a laser. The original microarray is then compared to the microarray completed after the dietary change. Those genes that are up-regulated by the dietary change will fluoresce, and those genes that are down-regulated will turn dark. Several research trials have demonstrated the linkage between nutrients and gene expression. In a Washington State study, cows with supplemented chromium propionate showed improved fat metabolism and increased milk production. When chromium was supplemented to 10 mg/d at measured intakes, milk pounds increased 2.6 kg/d between d 1 and d 90 of lactation, with a 4.6 kg/d increase between d 57 and d 90. McNamara et al determined that these changes were due to the up-regulating of five major genes. Another mineral that offers nutrigenomic promise is selenium. Research studies in mice, poultry, and pigs have shown reduced early embryonic loss and improved antioxidant function in reproductive tissues when diets were supplemented with this mineral. In future years, selection criteria may involve choosing animals who respond most efficiently to dietary changes. New trials involving minerals, fatty acids, and other targeted nutrients will refine our knowledge in this rapidly expanding field. Although this research is still in early phases, especially in dairy cattle, the ability to increase efficiency and profitability through the use of nutrigenomics shows great potential.

Key Words: Nutrigenomics, Chromium, Microarray

126 Genetics of feed conversion efficiency: using a dynamic metabolic model to investigate the patterns of nutrient flux in the most efficient dairy animals. C. Schachtschneider* and J. McNamara, *Washington State University, Pullman.*

Productive efficiency depends on processes such as feed intake and composition, synthetic ability of the mammary gland, and metabolic flux in visceral, muscle, and adipose tissues. These metabolic fluxes are functions of genotype, phenotype, and intake, including hormonal and neural responses. In order to identify patterns of metabolic flux in dairy cattle of varying genetic merit and intakes, an existing mechanistic metabolic model (Molly, UC Davis) was used. Data were collected from 2nd to 4th parity cows, including nutrient intake, milk component output and changes in adipose tissue and body protein (28 d prepartum to 90 DIM). Explicit inputs into the model included nutrient intake, initial body fat and protein, milk production, fat and protein output. Each cow (n = 42) was simulated separately from 0 to 120 DIM and fluxes in body and visceral energy and protein were output. Body fat, body protein

(skeletal muscle) and visceral protein all varied ($P < 0.05$) in their daily flux and overall change from 0 to 120 DIM for the top 20% most efficient versus lowest 20%, based on energy efficiency (absorbed energy/feed energy) during that period. Means (ranges) for all cows were 112 (89 to 139) Mcal/d for intake energy, 32.3 (19.9, 41.9) for maintenance; -0.51 (-1.74, -0.015) for change in body energy; and 0.843 (0.826, 0.862) for Net E efficiency (milk energy/(energy absorbed maintenance E)). These data are consistent with variations in maintenance (body nutrient fluxes) affecting overall efficiency while mammary efficiency approaches the theoretical maxima. Nitrogen intake was 0.66 (0.52, 0.81) kg/d; milk N, 0.21 kg/d (.16, .27), change in body N, -0.016 (-0.06, -0.004), N in urea was 0.31 (.26, .37) and N balance was -0.018 (-0.032, -0.008). Animals varied in non-mammary E and N use, and the model identified ($P < 0.05$) optimal differences in E and N in the 20 % top versus 20 % lowest efficient cows. We can use this approach to help identify the most efficient patterns of metabolism in non-mammary tissues, and eventually alter breeding strategies toward more efficient cows.

Key Words: Lactation, Efficiency, Model

127 The effects of inbreeding in Holstein dairy cattle. M. B. Rhoderick*, D. R. Winston, B. G. Cassell, and K. M. Olson, *Virginia Polytechnic Institute and State University, Blacksburg.*

Inbreeding in the Holstein breed has increased as a result of selection to improve an objective such as type or production for a long period of time. Inbreeding is the mating of related individuals and the concept is based on the probability of two genes being present at a locus that are identical by descent. Inbreeding is measured by the coefficient of relationship among cattle to determine a correlation between inbreeding level and performance traits. Analysis of data from Holstein Association USA, Inc. and the Animal Breeding Center at Cornell University from 1970 to 1998 indicated that the level of inbreeding increased over time. While the rate of inbreeding has declined, there are many negative effects associated with the level of inbreeding. Milk production losses per lactation were 35 kg per percentage of inbreeding greater than 1%. The amount of production lost increased to 55 kg per percentage of inbreeding within the range of 7 to 10%. Longevity of inbred cattle decreased as a result of decreased reproductive efficiency, decreased production and a slight increase in somatic cell score. Therefore, inbreeding has negative effects on management, profits, and cow health. Dairy managers should know the consequences of excessive inbreeding and should implement strategies including better record keeping and outcrossing to keep inbreeding at optimal levels.

Key Words: Inbreeding, Holsteins

128 Colostrum nutrition, immunization, and management when raising young dairy calves. A. Aguiar* and E. Jaster, *California Polytechnic State University, San Luis Obispo.*

Calves require proper nutrition, immunization and management in order to have proper growth and development. Calves need colostrum in order for passive transfer of immunoglobulins to assist the immune

system in resisting pathogens and diseases. With proper colostrum quality and quantity, calves have the ability to fight calf hood diseases. A method to evaluate passive transfer of colostral immunoglobulins is to evaluate serum protein content of calf blood. Relatively high levels of serum protein indicate calves may have received the proper passive transfer of immunoglobulins. Vaccination of calves to provide immunity is necessary to assist the calf in disease prevention. Early intervention and use of vaccines to provide immunization is necessary for calf survival. Vaccines require evaluation by the calf ranch to determine the suitability and immunization efficacy. By providing proper colostrum management, vaccines that provide adequate immunization and proper management, the calf will have the opportunity to survive and grow to its genetic potential.

Key Words: Calves, Colostrum, Vaccine

129 Enhancing fertility with omega-3 fatty acids. J. A. Tekippe*, *Iowa State University, Ames.*

Meeting the energy demand of high producing dairy cattle in early lactation can be difficult and failure to do so affects several physiological functions especially reproduction. Current evidence suggests that dietary supplementation of certain essential fatty acids (FAs), specifically omega-3 FAs, may improve reproductive efficiency in dairy cattle. Feeding supplemental fat provides additional energy, enabling the cow to achieve positive energy balance quicker and return to a normal estrus sooner. Both linoleic (C18:2) and linolenic (C18:3) are essential FAs that must be provided in the diet. Approximately 55% if the FA in flaxseed is linolenic (an omega-3 FA), whereas both soybeans and cottonseed contain 54% and sunflower seeds 68% linoleic (an omega-6 FA). Cows fed diets supplemented with various fats developed larger follicles and subsequently 23% larger corpus luteums (CL) on average. In another study, conception rates following an initial timed AI protocol were greater in cows fed flaxseed (72.6%) than for cows fed sunflower seed (47.5%). Early embryonic loss occurring in the first 28 days post insemination was reduced from 27.3% in cows fed sunflower seed compared to a 9.8% loss in cows fed flaxseed. Cows fed a mixture of omega-3 (linolenic) and omega-9 (oleic) FAs produced 22% more high quality embryos compared to those fed an omega-6 (linoleic) FA. Production of series 2 and series 3 prostaglandins occurs from separate pathways, both utilizing and competing for the same enzymes. Omega-3 FAs are the precursor for series 3 PGs, while omega-6 FAs are the precursor for series 2 PGs. Increasing the amount of omega-3 FAs in a cow's diet should result in the production of more series 3 prostaglandins (PG-3) and proportionately less series-2 PG. Since PG-2 is more biologically active in regressing the CL and reducing progesterone production, a shift from PG-2 to PG-3 should benefit pregnancy. In conclusion, feeding a source of omega-3 FAs such as flaxseed may enhance reproductive efficiency of dairy cows.

Key Words: Fertility, Omega-3, Flaxseed

130 Grazing under irrigation: A novel approach to pasture-based dairying. E. Waggoner*, *Clemson University, Clemson, SC.*

The goal of the dairy industry has been and always will be to efficiently produce milk. This may sound simple, but dairymen will tell you that

this task is not easily accomplished. With increasing feed costs and variable milk prices, it is a battle to make a living as a dairy farmer. At a time when dairies are either commercializing or leaving the industry, many are seeking other options. New methods of increasing efficiency and lowering costs are being explored to promote the survival of smaller farms. Pasture grazing is an appealing opportunity. The Southeastern United States is subject to high temperatures and humidity much of the year. These environmental factors have tremendous negative effects on cattle health and milk production, leaving cows seeking refuge in shade rather than consuming valuable forages. Many producers have made substantial investments in cooling systems; yet, have not addressed decreased forage consumption. A novel way to address both concerns is pasture grazing under irrigation. This form of pasture-based dairying maximizes forage utilization while also managing heat stress. With this plan, cattle are intensively grazed in fields managed by irrigation systems. As the irrigation equipment rotates around the pasture, cows follow the water, enjoying the cooling effects while consuming forages in a strip-grazing motif. Pasture grazing under irrigation provides advantages on a multi-discipline level to increase cattle comfort and milk production while lowering costs associated with confinement farming. Cropland irrigation and heat stress management are essential to farming in the Southeast. This plan integrates and improves upon both ideas. In addition to lower feed costs, improved cattle health, and maximized pasture based milk yield, irrigated grazing provides benefits of natural fertilization and improved field conditions as the cattle move throughout the pasture rather than congregating in one area. Consumers applaud efforts to produce milk in a natural, non-confined method with cow welfare in mind. Pasture grazing with irrigation is the alternative that is needed to make production possible and profitable on the small scale, pasture-based dairy.

Key Words: Grazing, Irrigation, Dairy

131 The natural fertilizer. K. M. Bridges*, *Louisiana State University, Baton Rouge.*

Often manure is thought of as useless waste that should be removed as quickly as possible. It harbors pathogens, smells bad, and just gets in the way. However, manure can be a valuable asset to the farmer. Many of the nutrients in the diet are not all used by the cow, and therefore some are excreted in the manure. These nutrients can be utilized as fertilizer if managed properly. The major nutrients used by plants are nitrogen, phosphorus, and potassium. The average lactating dairy cow excretes approximately 0.8 pounds of N, 0.12 pounds of P, and 0.45 pounds of K. The plant available amounts of these nutrients are mainly affected by storage, distribution, and other handling techniques. Manure can also be composted and sold for landscaping and home gardening, and it can be burned to produce methane, a valuable fuel. There are other management practices that can reduce pathogens, odor, and prevent environmental contamination. These practices include aerobic and anaerobic digestion and wetland production. Without sound waste management practices, environmental contamination may take place. Excess nutrients on cropland may become runoff and contaminate waterways, which could lead to eutrophication. Improper irrigation may cause nutrient buildup in the soil surface or leaching into groundwater. Denitrification of ammonia will contribute to greenhouse gases. There are agencies and regulations in place to prevent this occurrence. Manure, properly managed, is a versatile asset that can be used in many ways to possibly save or even make money for the farmer. If it is improperly managed, its value

decreases and pollution can occur. Therefore, manure, although it is waste, should not be thrown away.

Key Words: Manure, Fertilizer, Nutrients

132 Effects of heat stress and milk replacer strategy on calf growth, starter intake, and fecal scores. L. J. Berger*, G. A. Holub, and J. E. Sawyer, *Texas A&M University, College Station.*

The objective of this study was to evaluate the effects of heat stress and milk replacer strategy on calf performance. Holstein bull calves < 7 d of age were housed in fiberglass hutches in either a moderate heat stress period (MS; May 5 to July 2; n=47) or a high heat stress period (HS; July 25 to Sep 22; n = 43). Within period, calves were fed either a low input (LI; 454 g/d, 20% CP, 20% fat) or a high input (HI; 908 g/d 28% CP, 15% fat) milk replacer program beginning on d 7 until d 56. Calves had ad libitum access to a commercial starter diet and water. Intake of starter diet and fecal scores (1 = firm, 4 = watery) were recorded daily. Body weight was recorded every 7 d through d 56 (pre-weaning) and

from d 56 until d 104 (post-weaning) of each period. Rate of BW gain (ADG) was estimated from the regression of BW on time by calf pre- and post-weaning. Time required for calves to consistently consume starter diet and ADG were compared with heat stress period, replacer strategy, and their interaction as fixed effects. Fecal scores were evaluated as repeated measures with the above effects, time, and all interactions where calf was the subject. Calves fed HI had greater pre-weaning ADG ($P < 0.01$) than LI (0.73 vs. 0.48 ± 0.02 kg/d). Effect of replacer type on post-weaning ADG depended on heat level ($P = 0.03$). Calf ADG was similar for HI and LI during MS, but was greater ($P=0.05$) for HI in HS. More days were required to reach weaning (0.9 kg/d of starter diet for 3 consecutive days) during HS ($P < 0.01$, 39.3 vs. 48.6 ± 0.97). Heat stress, replacer strategy, and their interaction influenced fecal scores. Calves fed HI had higher ($P < 0.01$) fecal scores than those fed LI (2.18 vs. 1.82 ± 0.02). For calves fed HI, fecal scores increased as heat level increased from MS to HS ($P < 0.01$, 2.07 vs. 2.29 ± 0.02), while for calves fed LI fecal scores were similar under MS or HS ($P = 0.56$, 1.81 vs. 1.84 ± 0.03). High input milk replacer strategies resulted in higher calf ADG and appear to mitigate the effects of heat stress on post-weaning growth, despite reducing firmness of fecal matter.

Key Words: Calf, Growth, Nutrition

Symposium: Dairy Foods: Advances in Low Fat Cheese Research

133 Low fat cheese opportunities. J. Montel*, *Dairy Management Inc., Rosemont, IL.*

With over 90% household penetration, cheese is enjoyed by virtually everyone; consumed in everything from pizzas to cheeseburgers, salads and cheese snacks. Cheese is everywhere, both in home and away-from-home. In 2006, per capita consumption of cheese reached an all-time high of 32.4 pounds.

Today food choices are driven by three needs: convenience, taste and health & nutrition. In fact, health is the #1 driver of the food industry world wide. Consumers have certain health needs, whether that is less fat, less calories, less cholesterol or less sugar.

Even though consumers demand fat reduction, they are not willing to sacrifice taste or functionality in the foods they eat. In fact, a recent consumer survey recorded 86% of consumers stating taste as having an impact on their decision to buy foods and beverages. In other words, they want it all - both taste and less fat.

Since 2002, manufacturers have introduced 223 new low/no/reduced fat cheese items in the marketplace - the second highest segment of new product introductions in the cheese category. Despite these efforts low fat and fat free cheese account for only 2% of sales.

How big of an opportunity is good tasting, functional low/reduced fat cheese for the industry? Recent research found that 49% of consumers are interested in purchasing a "great tasting cheese with half the fat". In addition, DMI funded custom research with TNS (a well regarded research company) to quantify the sales opportunity for a great tasting reduced fat cheese with "cheese restrictors" consumers who love the taste of cheese but restrict their consumption because of fat concerns. They would significantly increase consumption of cheese with great tasting low fat cheese products.

In addition to retail opportunities, the foodservice channel offers significant volume especially in the schools channel where cheese could be at risk due to the implementation of wellness policies and the recent Institute of Medicine (IOM) guidelines. Cheese as an ingredient in pizza, sandwiches/burgers and a la carte represent cheese volume that the industry cannot afford to lose. Opportunities also exist within commercial foodservice as operators look to improve the nutritional profiles of menu items as well as create new good-tasting reduced fat menu items.

134 The impact of fat content on flavor of cheddar cheese. M. A. Drake*, *North Carolina State University, Raleigh.*

Consumer emphasis on health and nutrition is driving increased demand for nutritious and lower-fat foods. Despite previous studies on reduced fat cheese, information is critically lacking in understanding the flavor and flavor chemistry of reduced and low fat Cheddar cheeses and how they differs from their full fat counterparts. The objectives of this study were to characterize the flavor and flavor chemistry of low fat, reduced fat and full fat Cheddar cheeses. Cheddar cheeses with 32, 16, or 5 % fat were manufactured in triplicate with a single strain starter culture and ripened for 2 weeks, 3 mo, 6 mo and 9 mo. At each timepoint, cheeses were evaluated by sensory and instrumental volatile analyses. Flavor and volatile components of low fat Cheddar cheeses were distinct from full fat cheeses. Decreases in fat content resulted in decreases in milkfat flavor, higher whey flavor and a decrease in the rate of aged cheese flavor development compared to full fat cheeses. Free fatty acids

(butyric, hexanoic, nonanoic, and decanoic), furaneol, sotolon and saturated hydrocarbons were present at higher concentrations in low fat cheeses compared to full fat Cheddar cheeses while lactones (gamma nonalactone, gamma decalactone, delta decalactone) were predominant in full fat cheeses. Differences between the flavor of low fat and full fat Cheddar cheeses are due to differences in the biochemistry and are not solely a result of differences in volatile flavor compound release.

Key Words: Cheddar Cheese, Flavor, Low Fat

135 Effect of composition on the microbial ecology of low fat cheese. J. R. Broadbent*, *Utah State University, Logan.*

The absence of desirable flavor in reduced fat and low fat natural Cheddar cheeses limits consumer acceptability of these products. Flavor development in bacterial-ripened cheeses like Cheddar is largely a biochemical process that is driven by microbiological activity in the ripening curd. Although knowledge of the relationship between cheese bacteria and flavor development has advanced significantly in recent years, critical information is still lacking on how fat reduction, and corresponding compositional changes in low fat cheese such as lower salt-in-moisture content, influence the microbiology of cheese. Specific knowledge of how fat reduction influences the microbial ecology of cheese could lead to the identification of methods to enhance flavor development in low fat products. The objective of this work was to characterize microbiological differences in Cheddar cheeses containing 32 (full), 16 (reduced), or 5 % (lowfat) fat (wet wt). Cheeses were manufactured in duplicate at 3 locations with a single-strain *Lactococcus lactis* starter culture and ripened at 8°C. After 2 wks, 3 mo, 6 mo and 9 mo, the cheeses were sampled for starter and nonstarter lactic acid bacteria (NSLAB), and DNA was collected from cheese and cells for analysis by denaturing gradient gel electrophoresis (DGGE) of 16S rDNA fragments. Microbiological data showed interesting differences between cheeses made with different fat contents at all 3 sites. First, starter populations remained stable out to 3 mo in low fat and reduced fat cheeses before showing any decline, but in full fat cheese generally declined by at least 2 orders of magnitude by 3 mo. Additionally, NSLAB levels in low fat cheese exceeded 10⁶ by 6 wks, but populations in most reduced or full fat cheese did not attain that level even after 3-6 mo. DGGE studies are still ongoing, but results to date suggest the NSLAB fraction of all cheeses includes *Lactobacillus curvatus*, but several other species of bacteria have also been identified. A more complete understanding of the relationship between fat content and cheese microbiology should provide greater insight into the problems, and potential solutions, related to flavor development in lowfat Cheddar cheese.

Key Words: Lowfat Cheese, Cheese Microbiology, Nonstarter Bacteria

136 Effect of composition on the microbial metabolism of low fat cheese. J. Steele*, *University of Wisconsin, Madison.*

Low-fat cheeses differ significantly from that of their correspondent full fat varieties with regard to flavor. If we are to understand these

flavor differences, an understanding of how changes in cheese composition influences the structure and metabolism of the cheese microbiota is essential. Changes in chemical attributes during ripening such as simple and modified carbohydrates, organic acids, nucleic acids, serine-phosphate (free and bound), and glycoproteins; as well as starter culture enzyme activities: general aminopeptidase activity (AP), X-prolyl dipeptidyl aminopeptidase (PAP) and post-prolyl endopeptidase (PEP) were studied in cheeses made at 3 different dairy plants. Cheddar cheeses made with full, reduced and low fat content as well as the inclusion of a washing step in the making of the full fat cheeses were chemically analyzed. An HPLC method for the extraction and analysis of trace level carbohydrates was developed. Carbohydrate profile shows that as fat levels decreased, the levels of lactose and galactosamine and D-Lactate increased, however, only slight decreases of enzyme activities (PAP and PEP) were observed. Soluble nitrogen had no apparent change as fat content was decreased. The effect of the wash step decreased the levels of lactose, galactosamine and glucosamine from the available energy sources in cheese, yet only slight increases in heterofermentative products were observed, suggesting that the washing step did not remove all the energy sources available for the starter and non-starter bacteria present in these cheeses. Overall, this research demonstrates that the carbohydrates present to support microbial growth and metabolism differ in Cheddar cheese in a fat-dependant manner. These changes may influence the structure and metabolism of the cheese microbiota and hence cheese flavor.

Key Words: Low Fat Cheddar Cheese, Energy Sources, Microbiota

137 Impact of fat content on cheese texture. E. A. Foegeding*, *North Carolina State University, Raleigh.*

Fat is a key component in cheese as it impacts flavor and texture. However, there is a desire to produce reduced fat foods as a way to lower overall caloric intake. Therefore, the ultimate goal is to manufacture a cheese with a reduced level of fat while maintaining a desirable level of flavor and texture. A common problem in low fat cheeses is that the texture becomes rubbery with minimal breakdown during chewing. This implies that a basic understanding of what regulates the rheological and fracture properties of cheese microstructure may shed some light on how texture can be improved. There are two models that may explain the microstructural basis of texture. A filled gel model predicts that texture is based on the amount of filler particle, if the filler particle interacts or does not interact with the gel network, and the relative ratio of the network and filler particle rigidities. In this model, the casein gel network surrounds the fat particles. An alternative model is that of a closely packed system. In this model, protein particles are tightly packed with lipid particles. It is also possible to view cheese as starting out as a filled gel then being converted to a closely packed particle system when moisture is removed during manufacturing. Cheddar cheeses were manufactured containing 32%, 16% or 6% fat, and aged for 9 months. Sensory texture and fracture/rheological properties were determined initially at 2 weeks, then at 3, 6, and 9 months. The results from this investigation on cheddar cheese, along with published investigations on other cheeses, will be discussed based on filled gel and closely packed particles models.

Key Words: Cheese, Texture, Low Fat

138 Effect of fat reduction on the functional properties of slice on slice process cheese. L. E. Metzger*¹, S. Chandran¹, C. R. Daubert², M. Yurgec², and S. Ramsey², ¹*South Dakota State University, Brookings,* ²*North Carolina State University, Raleigh.*

A common form of process cheese called slice on slice (SOS) is manufactured using a chill roll or chill belt which forms and cools the molten cheese into a thin sheet; then cuts and stacks the slices into a loaf. As a result of machineability issues, low fat process cheese is not produced using a SOS manufacturing process. The objective of this research was to characterize the effect of fat reduction on the functional properties of SOS process cheese. Four process cheese formulations were developed including: full fat (30% fat); 25% reduced fat (22.5% fat); 50 % reduced fat (15% fat); and low fat (6.00% fat). Each formulation utilized the same skim milk natural cheese (1.4% fat) as the primary ingredient. Each formulation also contained 12% aged Cheddar cheese, was standardized to 2.2% salt, and was standardized to the appropriate fat content with butter oil. Each formulation was prepared on a small scale using a rapid visco analyzer to determine their cooked apparent viscosity. The cooked apparent viscosity of each formulation was similar and ranged from 3,149 to 3,328cP. Each formulation was then prepared in a Stephan Universal Cooker on a larger scale (1,500 g) and the rheological properties of each formulation were evaluated. Rheological analysis included: small deformation, compression, torsion, and tack. Rheological analysis demonstrated that the torsion stress, compression stress, tack extension, and tack energy significantly ($P < .05$) increased as the fat content decreased. These results demonstrate that fat reduction impacts the functionality of SOS process cheese. Subsequent research will evaluate the effect of formulation modifications on the functionality of SOS process cheese.

Key Words: Process Cheese, Low Fat

139 Advances in nonfat/lowfat process cheese for melting and ingredient use. J. A. Lucey*, *University of Wisconsin, Madison.*

In recent work at the University of Wisconsin, we have investigated various approaches to improving the melting and baking properties of lowfat/nonfat process cheese (PC). We have developed a novel approach to solve some of the critically important defects in lowfat/nonfat cheese. These defects include poor color, excessively hard or sticky texture, scorching during baking and surface skin formation. The first critical step is to manufacture a skim curd cheese base that has suitable properties for process cheesemaking. One method is to use direct acidification of skim milk to pH 5.6 with a calcium chelating agent, such as citric acid. This base could be used for process cheesemaking the same day of manufacture or stored and used within a few weeks to produce a softer, more meltable PC performance. In our method, we do not use any phosphate or citrate salts to chelate calcium. The acidification of base with citric acid is sufficient to reduce the crosslinking of caseins in curd formed by calcium phosphate. High concentrations (>0.5%) of traditional emulsifiers, such as mono- or diglycerides, are added to alter casein interactions. This produces a nonfat (or lowfat if the glycerides are included in the estimation of total fat) PC that has a white color and slices easily. The slices are not sticky. The cheese shreds easily, melts and flows during baking, maintains a white color during heating and after cooling and is bland in flavor. Another important benefit is this

product can be classified as a low sodium cheese as the only sodium that is added is what is added as a salt (preservative) in the base. This approach can also be used for lowfat natural cheese (e.g. Mozzarella) as the Nutrition Labeling and Education Act (NLEA) (21CFR 130.10) allows the addition of nonstandard ingredients to improve the texture of lowfat versions as long as the cheese is nutritional equivalent to the standard version. These novel approaches are very promising for producing lowfat or nonfat cheeses that have excellent functional properties for ingredient use.

Key Words: Lowfat Cheese, Process Cheese, Functionality

140 A novel technology for making lowfat cheese. N. Y. Farkye* and M. Arnold, *California Polytechnic State University, San Luis Obispo*.

Low fat Cheddar cheese containing less than 6% fat was manufactured by combining pre-determined portions of ripened full fat or reduced-fat Cheddar and/or enzyme-modified cheese with freshly made nonfat Cheddar cheese using novel mixing and stuffing technologies to produce a uniform product. Under normal conditions, mixing two streams of curds results in uneven distribution and mottled appearance of finished cheese. This technique results in cheese with a uniform appearance. Pasteurized and pre-acidified nonfat milk was used to make Cheddar-type cheese using commercial mesophilic lactic starter and Chymax™ as coagulant. After coagulation and cutting, the curd was cooked to the desired firmness and whey drained. The curd was mixed with pre-chopped ripened cheese or enzyme-modified cheese to provide flavor, then salted. Ingredients to help hold moisture may be added. Salted curds were pressed in Wilson-style cheese hoops for block cheese or stuffed into casings for logs. Both methods of curd treatment produced acceptable cheese. Finished cheese had characteristic flavor of the ripened cheese used in blend.

Key Words: Lowfat Cheese, Blending

141 Alternative manufacturing protocols for low fat cheese. M. Johnson*, *University of Wisconsin, Madison*.

Manufacturing protocols for cheese are often dictated by time and cost of manufacture. How the cheese will be used and shelf-life requirements also impact how the cheese should be made. Consequently, manufacturing methods that produce a cheese suitable for one application may not produce a cheese that fulfills the requirements for another. In addition, natural cheese used directly as a snack food, referred to as “table cheese”, is often made differently than a cheese that will be used as an ingredient. Cheese making technologies for low fat cheese have generally fallen into two categories; firstly, substantial acidification of the milk prior to rennet addition followed by either whey dilution or curd rinsing with cold water and secondly, limited acidification prior to rennet addition and limited water addition or curd rinsing. Major differences in both body and flavor characteristics can result depending upon which method is used. Slight modifications to both manufacturing methods include milk or cream homogenization, high pasteurization temperatures and addition of fat mimetics or whey protein aggregates. To reduce the cost of manufacture, standardization of milk through use of concentrated milk solids is commonly practiced and has introduced additional challenges but has also provided opportunities. This presentation will describe the preliminary results on the use of different acidulants, and characteristics of low fat cheese made without use of acidulants. A combination of lactic acid and citric as an acidulant enhanced softening and smoothness of body compared to just lactic acid but a curd rinse may be necessary to prevent making a cheese with excessively low pH. Cheese made using a non-wash method was prone to excessive acidity. However, the body and flavor of this cheese may be better for certain applications compared to a wash-curd cheese.

Key Words: Low Fat Cheese, Manufacturing Protocol, Body

Symposium: ADSA Southern Section Symposium: Responding to Hot Topics in Dairy Management

142 Biosecurity: Dealing with problem diseases. K. E. Olson*, *KEO Consulting, Schaumburg, IL.*

Biosecurity has always been important for the dairy industry, but it is a term that has expanded in meaning and come into the national consciousness in recent years. The reemergence of bovine tuberculosis and economic impact that a limited number of cases of bovine spongiform encephalopathy (BSE) has had in the U.S. and Canada, as well as the devastation that BSE and foot and mouth disease inflicted on the livestock industry in the United Kingdom, coupled with concerns over potential terrorist actions have been major drivers. There are national as well as individual farm components to biosecurity that need to be considered, but the ultimate goal regardless of the implementation level is to adopt practices that will prevent the introduction of disease causing agents. The primary producer focus must be on the farm level application of a biosecurity program that will help to address diseases of potential concern to their operation such as Leukosis, BVD, bovine tuberculosis and Johne's disease. Expanding operations and changing management practices increase the need for planning in this area. While some components are common to most biosecurity plans and are effective against multiple diseases, it is important to work with a veterinarian to develop a program suited to the individual operation. The presentation will explore trends in adoption of various practices commonly used. Factors to be considered in developing individual plans include diseases currently present on the operation and their prevalence, the risk of introducing other diseases, practices that are effective in limiting the potential of introducing or spreading the diseases of concern. Plans must be reviewed periodically to assess their effectiveness, with modifications made as needed. Properly implemented, farm level biosecurity plans will assist the operation in addressing their concerns while also complementing national plans that help to limit risk for all producers.

Key Words: Biosecurity, Farm Plan

143 Defending against mycoplasma mastitis. J. C. Beagley and M. W. Overton*, *University of Georgia, Athens.*

Mycoplasma is a unique class of pathogenic and nonpathogenic bacteria which lack a cell wall. Bovine mycoplasma diseases include mastitis, pneumonia, arthritis, otitis, genital infections, and keratoconjunctivitis. A variety of mycoplasmas have been isolated from infected mammary glands including *M. californicum*, *M. bovis genitalium*, *M. canadense*, and *M. alkalescens*, but *Mycoplasma bovis* is considered to be the most common and pathogenic species and its isolation from dairy herds has increased in recent years. Generally considered a contagious mastitis pathogen, differences between mycoplasma and other contagious pathogens have raised questions regarding the epidemiology of this disease. Introduction of infected animals into a herd is believed to be the most common source of new infections, but other clinically important sources include hematogenous spread from other body sites such as the respiratory or urogenital tract. These sites may serve as sources for other herd mates or for autoinfection in the mammary gland. Once established, mycoplasma mastitis can be highly contagious and rapidly

spread through a herd when inadequate control measures are utilized. Strict milking hygiene should be employed to reduce transmission risk and all herd additions should be properly screened. On-going herd surveillance including regular monitoring by bulk tank and individual milk cultures is important. Sensitivity of bulk tank cultures will depend upon how many cows are infected, degree of shedding, and method of culture. Multiple, repeated cultures should be taken before declaring an animal or a herd as negative. Positive cultures should be speciated in order to differentiate pathogenic from non-pathogenic mycoplasmas and acholeplasma. Once identified in a previously uninfected herd, string and individual sampling should be done to identify positive animals. Infected animals should be culled or segregated from uninfected herd mates to prevent further spread. The appropriate management approach utilized will depend upon how many animals are affected, the risk tolerance of the herd owner, and economics at the time of diagnosis.

Key Words: Mycoplasma, Mastitis

144 The use of distillers grains in dairy cattle diets. D. J. Schingoethe*, *South Dakota State University, Brookings.*

Distillers grains with solubles (DGS) is the major coproduct of ethanol production, usually made from corn, which is fed to dairy cattle. Distillers grains is a very good protein source (>30% CP) high in ruminally undegradable protein (~55% of CP), and is a very good energy source (NEL ~2.25 Mcal/kg of DM) for lactating cows. The modest fat concentration (10% of DM) and readily digestible fiber (~39% NDF) contribute to the high energy in DGS. Animal performance was usually similar when fed wet or dried products, although some research results tended to favor the wet products. Diets fed to dairy cattle can contain DGS as replacements for portions of both concentrates and forages, but usually replace concentrates. If replacing forages in lactating cow diets, adequate effective forage fiber is needed to avoid milk fat depression. With adequate forage fiber, milk fat content is not affected by any level of DGS feeding. Nutritionally balanced diets can be formulated that contain 20% or more of the diet dry matter as DGS. Such diets supported similar or higher milk production than when cows were fed traditional feeds. There is usually no advantage of feeding more than 20% DGS because the diet may contain excess protein and phosphorus, although production performance was very high even with more than 30% dried DGS in the diet. With more than 20% wet DGS in diets containing other moist feeds, gut fill may limit DM intake and production. While DGS can be fed with all forages, milk production may be slightly higher with alfalfa rather than corn silage, possibly due to an improved amino acid balance. The fiber in DGS, which often replaces high starch feeds, does not eliminate acidosis but minimizes its problems. Distillers solubles, which are often blended with distillers grains to provide DGS, can be fed separately such as "condensed corn distillers solubles". Additional distillers coproducts besides DGS are resulting from innovations in processing technology. Besides condensed distillers solubles, other products will include high protein DG, low fat DG, corn germ, and other products that can be utilized in dairy cattle diets.

Key Words: Distillers Grains, Dairy Cattle

145 Challenges of improving dairy cow fertility during summer heat stress: An ovum's perspective. J. L. Edwards*, *University of Tennessee, Knoxville.*

Since pregnancy is requisite for milk production, infertility in cows experiencing summer heat stress is an important economic problem facing the dairy industry. In spite of the widely accepted magnitude of this problem, progress towards developing a solution has been greatly hampered due to the multitude of factors and physiological processes altered by heat stress. This may explain in large part why a single strategy like modifying cow environment and/or use of other management protocols such as timed AI are not entirely beneficial for restoring fertility. Heat-induced reductions in fertility are pronounced when cows

experience heat stress at or near the time of estrus and are due in large part to direct effects of elevated temperature to compromise the maturing ovum and early embryo. While dependent on severity and duration, negative effects of heat stress on the maturing oocyte are concerning as the ovum contributes half of the genetic material and >99% of cytoplasm to the resulting embryo. In this presentation, data will be presented for providing new insight as to the specific processes within the maturing ovum that are altered by heat stress, consequences thereof and possible strategies for increasing dairy cow fertility. In addition, thermolability of the few embryos that do develop after fertilization of heat-stressed ova will be discussed.

Key Words: Heat Stress, Oocyte, Dairy Cow

Symposium: ALPHARMA Beef Cattle Nutrition and Beef Species Joint Symposium: Producing Quality Beef in a Bio-Based Economy

146 ASAS Centennial Presentation: Development and current issues of a corn-based beef industry. L. R. Corah*, *Certified Angus Beef LLC, Wooster, OH.*

The development of a beef industry, heavily dependent on corn utilization, began to occur in the 1940s. Started as a means to add value to the grain while improving consumer acceptance of beef, corn has become an integral part of beef production. Developments in the 21st Century—including unprecedented cattle prices, changes in beef demand, BSE, surge in energy costs, pricing differentiation of cattle prices based on quality, and industry consolidation—have dramatically changed the price of corn and cost of beef production. The future of the beef industry will be dependent on our ability to continue producing high-quality beef for a global market through effective use of genetics, new technologies, and economic management strategies.

Key Words: Corn, Feedlot, Beef Quality

147 Feeding strategies to reduce corn use. R. H. Pritchard*¹, D. D. Loy², and D. L. Boggis³, ¹*South Dakota State University, Brookings,* ²*Iowa State University, Ames,* ³*Kansas State University, Manhattan.*

The equilibrium among industries competing for corn grain has been disturbed by the dramatic increase in demand for corn use in ethanol production. The current situation differs from previous episodes of high corn prices in that there will be a long term increase in corn usage rather than a short term decrease in corn supply. This will alter cropping plans and reduce access to alternative grains. Biofuels development will increase competition for fats and oils, high fiber feeds, and the amount, form, and cost of ethanol by-products available. Having alternative feedstocks more available to substitute for corn in finishing diets will likely be the exception rather than the norm in many situations. These alternatives will often contain less energy than corn and limitations may exist on dietary substitution levels. Corn is substituted for roughage in finishing diets to increase ADG and to reduce feed/gain. In doing so, the corn per unit of live weight gain (LWG) increases. We can increase final diet roughage from <10% to levels of 20% or 30%, and achieve high growth rates and produce high Quality Grade beef. This requires access to a roughage source and imposes logistical challenges to larger capacity feedlots where most cattle are fed. We can reduce the corn/LWG by 8 to 10% by switching from rolled corn to steam flaked corn. Other potential savings in corn/LWG can be found in managing grain processing \times roughage source \times roughage level interactions. In older cattle (> 18 mo) reducing the targeted ribfat endpoint at harvest from the current 1.5 cm to 1.0 cm will greatly reduce corn use per unit of retail product; but would be less effective in younger cattle. While implants cause increased intake and final BW, they along with other technologies, effectively reduce corn/LWG. The most dramatic effects in reducing corn usage will come from extensive cattle production systems that increase the amount of growth occurring outside the feedlot. This will likely coincide with a change in the genetics and phenotype of cattle as well as a reduction in total beef cow numbers.

Key Words: Beef, Feeding, Corn

148 Environmental considerations of feeding bio-fuel co-products. N. A. Cole*¹, M. S. Brown², and J. C. MacDonald³, ¹*USDA-ARS-CPRL, Bushland, TX,* ²*West Texas A&M University, Canyon,* ³*Texas AgriLife Research, Amarillo, TX.*

The high concentrations of some nutrients in distiller's grains (DG) make formulation of diets difficult and can lead to environmental concerns. These concerns will differ with feedlot location, feedlot size, diet formulation, and grain processing method used. Feeding DG in dry-rolled corn-based diets (DRC) does not apparently affect DM digestion or total DM excretion; whereas, with steam-flaked corn-based diets (SFC) the feeding of DG decreases DM digestibility. With SFC-based diets the quantity of pen manure collected increased about 10% for each 10% increase in dietary DG concentration (DM basis); whereas it increased 0 to 7% with DRC-based diets. With SFC-based diets, the N and P concentrations of collected manure were not affected by feeding of DG. Phosphorus excretion (and acres of cropland required for manure removal) increases approximately 10 to 25% for each 10% increase in dietary DG concentration. The effects of feeding DG on subsequent ammonia emissions may vary with season and dietary N concentrations. In our studies, N volatilization as a percentage of N intake, decreased about 20% when DG was fed (15 or 20% of DM); however, because of greater N intake, total N volatilization losses (kg/steer) were not affected. During production and storage, DG emit volatile organic compounds (VOC) that could potentially contribute to odors or ozone formation. High sulfur concentrations in DG could affect animal health as well as emissions of hydrogen sulfide and other odorants. British and Nebraska studies suggest that feeding of DG can decrease enteric methane production in high-roughage diets; however, the effects in high-concentrate diets are not known. To our knowledge, the effects of feeding DG on excretion of physiologically active compounds (antibiotics, hormones, etc.) have not been studied. In conclusion, it appears that the feeding of DG may have environmental effects that need to be considered when determining ingredient value and optimal diet formulations.

Key Words: Distiller's Grains, Beef Cattle, Environment

149 Precursors to enhance marbling. S. B. Smith*, J. E. Sawyer, R. D. Rhoades, and M. A. Brooks, *Texas A&M University, College Station.*

The overall process of lipid synthesis in marbling (intramuscular; i.m.) and s.c. adipose tissues is similar in that both incorporate the same long-chain fatty acids into neutral lipids, and both adipose tissues synthesize fatty acids *de novo* from acetate and glucose. However, the relative rates of incorporation of specific fatty acids, acetate, and glucose differ markedly between adipose tissue depots. Oleic acid (18:1n-9) and linoleic acid (18:2n-6) are incorporated into lipids in s.c. adipose tissue at nearly twice the rate observed in i.m. adipose tissue. Thus, any dietary treatment that increases absorption oleic or linoleic acid may promote adiposity of s.c. adipose tissue disproportionately. The rate of synthesis of lipids from acetate *in vitro* is as much as 10-fold greater in s.c. than in i.m. adipose tissue. However, the overall metabolism of glucose (to CO₂, lactate, and fatty acids) typically is greater in i.m. than in s.c. adipose tissue and, in i.m. adipose tissue, glucose can be the predominant *de novo* precursor

of fatty acids *in vitro*. Recent investigations have demonstrated that, as adipose tissue depots mature, response to insulin *in vitro* is reduced. In 24-mo-old, corn-fed steers, insulin had no effect on the incorporation of glucose into lipids in s.c. adipose tissue, but stimulated lipid synthesis from glucose in the less mature i.m. adipose tissue. In adipose tissues of hay-fed steers fed to the same BW as corn-fed steers, insulin was completely without effect on the conversion of glucose to lipid. The same pattern was confirmed in 16-mo-old, corn-fed steers, in that insulin nearly doubled the rate of glucose incorporation into lipids in i.m. adipose tissue, but had no effect in s.c. adipose tissue. Feedlot steers fed dry-rolled corn (DRC) plus 30% wet distillers grains (WDG) had nearly three times as much fecal starch as steers fed steam-flaked corn (SFC) plus 30% WDG. Marbling scores were greater in carcasses of steers fed DRC (540) than in steers fed SFC (496). These data indicate that greater passage of starch into the small intestine may increase free glucose absorption which in turn may stimulate insulin secretion; this would promote i.m. adipose tissue development.

Key Words: Beef Cattle, Marbling, Precursors

150 Post-harvest strategies to enhance beef quality. J. O. Reagan*, NCBA, Centennial, CO.

Producing a consistent, high quality beef product has been identified in beef quality audits as a primary key to increasing customer satisfaction and consumer demand. Improving beef quality traits, such as tenderness, flavor and juiciness, is complex as these traits are influenced by genetic and environmental factors (nutrition, health, management) at the production level, harvest and post-harvest management strategies and cooking methodology. While efforts are being made to improve beef quality through genetic evaluation and marker assisted selection, the primary pre-harvest strategy to enhance beef quality has been to utilize extended feeding periods on highly concentrated grain diets. Increased grain prices, driven partially by increased demand for grains from the biofuels industry, bring doubt to whether this feeding strategy will be economically viable in the future. Numerous post-harvest technologies have been utilized over the years with the primary target being the improvement of tenderness. Early technologies included post-mortem aging to increase protein degradation through enhanced enzyme activity, altering the rate of carcass chilling to prevent cold-shortening of muscle fibers, and mechanical tenderization to physically cut myofibrils via processes such as grinding and blade tenderization. High- and low-voltage electrical stimulation have been used to increase pH decline, to enhance the aging process and to create physical tearing of muscle fibers. Cutting and muscle stretching strategies have also been employed to increase

sarcomere length through pre-rigor stretching. More recently, injection or marination of beef with enzymes, calcium, phosphates, salts, and anti-oxidants have been used to chemically tenderize beef by enhancing degradation of connective tissues or by increasing pH and water holding capacity. Continued high feed prices will potentially reduce beef quality due to reduced energy levels in diets and shorter feeding periods making post-harvest beef quality enhancement processes even more critical to maintaining consistent supplies of high quality beef.

Key Words: Beef, Quality, Post-Harvest

151 ASAS Centennial Presentation: Using grain and biomass for feed versus fuel. J. Lawrence*, Iowa State University, Ames.

Agriculture is amidst one of the largest changes since the move from horses to tractors. Ironically, as Ray points out, when we adopted petroleum we took land that was used to produce fuel for work animals or woodlots to heat our homes and moved it to food production. Currently, the US and the rest of the world are emphasizing renewable energy. This policy shift, reflected in the 2007 Energy Bill, grew out of a perfect storm of higher oil prices, national security interests since September 11, 2001 and lobbying efforts from agriculture and environmentalists. The mandated targets in the Energy Bill of 36 billion gallons a year of renewable fuels with 15 billion gallons coming from conventional (grain) sources by the year 2022 is an aggressive goal, but there is construction, earth moved and announcements made to reach these goals a decade ahead of schedule if economics cooperate. The demand for biofuel feedstock that was formerly feedstuffs is driving up prices for grains, forages and the land to produce them. Yet, in spite of near record high corn prices in early 2008, red meat and poultry production is forecast to be at record high levels. The impacts for animal agriculture will vary from producers to consumers. While feed cost is often 50-70% of animal production cost, it is typically less than 20% of the retail meat price and meat is a fraction of the consumer's food bill. Economics will serve as governor on the pace of ethanol expansion and will dictate the size of the livestock and poultry production sector in the future. The economic interactions are complex and given time and technology will find a new equilibrium where we produce both food and fuel, but in perhaps a different ratio than we have in the recent past. Economic modeling to date shows a rather modest change in long-run livestock and poultry production. This paper will discuss the winners and losers, and potential unintended consequences?

Key Words: Ethanol, Biofuels, Food

Animal Health III

152 Stress and Immunity: Implications on animal health and production. J. A. Carroll^{*1}, T. H. Elsasser², J. C. Laurenz³, R. D. Randel⁴, J. L. Sartin⁵, and T. H. Welsh, Jr.⁶, ¹*Livestock Issues Research Unit, USDA-ARS, Lubbock, TX*, ²*Growth Biology Laboratory, USDA-ARS, Beltsville, MD*, ³*Department of Animal and Wildlife Science, College of Agriculture, Natural Resources and Human Sciences, Texas A&M University System, Kingsville, TX*, ⁴*Texas AgriLife Research and Extension Center, Texas A&M System, Overton, TX*, ⁵*Department of Anatomy, Physiology & Pharmacology, College of Veterinary Medicine, Auburn University, Auburn, AL*, ⁶*Departments of Animal Science and Veterinary Integrative Biosciences, Texas AgriLife Research, Texas A&M System, College Station, TX*.

Throughout their production cycle, domestic livestock experience various stressors and varying magnitudes of stress that inhibit health and productivity. As researchers have continued to explore the complex interactions between stress and production parameters such as growth, reproduction, and health, multidisciplinary efforts emerged that have led to a greater understanding of homeostatic regulation. Based upon these efforts, our knowledge has extended beyond the “all or none” biological activity strictly associated with the “fight or flight” response. For instance, researchers have demonstrated that the combined immunological effects of glucocorticoids and catecholamines result in a well-orchestrated biological event designed to prevent over-stimulation of innate immunity and the production of proinflammatory cytokines while simultaneously priming the humoral immune response in an effort to provide adequate immunological protection. The perception of stress in domestic animals has evolved as well, now including indices such as environmental stress, nutritional stress, social stress and prenatal stress. Animal stress is now identified as a unique event that elicits a specific behavioral, physiological, neuroendocrine, endocrine, and/or immune response that may be as unique as the stressful event itself. Additionally, there has been an increased effort to elucidate the interactions between stress responsiveness and immunological parameters in animals that may be either predisposed to or resistant to the detrimental effects of stress due to genetic programming and/or prior experiences. Of particular interest are animals that demonstrate differential stress and immunological responses due to previous exposure to various managerial, environmental, nutritional, or pathogenic stressors or due to varying temperaments within a genetically similar group of animals. Continued research efforts into these complex interactions may allow the implementation of alternative management practices, improved selection programs, and/or implementation of various nutritional strategies to prevent or overcome significant production losses and animal health care costs for livestock producers.

Key Words: Stress, Immunity, Health

153 Neck rails improve udder and stall hygiene but increase risk of lameness. F. Bernardi^{*1,2}, J. Fregonesi^{1,3}, C. Winkler², D. M. Veira⁴, M. A. G. von Keyserlingk¹, and D. M. Weary¹, ¹*University of British Columbia, Vancouver, BC, Canada*, ²*University of Natural Resources and Applied Life Sciences, Vienna, Austria*, ³*Universidade Estadual de Londrina, Londrina, PR, Brazil*, ⁴*Agriculture and Agri-Food Canada, Agassiz, BC, Canada*.

Housing conditions for dairy cows are thought to affect lameness but almost no experimental work has addressed this link. The aim of the

current study was to assess the effect of one feature of free stall design, the position of the neck rail, testing the prediction that cows housed in pens with neck rails would spend less time standing inside the stall and have reduced gait scores relative to cows housed in pens without neck rails. Cows (n = 32) were housed in 8 pens. Treatments were tested using a crossover design; treatments were allocated alternately to pen at the beginning of the experiment and switched half way through the 10-wk experiment. Cows spent approximately 30 min /d standing with all 4 hooves in stalls without neck rails, but almost never performed this behavior when neck rails were present. Instead, cows in pens with neck rails spent more time spent standing with only the front 2 hooves in the stall. Over the 5 weeks on each treatment, gait scores worsened for cows kept in pens with the neck rail compared to pens without. Of 13 new cases of lameness 11 occurred in pens with neck rails. Similarly, of the 16 new cases of sole lesions, 15 occurred during the period when cows were housed in with neck rails. Stalls without neck rails were 9 fold more likely to be contaminated with fecal matter and urine, and cows using those stalls had 30% dirtier udders and 15% longer teat cleaning times. This study provides the first experimental evidence that aspects of stall design can reduce the risk of lameness and hoof disease. The results also illustrate that changes in design that result in improvements in cow comfort and hoof health can come at the expense of cow and stall cleanliness.

Key Words: Lameness, Udder Hygiene, Stall Design

154 Cytokine secretion in periparturient dairy cows naturally infected with *Mycobacterium avium* subsp. *paratuberculosis*. E. L. Karcher^{*1}, D. C. Beitz¹, and J. R. Stabel², ¹*Iowa State University, Ames*, ²*ARS-USDA, National Animal Disease Center, Ames, IA*.

Johne's disease, caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP), has a devastating impact on the dairy industry. Cows typically are infected as neonates, and stressors, such as parturition, may induce the transition from the subclinical to a more clinical stage of disease. The objective of this study was to characterize cytokine secretion in periparturient dairy cows naturally infected with MAP. Twenty-five Holstein cows were classified according to infection status into three groups consisting of 8 noninfected healthy cows, 10 subclinical cows, and 7 clinical cows. Peripheral blood mononuclear cells (PBMCs) were isolated and cultured at 1.4×10^6 cells/mL with either medium alone (nonstimulated, NS), concanavalin A (ConA), or MAP whole cell sonicate (MPS). Culture supernatants were removed and analyzed by ELISA to detect the secretion of IFN- γ , IL-4, IL-10, and TGF- β . Production of IFN- γ by MPS-stimulated PBMCs was greater ($P < 0.01$) in subclinical cows compared with control cows and tended to be greater ($P < 0.11$) than in clinical cows. Similarly, when PBMCs were stimulated with either ConA or MPS, IL-10 secretion was greater ($P < 0.04$) in subclinical cows compared with controls. In contrast, secretion of IL-4 by MPS-stimulated PBMCs was greater in clinical cows compared with control ($P < 0.004$) and subclinical cows ($P < 0.04$). There was a tendency for NS PBMCs from infected cows to have increased secretion of TGF- β compared with the control, but secretion of TGF- β by ConA and MPS-stimulated PBMCs was not affected by infection group. Parturition evoked significant effects on cytokine secretion with observed increases in IFN- γ , IL-10, IL-4, and TGF- β , depending upon infection status of the cows and the in vitro stimulant used. Results of this study indicate that in dairy cows the secretion of

many key cytokines is modulated by natural infection with MAP and by the periparturient period.

Key Words: Cytokines, Periparturient, *Mycobacterium avium* subsp. *paratuberculosis*

155 A clinical trial evaluating MorindaMax™ Calf® immune-supplement on health and performance of preweaned, Holstein, heifer calves. V. J. Brooks¹, T. J. Paulus¹, T. DeWolfe¹, R. G. Godbee², S. F. Peek¹, S. M. McGuirk¹, and B. J. Darien*¹, ¹University Wisconsin, Madison, ²University Nevada, Reno.

Neonatal calves are at high risk for disease as their immune system is developmentally immature and incapable of mounting an adequate response to infectious pathogens. While adequate colostrum intake and properly used antibiotics can provide much protection for the neonate, increased antibiotic scrutiny and consumer demand for organic products has prompted investigations of natural immunomodulators for enhancing calf health and production. The objective of this clinical trial was to evaluate the effects of MorindaMax™ Calf® on health and performance of preweaned, Holstein heifer calves on a commercial calf-raising farm. MorindaMax™ Calf® is a commercially-available supplement for bovine neonates made from the *Morinda citrifolia* (noni) fruit. Noni is a natural product that has a broad range of immune-enhancing effects including: antibacterial, anti-inflammatory, anti-tumorigenesis, anti-oxidant and anti-fatigue activity. Two formulas (A and B; n=143) were tested against a control group of newborn calves (n=73). Calves received 0, 15 or 30 ml q 12 hr of either formula for the first 3 weeks of life. The effect of formula type on weaning age, weight gain, morbidity and mortality were analyzed through weaning (~5-8 weeks). Calf health was evaluated through daily physical exams which were recorded as health scores and dictated whether the calf required medical treatment or not. Results demonstrated a significant increase in number of calves weaned by 6 weeks of age that had received 15 ml q 12 hr of formula A relative to control calves. Additionally, calves receiving 30 ml q 12 hr of formula B had a significant reduction in respiratory, gastrointestinal and total medical treatments required relative to control calves. Early weaning and fewer required antibiotic treatments may result in monetary savings for the farmer through the production of healthier animals that require less time and treatments in the preweaning stage.

Key Words: MorindaMax, Immune-supplement, Calves

156 Effect of weaning strategy on immunological, hematological and physiological responses of beef calves. E. M. Lynch*^{1,2}, B. Earley¹, M. McGee¹, and S. Doyle², ¹Teagasc, Grange Beef Research Centre, Dunsany, Co. Meath, Ireland, ²National University of Ireland, Maynooth, Co. Kildare, Ireland.

The effect of weaning strategy on immunological, hematological and physiological responses was determined using 36 beef calves (276, s.d. 37.0 kg). Following abrupt weaning, calves were either 1) housed (WH) immediately in a slatted floor shed and offered grass silage *ad libitum* and supplementary concentrates or 2) remained at pasture (WP) and housed on day 35 post-weaning. Blood samples were collected by jugular venipuncture at weaning (day (d) 0) and on d 2, 7, 14, 21, 28, 35 (housing), 37, 42, 49 and 56. Plasma fibrinogen and haptoglobin concentration, in vitro interferon- γ (IFN- γ) production, plasma cortisol

and dehydroepiandrosterone (DHEA) concentration, total leukocyte number and subsets were determined. Plasma fibrinogen and haptoglobin increased ($P < 0.05$) in WH and WP calves for 21 d post-weaning. Post-housing, fibrinogen decreased ($P < 0.05$) and haptoglobin was unchanged ($P > 0.05$) in WP calves. IFN- γ production decreased ($P < 0.01$) in WH calves post-weaning, whereas no change ($P > 0.05$) was observed for WP calves post-weaning or -housing. Total leukocyte number decreased ($P < 0.05$) by d 7 post-weaning in WH calves and did not return ($P < 0.001$) to pre-weaning baseline, whereas in WP calves, it increased ($P < 0.01$) until d 21 post-weaning and subsequently decreased ($P < 0.02$) post-housing. Neutrophil number in WP calves increased ($P < 0.02$) on d 2 and d 7, whereas lymphocyte number was unchanged from d 0 to d 7. Neutrophil number in WH calves decreased ($P < 0.05$) on d 14 until d 56 whereas lymphocyte number increased ($P < 0.05$) on d 21 to d 56. Plasma cortisol increased ($P < 0.05$) from pre-weaning baseline to d 21 in WH and WP calves, but was unchanged ($P > 0.05$) in WH and WP calves from d 28 to d 56. Plasma DHEA was unchanged ($P > 0.05$) throughout the study. In conclusion, abrupt weaning altered leukocyte populations and acute phase protein profiles in WH and WP calves. The lower circulating leukocyte count and reduced IFN- γ response observed for WH calves suggests that abrupt weaning may be exacerbated by immediate housing.

Key Words: Weaning, Immunity, Cortisol

157 Dietary Colicin E1 prevents experimentally induced post-weaning diarrhea but does not provide a growth promoting effect. S. A. Cutler¹, N. A. Cornick¹, S. M. Lonergan¹, and C. H. Stahl*², ¹Iowa State University, Ames, ²North Carolina State University, Raleigh.

Post-weaning diarrhea (PWD) causes significant economic losses to the U.S. swine industry despite the use of antibiotic prophylaxis. While the dietary addition of sub-therapeutic levels of antibiotics is used for disease prevention, it has also been suggested to have an independent growth promoting effect. In a proof of concept study, we have demonstrated that dietary inclusion of Colicin E1 is effective in preventing PWD. In the current study, we examined the efficacy of dietary supplementation with Colicin E1 in preventing PWD using a seeder pig model as well as in promoting growth independently of a disease challenge. Eight pigs were orally inoculated with 10^9 CFU of an ETEC strain isolated from piglets with PWD. Two animals (paired by body weight) that exhibited severe diarrhea two days post-inoculation were placed into pens of piglets that were either fed a basal diet or the basal diet plus 20 mg Colicin E1/kg. An additional group of littermates were fed the same diets, in the absence of the ETEC challenge to investigate the effect of dietary inclusion of Colicin E1 alone. In the first week of exposure to the seeder animal, the challenged control animals gained less weight ($P < 0.05$) than the Colicin E1 treated pigs. A trend existed for lower body weight in the challenged control animals as compared to the Colicin E1 fed pigs at weeks 2, 3, and 4 ($P < 0.1$). No significant differences in body weight between the control and Colicin E1 fed non-challenged pigs were seen at any point in the study, nor were there differences in body weight between the challenged Colicin E1 fed animals and the non-challenged animals. In the first week after the seeder challenge, 4 of the control animals lost weight and two of those pigs lost more than 10% of their initial body weight. In total, over 75% of the control pigs had PWD by the end of the first week of the study, compared with 30% of the Colicin E1 fed pigs. Dietary addition of Colicin E1 is effective in preventing PWD under industry relevant conditions; however, no

growth promoting effect in the absence of a disease challenge was seen in this experiment.

Key Words: Post-weaning Diarrhea, Pig, Bacteriocin

158 Effects of PCV2 vaccine on growth performance and mortality rate of pigs in a PCV2-positive commercial swine herd. J. Y. Jacela*, S. S. Dritz, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, J. L. Nelssen, R. C. Sulabo, and J. R. Bergstrom, *Kansas State University, Manhattan*.

A total of 1,470 pigs (8.8 kg) were used in a swine farm with a history of Porcine Circovirus Disease (PCVD) to evaluate the effects of two commercial Porcine Circovirus Type 2 (PCV2) vaccines on growth and mortality rates. The first vaccine was administered a week after weaning (1-dose; Suvaxyn™ PCV2 One Dose, Fort Dodge®) while the second was administered at weaning and three wk later (2-dose; Circuvent™ PCV, Intervet®). A group of unvaccinated pigs served as a control group. Individual weights were taken at d 0 (weaning), 113, 143, and 152 (off-test). Pigs commingled during the growing period. A subsample of necropsied pigs had histopathologic lesions associated with PCVD. On d 113, the 2-dose group was heavier ($P < 0.05$) than the control group (86.5 vs 82.5 kg) with the 1-dose group intermediate (85.4 kg). At d 143, both the 1-dose and the 2-dose pigs were heavier than the control pigs by 3.4 and 4.6 kg ($P < 0.05$), respectively, with the two vaccinated groups not significantly different. The 2-dose group was heavier ($P < 0.05$) than the controls (120.2 vs 116.4 kg) while the 1-dose group was intermediate (118.8 kg) at off test. Weight gap between vaccinates and controls were smaller at off-test compared to d 143 due to a wider on-test days variability as a result of multiple marketing days. The 1-dose and 2-dose groups had greater ADG ($P < 0.05$) compared to the controls from d 0 to 113 (676 and 689 vs 653 g), d 0 to 143 (717 and 726 vs 694 g), and at off-test (726 and 735 vs 703 g). From d 113 to 143 and off test, ADG between groups were not different suggesting that the increase in growth rate in vaccinated pigs occurred from d 0 to 113. No significant difference in mortality rates between treatments were observed but each vaccinated group had numerically lower mortality than control pigs (7.8 and 7.7 vs 11.0%). Both vaccines in this trial were effective in mitigating the effects of PCV2 virus on growth performance of pigs in a PCV2-positive herd.

Key Words: PCVD, PCV2, Vaccine

159 Effect of feeding *Mucuna pruriens* to sheep on helminth parasite infestation in lambs. C. M. Huisden*, A. T. Adesogan, J. M. Gaskin, C. H. Courtney, A. M. Raji, and T. Kang, *University of Florida, Gainesville*.

Mucuna pruriens is a tropical legume anecdotally reputed to have anthelmintic properties. The aim of this study was to determine if ingestion of *Mucuna* seeds reduces helminth parasite infestation in lambs. Thirty-six Dorper x Katahdin ram lambs (\pm 6 months old, 28.8 \pm 5 kg body weight) were dewormed subcutaneously with levamisole (2 ml/45.4 kg), balanced for fecal egg counts and body weight, and randomly allocated to 3 treatment groups. The 12 lambs in each treatment group were randomly assigned to 4 pens, each containing 3 lambs. All lambs were fed ad libitum amounts of an isonitrogenous (14% CP), isocaloric (64% TDN) total mixed ration in which the main protein supplement was cotton seed

meal or *Mucuna*. Treatments consisted of a control diet, a diet in which *Mucuna* replaced cotton seed meal and a further treatment that involved administering levamisole (2 ml/45.4 kg) to lambs fed the control diet. Lambs were adapted to diets for 2 wk and trickle infected three times per wk by gavage with infectious *Haemonchus contortus* larvae (2000 larvae/lamb) for 3 wk. Subsequently, 2 lambs per pen were necropsied and the third lamb was grazed on bahiagrass pasture for 14 d and then necropsied. Levamisole treatment decreased fecal egg counts by 87% (58 vs. 445 eggs/g) and abomasal worm counts by 83% (1170 vs. 202 worms/lamb). *Mucuna* intake did not affect fecal egg counts (412 vs. 445 eggs/g) or abomasal worm counts (958 vs. 1170 total worms), though a numerical ($P \geq 0.10$) reduction was evident. Neither levamisole nor *Mucuna* treatment affected anemia indicators [FAMACHA (2), packed cell volume (32.4%) and blood protein (6 g/dl)], daily feed intake (2.5 kg), final body weight (37.9 kg), average daily gain (0.31 kg/d) and dressing (48.8%). *Mucuna* intake did not reduce infection in lambs fed a high quality diet. Pathological signs of infection were obscured, most likely by a combination of well balanced rations and lambs of breeding known to be at least somewhat inherently resistant to this parasite as compared to highly improved breeds. Future studies should examine if *Mucuna* exhibits anthelmintic properties in more susceptible lambs fed poorer quality diets.

Key Words: *Mucuna*, *Haemonchus*, Anthelmintic

160 The effect of the synthetic glucocorticoid dexamethasone on clock gene expression in bovine neutrophils. S. J. Nebzdoski*, L. M. Nemeč, and T. F. Gressley, *University of Delaware, Newark*.

Glucocorticoid induced suppression of neutrophil function contributes to cattle disease. Although circadian rhythms drive immune function in other species, the role of circadian rhythms on bovine neutrophil function is unknown. A study was conducted to determine the influence of the synthetic glucocorticoid dexamethasone (dex) on circadian rhythms of gene expression in bovine neutrophils. Six Holstein steers averaging 225 kg were injected with either saline (control) or dex (0.1 mg/kg BW). One wk later the opposite treatments were administered. Photoperiod was controlled with lights on at 0700h and off at 1700h which roughly coincided with the natural sunrise and sunset. Neutrophils were collected from blood sampled by jugular catheters at 0, 4, 8, 12, 16, 20 and 24h following administration of treatment. Quantitative real-time PCR was used to determine mRNA expression of *L-selectin* and multiple clock genes including *Bmal1*, *Clock*, *Per1*, *Rev-erb α* and *CK1 ϵ* relative to the expression of the housekeeping genes *RPS9* and β -*actin*. A mixed model was used to quantify the effects of treatment (dex vs. control), time (0, 4, 8, 12, 16, 20, 24h) and their interaction on gene expression. Treatment affected expression of *L-selectin*, *Clock*, *Per1* and *Rev-erb α* ($P < 0.001$) and tended to affect *Bmal1* ($P = 0.07$). Relative to the control treatment, dex decreased expression of *L-selectin* 2-fold, *Bmal1* by 14%, *Clock* by 79% and *Rev-erb α* by 47%. Expression of *Per1* increased 26-fold. Time affected *Clock*, *Per1*, *Rev-erb α* and *CK1 ϵ* ($P < 0.01$). Expression of *Clock*, *Per1* and *CK1 ϵ* peaked at 4h and reached a nadir at 24h. *Rev-erb α* expression peaked at 4h and was lowest at 16h. An interaction between treatment and time was found for *Clock* and *CK1 ϵ* ($P \leq 0.001$). Relative to the saline treatment, dex depressed *Clock* expression at all times with the greatest difference at 8h and the least difference at 20h. Additionally, *CK1 ϵ* expression increased at 4 and 8h but decreased at 20h after dex treatment ($P \leq 0.05$). Glucocorticoid induced changes in circadian rhythms of gene expression may be important in regulating the functionality of bovine neutrophils.

Key Words: Clock Genes, Dexamethasone, Neutrophils

Symposium: ASAS Cell Biology: The Role of MicroRNA on Cell Function

161 MicroRNA: Mechanism of gene regulation. T. G. McDaneld*, USDA/ARS U.S. Meat Animal Research Center, Clay Center, NE.

MicroRNA (miR) are a class of small RNAs that regulate gene expression by inhibiting translation of protein encoding transcripts through activation of a specific cellular pathway. The small RNA classified as miR are short sequences of 18-26 nucleotide long, encoded by nuclear genes with distinctive properties that comprise 1-5% of known genes. During processing from the primary transcript, the mature miR sequence is loaded into an RNA:protein complex known as the "RNA induced silencing complex" (RISC). The sequence of the miR loaded in the complex targets the RISC to specific binding sites in the 3'UTR of mRNA transcripts, resulting in either degradation of the miR:mRNA complex or translocation to P-bodies. In either case, association of RISC with mRNA causes decreased translation of the targeted gene product. Approximately 40% of genes have transcripts that are potential targets for miR, suggesting that miR play an important role in multiple cellular processes. A single miR can target numerous distinct mRNA for decreased translation, and as a result miR appear to be intimately involved in developmental decisions including cell fate, cell cycle progression, apoptosis, adipocyte differentiation, and processes that alter muscle development and growth. Implication of miR in such a wide array of cellular processes has increased interest in evaluating miR in multiple biological models.

Key Words: MicroRNA, Gene Regulation

162 Role of MicroRNAs in hepatocarcinogenesis in an animal model. K. Ghoshal*, J. Datta, and H. Kutay, *Ohio State University, Wooster.*

In the post-genome era lot of effort has been expended to elucidate the function of noncoding regions of the genome that was previously considered as "junk DNA". Majority of these DNAs codes for RNAs ranging in size from ~100 to ~10,000 nucleotides. MicroRNAs (miRs) are ~21-nucleotide-long RNA that regulate expression of protein-coding genes by post-transcriptional mechanisms. Most of these miRs, highly conserved among animals, function by base pairing with the 3'-UTR of mRNA resulting in translational repression or mRNA degradation. MiR genes transcribed by RNA polymerase II, can be intergenic, intronic or polycistronic. Primary miRNAs are processed by ribonucleases to mature miRs. Like mRNAs, some miRs are ubiquitously expressed whereas others are tissue specific. Each miR targets several mRNAs, which in turn, are regulated by multiple miRs, underscoring their complex regulatory role. MicroRNAs are involved in every aspect of biology that include differentiation, development, immune response, drug resistance etc. Aberrations in microRNA expression appear to play a causal role in different disease processes including cancer. Studies from several laboratories have shown that microRNA signature is altered in

primary hepatocellular carcinomas that can be used as a prognostic marker. In an animal model of diet-induced hepatocarcinogenesis we have shown that miR expression profile in the rodent liver tumors is quite similar to those in humans. Some miRs are deregulated an early stages of tumorigenesis implicating their role in preneoplastic transformation of hepatocytes. Currently we are pursuing potential role of some of the deregulated miRs in hepatocarcinogenesis.

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Key Words: MicroRNA, Liver Cancer, Tumor Suppressor Genes

163 MicroRNAs in the ovary and female reproductive tract. L. Christenson*, M. Carletti, S. Fiedler, L. Luense, and X. Hong, *University of Kansas Medical Center, Kansas City.*

Post-transcriptional gene regulation plays a vital role in male and female germ cell function, but our understanding of this regulatory process in somatic cells and its impact on reproductive tissue development and function is not understood. In mammalian cells, microRNAs (miRNA) are key post-transcriptional regulators and function primarily by modulating translation of their target mRNAs. Mature miRNAs are synthesized through a multi-step process that concludes with the cleavage of stem-loop pre-miRNAs by the RNase III enzyme, Dicer. To understand the role of miRNA mediated post-transcriptional gene regulation in somatic cells of the female reproductive tract and in ovarian granulosa cells, mice with loxP insertions in the Dicer gene were crossed with mice expressing Cre-recombinase driven by the anti-Mullerian hormone receptor-2 (AmhR2) promoter. Female *Dicer^{fl/fl};AmhR2-Cre* mice (n=6) mated to fertile males failed to produce offspring. Mating was confirmed, thus estrus and presumably normal follicular estrogen synthesis occurred in these mice. General morphological and histological evaluation of these tissues indicated that the oviduct and uterus were half the size of their littermate controls and a severe disruption of the oviductal lumen at the utero-tubal junction was evident. Ovarian function was also not normal in the *Dicer^{fl/fl};AmhR2-Cre* mice as evidenced by reduced ovulation rates and the relative absence of corpora lutea. To further understand the role of miRNAs in the ovulatory process, expression of ovarian granulosa cell miRNAs, before (0 h) and 4 h after the luteinizing hormone (LH/hCG) surge was evaluated. More than 200 miRNAs were detected in granulosa cells and 15 of these exhibited differential expression ($P < 0.05$). Three miRNAs, miRNA-21, -132 and -212 exhibited a pronounced (7.5 to 20-fold) up regulation in response to in vivo hCG treatment. Subsequent in vitro studies with granulosa cells and antagonists (i.e., anti-mirs and complementary LNA primers) to these specific miRNAs has implicated these miRNAs in regulation of apoptosis and general translation control. This work is supported by NIH grant HD051870.

Key Words: microRNA, Granulosa Cell, Ovary

Symposium: Bioethics: Value of Bioethics Leadership for Food Animal Agriculture

164 Bioethics across the disciplines: Leadership and mutual respect. G. Varner*, *Texas A&M University, College Station.*

What must philosophers and animal scientists do in order to work productively together in the debate about animals ethics issues? A clarion call from animal scientists to philosophers was given by David Fraser in his 1999 article "Animal ethics and animal welfare science: bridging the two cultures." Fraser argued that several features of what he called "type 1 philosophy" had driven a wedge between philosophers and animal scientists. He described "type 1 philosophy" as endorsing a monolithic and individualistic moral principle, and as tending to lump together diverse animals and diverse practices involving them. Fraser held up as examples of "type 1" philosophy both Tom Regan, who is a rights theorist, and Peter Singer, who is a utilitarian. I agree that good philosophical leadership in the discussion of animal ethics requires us to avoid the problems that Fraser identified, but in this presentation I will stress that this does not require us to abandon utilitarian thinking in ethics. On the contrary, the two-level utilitarianism of R.M. Hare (who happens to have been Peter Singer's dissertation advisor) can endorse a diverse and context-sensitive set of what Hare called "intuitive level" rules. As a result, diverse animals and practices will not be "lumped together" and decisions about animals will sometimes involve conflicting principles, some of them focused at the population- or ecosystem-level. This must surely be a welcome result from the animal scientists' perspective, since defenders of agriculture and other uses of animals so often use utilitarian arguments. For their part, what must animal scientists do? For one thing, if they are going to think like utilitarians, then they must take seriously questions about animal consciousness. For utilitarianism is a sentientist doctrine: it ascribes intrinsic value to positive states of consciousness. So to apply utilitarian reasoning to our treatment of animals, animal scientists will have to include references to consciousness in their definitions of animal welfare. They must also be willing to admit that traditional assumptions about various practices could turn out to be mistaken. For while utilitarian thinking has an inherent conservative bias - insofar as all of the costs of proposed reforms must be taken into consideration-utilitarian thinking can also ground revolutionary changes, especially over the long haul.

Key Words: Ethics, Animal Science, Utilitarianism

165 Bioethics: The need for leadership and how societies should respond. M. G. Hogberg*, *Iowa State University, Ames.*

The symbiotic relationship between people and animals is well documented over time. As societies in the developed countries have changed from agrarian to industrial, consumer expectations on how and where animal are raised and used have also changed. This paper will focus on trends in society that impact animal agriculture and implications for professional societies in the animal agriculture field. Professional societies have a responsibility to create, distribute and use knowledge to meet society goals and do this in a socially responsible manner. In addition, societies have a role in providing science-based information to consumers and policy makers. Specific examples will be discussed on pro-active approaches that societies can do to meet the challenges of social responsibility in the area of bioethics.

166 Bioethics: The need for leadership and how the societies should respond. M. P. Lacy*, *University of Georgia, Athens.*

More and more scrutiny is being given to the use of animals in research and teaching. The use of animals for almost any reason (food, companionship, exhibit, etc.) has been questioned by some from an ethical perspective. Animal, dairy and poultry scientists obviously are trained and most interested in the science of animals, their production and use. We have left the discipline of ethics to philosophers. Bioethics is a complex, controversial and polarizing subject. Its origins go back at least to the Nuremberg War Crimes Trial, but recent advances in human medicine including stem cell therapies, cloning, genetic screening, etc. have resulted in accentuated attention to this area. Although bioethics has primarily focused on research or medical treatment related to humans, some want to apply bioethics to any living organism that can sense pain or fear. Physicians have found it necessary to insert themselves into the debate regarding medical bioethics. Likewise, animal, dairy and poultry scientists will have to venture into the debate regarding ethical use of animals. Doing so will be neither easy nor pleasant. Critics will claim we cannot be unbiased in such a debate, and it will be challenging to counter such arguments. Most of us believe the use of animals for research, instruction, food and companionship is certainly ethical, and it is difficult for some of us to see another side to the debate. As I consider the future of our disciplines and industries, it appears the next generation of animal, dairy and poultry scientists will have to be as well educated in ethics as in science. It will be important that these future scientists be trained and prepared to counter the argument that they are biased about the ethics of animal use simply because they are trained as animal, dairy or poultry scientists. Professional societies will need to continue to strive to be involved in the bioethics debate and provide unbiased, science based information just as they are involved today in controversial issues such as animal welfare, environmental protection and food safety.

Key Words: Poultry Science, Bioethics

167 ASAS Centennial Presentation: Role of industry leaders in addressing bioethical issues. J. W. Lauderdale*, *Lauderdale Enterprises, Inc., Augusta, MI.*

Food animal agriculture has numerous organizations recognized as providing leaders to address bioethical issues associated with food animal agriculture, such as: production, processing, marketing, production and health products, news media, and research and extension. This presentation is limited to the animal agriculture commercial organizations (Animal health companies) supplying products to enhance animal productivity and animal health. Animal health and productivity products reach the market only following exhaustive research and development (science) and approval by national and worldwide regulatory bodies (science in the USA through the Food & Drug Administration, Center for Veterinary Medicine). Until the 1990s, leaders in the commercial industry relied on science to defend products to enhance animal productivity and animal health. However, in the 1990s bioethics began to be used in discussions as to what products are "acceptable from a bioethics perspective", with bovine somatotropin being an excellent example. Currently, declaration of ethics associated with animal agriculture is promulgated primarily from academically based and advocacy groups

in the USA. Therefore, commercial industry leaders must become proactively engaged in bioethical issues in order to influence direction and outcome of decisions regarding bioethical issues that will influence food animal agriculture. If such engagement is based on understanding both the science and bioethics of the issues, with commitment to understand and act responsibly, leaders from animal health companies will contribute positively to the advancement of food animal agriculture. Such contribution will enhance the ability to provide animal products that are safe to consume, are produced consistent with environmental preservation, are produced in a manner consistent with bioethics, and are in sufficient quantity and quality to meet the increasing world population demand for animal derived foods.

Key Words: Bioethics, Food Animals, Industry Leadership

168 Summary and perspective from within. D. J. R. Cherney*,
Cornell University, Ithaca, NY.

Post-World War II changes in society and government policy led to drastic changes in animal production in the United States. Animal scientists led the way with better production systems, better breeding, better vaccinations, and better health care. Lifestyles of our society changed, leading to greater leisure time, and greater time to reflect on societal ills. Production efficiency has continued to increase, but at what costs? Do our societies and animal industries pay attention to societal needs, including animal welfare, worldwide food shortages, environmental pollution problems and ethics? Our animal sciences have undergone drastic changes in the ways we do science and the questions we research. The background of the people in our societies has changed. Our leaders in industry and the animal societies have been catalysts for some of these changes and will need to continue to be at the forefront of these issues to keep our industries viable in this ever changing world.

Key Words: Bioethics

Symposium: Breeding and Genetics: Training of Future Animal Breeders

169 Training graduate students in animal breeding: A historical prospective. E. J. Pollak*, *Cornell University, Ithaca, NY.*

The training of animal breeding students has historically been based on the blending of information from basic and population genetics, statistics, and animal science. Statistics provided breeding students with the foundation in methods of estimation of effects and variance components and modeling strategies for varying types of phenotypes (e.g., continuous, categorical or survival data). Genetics provided foundations in understanding of the biology of inheritance, of additive and nonadditive effects and population theory for selection. Animal science provided the biological understanding of traits within our domestic species of interest as well as insight into industry needs, management practices, and constraints. The advent of a computer science curriculum provided for the skills to develop computational tools for analysis of data to meet research needs, especially in cases where large volumes of data are analyzed. Concepts and tools from these disciplines were brought together in animal breeding courses that focused on developing and implementing strategies for genetic assessment, selection and mating plans. What changed over the decades of training students in animal breeding were not the foundation disciplines but rather the nature of the information gleaned from those disciplines and from the changes in technology for implementing animal breeding plans. Focus in this presentation will be on understanding the history of educating animal breeding students in quantitative genetics theory with an eye on how this history should guide us into the future given the impending large impact of molecular biology on animal agriculture and particularly on opportunities for application in animal selection.

Key Words: Training, Animal Breeder, Quantitative Genetics

170 Graduate education utilizing distance learning. R. M. Lewis*¹, B. B. Locke¹, M. S. Ames¹, R. M. Enns², J. M. Rumph³, T. W. Wilkinson¹, and E. J. Pollak⁴, ¹*Virginia Tech, Blacksburg*, ²*Colorado State University, Fort Collins*, ³*Michigan State University, Lake City*, ⁴*Cornell University, Ithaca, NY.*

Graduate-level education in animal breeding and genetics is in a state of dilemma: there are too few faculty members with expertise in this discipline at individual institutions to provide comprehensive training. A potential solution is an inter-institutional distance education curriculum. A consortium of universities is attempting to address this challenge by developing seven online courses to supplement Masters degree-level instruction in existing degree programs. The choice of courses was based on a national survey. In total 125 faculty members from 46 land-grant institutions were contacted, and nearly 50% responded. Feedback was sought on the extent and comprehensiveness of graduate-level training in breeding and genetics at their institution, and whether modularized online courses might offer a vehicle for addressing gaps in their program. Ninety-three percent of respondents believed online courses were an acceptable method to deliver advanced training, and 86% believed that a comprehensive distance learning curriculum was needed. The ADDIE instructional design model - analyze, design, develop, implement, evaluate - is being used for course construction. Evaluation is

central. In addition to student evaluations, each course will undergo review by four content experts, two from outside the consortium, and a specialist in instructional design. In order to be sustainable, the curriculum requires an organizational infrastructure. Thus, another aim is to coordinate partner institutions in the accreditation, delivery and cost-recovery of the resulting curriculum. The structure established will be designed to encourage participation of other institutions in the development of additional distance learning courses. Thus far two courses have been prepared, with one taught and the other in progress. Twenty students from 11 universities have participated in each course. Feedback has been very positive. The inter-institutional sharing of distance education programming appears to be a viable strategy to meet student, industry and academic needs for advanced training in animal breeding and genetics.

Key Words: Graduate Education, Distance Learning, Breeding and Genetics

171 Challenges of training quantitative graduate students. I. Misztal* and J. K. Bertrand, *University of Georgia, Athens.*

Acute shortage of quantitative geneticists (QG) in animal breeding has occurred in the U.S.; therefore, despite recruiting efforts, including those by professional companies, demands are not met. This is because the supply of quality graduates is low.

The QG shortage is partly a result of a past shift in funding from quantitative to molecular genetics. Consequently, new types of training were needed, notably in lab techniques. Now, as the molecular information becomes available through commercial products, the lab experience is less important, and the training required by current molecular geneticists has de facto become similar to those of quantitative geneticists. In particular, future success in the hot area of genomic selection will be largely dependent on scientists with quantitative skills: manipulating the genomic information requires quantitative skills and good genomic EBV requires good conventional EBV.

Several steps should be taken to provide more and talented graduates for animal breeding in QG. Currently, the supply of QG Ph.D. candidates is limited and those applying often have limited background and motivation. One way of increasing the number of U.S. candidates is to substantially raise scholarships, at least to a level comparable to that paid at EU institutions. Many generic courses fail to excite students and specialized courses with low enrollment lack the critical mass. Replacement of these courses by short courses with specific focus can provide strong motivation to excel due to peer competition, while also creating a social environment among graduates from different institutions. As a student can easily be overwhelmed by too many courses, some semesters need to be designated for short courses only, and a mechanism to provide credits to students from non-home institutions needs to be worked out. Finally, much larger competitive, special grants, and industry (including matching funds) QG funding should be made available to interested faculty, to provide incentives to departments to retain and hire more QG faculty.

Key Words: Quantitative Genetics, Graduate, Training

172 Alternative teaching techniques for new and smaller animal breeding programs. C. D. Dechow*, *Penn State University, University Park.*

Animal breeding programs at many universities consist of one or two faculty members who also have a large undergraduate teaching or extension appointment. A small number of animal breeders within a department combined with limited support for their research program create obvious teaching challenges. Effective upper level animal breeding courses require a critical mass of students and if all animal breeding courses are taught by the same instructor, the curriculum focus can be limited. Animal breeding students might also feel isolated because of limited interaction with other animal breeding students. There is a strong demand for well trained animal breeding students despite these challenges and faculty members must pursue alternate avenues to train students. The challenges associated with low course enrollment have led to the development of online animal breeding courses that are recently available. While online courses alone will not satisfy all teaching needs, they will help fill the classroom void. Alternative teaching or learning techniques are not limited to online courses. Short courses and professional meetings provide learning opportunities and interaction with other faculty and future animal breeders. Many students would benefit from a semester spent studying abroad or at a peer institution with a larger faculty and student base in animal breeding. An example program is the Traveling Scholar Program of the Committee on Institutional Cooperation, which facilitates tuition and stipend payments for graduate students studying at different Big Ten universities. Partnerships between industry and university faculty can provide support for graduate training while exposing students to practical industry research needs. Finally, undergraduate student research and honors projects can be an effective tool to generate interest in animal breeding and complete small research projects with limited cost. The landscape for training animal breeding students has changed. There are new challenges to overcome, but tools to meet those challenges are in place and small animal breeding programs can help provide tomorrow's animal breeders.

Key Words: Animal Breeding, Teaching

173 Quantitative genetics training to meet the needs of the breeding industry. M. M. Lohuis*, *Monsanto Company, St. Louis, MO.*

The supply of well-trained graduate students for quantitative genetics roles in the plant and animal genetics industries is not keeping up with demand. With the apparent reduction in supply/demand, breeding companies are now also hiring graduates with degrees in statistics, bioinformatics and computer science into quantitative genetics roles traditionally held by animal or plant breeding graduates. Although, the breeding industries continue to consolidate, and reliable and comprehensive software packages are increasingly available, the demand for quantitative geneticists is remaining constant or increasing. Breeding companies continue to run breeding programs that require data manipulation, variance component estimation and genetic evaluations. However, they are also adding new dimensions to their programs that can involve the incorporation of genetic marker data, longitudinal data and/or more complex mixed models. With the availability of relatively affordable SNP multiplex genotyping platforms, very large datasets (i.e. greater than 150M SNP data points) are becoming more commonplace. Simultaneously, considerable work is required for optimization, simulation and breeding strategy to make these high-dimension breeding programs tractable and profitable in an industry setting. Traditional strengths of quantitative genetics graduates continue to be solid training in quantitative genetics principles, applied statistics, selection theory and computing skills. Traditional shortcomings tend to be limited knowledge of molecular and structural/functional genomics, inconsistent training in bioinformatics and breeding strategies and a lack of collaborative research and networking skills. Demand continues to grow for quantitative genetics graduate students that have a comprehensive knowledge of both quantitative and molecular genetics principles and techniques, together with the ability to collaborate with scientists from related fields and continue to grow and adapt to new technologies as they develop.

Key Words: Training, Genetics, Breeding

Companion Animals: Comparative Animal Biology

174 Diet transition time and stabilization of apparent digestibility in the feline. S. K. Martin*¹, M. R. C. de Godoy¹, D. L. Harmon¹, E. S. Vanzant¹, R. M. Yamka², K. G. Friesen², and K. R. McLeod¹, ¹University of Kentucky, Lexington, ²Hill's Pet Nutrition, Inc., Topeka, KS.

An experiment was conducted to determine the effects of length of dietary adaptation time on apparent nutrient digestibility in felines. Ten adult female shorthair cats were used to evaluate nutrient digestibility of 2 extruded dry test foods; differing only in inert marker included (Cr and Ti). Each experimental period (n=5/diet) consisted of 7 d adaptation and 21 d of total fecal and urine collection. Prior to each experimental period, cats were fed an extruded dry maintenance food for at least 3 wks. In comparison to the maintenance food, test foods were designed to have differing nutritional profiles with lower amounts of protein (29.7 vs. 33.7%) and fat (20.2 vs. 24.3%) and higher amounts of total dietary fiber (8.5 vs. 3.0%), and differences in ingredient composition. Foods were fed to meet maintenance energy requirements for adult cats. Dietary transition was conducted by incrementally increasing the proportion of test food by 25% on d 1, 3, 5, and 7 of each period. Fecal and urine samples were collected daily. Cats did not produce fecal samples on a daily basis, and accordingly samples were composited by week. Data were analyzed as a crossover design with repeated measures over time. Across test foods, dry matter digestibility (DMD) was unaffected (P = 0.86) by adaptation time; averaging 79.7, 80.1, 80.3% for wk 1, 2, and 3 respectively. Coefficients of variation were 4.07, 3.37, 4.78% for wk 1, 2, and 3 respectively. Similarly, nitrogen digestibility (ND) was unaffected (P = 0.61) by time, averaging 80.7, 81.5, 81.7% for wk 1, 2, and 3, respectively. Coefficients of variation were 4.32, 2.84, 3.58% for wk 1, 2, and 3 respectively. Results indicate that 7-d food adaptation period is satisfactory for apparent total tract nutrient digestibility stabilization in cats undergoing transition between dry extruded foods.

Key Words: Cat, Digestibility, Food Adaptation

175 Low-level fructan supplementation is effective in modifying stool protein catabolite concentrations but not gut microbiota populations in adult dogs. K. Barry*¹, D. Hernot¹, I. Middelbos¹, C. Francis², B. Dunsford², and G. Fahey, Jr.¹, ¹University of Illinois, Urbana, ²GTC Nutrition, Golden, CO.

Five ileal-cannulated adult dogs were utilized in a 5 x 5 Latin square design to determine the effects of fructan type and concentration on nutrient digestibility, stool protein catabolite concentrations, and microbiota in ileal digesta and feces. Five diets were evaluated that contained either cellulose alone or with inulin or short-chain fructooligosaccharides (scFOS) at 0.2 or 0.4% of the diet. Dogs were fed 175 g of their assigned diet twice daily. Chromic oxide served as a digestibility marker. Nutrient digestibility; ileal and fecal pH, ammonia concentrations, short- and branched-chain fatty acid concentrations, and microbial populations; ileal IgA concentrations; and fecal concentrations of phenols, indoles, and biogenic amines were measured. No differences were observed in ileal pH or concentrations of ammonia, acetate, or isobutyrate, or fecal concentrations of indole or valerate. Ileal dry matter (DM), organic matter (OM), and crude protein (CP) digestibilities; total tract DM and OM digestibilities; fecal concentrations of phenylethylamine; and

ileal concentrations of *E. coli* increased linearly (P<0.05) with inulin supplementation and fecal concentrations of phenol decreased linearly (P<0.05). Fecal concentrations of acetate and propionate decreased quadratically (P<0.05) with inulin supplementation. Ileal DM, OM, and CP digestibilities increased linearly (P<0.05) with scFOS supplementation and fecal concentrations of phenol decreased linearly (P<0.05). Total tract DM and OM digestibilities; ileal butyrate concentrations; fecal p-cresol, butyrate, and isobutyrate concentrations; and ileal Clostridium perfringens concentrations increased quadratically (P<0.05) with scFOS supplementation. Both supplemental fructans modified stool protein catabolites, but scFOS appeared to result in more significant modifications than did inulin. While a higher level of inclusion would be recommended to modify gut microbiota populations, low-level inclusion of either fructan is effective in modifying stool protein catabolite concentrations in the terminal ileum and feces of adult dogs.

Key Words: Fructan, Dog, Protein Catabolite

176 Influence of dietary protein content and source on digestibility patterns, osmolality and fecal quality in dogs differing in body size. J. Nery*¹, C. Tournier², V. Biourge², L. Martin¹, H. Dumon¹, and P. Nguyen¹, ¹Ecole Nationale Veterinaire de Nantes, Nantes, France, ²Royal Canin, Aimargues, France.

Large breed dogs are known to be more sensitive to diet than smaller ones and consequently to produce feces of poorer quality. A higher overall total apparent digestibility was previously associated to higher fermentation rates and higher luminal osmolality, in the colon of large breed dogs. The use of highly digestible protein and a reduction of crude protein (CP) level could constitute a solution to decrease colonic osmolality and improve large dog's fecal quality. The aim of this study was to assess the effect of protein source and level on total digestibility, osmolality and fecal quality in dogs differing in body size.

27 healthy female dogs were divided in 4 groups according to body weight and propensity to produce soft feces. Five diets varying in protein source (wheat gluten and/or poultry meal) and level (20%, 28% and 36% CP as fed) were tested. Feces were collected and scored on a daily basis during a 7-day test period preceded by a 7-day adaptation period. Moisture, and apparent digestibility coefficients (ADC) of DM, energy, fat, CP and ash, were determined from the feces collection pool. Osmolality was analysed from freshly voided feces. Data were analyzed using Kruskal-Wallis nonparametric test and Bonferroni/Dunn post-hoc test.

Fecal quality decreased with dog size (p<0.0001) and was lower for poultry meal diets (p<0.0001). ADC increased with dog size, was lower when poultry meal was the major protein source and varied inversely to dietary protein level. Fecal osmolality varied with source (p<0.001) but not with CP content of diet, being higher for poultry diets. No effect of dog size was found for this parameter.

Conclusions: Protein source has proven to be a good mean to modulate fecal quality in sensitive dogs due to its effect on digestibility and fecal osmolality. Conversely differences of fecal quality between different dog's size and levels of CP fed do not seem to be related with fecal osmolality.

Key Words: Fecal Quality, Dog, Osmolality

177 Evaluation of high protein diets in kittens during their first year of life. B. M. Vester*¹, K. J. Liu², T. L. Keel¹, T. K. Graves¹, and K. S. Swanson¹, ¹University of Illinois, Urbana, ²Natura Manufacturing, Inc., Fremont, NE.

Diets containing high concentrations of protein are now available on the mass market for cats. The objective of this experiment was to evaluate cats through their first year of life while being fed either a high(HP)- or moderate-protein(MP) diet. Eight dams were randomized onto 1 of the 2 test diets (53 and 34% protein, respectively). These dams were fed the diets for 1 mo prior to mating, and were all mated to 1 male. Upon queening, the male offspring were evaluated for 14 mo. All kittens were weaned at 8 wk of age onto the same treatment diet as the dam and were allowed to consume ad libitum throughout the study. Food intake and refusals were measured daily. Kittens were housed by litter from wk 8 to 16 then pair housed by diet. Blood samples were collected at 6 mo, and 12 mo after birth and analyzed for glucose, leptin, insulin, NEFAs, and triglycerides. Body composition using DEXA was determined at 8 wk, 8 mo, and 14 mo of age and an intravenous glucose tolerance test was conducted at 8 mo and 14 mo of age. Kittens were castrated and an adipose biopsy taken at 8 mo of age. Activity was quantified using Actical monitors at 6, 9, and 12 mo of age. Dry matter intake and body weight were not different between the 2 diet groups. Leptin did not differ between diets, but increased (P<0.05) over time from 6 mo to 12 mo of age. NEFAs were highest (P<0.05) at 6 mo of age and tended to be higher (P<0.10) in kittens fed the HP diet. Triglycerides were increased (P<0.05) in kittens fed the HP diet at 8 wk of age, but were not different at 6 mo or 12 mo. Activity was not affected by diet, but activity during the light period tended to decrease (P<0.10) as the cats aged. Kittens fed the HP diet tended to have increased (P<0.10) grams of lean mass compared to kittens fed the MP diet. Glucose area under the curve (AUC) was decreased (P<0.05) at 14 mo compared to 8 mo, but was not affected by diet. Insulin AUC was higher (P<0.05) in kittens fed the HP diet compared to the kittens fed the MP diet at 14 mo of age. Based on indices measured in this study, a HP versus MP diet appears to be a suitable replacement to the carbohydrate-based diets mass marketed to feline owners.

Key Words: Cat

178 Influence of feeding raw or extruded feline diets on nutrient digestibility and nitrogen metabolism in African wildcats. B. M. Vester*¹, S. L. Burke², K. J. Liu³, C. L. Dikeman², L. G. Simmons², and K. S. Swanson¹, ¹University of Illinois, Urbana, ²Henry Doorly Zoo, Omaha, NE, ³Natura Manufacturing, Inc., Fremont, NE.

The African wildcat is one of the closest ancestors to the domestic cat and is believed to have similar nutrient requirements to domestic felids, but research is lacking. Small exotic cats housed in captivity are often fed a raw meat-based diet, which poses a risk of bacterial contamination. The objective of this experiment was to determine the effects of feeding a high protein extruded kibble diet versus a raw meat diet on nutrient digestibility, nitrogen balance, and blood metabolite concentrations in African wildcats. Five African wildcats were randomized onto either a high-protein extruded kibble diet or a raw meat carnivore diet. The study was executed as a crossover design, consisting of 21 d periods, with a 16 d adaptation phase, a 4 d fecal and urine collection phase, and

1 d for blood collection. Cats were housed individually in metabolism cages and fed to maintain body weight. Food offered and refused was measured daily. Both fresh and acidified urine was collected during the 4 d collection period for urinalysis and nitrogen measurement. A fresh fecal sample was collected for short chain- and branched chain- fatty acid analysis. Blood was analyzed for serum chemistry and leptin. Overall, both diets appeared to be well digested by the cats. Protein digestibility was higher (P<0.05) when cats were fed the raw meat diet versus the kibble. Nitrogen balance was positive for both diets (1.95 kibble diet versus 0.76 raw meat diet) and mirrored body weight changes (baseline 3.4 kg, kibble 3.6 kg, and raw meat 3.4 kg). Fecal propionate concentrations tended to be higher (P<0.10) when cats were fed the raw meat diet, however, fecal butyrate concentrations tended to be higher when cats were fed the kibble diet. Blood analysis showed few differences between diets, but alanine aminotransferase activity was higher (P<0.05) when cats were fed the raw meat diet. These data indicate that feeding an extruded kibble diet to African wildcats appears to be a suitable replacement to a raw meat diet.

Key Words: African Wildcat, Raw

179 Vitamin and mineral comparisons between captive and free-ranging koalas (*Phascolarctos cinereus*), possible explanations for hip dysplasia. D. A. Schmidt*¹, W. A. Ellis^{1,2}, F. B. Bercovitch¹, Z. Lu³, T. C. Chen³, C. Hamlin-Andrus¹, G. W. Pye¹, and M. F. Holick³, ¹Zoological Society of San Diego, San Diego, CA, ²University of Queensland, Brisbane, Australia, ³Vitamin D, Skin and Bone Laboratory, Boston University School of Medicine, Boston, MA.

A retrospective/prospective study of koalas (*Phascolarctos cinereus*) bred at the San Diego Zoo has documented 55 cases of moderate to severe hip dysplasia, with varying degrees of bone malformation. While the cause of the dysplasia is likely genetic, abnormal bone development due to insufficient concentrations of vitamin D for calcium absorption needed investigation. Most koalas housed at the San Diego Zoo are managed indoors without access to direct, unfiltered sunlight. Zoo koalas only consume eucalyptus leaves and few plants have significant concentrations of vitamin D₂ and D₃. Serum samples from 22 zoo and 19 free-ranging koalas were analyzed for Ca, Cl, Co, Cu, Fe, Mg, Mn, Mo, P, K, Se, Na, Zn, and vitamins A, D, and E. Zoo and free-ranging koalas and males and females were compared using student's t-tests (P≤0.05). No differences were found between genders within the zoo population. Calcium concentrations were different between zoo and wild koalas, averaging 10.7 and 10.3 mg/dL, respectively. However, these concentrations are considered within the normal range for other species. Chloride and Se concentrations were also higher in zoo koalas than in wild koalas, while P and Zn concentrations were higher in the wild animals. Although Mo concentrations averaged 4.8 ng/ml in captive koalas, concentrations were not detectable in the free-ranging population. Manganese concentrations ranged from not detectable to 2.5 ng/ml for captive koalas, but averaged 11.09 ng/ml for the free-ranging animals. Vitamin D (25-hydroxyvitamin D₂ and D₃) was analyzed using an RIA kit for humans. Concentrations were detected in the captive koalas with results near the minimal functional detectable limits of the assay. The free-ranging koalas had no detectable serum concentrations of vitamin D₃, raising concerns about the validity of the test in this species.

Key Words: Koala, Vitamin, Mineral

180 Using regression analysis to determine the quantities of browse component dry matter on branches of Carolina willow (*Salix caroliniana*). M. L. Schlegel^{1,2}, A. McComb^{2,3}, and E. V. Valdes², ¹The Zoological Society of San Diego, San Diego, CA, ²Disney's Animal Programs, Lake Buena Vista, FL, ³North Carolina State University, Raleigh.

One challenge in determining browse intake of zoo animals is quantifying the initial component composition. Depending on the animal species, animals will consume not only the leaves, but also the stems, bark, and wood. The objective of this project was to determine the relationship between branch diameter and the quantity of browse component DM on branches of Carolina willow (*Salix caroliniana*). Eighteen branches of willow were harvested in central Florida between April and May, weighed wet (range = 0.05 to 2.9 kg), and the base branch diameter measured (range = 7.75 to 42.25 mm) using calipers. Each branch was separated into five components (leaves, green stems, woody stems < 0.5 cm in diameter, bark from stems > 0.5 cm in diameter, and wood from stems > 0.5 cm in diameter). Components were dried at 55 °C to determine quantity of DM and to calculate total branch DM. Regression analysis of branch diameter versus branch component DM and total branch DM was done using Microsoft Excel. All prediction equations (branch component DM, g = diameter coefficient × branch diameter, mm + intercept) contained significant ($P < 0.05$) regression coefficients (Table 1). Using these predictive regression equations, the quantity of DM offered from each browse component can be estimated and the quantity of browse consumed determined when the browse components refused are separated and dried. Although this set of predictive equations is useful for Carolina willow only, the concept can be applied to other browse species fed.

Table 1. Regression coefficients to predict Carolina willow (*Salix caroliniana*) branch component DM (g) based on branch diameter (mm)

Branch Component	Coefficients				
	Intercept	SE	Diameter	SE	r ²
Leaves	-55.20	18.75	5.92	0.93	0.70
Green stems	-16.77	5.88	1.86	0.29	0.70
Woody stems < 0.5 cm in diameter	-22.37	3.48	2.33	0.17	0.91
Bark from stems > 0.5 cm in diameter	-69.69	10.42	6.19	0.52	0.89
Wood from stems > 0.5 cm in diameter	-186.82	27.23	16.20	1.35	0.89
Total branch	-350.86	52.24	32.50	2.59	0.90

Key Words: Willow, Browse, Composition

181 An epidemiological study into the effect of captive diets on reproductive success in Humboldt and African penguins. R. McClements^{1,3}, K. Slifka², and A. Ward³, ¹University of Sydney, Camperdown, NSW, Australia, ²Dallas Zoo and Aquarium, Dallas, TX, ³Zoo Nutrition Services, Fort Worth, TX.

Captive breeding of exotic avian species for conservation and species management programs have received considerable attention in recent years. These programs promote self-sustaining populations, however production is often less successful than anticipated. Reproductive success among institutions holding African (*Spheniscus demersus*) and Humboldt (*Spheniscus humboldti*) penguins varies considerably, thus it was the aim of the experiment to determine whether nutrition was a factor. Commencing in 2003, a two-year epidemiological study was conducted through the collection of fish, eggs, and reproductive histories from sixteen institutions holding a minimum of six penguins. Fish and egg samples were analyzed for fatty acids and fat soluble vitamins and the results correlated with historical success. The most significant finding was higher concentrations of linoleic acid in the eggs from the institutions with the best reproductive success ($8.55 \pm 0.45 \mu\text{g/g}$) compared to those with only moderate success ($1.43 \pm 0.44 \mu\text{g/g}$). The increase in linoleic acid resulted in the ω -3 to ω -6 fatty acid ratios becoming similar to those observed in the eggs of free-ranging piscivorous and carnivorous birds. Additionally, all eggs contained relatively high concentrations of α -tocopherol ($175.7 - 353.0 \mu\text{g/g}$). These concentrations were considerably higher than previously observed in free-ranging piscivorous species, suggesting that the dietary supplementation resulted in egg concentrations higher than probable needs. These data suggest nutrition may be a factor in the lower reproductive success among institutions, however determining the magnitude and effect of these differences require a subsequent controlled study.

Key Words: Captive Breeding, Fatty Acids, Fat Soluble Vitamins

Forages and Pastures I

182 Reduced ferulate cross link concentration is associated with improved fiber digestibility of corn stover at silage maturity. H. G. Jung*^{1,2} and R. L. Phillips², ¹USDA-ARS, St. Paul, MN, ²University of Minnesota, St. Paul.

Ferulate cross linking of lignin to arabinoxylan is correlated with fiber digestibility in perennial cool-season grasses; however, similar data have not been reported for warm-season grasses. Our objective was to determine if ferulate cross link concentration is associated with fiber digestibility in corn stover at silage maturity. Four mutant corn lines selected for low ferulate ester concentration in seedling leaves, parental control line, and four backcross lines were grown in a replicated field trial and evaluated for NDF, ADL, and ferulate cross link concentrations, and in vitro NDF digestibility (IVNDFD) of leaf blades, sheaths, and stems at silage maturity. Low ferulate corn lines had lower concentrations of NDF, and less ADL and ferulate cross links as a proportion of NDF, and higher 24- and 96-h IVNDFD than did the control line. Backcross lines were intermediate for all traits. While growth environment (year and location) influenced all forage quality traits, corn lines generally maintained differences across environments. Ferulate cross link concentration was negatively correlated with 24- and 96-h IVNDFD for leaves ($r = -0.52$ and -0.92 , respectively), sheaths ($r = -0.47$ and -0.52 , respectively), and stems ($r = -0.71$ and -0.78 , respectively). NDF concentration was always correlated with IVNDFD ($r = -0.38$ to -0.95) and ADL was similarly correlated with IVNDFD except for leaves. Ferulate cross link concentration was correlated with NDF ($r = 0.81, 0.68,$ and 0.75 for leave, sheath, and stem, respectively) and ADL ($r = 0.41$ and 0.84 for sheath and stem, respectively) concentration. Correlations of NDF and ADL with ferulate cross links indicate the inter-relatedness of forage quality traits, and preclude concluding that ferulate cross links are a mechanism that controls IVNDFD. However, because ferulate esters are required for cross link formation and the mutant corn lines selected for low seedling ferulate esters had reduced ferulate cross links as predicted, our data support the hypothesis that ferulate cross links modify cell wall structure such that digestibility is altered.

Key Words: Ferulate Cross Links, Fiber Digestibility, Corn Silage

183 Evaluation of alfalfa hays with down-regulated lignin biosynthesis. D. R. Mertens*¹ and M. McCaslin², ¹US Dairy Forage Research Center, Madison, WI, ²Forage Genetics International, Nampa, ID.

Our objective was to assess the impact of down-regulating the COMT or CCOMT enzymes in the lignin biosynthesis pathway on the intake and digestibility of alfalfa. Two genetic lines were developed: one with COMT down-regulated or not (COMTnull) and the other with CCOMT down-regulated or not (CCOMTnull). Hays were harvested at first-cutting in ID. Amylase-treated NDF organic matter (aNDFom), ADF and ADL were (% of DM): 38.2, 31.3, & 5.3 for COMT; 39.0, 32.0, & 5.8% for COMTnull; 39.4, 32.6, & 5.2 for CCOMT; 39.4, 32.8, & 5.9 for CCOMTnull; 38.4, 23.7, & 1.3 for corn silage; and 7.5, 2.6, & 0.2 for the concentrate mixture (Mix). Chopped hays were fed as hay-only and in TMR containing 50% hay, 10% corn silage and 40% Mix to young lambs during four 5-week trials. Lambs were blocked by BW and 3 were assigned to each treatment. Digestibility and intake were determined on a reference alfalfa as a covariate. Digestibility was measured at ad libitum (AL) and restricted intakes (RESTR = ~1.8% BW/d). Data was analyzed

using GLM: hays were compared using a split-plot in time design with BlockXTreatment as the error variance and TMR were compared using a replicated Latin-square design with the residual as the error variance. Down-regulating COMT and CCOMT lowered ADL with little change in other components. When hay-only was fed at AL intakes, COMT had greater DMD (.675 vs .645) and greater NDFD (.575 vs .491) than its null ($P < .05$). Down-regulated CCOMT yielded smaller differences in DMD (.653 vs .637) and NDFD (.501 vs .464) that were significant when adjusted for the covariate. Intake of NDF (%BW/d) was greater for COMT than its null (1.60 vs 1.42), but not for CCOMT (1.38 vs 1.32). Responses were similar during RESTR, but generated higher probabilities. Differences in DMD and NDFD were less when hays were fed in TMR and only those for COMT were significant. In TMR, NDFD was lower than hay-only. We conclude that down-regulating COMT and CCOMT in alfalfa results in improved digestibility and this effect is negatively affected by feeding hays in TMR.

Key Words: Alfalfa, Digestibility, Lignin

184 Lactating cow responses to alfalfa hays with down-regulated lignin biosynthesis. D. Weakley*¹, D. R. Mertens², and M. McCaslin³, ¹LongView Animal Nutrition Center, Gray Summit, MO, ²US Dairy Forage Research Center, Madison, WI, ³Forage Genetics International, Nampa, ID.

The objective was to assess the impact of down-regulating the COMT or CCOMT enzymes of the lignin biosynthesis pathway in alfalfa on production, intake and digestibility responses by lactating dairy cows. Two genetic lines were developed: one with COMT down-regulated or not (COMTnull) and the other with CCOMT down-regulated or not (CCOMTnull). Hays were harvested at first-cutting in ID. Chopped hays were fed in TMR containing 50% hay, 10% corn silage and 40% of a concentrate mixture containing finely ground corn, soybean meal and fat supplementation as the major ingredients. Ration CP, NDF, and ADF were (% of DM): 18.1, 31.1, & 20.2 for COMT; 18.4, 29.3, & 19.6% for COMTnull; 18.1, 31.2, & 20.6 for CCOMT; and 18.3, 31.1 & 20.6 for CCOMTnull. Twelve multiparous cows were used to compare each down-regulated treatment to its null in a two-period crossover design (3-week periods) in two separate experiments. Cows were blocked into two levels of milk production and three cows of each block were assigned to the treatment or null in period 1. Data was analyzed using GLM: treatments were compared within genetic lines using a replicated crossover design with the residual as the error variance. Production of FCM (kg/d) was higher for COMT than its null (38.5 vs 37.3) at $P < .10$, but was not different between CCOMT and its null (38.4 vs 39.4). Compared to nulls, milk fat (%) was not different for COMT (3.05 vs 3.06) or CCOMT (3.35 vs 3.40) nor was DMI (kg) different for COMT (23.2 vs 23.2) or CCOMT (26.0 vs 25.9). Digestibility of NDF was increased by down-regulation of both COMT (.535 vs .425) and CCOMT (.486 vs .445) at $P < .01$. The .97 kg additional digestible matter in the COMT diet compared to its null resulted in 1.3 kg more milk (3.05% fat), but the .36 kg greater digestible matter in CCOMT did not increase milk yield. We concluded that down-regulating COMT and CCOMT in alfalfa results in improved fiber digestibility and this effect appears to be greater for COMT than for CCOMT.

Key Words: Alfalfa, Digestibility, Lignin

185 Digestibility, milk fatty acid profile, and plasma amino acids in lactating dairy cows fed alfalfa cut at sundown or sunup. A. F. Brito*¹, G. F. Tremblay², C. Benchaar¹, A. Bertrand², Y. Castonguay², G. Bélanger², R. Michaud², H. Lapierre¹, D. R. Ouellet¹, H. V. Petit¹, and R. Berthiaume¹, ¹Dairy & Swine R&D Centre, Agriculture & Agri-Food Canada, Sherbrooke, QC, Canada, ²Soils & Crops R&D Centre, Agriculture and Agri-Food Canada, Quebec, QC, Canada.

Alfalfa (*Medicago sativa*) cut at sundown has been shown to contain more total nonstructural carbohydrates (TNC) than that cut at sunup. Our objective was to test the effects of cutting alfalfa at sundown (PM) vs. sunup (AM) on digestibility, milk fatty acid (FA), and concentration of plasma AA. Alfalfa was conserved as baleage (530 g/kg DM) into individually wrapped large rectangular bales. Sixteen multiparous lactating Holstein cows were randomly assigned to 1 of 2 treatments: PM or AM alfalfa in a crossover design. Cows were fed only baleage that contained (g/kg DM): 179 vs. 189 CP and 128 vs. 105 TNC for PM vs. AM, respectively. Feces (total collection) and milk were collected for 5 consecutive days (n = 8 cows). Total tract OM digestibility was greater in cows fed PM while the opposite was observed for N. No differences between treatments were found for DM and NDF digestibilities. Minor changes in milk FA profile were observed as C14:1, C16:1, and C20:4n6 were all significantly lower in cows fed PM. Feeding PM baleage increased plasma concentration of Lys, Met ($P = 0.07$), nonessential AA (NEAA), and total AA (TAA) but had no effect on branched-chain AA (BCAA) and essential AA (EAA). In summary, cows fed PM baleage had higher OM digestibility and plasma concentration of Lys, NEAA, and TAA.

Table 1.

Item	Time of cut		SED	P-value
	PM	AM		
DM Intake, kg/d	19.2	18.5	0.41	0.11
DM Digestibility, %	64.3	63.3	0.59	0.16
OM Intake, kg/d	17.1	16.3	0.36	0.07
OM Digestibility, %	65.4	63.7	0.46	0.01
NDF Intake, g/d	7.45	7.39	0.18	0.76
NDF Digestibility, %	47.3	48.0	0.97	0.50
N Intake, g/d	556	569	11.5	0.29
N Digestibility, %	68.7	69.9	0.51	0.05
Plasma AA, μM				
Lys	98.9	82.6	6.20	0.02
Met	27.7	25.4	1.18	0.07
NEAA	1,183	1,074	28.0	<0.01
TAA	2,118	1,970	57.6	0.02

Key Words: Alfalfa, Diurnal Cut, Dairy Cows

186 Effects of cutting alfalfa at sundown or sunup on omasal flow of nutrients in lactating dairy cows. A. F. Brito*¹, G. F. Tremblay², C. Benchaar¹, A. Bertrand², Y. Castonguay², G. Bélanger², R. Michaud², H. Lapierre¹, D. R. Ouellet¹, and R. Berthiaume¹, ¹Dairy & Swine R&D Centre, Agriculture & Agri-Food Canada, Sherbrooke, QC, Canada, ²Soils & Crops R&D Centre, Agriculture & Agri-Food Canada, Quebec, QC, Canada.

Alfalfa (*Medicago sativa*) cut in the afternoon has been shown to contain more total nonstructural carbohydrates (TNC) than that cut in the

morning. Our objective was to investigate the effects of diurnal cut (PM vs. AM) on omasal flow of nutrients. Alfalfa was conserved as baleage (530 g/kg DM) into individually wrapped large rectangular bales. Eight multiparous lactating Holstein cows fitted with ruminal cannulae were randomly assigned to 1 of 2 treatments: PM or AM alfalfa in a crossover design. Cows were fed only baleage that contained (g/kg DM): 179 vs. 189 CP and 128 vs. 105 TNC for PM vs. AM, respectively. Cobalt-EDTA and YbCl₃ were continuously infused into the rumen to estimate digesta passage of nutrients using the omasal sampling technique. Intakes and omasal flows of DM and OM tended to be higher in cows fed the PM compared to the AM baleage suggesting increased availability of nutrients to the animals. Intake of N and omasal flows of N fractions did not differ significantly between treatments. The same was observed for the omasal flows of Lys, Met, branched-chain AA (BCAA), essential AA (EAA), nonessential AA (NEAA), and total AA (TAA). In conclusion, feeding alfalfa baleage with contrasting TNC levels had no effect on omasal flow of N compounds in lactating dairy cows.

Table 1.

Item	Time of cut		SED	P-value
	PM	AM		
DM Intake, kg/d	19.8	18.9	0.42	0.09
DM Flow, kg/d	13.4	12.7	0.29	0.06
OM Intake, kg/d	17.5	16.7	0.38	0.07
OM Flow, kg/d	9.61	9.20	0.20	0.09
N Intake, g/d	560	574	12.2	0.30
N Flow, g/d	451	458	12.4	0.57
Ammonia N Flow, g/d	6.38	5.88	0.71	0.51
NAN Flow, g/d	444	452	12.7	0.56
Lys Flow, g/d	134	138	5.9	0.52
Met Flow, g/d	49.1	50.1	2.29	0.68
EAA Flow, g/d	894	926	42.5	0.48
NEAA Flow, g/d	736	761	28.5	0.42
TAA Flow, g/d	1,629	1,687	71.0	0.45

Key Words: Alfalfa, Diurnal Cut, Omasal Flow

187 Which native Sicilian pasture plants make the difference for milk aroma quality? I. Schadt*¹, T. Rapisarda¹, G. Belvedere¹, F. La Terra¹, G. Azzaro¹, P. J. Van Soest², G. Licitra^{3,1}, and S. Carpino¹, ¹CoRFiLaC, Regione Siciliana, Ragusa, Italy, ²Cornell University, Ithaca, NY, ³D.A.C.P.A., University of Catania, Catania, Italy.

It has been shown that cheeses produced from cows consuming native pastures versus total mixed ration (TMR) differ in aroma compounds and sensory properties (Carpino et al. 2004, J. Dairy Sci. 87:816-830; Carpino et al. 2004, J. Dairy Sci. 87:308-315). In the present study *Anthemis arvensis*, *Calendula arvensis*, *Sinapis arvensis*, *Chrysanthemum coronarium*, and Geraniaceae spp. were evaluated individually for their capacity to influence milk aroma. The plant species were collected at flowering age, and part of the forage was dried to produce hay. Single doses of fresh and dried forage were fed individually *ad libitum* to two dairy cows in mid lactation. The cows were adapted to a TMR ration and TMR was given to the cows, at the middle and the end of the experiment as controls. A time of seven days between treatments was maintained. Animals were held off feed for five hours before and after treatments. Feed intake was recorded by weighing provided forage, TMR and refusal. Milk was sampled the day before and the same day of the

treatment during the evening milking before and after feeding. Aroma profiles of the milk samples were analyzed with a MS-based Electronic Nose (SMartNose), and differences were statistically evaluated using Principal Components Analysis. SMartNose showed different aroma profiles for milk samples collected after forage provision, before and after TMR feeding. With exception of *Sinapis arvensis*, the milk samples obtained from fresh forage were different from those obtained from hays. In conclusion, all examined forage species, both fresh and dried, had impact on milk aroma as detected by SMartNose. Feeding of the fresh forage may have a different effect compared to the respective hay.

Key Words: Pasture, SMartNose, Milk Aroma

188 Effects of supplementing tanniferous sainfoin hay on nitrogen metabolism of grass-fed dairy cows. F. Dohme*¹, A. Scharenberg¹, and M. Kreuzer², ¹*Agroscope Liebefeld-Posieux, Research Station ALP, Posieux, FR, Switzerland*, ²*ETH Zurich, Institute of Animal Science, Zurich, ZH, Switzerland*.

Condensed tannins (CT) are able to form complexes with feed proteins. This property may reduce the metabolic stress of lactating cows fed grass-based diets which often result in a high ammonia load. In a replicated 3 × 3 Latin Square arrangement, 6 ruminally cannulated Holstein cows were randomly assigned to 3 treatments. In treatment GF cows received only cut pasture grass, whereas in treatments GH and SH 3 kg of hay obtained either from grass-clover or sainfoin swards, respectively, were additionally supplied. From a milk yield of 22 kg/d onwards, cows were fed 0.5 kg/d of barley per kg additionally produced milk. Each of the 3 consecutive experimental periods consisted of a 14-d adaptation and a 7-d balance period where feed intake was recorded daily and feces and urine were collected quantitatively. On the last d of each balance period ruminal fluid and blood were sampled every 4 h from 0700 to 1900. Data were analyzed by the MIXED procedure of SAS and means were separated using the PDIF option. Intake of total DM (19.6 kg/d) and grass DM (14.3 kg/d) did not differ among treatments. Although the amount of hay DM consumed in treatment SH (1.27 kg/d) was less than offered and lower than in treatment GH (1.83 kg/d), the higher CP content of sainfoin hay (201 g/kg DM) compared to grass-clover hay (131 g/kg DM) and fresh grass (124 g/kg DM) caused the highest daily N intake with SH (412 g) followed by GH (405 g) and GF (392 g; P<0.05). Concomitantly, fecal N excretion was higher (P<0.05) with SH compared to GF and GH resulting in the highest (P<0.05) proportion of fecal N in total N intake. In contrast, no (P<0.05) differences were observed in excretion of urinary N. Ruminal ammonia and plasma urea concentration were lowest (P<0.05) with GH compared to GF and SH. Plasma urea concentration decreased over the day (P<0.001). In conclusion, the lack of positive effects of CT might be explained by their relatively low content in sainfoin used (55 g/kg DM) or the low proportion of sainfoin

in the total diet or both. Moreover, in this study ammonia load might be too low as that CT could have had an impact.

Key Words: Condensed Tannins, Dairy Cow, Nitrogen Balance

189 Modeling manure OM and N composition of dairy cows fed grass silage based diets. J. Dijkstra*¹, A. Bannink², E. A. Lantinga³, and J. W. Reijs⁴, ¹*Animal Nutrition Group, Wageningen University, Wageningen, The Netherlands*, ²*Animal Sciences Group, Wageningen UR, Lelystad, The Netherlands*, ³*Biological Farming Systems Group, Wageningen University, Wageningen, The Netherlands*, ⁴*Agricultural Economics Research Institute, Wageningen UR, Wageningen, The Netherlands*.

Nitrogen pollution in dairy farming may be lowered by reducing N output in excreta and by optimizing manure C:N ratio and N composition. An extant mechanistic model of digestion and fermentation processes was modified to simulate the fecal and urinary composition of dairy cattle fed grass silage (*Lolium perenne* L.) based diets. Total N excretion was partitioned into three fractions representing availability of N to plants, viz. immediately available N (N_M; mainly urea), easily decomposable N (N_E; urinary non-urea N, endogenous N and microbial N) and resistant N (N_R; N in undigested feed). Four different types of grass silages were explored at high (HF) and low (LF) N fertilization level and early (EC) or late (LC) cutting. For each grass silage, 10 supplementation strategies that differed in level and type of supplement were studied. Simulated urinary N excretion showed large variation between silages, but variation in simulated fecal N excretion was small. Urinary N excretion and the N_M fraction decreased considerably with lowered fertilization level and, to a smaller extent, with delayed cutting. The simulated N_E and N_R excretion (in g/d) were relatively constant though. A lower fertilization level or delayed cutting increased simulated manure C:N ratio.

Table 1. Simulated excretion and manure composition (means across 10 supplementation strategies)

	HFEC	LFEC	HFLC	LFLC	Range
Milk N, % feed N	24.9	30.8	26.7	32.7	22.6 - 37.1
Manure C:N	4.6	6.3	6.5	8.8	3.4 - 10.6
Total OM excretion, kg/d	5.0	4.7	5.4	5.2	3.7 - 6.3
Urine OM excretion, kg/d	0.9	0.5	0.6	0.4	0.2 - 1.1
Total N excretion, g/d	483	337	372	268	211 - 558
Urine N excretion, g/d	323	180	218	123	81 - 388
N _M , % excreted N	59.2	45.5	50.8	37.5	29.3 - 63.5
N _E , % excreted N	29.7	37.9	34.4	43.7	26.9 - 48.9
N _R , % excreted N	11.1	16.6	14.8	18.8	9.6 - 21.8

Key Words: Manure Composition, N Efficiency, Modeling

Nonruminant Nutrition: Mineral

190 Effect of phytic acid on apparent ileal digestibility of minerals in piglets. T. A. Woyengo¹, A. Cowieson², O. Adeola³, and C. M. Nyachoti¹, ¹University of Manitoba, Winnipeg, MB, Canada, ²Danisco (UK) Limited, Marlborough, UK, ³Purdue University, West Lafayette, IN.

An experiment was conducted to determine the effects of phytic acid (PA) on apparent ileal digestibility (AID) of minerals in piglets. Seven ileal-cannulated weanling pigs were fed a casein-corn starch-based diet with PA (as sodium salt) at 0.0, 0.5, 1.0, or 2.0% in 4 × 4 Latin square design with 3 added columns to give 7 replicates per treatment. The basal diet was formulated to meet NRC (1998) requirements for energy, AA and minerals for weanling pigs and contained chromic oxide (0.3%) as a digestibility marker. The AID of ash, and of 2 multivalent macro-minerals, that is, Ca and P were both linearly and quadratically reduced ($P < 0.05$) by an increase in the level of PA in diet; whereas that of another multivalent macro-mineral, that is, Mg was only linearly reduced ($P < 0.05$) by the PA. An increase in dietary level of PA also resulted in reduced AID of monovalent macro-minerals, that is, Na and K (linear and quadratic, $P < 0.05$), though the differences between diets without and with PA were only significant when PA was added at 2% (49.2 vs -37.9% for Na and 87.6 vs 81.1% for K). The AID values for ash, P, Na and Mg were negative, that is, -54, -27.7, -37.9 and -3.0%, respectively, when PA was supplemented at 2%. The results suggest that PA can reduce the AID of minerals in piglets. The reduced AID of minerals due to PA is partly attributed to their increased endogenous losses as evidenced by negative AID values of some of the minerals and ash at the highest dose of PA used in the current study. The increase in endogenous flow of Na and K may particularly be important as an increased presence of these minerals in the gut will effectively alter electrolyte balance and hence the capacity of the enterocytes to transport AA, glucose and other nutrients. These data are suggestive of potentially adverse consequences of PA on secretion and absorption balance.

Key Words: Phytic Acid, Mineral Digestibility, Piglets

191 Impact of steeping high-moisture corn with phytase on growth performance and phosphorus utilization in liquid-fed starter pigs. D. Columbus*, S. J. Niven, C. L. Zhu, and C. F. M. deLange, University of Guelph, Guelph, ON, Canada.

The application of phytase in conventional dry pig diets has been studied extensively and improves digestibility of phosphorus (P). The efficacy of phytase may be improved by steeping feedstuffs with phytase prior to feeding. A performance study was conducted to determine the value of steeping high-moisture corn (HMCorn) with phytase for use in P-limited liquid diets. Five pens of 16 pigs (weaned at 19 to 23 days of age; 6.7 ± 0.24 kg BW) were assigned to each of five 3-phase feeding programs for 7 weeks (total P was 0.69, 0.48, and 0.45 % in phase I, II and III diets, respectively). The HMCorn based diets were formulated to contain graded levels of added phytase (0, 62.5, or 125 FTU/kg DM HMCorn) which was added either to a mix of HMCorn and water and allowed to steep for a minimum of 24-h or to the dry feed supplement and mixed with the HMCorn at the time of feeding. The addition of phytase had no impact on ADG or G:F ($P > 0.10$). The soluble P content in duodenal digesta was increased with the addition of phytase (63.3 vs. 49.6 % of total P; $P < 0.05$). Allowing HMCorn to steep prior to feeding did not

increase solubilization of P in digesta (65.6 vs. 61.1%; $P > 0.10$). There was no impact of dietary treatment on total tract digestibility of P ($P > 0.05$). Urinary P excretion was higher in pigs fed diets with added phytase (280 vs. 7.59 $\mu\text{g}/\text{mL}$; $P < 0.05$). Addition of phytase to the diets resulted in greater contents of P in carcass (1.56 vs. 1.32%; $P < 0.001$) and metacarpal bones (5.67 vs. 5.40 %; $P < 0.05$). Metacarpal breaking strength was higher in pigs fed diets with 125 FTU/kg vs. 62.5 FTU/kg added phytase (33.0 vs. 30.3 kg; $P < 0.05$). Added phytase improved retention of P in starter pigs fed P-limited HMCorn based liquid diets, however, there appears to be no benefit to steeping HMCorn with phytase prior to feeding. Responses to both levels of phytase were similar and indicate greater efficacy of phytase in liquid diets than dry diets.

Key Words: High-Moisture Corn, Phytase, Starter Pigs

192 The effects of dietary calcium to total phosphorus ratio (Ca:tP) in diets containing 1000 FTU/kg of phytase on performance in 10-25 kg pigs. K. L. Saddoris*, S. B. Williams, D. W. Dean, and D. R. Cook, Akey, Lewisburg, OH.

Crossbred pigs ($n=924$) with an average initial weight of 10.8 ± 0.13 kg were used to determine the optimal Ca:tP ratio in 10-25 kg pigs fed diets supplemented with 1000 FTU/kg of phytase (Phyzyme XP[®]). The experimental design was a split plot with sex serving as whole plot and diet serving as subplot. Pigs (22 pigs/pen) were randomly allotted to one of six dietary treatments within sex and block and fed ad libitum for 23 d. Dietary treatments consisted of a basal corn-soybean meal diet with 1000 FTU/kg of Phyzyme XP[®] and 0.45% tP (0.15% aP) provided by corn, soybean meal, and dicalcium phosphate. Dietary Ca concentration of the basal diet was 0.40% and Ca:tP ratios were altered by addition of calcium carbonate to achieve Ca concentrations of 0.50, 0.60, 0.70, 0.80, or 0.90%. Calculated Ca:tP ratios were 0.88, 1.11, 1.33, 1.55, 1.77, and 2.0 for dietary treatments 1 thru 6, respectively. Increasing dietary Ca concentrations from 0.40 to 0.90 resulted in a linear ($P < 0.01$) decrease in ADG (595 to 532 g/d) and G:F (0.666 vs. 0.613). Additionally, ADFI decreased (linear, $P < 0.05$) by 3% as dietary Ca concentrations increased from 0.40 to 0.90%. Pigs fed the 0.40% Ca diet were 5% heavier ($P < 0.01$) at the end of the trial period compared to pigs fed diets with 0.90% Ca (24.60 vs. 23.36 kg). Overall, increasing the dietary Ca:tP ratio from 0.88 to 2.0 by increasing Ca concentrations resulted in an 11.8, 3.0, and 8.6% reduction in ADG, ADFI, and G:F respectively. These data indicate Ca:tP ratios as low as 1.11:1 negatively impact performance traits, and that dietary Ca may have a negative effect on the efficacy of phytase to release P from phytate. In conclusion, P release values assigned to phytase may be dependent upon dietary Ca concentrations. Further research is necessary to determine the Ca:tP ratio necessary to optimize phytate-P release with usage of 1000 FTU/kg of phytase.

Key Words: Swine, Phytase, Calcium

193 MINTREX[®]Zn provides similar performance to ZnO in nursery pigs at lower inclusion. R. J. Harrell, B. V. Lawrence*, R. Anderson, F. Navarro, and C. D. Knight, Novus International Inc., St. Charles, MO.

Zinc is a trace mineral with multifunctional properties including a role in normal growth, immunity, skin integrity, and an essential component in a multitude of enzyme reactions. Organic trace minerals offer the opportunity to feed less total mineral because of improved bioavailability compared to inorganic sources. MINTREX[®]Zn (ZnMin) contains 2 HMTBa ligands chelated with one Zn molecule. This study examined the effect of Zn source and level on weaned pig performance. Pigs with an average initial weight of 7.06±0.13 kg were blocked by sow parity (1 vs. 2-4 vs. 5+) and randomly assigned to one of five Zn diets: 120:0, 0:0, 60:0, 30:30, and 0:60 ppm Zn as ZnO:ZnMin, respectively. Complex diets were formulated to meet or exceed the requirements of weaned pigs except for Zn. Diets were fed in 3 different phases (0 to 10, 11 to 21, and 21 to 35 days postweaning). No differences in ADG or ADFI were detected from 0 to 10 or 11 to 21 days of study ($P > 0.15$). Pigs fed the 0:0 (0.933±0.050) zinc diet had 13% lower GF than pigs fed the 120:0 (1.074±0.050) and 30:30 (1.079±0.050) ppm Zn diet ($P < 0.05$) from 0 to 10 days. No differences in GF were detected between treatments from 11 to 21 days of study ($P > 0.15$). Pigs fed the 120:0 (563±15 g/d) had 10% greater ADG ($P < 0.05$) than the 0:0 (507±15 g/d) and 60:0 (520±15 g/d) fed pigs, but similar ADG to pigs fed the 30:30 and 0:60 Zn diets ($P > 0.10$) from 21 to 35 days. Pigs fed the 120:0 (0.696±0.007), 30:30 (0.692±0.007), and 0:60 (0.683±0.007) had similar GF ($P > 0.15$), but higher than pigs fed the 0:0 Zn diet (0.663±0.007; $P < 0.05$) from 21 to 35 days. Overall, from 0 to 35 days, no differences in final bodyweight, ADG or ADFI were detected between treatments ($P > 0.10$). Pigs fed the 120:0 (0.742±0.005), 30:30 (0.747±0.005), and 0:60 (0.738±0.005) had similar GF ($P > 0.20$), but were all higher than the 0:0 Zn diets (0.717±0.005; $P < 0.05$). These results suggest that at least 21 days postweaning are needed to elicit signs of a Zn deficiency and dietary Zn concentrations can be reduced by feeding MINTREX[®]Zn.

Key Words: Zinc, Source, Swine

194 Combination of organic and inorganic trace minerals for sows and weaned pigs. G. J. M. Lima^{*1}, F. Catunda², W. Close³, L. C. Ajala¹, and F. Rutz⁴, ¹Embrapa – Swine and Poultry Res. Center, Brazil, ²Alltech, Brazil, ³Close Consulting, U.K., ⁴UFPel, Brazil.

This study was conducted to determine the effects of combining inorganic and organic sources of trace minerals (TM) on the performance of sows along five consecutive parities and their offspring. In Experiment 1, 80 gilts were randomly divided and given two diets: T1 – TM supplemented with inorganic sources (120 ppm Zn, 40 ppm Mn, 120 ppm Fe, 15 ppm Cu, 0.3 ppm Se); T2 – TM supplemented with a combination of inorganic and organic sources in the following amounts: 80 + 40 ppm Zn, 20 + 20 ppm Mn, 30 + 90 ppm Fe/kg, 5 + 10 ppm Cu, 0 + 0.3 ppm Se, 0 + 200 ppb Cr, respectively. In Experiment 2, 96 weaned piglets from T1 and T2 fifth parity sows were equally allotted to receive diets with either inorganic or inorganic + organic TM, at the same levels described, in a 2 X 2 factorial experiment. In both experiments there was no significant interaction among main factors ($P > 0.05$). Sow reproductive variables as well as piglet weights at birth and at weaning were not affected by treatments ($P > 0.05$). Combination of inorganic and organic TM significantly increased the number of live piglets at birth (10.93 ± 0.17 vs. 11.80 ± 0.17, $P = 0.0003$) and at weaning (10.16 ± 0.16 vs. 10.90 ± 0.15, $P = 0.0008$) and decreased the number of stillbirths (0.48 ± 0.05 vs. 0.30 ± 0.05, $P = 0.007$) and mummies (0.10 ± 0.03 vs. 0.04 ± 0.03, $P = 0.12$). Milk selenium was increased (28.71 ± 1.99 vs. 38.94 ± 2.00 ppb, $P = 0.0004$) with the inclusion of organic TM. In Exp. 2, there was no significant effects of sow or piglet dietary treatments or their

interaction ($P > 0.05$) except for feed conversion ratio, which was better for piglets born from sows that were fed T2 diets (1.67 ± 0.02 vs. 1.62 ± 0.02, $P = 0.06$). While the combination of inorganic and organic TM confirms previous positive effects on litter size, this finding has yet to be completely understood. It may be hypothesized that the increase of bioavailability of the organic TM sources is responsible for part of the verified benefits. In addition, it may be that inorganic TM at NRC levels have detrimental effects.

Key Words: Litter Size, Reproductive Performance, Milk Composition

195 Effects of copper sulfate, tri-basic copper chloride, and zinc oxide on weanling pig growth and plasma mineral levels. N. W. Shelton^{*1}, M. D. Tokach¹, J. L. Nelssen¹, R. D. Goodband¹, S. S. Dritzt¹, J. M. DeRouchey¹, and G. M. Hill², ¹Kansas State University, Manhattan, ²Michigan State University, East Lansing.

Two four-wk experiments were conducted to determine the effects of increasing dietary Zn and Cu levels on weanling pig performance. In each experiment, 180 21-d old weanling pigs (PIC; 5.65 kg in Exp. 1, and 5.98 kg in Exp. 2) were allotted to six treatments with five and six replications in Exp. 1 and 2, respectively. Control diets contained 165 ppm Zn and 16.5 ppm Cu provided by the trace mineral premix. In Exp. 1, treatments were arranged as a 2 × 3 factorial using two levels of added Cu from tri-basic copper chloride (TBCC; 0 or 150 ppm) and three levels of added Zn from ZnO (0, 1500, or 3000 ppm from d 0 to 14 and 0, 1000, or 2000 ppm from d 14 to 28). From d 0 to 28, TBCC increased ($P < 0.01$) ADG (375 vs 344 g/d) and ADFI (509 vs 469 g/d) over control pigs. Increasing dietary Zn increased (linear, $P < 0.003$) ADG and ADFI from d 0 to 14 (184, 192, and 233 g/d; 226, 238, and 279 g/d) and d 0 to 28 (342, 352, and 385; 463, 479, and 525). Dietary Cu had no ($P > 0.63$) effect on plasma Cu. The only Cu × Zn interaction was for plasma Zn ($P < 0.03$) with plasma Zn increasing to a greater extent when Zn was added to diets without TBCC than when added to diets with TBCC. In Exp. 2, treatments were arranged as a 2 × 3 factorial using two levels of added Zn from ZnO (0 or 3000 ppm from d 0 to 14 and 0 or 2000 ppm from d 14 to 28) and three Cu treatments (control, 125 ppm from TBCC, or 125 ppm from CuSO₄). There were no Zn × Cu interactions ($P > 0.21$). From d 0 to 28, adding TBCC and CuSO₄ increased ($P < 0.01$) ADG (304, 333, and 359 g/d), ADFI (465, 490, and 506 g/d) and G:F (0.65, 0.68, and 0.71). Adding dietary ZnO also increased ($P < 0.01$) overall ADG (315 vs 349 g/d) and ADFI (466 vs 507 g/d). The greatest response to ZnO was from d 0 to 14 where ADG (175 vs 225 g/d), ADFI (227 vs 255 g/d), and G:F (0.77 vs 0.88) were all increased ($P < 0.02$). Contrary to many earlier trials, the growth responses from Zn and Cu were additive in these experiments.

Key Words: Weanling Pig, Zinc, Copper

196 Effects of various copper sources on copper bioavailability in broiler chickens. B. J. Min^{*1}, S. J. Park², R. A. Samford³, and S. W. Kim¹, ¹North Carolina State University, Raleigh, ²Texas Tech University, Lubbock, ³Albion Advanced Nutrition, Clearfield, UT.

A total of 560, 1 d old, broiler chickens was used to determine bioavailability of copper when various dietary copper sources were used. Twenty

birds were killed at d 0 and ground for carcass sampling. Remaining 540 birds were allotted to 6 dietary treatments: NC (without Cu supplementation); PC (with 25 ppm Cu from Cu-sulfate); CUGLY (with 25 ppm Cu from Cu-glycine chelates); CULYS (with 25 ppm Cu from Cu-lysine chelates); CUAX (with 25 ppm Cu from Cu amino acid complex); and CUAC (with 25 ppm Cu from Cu amino chelates). There were 6 replicates per treatment with initially 15 birds per stainless steel brooder cage with the heater. Birds had feed and water ad libitum during 21 d feeding period. Body weight and feed intake were measured on d 3, 5, 7, 14, and 21. Groups of 3 birds were randomly selected and killed at d 3, 5, 7, 14, and 21, ground together for each day, sampled, and analyzed for Cu. The ADG, ADFI, and gain:feed ratio did not differ among treatment groups. Contents of Cu (mg/bird) in PC (18.08), CUGLY (19.90), CULYS (21.92), CUAX (19.83), and CUAC (19.43) were greater ($P < 0.05$) than NC (6.47) at d 21. Bioavailability of Cu from CUGLY (48.1%), CULYS (52.4%), CUAX (49.5%), and CUAC (47.7%) was greater ($P < 0.05$) than NC (42.0%) during week 1. Bioavailability of Cu from CUAC (50.5%) and CULYS (49.8%) was greater ($P < 0.05$) than NC (44.5%) and CUAX (46.1%) during week 2. Bioavailability of Cu from CULYS (52.4%) was the greatest ($P < 0.05$) and that of CUAC (47.7%), CUGLY (48.9%), and CUAX (49.5%) was greater ($P < 0.05$) than NC (39.0%) and PC (44.1%) during week 3. During the entire period, bioavailability of Cu from CULYS (52.4%) was not different from CUAC (49.0%) but greater ($P < 0.05$) than CUGLY (47.8%), CUAX (47.7%), NC (36.3%) and PC (45.8%). This study indicates that supplement of Cu at 25 ppm from Cu-lysine and Cu amino acids chelates have beneficial effects on Cu bioavailability compared to the use of Cu from Cu sulfate by broiler chickens until d 21 of age.

Key Words: Bioavailability, Broilers, Copper Amino Acid Chelate

197 Supplementing inorganic or organic Se to diets using grains grown in various regions of the United States. D. C. Mahan^{*1}, J. E. Pettigrew¹, M. D. Lindemann², G. L. Cromwell¹, P. S. Miller¹, E. van Heugten¹, S. W. Kim¹, T. D. Crenshaw¹, M. J. Azain², and C. R. Dove², ¹NCCC-42 Committee on Swine Nutrition, ²AS 1012 Committee on Swine Nutrition.

Grains grown in various regions of the US vary in their indigenous Se contents that could affect pig tissue Se concentrations and performance responses. A regional study was conducted to evaluate the effects of adding inorganic Se (Na selenite) or organic Se (Se enriched yeast) at 0.15 or 0.30 ppm to grower-finisher pig diets on subsequent tissue Se and performance responses. A basal diet without supplemental Se served as a negative control. The study was a $2 \times 2 + 1$ factorial conducted in a randomized complete block design in 18 total replicates using a total of 240 pigs. Similar diet formulas were used but incorporated locally grown corn and soybean meal into the diets and were fed from 25 to 115 kg BW. The study was conducted at 9 stations (IL, KY, NE, NC, OH, TX, SD, WI, and GA) with each station completing 2 replicates. Serum Se and glutathione peroxidase (GSH-Px) activity were determined. Samples of liver, loin, and hair were collected at harvest and analyzed for Se. The corn fed and the loin Se at harvest for each station (expressed as mg/kg) were: IL, 0.028, 0.126; KY, 0.017, 0.096; NE, 0.283, 0.345; NC 0.074, 0.082; OH, 0.044, 0.119; TX, 0.132, 0.289; SD, 0.234, 0.527; WI, 0.075, 0.264; and GA, 0.026, 0.130, respectively, and differed ($P < 0.01$) by station. There were increases ($P < 0.01$) in loin, liver, and hair Se concentrations as dietary Se increased within each station, but a greater increase occurred when organic Se was fed. This resulted in a Se source \times level interaction ($P < 0.01$). Serum Se and GSH-Px activity increased

($P < 0.01$) when both Se sources were fed. These results indicate a large difference in grain Se concentrations among the states, that organic Se was incorporated at greater concentrations in the loin, liver, and hair tissues of grower-finisher pigs than inorganic Se, and that this increase occurred in the pigs from each state.

Key Words: Pigs, Selenium

198 Effects of dietary selenium on expression of selenoproteins and activity of antioxidant enzymes in endocrine tissues of growing male pigs. J. C. Zhou¹, J. G. Li¹, K. N. Wang¹, X. Xia¹, Y. J. Zhang¹, Y. Liu¹, Y. Zhao¹, and X. G. Lei^{*1,2}, ¹Int. Ctr of Future Agriculture for Human Health, Sichuan Agri. Univ., Ya'an, China, ²Cornell University, Ithaca, NY.

Expression and function of selenoproteins in endocrine tissues remain unclear. The present study was conducted to determine responses of mRNA levels of 12 selenoproteins and activities of four antioxidant enzymes in three endocrine organs of pigs to dietary Se deficiency or excess. A total of 30 weanling male pigs (3-wk old) were fed a corn-soybean meal based, Se-deficient (0.02 mg/kg) diet for 4 wk to adjust body Se status and then fed the basal diet supplemented with 0, 0.3 or 3.0 mg Se/kg as Se-enriched yeast (Angel Yeast, Hubei, China). After 8 wk, six pigs from each group were killed to collect plasma, liver, pituitary, thyroid and testis for analysis. Concentrations of Se in the four tissues and plasma increased ($P < 0.05$) with the increment of dietary Se. While dietary Se supplementation enhanced ($P < 0.05$) glutathione peroxidase activity in the four tissues, it did not affect activities of glutathione reductase, glutathione S-transferase, or total superoxide dismutase in any tissue. As determined by quantitative real-time RT-PCR, mRNA levels of *GPX1*, *Txrd1*, *SelN* and *SelW* in liver were lower ($P < 0.05$) in the Se-deficient group than the Se-supplemented groups. However, mRNA levels of *Txrd1* and *Sep15* in testis were decreased ($P < 0.05$) by supplementing 3 mg of Se/kg compared with the other two groups. Relatively high expressions of *GPX4*, *ID3*, *Sep15*, *SelK* and *SelN* were detected in pituitary, which was fairly independent of dietary Se concentrations. In conclusion, dietary Se deficiency and excess affected tissue Se concentrations in the three endocrine organs similarly to that in liver, but exerted less impact on the mRNA expression of multiple selenoprotein genes.

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Key Words: Endocrine, mRNA, Selenoprotein

199 Effects of sodium bisulfate on growth performance, slurry characteristics, and nutrient excretion of finishing pigs. J. Jarrett^{*}, S. Carter, J. Bundy, M. Lachmann, and T. Walraven, *Oklahoma State University, Stillwater.*

Sodium bisulfate (NaHSO_4) is a strong acid that has been used in the poultry industry as a litter additive to reduce pH and ammonia emissions. Little is known about the effects of NaHSO_4 in swine slurry when administered as a feed additive. A total of 80 crossbred ($D \times (L \times Y)$) pigs were used to determine the effects of NaHSO_4 addition to a traditional corn-soybean meal diet on growth performance, slurry

pH and electrical conductivity, and DM, N, and P excretion during a 100-d finishing period. Pigs were blocked by BW, sex, and ancestry and allotted to one of two dietary treatments. The control was a fortified corn-soybean meal diet and the treatment diet consisted of the control diet + 0.30% NaHSO₄. Diets were fed in four phases (40 to 62, 62 to 90, 90 to 108, 108 to 128 kg) and formulated on true digestible lysine (0.92, 0.79, 0.65, 0.56%). NaHSO₄ was added at the expense of sodium chloride to maintain sodium levels. Pigs were housed in 4 identical, environmentally-controlled rooms equipped with a shallow pit, pull-plug system (20 pigs/room, 2 rooms/trt). Feed intake, pig weight, pit volume, and slurry pH and EC were measured on a weekly basis. Feed and slurry samples were collected weekly and analyzed for DM, N, and P. During the 100-d finishing period, there was no difference ($P >$

0.10) in ADG (0.79 vs. 0.81 kg), ADFI (2.11 vs. 2.19 kg), or G:F (0.37 vs. 0.37). Also, no difference ($P > 0.10$) was observed in pit pH (7.15 vs. 7.20). However, electrical conductivity (8.22 vs. 9.18 mS) of the slurry tended to increase ($P < 0.09$) for pigs fed NaHSO₄. There was no difference ($P > 0.10$) in daily DM (230 vs. 237 g), N (33.7 vs. 31.4 g) or P (6.0 vs. 6.2 g) excretion between the 2 diets. NaHSO₄ addition did not affect ($P > 0.10$) excretion of sodium or ammonium-N. Sulfur excretion (2.4 vs. 4.0 g) tended to increase ($P < 0.09$) in pigs fed NaHSO₄. These results suggest that dietary addition of NaHSO₄ does not affect growth performance, pit characteristics, or DM, N or P excretion of finishing pigs.

Key Words: Pigs, Sodium Bisulfate, Nutrient Excretion

Nonruminant Nutrition: Protein and Amino Acids

200 Is niacin (vitamin B₃) a modulator of the effect of supplementary tryptophan on tryptophan metabolism and growth responses in early-weaned pigs? J. J. Matte*¹, A. Giguère¹, D. Melchior³, and N. LeFloch², ¹*Agriculture and Agri-Food Canada, Sherbrooke (STN-Lennoxville), QC, Canada*, ²*INRA-SENAH, St-Gilles, France*, ³*Ajinomoto-Eurolysine SAS, Paris, France*.

The present experiment aimed to determine if tryptophan (Try) metabolism and growth responses to dietary Try are modulated by dietary niacin (B₃) in weanling piglets. A group of 104 piglets (52 pens of 2 animals), weaned at 3 wk of age, were distributed, at 4 wk of age (BW:7.6 kg, SE:0.2), in 4 factorial dietary treatments: 2 additions of B₃, 15 (LB₃) vs. 45 ppm (HB₃) and 2 additions of Try, 0 (-Try) vs. 0.10% (+Try) for Try/Lys ratios of 0.16 vs. 0.23, respectively. Growth performance was recorded every wk from 4 to 10 wk of age. Fasting blood samples were taken at 4, 6, 8 and 10 wk of age. At 11 wk of age, repeated blood samples were collected after a meal on 6 piglets per treatment for measurements on Try and insulin metabolisms. No treatment effect was observed on overall ADG, ADFI or G:F ($P > 0.3$). However, ADFI tended to be higher ($P < 0.10$) in HB₃ than LB₃ (685 vs. 652 g, SE:21) from 4 to 6 wk of age as well as ADG (716 vs. 699 g, SE:12, $P < 0.06$), from 6 to 10 wk of age. No treatment effect ($P > 0.2$) was observed on plasma Try or kynurenin (Kyn), an intermediate metabolite of Try catabolism. The response of plasma nicotinamide (Nam), a product of Try catabolism and indicator of B₃ status, to dietary B₃ differed according to dietary Try ($P < 0.01$), with overall values of 1.4, 3.3, 4.1 and 5.3 μM (SE:0.1) in -Try LB₃, -Try HB₃, +Try LB₃ and +Try HB₃, respectively. Post-meal plasma Try (96.2 vs. 72.3 μM , SE:0.1) and Kyn (1.7 vs. 1.3 μM , SE:0.1) were higher ($P < 0.01$) in +Try vs. -Try. There was no treatment effect on post-meal C-peptide and glucose ($P > 0.12$) but insulin (280.5 vs. 343.7 pM, SE:25.2) and the ratio insulin:C-peptide (0.39 vs. 0.43, SE:0.02) were lower ($P < 0.05$) in +Try vs. -Try. The treatment effects on both growth and plasma Nam suggest that the LB₃ level was suboptimal. Dietary treatment effects on plasma Nam and on post-meal plasma Try and Kyn suggest a lack of sparing effect of dietary B₃ on Try, part of supplemental Try being directed through catabolism whatever the dietary B₃. Supplemental Try also accelerated insulin clearance after a meal without apparent consequence on glucose utilisation.

Key Words: Tryptophan, Niacin, Piglets

201 Effect of replacing fish meal with synthetic amino acids on the growth performance of nursery pigs. C. L. Bradley*¹, C. V. Maxwell¹, Z. B. Johnson¹, J. L. Ustry², and J. W. Frank¹, ¹*University of Arkansas, Fayetteville*, ²*Ajinomoto Heartland LLC, Chicago, IL*.

Rising feed costs are challenging producers to find alternative protein sources for swine rations. The objective of this study was to determine if fish meal (FM) could be replaced with synthetic amino acids (AA) in phase 1 and 2 nursery diets. Weaned pigs ($n = 200$; Monsanto GPK35 \times EBU; 21.7 ± 0.2 d of age; initial BW 7.43 ± 0.01 kg) were used in a 34 d growth study. The pigs were blocked by weight in a randomized complete block design (5-6 pigs per pen and 7 pens per treatment). Pigs were fed one of five dietary treatments that contained decreasing levels of FM. Phase 1 (d 0-4; 1.6% Lys) diets ranged from 8 to 0% FM and 0.075 to 0.544% added L-Lys. Phase 2 (d 4-19; 1.52% Lys) diets ranged

from 6 to 0% FM and 0.275 to 0.627% added L-Lys. Other AA (DL-Met, L-Thr, and L-Val) were used in the diet formulations to maintain ideal ratios of Met + Cys, Thr, and Val at minimums of 0.58, 0.60, and 0.65 to lysine, respectively. Pigs were fed a common corn-soy diet supplemented with 0.333% L-Lys, 0.154% DL-Meth, and 0.100% L-Thr in phase 3 (19-34 d; 1.47% Lys). None of the diets were supplemented with L-Trp. There were no differences ($P > 0.12$) in ADG and ADFI throughout the study. There was a linear decrease ($P < 0.01$) in G:F as FM was replaced with AA in the diet during phases 1-2 (0.768, 0.800, 0.739, 0.740, and 0.718); however, there was no effect of dietary treatment on G:F during phase 3 ($P = 0.27$) or overall ($P = 0.23$). Final BW were not different as FM was replaced with AA (23.75, 24.07, 23.08, 23.42, and 23.64 kg; respectively, $P = 0.32$). Although G:F decreased as FM was replaced with AA during phase 2, there were no effects on overall growth performance or final BW. These results suggest that synthetic amino acids may be used to replace fish meal in nursery diets without compromising overall growth performance of the pigs.

Key Words: Pigs, Fish Meal, Amino Acids

202 ASAS Early Career Achievement Award presentation: Balancing amino acids for reproductive performance of sows. S. W. Kim*, *North Carolina State University, Raleigh*.

Improving efficiency of protein utilization is important for pregnant sows under restricted feed allowance to support the growth of fetuses and mammary glands especially during late gestation and for lactating sows with limited feed intake to support the mammary gland growth and milk production especially for primiparous sows. Series of studies were conducted to characterize requirements and ideal ratios of amino acids for (1) fetal growth, (2) mammary gland growth, and (3) maternal tissue gain for gestating sows and for (4) mammary gland growth, and (5) maternal tissue gain for lactating sows. A total of 97 pregnant sows and their fetuses and a total of 174 lactating sows and their nursing piglets were used for these studies to collect fetal tissues, mammary tissues, and maternal tissues for amino acid analysis. Requirements and ideal ratios of amino acids for sows changed dynamically depending on stages of pregnancy. Suggested daily Lys requirements were 6.83 and 15.26 g and relative ideal ratios for Lys:Thr:Val:Leu were 100:79:65:88 and 100:71:66:95 for 0 to 70 and 70 to 114 of gestation, respectively. Requirements and ideal ratios of amino acids for lactating sows changed dynamically depending on potential amounts of protein mobilization from maternal tissues which are related to voluntary feed intake and milk production. Suggested ideal ratios for Lys:Thr:Val:Leu were 100:59:77:115 and 100:69:78:123 if body weight losses of sows during 21 d lactation are 0 and 33 to 45 kg, respectively. To optimize efficiency of dietary protein utilization by sows, the dietary amino acid content and ratios can be adjusted by stages of pregnancy and by expected feed intakes or parities of sows during lactation considering the dynamic changes in the requirements and ideal ratios of amino acids. Acknowledgements to RA Easter, IK Han, WL Hurley, DH Baker, G Wu, and F Ji.

Key Words: Amino Acid, Ideal Protein, Sow

203 Adaptation of protein metabolism to changes in lysine intake in growing pigs. J. J. G. C. Van den Borne*, S. Borgjink, J. Dijkstra, and W. J. J. Gerrits, *Wageningen University, Wageningen, The Netherlands.*

The indicator amino acid technique is a well-known tool to estimate amino acid requirements within a subject. It involves measurement of responses in protein metabolism to step-wise changes in amino acid imbalance. The objective of this experiment was to compare lysine requirement estimates from increasing vs. decreasing titration strategies, and to study adaptive responses to changes in lysine intake. Pigs (n=14; 27.1±0.2 kg) were housed in metabolism crates and assigned to one of two treatments, with digestible lysine intake either increasing from 4.7 to 14.0 g/kg (INCR) or decreasing from 14.0 to 4.7 g/kg feed (DECR) in 7 equidistant steps, at identical intakes of other nutrients. Each step lasted 4d. Four complete 24h urine collections were performed from all pigs for each lysine level. Total urinary N and urea excretion were determined for all 24h collections. [¹⁵N]glycine was provided orally at d 3 of each lysine level and enrichment was measured in urinary urea. A linear-plateau model was fitted to N efficiency (in %) data. Treatment effects on slopes and inflection point estimates of the model were then analyzed statistically. Based on the F-test, for 11 of the 14 pigs the linear-plateau model fitted data better ($P<0.01$) than a straight line. The slope was higher ($P<0.01$) for DECR than for INCR (4.7 vs. 3.8 %/g). The lysine requirement, estimated from the inflection point, was lower ($P<0.05$) for DECR (10.1 g/kg) than for INCR (11.4 g/kg). Protein turnover increased linearly with lysine intake. With increasing lysine intakes, the increase in protein turnover rates was markedly greater for DECR than for INCR ($P<0.05$). No consistent changes in urinary N output were observed between the 4 subsequent 24h collections, although it was lower ($P<0.05$) for d 1 and 3 compared with d 2 and 4. In conclusion, increasing and decreasing lysine titration strategies resulted in different estimates for lysine requirement in pigs, indicating that adaptive processes in protein metabolism interfere with requirement estimates in within-subject titration techniques.

Key Words: Pig, Lysine, Protein Metabolism

204 Effects of fortifying low crude protein diet with crystalline amino acids on ammonia and uric acid production and excretion in broilers. N. F. Namroud, M. Shivazad*, and M. Zaghari, *University of Tehran, Karaj, Tehran, Iran.*

A study was conducted to evaluate the effects of providing all EAA in low CP diets equal to that of higher CP diets in broilers. Also, the effects of additional mixture of Gly and Glu or supplementation of excess EAA to low CP diets on the live performance, body composition, and excreta characteristics including pH, moisture, nitrogen, uric acid, ammonia concentration, and some blood factors related to nitrogen metabolism were measured to assess the reason of decreasing performance, especially appetite in low CP diets that have adequate amount of EAA. Male broiler chickens growing from 10 to 28 days of age were fed 8 experimental diets. Reducing dietary CP below 19% affected live performance and fat deposition in whole-body and abdominal cavity significantly ($P\leq 0.05$). Adding the Gly and Glu mixtures to low CP diets improved live performance and decreased fat deposition ($P\leq 0.05$). Nitrogen content, ammonia, uric acid level, moisture, and acidity of excreta were influenced by dietary CP ($P\leq 0.05$). Blood ammonia level was increased, and plasma uric acid was decreased with reduction of CP to 17% ($P\leq 0.05$). Supplementing Gly and Glu to low CP dietary treat-

ments increased plasma and excreta uric acid level in spite of decreasing level of ammonia production ($P\leq 0.05$). Reduction of dietary CP had no significant influence on the most free plasma amino acid levels; however, appetite was depressed ($P\leq 0.05$). The liver weight was elevated with increase in blood ammonia level ($P\leq 0.05$). This difference may be due to adaptation process of liver to high blood ammonia level. Therefore, our suggestion is that blood ammonia level, which has fatal effects on living cells may regulate appetite, besides the aminostatic mechanism in broilers.

Key Words: Crude Protein, Ammonia, Broiler

205 The effect of the level of crude protein and dietary fiber on the productive performance and health status of piglets. R. G. Hermes*, F. Molist, M. Iwazaki, M. Nofrarias, J. Gasa, and J. F. Pérez, *Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.*

Protein (CP) and dietary fiber (DF) are considered factors involved on the digestive maturation and health status of piglets. In the present study, ninety six 35-days-old piglets (7.66 ± 0.92kg BW) were placed in 32 pens of 3 animals each, and allotted to four dietary treatments for 21 days. The four diets were formulated based on rice, dairy products and soybean meal in a 2×2 factorial design, with 2 levels of CP (LP, 16%CP and HP, 19%CP) and 2 levels of DF (LF, 5%NDF and HF, 7% NDF). The HF diet was obtained by the supplementation of the basal diet with 4% of wheat bran and 2% of sugar beet pulp. Animal performance was weekly registered, and samples of feces collected for microbiology on days 1 and 21. On day 21, one pig from each pen was sampled for blood analyses of the acute-phase protein (PigMap) and sacrificed to register the digestive tract weight and colon histology. Animals fed on the HF diet increased the average daily gain (390 vs. 457 g/d; $p\leq 0.001$), and the large intestine weight (4.4 vs. 5.4% of BW; $p\leq 0.05$). It coincided with a decrease ($p\leq 0.05$) on the *E. coli* counts (7.77 vs. 6.86 log of CFU/g feces), and an increase ($p\leq 0.05$) on the ratio Lactobacilli:Enterobacteria (0.76 vs. 1.37). On the other hand, CP level did not modify the productive performance, but HP increased the weight (% of BW) of the small (6.5 vs. 7.7), and large intestine (3.8 vs. 4.3) ($p\leq 0.05$). In the large bowel, HP diet increased the numbers of goblet cells (4.6 vs. 5.4/100µm; $p\leq 0.05$), while reduced the numbers of intraepithelial lymphocytes (1.8 vs. 1.3/100µm; $p\leq 0.05$). In relation with the health status, a significant interaction was observed, with the LP-HF treatment showing the highest incidence of diarrhea, antibiotic interventions and PigMap concentration ($p\leq 0.05$). As a whole, CP has major effects on the gastrointestinal growth, while DF promotes major changes on the microbial colonization. An early increase on DF supplementation appears to promote a healthier status when this change is concomitant with a high CP level.

Key Words: Piglets, Dietary Fiber, Health Status

206 Pea protein as a substitute of soy bean protein in diets for young pigs: Effects on nutrient digestibility and digestive traits. D. G. Valencia¹, M. P. Serrano¹, C. Centeno², R. Lázaro¹, and G. G. Mateos^{*1}, ¹Universidad Politécnica de Madrid, Spain, ²Instituto del Frio, C.S.I.C., Madrid, Spain.

A trial was conducted to study the effects of using pea protein concentrate (PPC), soybean meal (SBM) or fullfat soybean (FFSB) as a substitute

of soy protein concentrate (SPC) on coefficient of ileal apparent digestibility (CIAD) of nutrients and digestive traits of piglets. The design was completely randomized with four treatments and six replicates of one piglet each. Four isonutritive diets (2,490 kcal NE/kg and 1.28% available Lys) were formulated and fed to pigs from 26 to 48 d of age. The main difference among these diets was the protein source used. In all cases the source tested supplied 5.5% of the dietary protein (CP). The CIAD of dietary components, the pH of the gastro intestinal tract (GIT), and the weight of digestive organs and spleen were measured at 48 d of age. Protein source had no effect on CIAD of CP or amino acids. However, the CIAD of organic matter (0.813 and 0.813 vs. 0.789 and 0.768) and gross energy (0.810 and 0.816 vs. 0.789 and 0.768) was greater for pigs fed SPC and SBM than for pigs fed PPC and FFSB ($P \leq 0.01$). The weight of the GIT was greater for pigs fed FFSB and PPC than for pigs fed SBM with pigs fed SPC being intermediate (61.0, 60.3, 52.8, and 55.9 g/kg body weight, respectively; $P \leq 0.05$). The poorer nutrient digestibility observed in pigs fed PPC and FFSB as compared to pigs fed SBM or SPC might be related to the higher TI content of these protein sources (4.9 and 4.7 vs. 2.7 and 1.6 g/kg). In summary, the inclusion of pea protein concentrate and fullfat soybean in the diet impairs ileal digestibility of organic matter and gross energy at 48 d of age. The replacement of soya bean meal by pea protein or soy protein concentrate in piglet diets, to improve nutrient digestibility, is not justified.

Key Words: Pea Protein Concentrate, Soy Bean Products, Digestibility in Piglets

207 Metabolizable energy and nitrogen-corrected metabolizable energy of meat and bone meal for pig. O. A. Olukosi* and O. Adeola, *Purdue University, West Lafayette, IN.*

Apparent metabolizable energy (AME) and nitrogen-corrected AME (AMEn) of 14 meat and bone meal (MBM) samples were determined using barrows. Treatments consisted of 1 standard corn-soybean meal (SBM) diet and 14 test diets in which each of the 14 MBM samples replaced equal quantities of corn and SBM in the standard diets such that the ratio of corn:SBM was the same in all the 15 diets. Each dietary treatment had 9 barrows. The barrows were allowed 5 d of adjustment to metabolism cages and diets and 5 d of feeding and total collection of feces and urine. The diets, urine and feces were analyzed for gross energy (GE) and N. Correlation, regression, partial correlation and model development and selection analyses were used to determine relationship among proximate fractions and AME or AMEn and for choosing the optimum prediction equation. The AME values were significantly different ($P < 0.05$) among the 14 MBM samples and ranged from 2,611 to 3,890 kcal/kg, whereas AMEn ranged from 2,512 to 3,794 kcal/kg and was not significantly different among the MBM samples. Proximate components were correlated to AME and AMEn of the MBM samples. There were negative correlations between AME and Ca, P, and ash ($r^2 = -0.43, -0.48$ and -0.49 , respectively), AMEn was also negatively correlated to the same chemical components with similar r^2 values. Both AME and AMEn were positively correlated to fat ($r^2 = 0.42$ and 0.43 for AME and AMEn, respectively) and protein ($r^2 = 0.17$ and 0.16 for AME and AMEn, respectively). The best two-model predictors were protein and fat, adding GE to these two improved the precision of the prediction equation. The best prediction equation for AME was based on 5 variables and was $7,756 - (0.84 \times \text{GE}) + (704 \times \text{P, \%}) + (156 \times \text{Ca, \%}) + (129 \times \text{Fat, \%}) - (268 \times \text{Ash, \%})$. For AMEn, the best prediction equation was $7,664 - (0.85 \times \text{GE, kcal/kg}) + (707 \times \text{P, \%}) + (154 \times \text{Ca,$

$\%$) + $(132 \times \text{Fat, \%}) - (268 \times \text{Ash, \%})$. In conclusion, although no single chemical component explained more than 50% of the variations in AME and AMEn of the MBM, but in combination provide information that may be used to predict the energy value of MBM.

Key Words: Energy, Meat and Bone Meal, Proximate Components

208 Amino acid and energy digestibility in soybean meal from high-protein and low-oligosaccharide varieties of soybeans fed to growing pigs. K. M. Baker* and H. H. Stein, *University of Illinois, Urbana.*

Two experiments were conducted using 5 sources of soybean meal (SBM) that included hexane extracted SBM produced from high-protein soybeans (SBM-HP) and from conventional soybeans, and mechanically expelled SBM produced from high-protein soybeans, low-oligosaccharide soybeans (SBM-LO), and conventional soybeans. The standardized ileal digestibility (SID) of CP and AA in the 5 sources of SBM were measured in Exp. 1. Five diets that each contained 1 source of SBM as the only AA-containing ingredient and a N-free diet were formulated. Twelve growing barrows (initial BW: 67.7 kg) were allotted to a replicated 6×6 Latin square design with 6 periods and 6 diets. Each period lasted 7 d and ileal digesta were collected on d 6 and 7 of each period. With the exception of Trp, no differences in SID values between the extracted SBM-HP and the extracted conventional SBM were observed. The expelled SBM-HP and SBM-LO had greater ($P \leq 0.05$) SID for His, Ile, Lys, Thr, and Val than the expelled conventional SBM. The SID for all indispensable AA in the expelled SBM-HP were greater ($P \leq 0.05$) than in the extracted SBM-HP, and for the conventional SBM, the SID for Arg, Ile, Leu, Phe, and Trp were greater ($P \leq 0.05$) in the expelled meal than in the extracted meal. Experiment 2 was conducted to measure ME in the 5 sources of SBM using 48 growing barrows (initial BW: 38.6 kg) that were placed in metabolism cages and randomly allotted to 6 diets with 8 replicates per diet. A corn-based diet and 5 diets based on a mixture of corn and each source of SBM were formulated. Urine and feces were collected during a 5-d collection period, and values for ME in each source of SBM were calculated using the difference procedure. Results showed that ME in the extracted SBM-HP was greater ($P \leq 0.05$) than in the extracted conventional SBM (4,074 vs. 3,672 kcal/kg DM). The ME in the expelled SBM-HP was also greater ($P \leq 0.05$) than in the expelled conventional SBM and in the SBM-LO (4,059 vs. 3,620 and 3,721 kcal/kg DM). It is concluded that SBM-HP has a greater feeding value than conventional SBM.

Key Words: High-Protein Soybean Meal, Low-Oligosaccharide Soybean Meal, Pigs

209 Standardized ileal amino acid digestibilities in grain legumes for pigs. D. Jeziorny*¹, R. Mosenthin¹, M. Eklund¹, and M. Rademacher², ¹*University of Hohenheim, Stuttgart, Germany,* ²*Evonik Degussa GmbH, Hanau-Wolfgang, Germany.*

It has been agreed upon to use standardized ileal digestibilities (SID) of CP and AA in diet formulation for pigs. This study with grower pigs was conducted to determine SID values in different cultivars of faba beans, peas and lupins. Moreover, ileal digestibilities of starch in faba beans and peas were also determined. Three consecutive experiments

were conducted with 6 barrows each (initial BW 23.2 ± 1.9 kg). The pigs were fitted with a simple T-cannula at the distal ileum. In total, 18 assay feed ingredients, including 6 cultivars of faba beans (25 to 30% CP, as-fed) or peas (20 to 23% CP, as-fed), 5 cultivars of lupins (31 to 42% CP, as-fed) and 1 soybean meal (SBM) (49% CP, as-fed) as reference component were tested in a randomized row-column-design with 6 periods in each experiment ($n = 6$ per assay feed ingredient). The assay feed ingredients were added to a corn starch casein-based basal diet at the expense of corn starch. Each assay diet supplied approximately 50% of the total CP and AA content from the assay feed ingredient and casein, respectively. Both SID of CP and AA and ileal digestibility of starch in legume seeds were determined according to the principles of the difference method. The SID of CP differed ($P < 0.05$) between faba beans, peas and lupins, ranging between 69 to 81, 77 to 82 and 85 to 89%, respectively. The SID of Lys, Met, Trp, Ile and Phe in these grain legumes were lower compared to SBM ($P < 0.05$). The SID of most AA in faba beans and peas were lower compared to lupins or SBM ($P < 0.05$). The SID of CP and AA in faba beans was partly affected by cultivar ($P < 0.05$). The ileal digestibilities of starch in peas and faba beans were similar ($P > 0.05$), ranging between 78 to 89 and 77 to 84%, respectively. In conclusion, mean SID values for CP and AA in grain legumes are in good agreement with tabulated values, however, for individual cultivars these values may vary.

Key Words: Standardized Ileal Amino Acid Digestibility, Grain Legumes, Pig

210 True ileal amino acid digestibility in cecectomized roosters and lysine bioavailability in chicks fed distillers dried grains with solubles. A. A. Pahn*, J. E. Pettigrew, C. S. Scherer, D. H. Baker, C. M. Parsons, and H. H. Stein, *University of Illinois, Urbana*.

The concentration of true ileal digestible (TID) Lys and relative bioavailable Lys in 7 sources of distillers dried grains with solubles (DDGS)

fed to poultry were compared. We also evaluated the use of 2 in vitro procedures, reactive Lys and color score, to predict the concentration of TID Lys and bioavailable Lys in DDGS. The TID of AA in all sources of DDGS were measured using cecectomized roosters. Relative bioavailable Lys in all sources of DDGS were measured using standard curve methodology. Initially, 9-d total gain of chicks fed increasing levels of L-Lys HCl was measured and a regression equation was derived by plotting the bioavailable Lys intake against 9-d total gain of chicks. Seven additional diets were formulated to contain each of 7 sources of DDGS, and 9-d total gain of chicks fed these diets was measured. The 9-d total gain of chicks fed diets containing DDGS was used in the regression equation to predict the relative bioavailable Lys. The 7 DDGS sources were analyzed for reactive Lys using the guanidination procedure, and Hunterlab L, a, and b scores were measured to determine the degree of lightness, redness, and yellowness in the samples. Results showed that the TID for Lys among the 7 DDGS sources varied ($P < 0.05$) from 52.7 to 70.4%. The average TID for Lys was 61.4%. Concentration of relative bioavailable Lys did not differ among the 7 sources of DDGS. The average concentration of TID Lys in DDGS was not different from the concentration of bioavailable Lys (0.47% and 0.53%, respectively). The concentration of TID Lys was correlated ($r^2=0.84$, $P < 0.05$) with the concentration of reactive Lys in the samples. Hunterlab L scores of DDGS was correlated ($r^2=0.90$, $P < 0.05$) with the concentration of bioavailable Lys. In conclusion, the concentration of TID Lys in DDGS is close to the concentration of bioavailable Lys in chicks. Values for reactive Lys and Hunterlab L may be used to estimate the concentration of TID Lys and bioavailable Lys in DDGS, respectively.

Key Words: Digestibility, Bioavailability, DDGS

Ruminant Nutrition: Growing Youngstock, Calves and Heifers

211 Evaluating residual feed intake on performance of growing and finishing steers. C. O. Trejo*, L. L. Berger, D. B. Faulkner, J. M. Dahlquist, and T. G. Nash, *University of Illinois, Urbana*.

Improving feed efficiency in the beef cattle industry has become increasingly important as feed costs continue to rise. Residual feed intake (RFI) has been proposed as an efficiency trait that appears to be independent of most other performance traits. The objective of this trial was to evaluate RFI on performance of growing and finishing steers. Residual feed intake was calculated as the difference between the actual dry matter intake (DMI) and a predicted DMI. The predicted DMI was defined as a linear regression of DMI, average daily gain (ADG), and metabolic body weight ($BW^{0.75}$). Two groups were classified for the growing and finishing phase: Low RFI (<0.5 SD) and High RFI (≥ 0.5 SD). One hundred and sixty Angus, Simmental, and Angus-Simmental cross bred early weaned steers were fed during 112 days either of two diets: high concentrate (65% cracked corn, CC) or high fiber (38% soy hulls). Steers were fed with a common finishing diet (50% CC and 25% dry distillers grains with solubles) for approximately 152 more days. There was no significant interaction ($P > 0.05$) between the two diets and the RFI classification groups during the growing phase in performance. No differences were found for ADG ($P = 0.28$) and DMI ($P = 0.13$). Steers with low RFI were heavier ($P = 0.037$) at the end of the growing phase and had higher ($P = 0.003$) feed efficiency than the low RFI steers. There was a significant difference ($P < 0.001$) between the individual RFI values of each group. For the finishing phase, there were no differences for final BW and ADG between each of the RFI groups. However, steers in the low RFI group ate 1.24 kg/d less ($P = 0.0001$) and had higher ($P < 0.001$) gain:feed ratio than the high RFI group. There was 1.54 kg/d difference on RFI between the two groups. Identifying steers with low RFI potential can help improve feed efficiency and profitability during the growing and finishing phase.

Key Words: Residual Feed Intake, Early Weaned Steers

212 Relationships between residual feed intake and carcass-quality traits in Santa Gertrudis steers. F. R. B. Ribeiro*¹, R. K. Miller¹, E. G. Brown², P. A. Lancaster¹, L. O. Tedeschi¹, S. Moore³, D. DeLaney³, and G. E. Carstens¹, ¹Texas A&M University, College Station, ²Stephen F. Austin State University, Nacogdoches, TX, ³King Ranch, Kingsville, TX.

Our objective was to examine the phenotypic associations between residual feed intake measured during the growing (GRFI) and finishing (FRFI) phases, and carcass traits and tenderness in Santa Gertrudis steers ($N = 113$). Individual intakes were measured while steers were fed high-roughage (ME = 2.26 Mcal/kg) and high-grain (ME = 3.0 Mcal/kg) diets for 77 and 88 d during the growing and finishing phases. For each phase, RFI was calculated as the residual value from linear regression of DMI on mid-test $BW^{0.75}$ and ADG. For each phase, steers were categorized into low, medium and high RFI groups based on ± 0.50 SD from the mean of 0.0 ± 0.84 and 0.0 ± 0.98 for GRFI and FRFI, respectively. Steers were harvested at about one cm 12th rib fat thickness (BF). After 24 h, a LD sample was removed for calpastatin activity (CAP). At 48 h, carcass traits (hot carcass weight (HCW), LD muscle area (LMA), kidney, pelvic and heart fat (KPH), BF and marbling score (MS)) were measured, and yield grade (YG) calculated. Two 12th rib steaks were aged 1- (WSF1) or 14-d (WSF14) for Warner-Bratzler shear force.

RFI during the growing phase was weakly correlated (0.19 ; $P < 0.05$) with WSF14, but not ($P > 0.05$) with HCW, LMA, BF, KPH, YG, MS, WSF0 or CAP. Steaks from low and medium GRFI steers had lower ($P < 0.05$) WSF14 (2.2 and 2.1 vs 2.4, respectively) than steaks from high GRFI steers. FRFI was correlated ($P < 0.05$) with BF (0.27) and CAP (0.19), but not with other carcass traits. Carcasses from low-FRFI steers had less ($P < 0.01$) BF (0.97 vs 1.24 cm), lower ($P < 0.05$) YG (2.7 vs 3.2), but similar LDA (78 vs 75 cm²) and MS (475 vs 481) than carcasses from high-FRFI steers. Steaks from medium-FRFI steers had lower ($P < 0.05$) WSF14 than steaks from high FRFI steers. The low-FRFI steers had lower ($P < 0.05$) CALP (2.57 vs 2.81) than high-FRFI steers. Carcasses from low FRFI steers (more efficient) were leaner, but had similar marbling scores as carcasses from high RFI steers. Results suggest that selection for improved RFI will not have a negative impact on marbling and beef tenderness.

Key Words: Carcass Traits, Tenderness, Residual Feed Intake

213 Predicting water intake by yearling steers during the summer. J. L. Lacey*, J. J. Wagner, and T. E. Engle, *Colorado State University, Fort Collins*.

Four hundred and thirty-two crossbred yearling steers ($339 \text{ kg} \pm 4.8$) housed in 48 pens were used to study relationships between water intake (WI), dry matter intake (DMI), various measures describing the weather, and water quality. Because every two pens shared a common water fountain, 24 observations were available for this analysis. Water sources included: reverse osmosis water (RO) versus high sulfate well water. Average sulfate concentrations for the RO water treatment was $253.14 \pm 101.12 \text{ mg per L}$ versus $637.4 \pm 36.81 \text{ mg per L}$ for well water. Mean daily temperature (TEMP), humidity (HUM), dew point (DP), wind speed (WIND), and precipitation (RAIN) data were obtained from the weather station located at Lamar Municipal Airport located approximately 2 km from the Southeast Colorado Research Center. Equations predicting WI were developed using mixed model procedures. Water intake increased $1.25 \pm 0.17 \text{ L per kg increase in DMI}$ ($P < 0.0001$), $0.82 \pm 0.07 \text{ L per degree C increase in TEMP}$ ($P < 0.0001$), $0.68 \pm 0.07 \text{ L per degree C increase in DP}$ ($P < 0.0001$), and $2.12 \pm 1.25 \text{ L per head if RO water was used as compared with well water}$ ($P < 0.11$). Water intake declined $0.19 \pm 0.04 \text{ L per \% unit increase in HUM}$ ($P < 0.0001$) and was reduced by $0.05 \pm 0.02 \text{ L for each km/h increase in WIND}$ ($P < 0.04$). There was no significant difference in water intake due to precipitation ($P > 0.95$). Predicted WI from the current study was reasonably close to WI predicted by equations listed in NRC (2000).

Key Words: Steer, Feedlot, Water Intake

214 Combinations of steam-flaked corn, dry-rolled corn, and dried corn distiller's grains with solubles for feedlot heifers. P. L. Black*¹, G. L. Parsons¹, M. K. Shelor¹, K. K. Karges², M. L. Gibson², and J. S. Drouillard¹, ¹Kansas State University, Manhattan, ²Dakota Gold Research Association, Sioux Falls, SD.

Crossbred heifers ($n = 689$, $302 \pm 65 \text{ kg}$ initial BW) were used to evaluate finishing performance of cattle fed combinations of steam-flaked corn

(SFC), dry-rolled corn (DRC), and dried corn distiller's grains with solubles (DDG). The study was conducted as a randomized complete block using a 2 × 2 factorial arrangement of treatments. All diets contained SFC, and factors consisted of the levels of DDG (0 or 25%) and DRC (0 or 25%). Heifers were individually weighed and blocked into heavy and light groups. Within block, heifers were assigned randomly to pens containing 25 animals each, with 7 pens per treatment. Heifers were fed once daily *ad libitum* for 137 to 157d. ADG, DMI, and feed conversion efficiency were not different among treatment groups ($P < 0.05$). Heifers fed DRC had greater dressing percentages than their counterparts fed diets without DRC ($P < 0.05$). Feeding DDG also increased dressing percentage ($P < 0.05$). There were no differences among treatments with respect to HCW, quality grade, yield grade, 12th rib fat thickness, KPH, longissimus muscle area, incidence of liver abscess, or total carcass value. Partial substitution of SFC with DRC or DDG yielded comparable feedlot performance and carcass value with lower input cost.

Table 1. Performance and carcass traits of cattle fed SFC finishing diets with 0 or 25% DDG and 0 or 25% DRC.

	SFC		SFC/DRC		SEM
	0% DDG	25% DDG	0% DDG	25% DDG	
Carcass adjusted ADG, kg	1.40	1.41	1.44	1.46	0.03
Gain:feed	0.174	0.165	0.166	0.160	0.0029
Dressed yield, % ^a	62.58	63.65	63.76	64.62	0.46
HCW, kg	328	326	330	330	4.3
USDA Choice or higher, %	43.5	42.1	49.3	39.3	4.6
USDA yield grade	2.69	2.78	2.76	2.66	0.10
Total carcass value, \$	934	931	948	935	14.0

^a Main effects of DDG and DRC, $P < 0.05$

Key Words: Distiller's Grain, Cattle, Finishing

215 Cow live weight is negatively related to feed efficiency of cow/calf pairs from birth to weaning¹. T. Z. Albertini^{*2}, S. R. de Medeiros³, R. A. de A. Torres Júnior³, and D. P. D. Lanna², ¹Fapesp, Embrapa, ²ESALQ-USP, Piracicaba, SP, Brazil, ³Embrapa Beef Cattle, Campo Grande, MS, Brazil.

Feed efficiency of beef cows and their calves from birth to weaning was determined. Cow/calf pairs were individually fed from 26±12 d (mean±standart deviation) of life to weaning at 210 d. Forty adult non-pregnant cows were evaluated: 20 1/2 Caracu x Nelore, 10 1/2 Angus x Nelore and 10 Nelore. The 1/2 Caracu x Nelore and Nelore cows were bred to Red Angus bulls and the 1/2 Angus x Nelore were bred to Canchim (5/8 Charolais) bulls. The diet (2.3±0.1 Mcal ME/kg and 11.2±2.3% CP) was fed in variable amounts and adjusted every 28 days to keep the weight and body scores of the cows unchanged. The same diet was offered *ad libitum* to the calves (beginning at 2 months *postpartum*). Milk production was determined by milking each cow, at a minimum of 8 points in lactation. Correlations among efficiency indexes were evaluated using MANOVA option of Proc GLM in SAS. Regression analysis was used to compare the efficiency of cow/calf pairs and live weight of cows. The model included the effects: start of

feeding period, genetic group, sex and age of calf at beginning of the experiment. Efficiency of cow/calf pairs was 33.9±3.6 g LWG_{210d}/Mcal metabolizable energy. Efficiency of calves was 89.1±8.2 g LWG_{210d}/Mcal of total MEI (milk+solid diet). The live weight of cows was 450±55 kg. Phenotypical correlations showed a strong negative correlation between the live weight (LW) of cows and the efficiency of cow/calf pairs ($r=-0.65$; $P<0.001$). The linear regression of efficiency of cow/calf and cow's LW was: $y = -0.0397x + 52.61$ ($R^2 = 0.43$). There was a positive, although less dramatic, correlation between cows LW and the efficiency of progeny efficiency (g gain_{210d}/Mcal of calves MEI; $r=0.35$; $P<0.05$). In conclusion, heavier cows were associated with lower cow/calf pair efficiencies. However the progenies of heavier cows are more efficient in pre-weaning.

Key Words: Growth, Bioenergetics, Milk

216 Effects of using wheat gluten and rice protein concentrate in calf milk replacers. T. M. Hill^{*}, H. G. Bateman, II, J. M. Aldrich, and R. L. Schlotterbeck, Akey, Lewisburg, OH.

There is limited information in the literature on feeding milk replacers (MR) containing either hydrolyzed wheat gluten (HWG; 80% CP) or rice protein concentrate (RPC; 80% CP) to calves under 2 months of age. These protein sources appear to have little or no antinutritional properties unlike several other plant proteins and they are widely used in MR. Trial 1 compared feeding 26% CP, 17% fat MR that contained A) 0, B) 6, or C) 12% HWG replacing whey CP. The MR were fed at 0.681 kg/d (reconstituted to 4.6 L) halved into AM and PM feedings for 39 d, followed by 0.341 kg/d for d 40 to 42 (AM feeding only). Holstein calves (43 kg BW and 5.0 mg serum protein/dL initially) 2 to 3 d old from one source were used. Trial 2 compared feeding 26% CP, 17% fat MR that contained A) 0, B) 8, or C) 16% RPC replacing whey CP. The MR were fed at 0.681 kg/d (reconstituted to 4.6 L) halved into AM and PM feedings for 25 d, followed by 0.341 kg/d for d 26 to 28 (AM feeding only). Holstein calves (42 kg BW and 4.8 mg serum protein/dL initially) 2 to 3 d old from one source were used. Within trial, the MR were formulated to have equal concentrations of CP, fat, Lys, Met, Ca, P, and added trace minerals, vitamins, and decoquinat. All MR were adequate in essential amino acids. Each trial was analyzed as a completely randomized design using the MIXED procedure of SAS. Means were separated using linear and quadratic contrast statements. In Trial 1, pre-weaning ADG (0.640, 0.561, and 0.505 kg/d), starter intake, and hip width change decreased linearly ($P < 0.05$) with increasing concentration of HWG in the MR. In Trial 2, ADG (0.389, 0.340, and 0.178 kg/d) and feed efficiency declined linearly ($P < 0.05$) as RPC increased in the MR. Post-weaning performance did not differ among MR treatments in Trials 1 and 2. In these trials, pre-weaning ADG of calves less than 2 mo old was reduced when either HWG or RPC replaced whey protein in a MR.

Key Words: Wheat Gluten, Rice Protein Concentrate, Milk Replacer

217 The effects of controlled feeding a high concentrate or high forage diet at four nitrogen intakes on nitrogen utilization in dairy heifers. G. I. Zanton^{*} and A. J. Heinrichs, The Pennsylvania State University, University Park.

The hypothesis of this experiment is that N provided in a high concentrate (HC) ration will be utilized with a greater efficiency than a high forage ration (HF) by postpubertal dairy heifers and that the response will be affected by level of N intake (NI). To test this hypothesis, 8 Holstein heifers (beginning at 362 ± 7 kg and 12.3 ± 0.4 mo) were fed eight rations according to a split-plot, 4×4 Latin square design. Treatments were formulated to contain 75% or 25% forage (corn silage and chopped wheat straw) and 4 levels of NI (0.94, 1.62, 2.30, 2.96 g N/kg $BW^{0.75}$ per d) and were fed to equal ME intake (182 kcal/kg $BW^{0.75}$). Blood samples were collected over d 19-20 and feces and urine were collected the final 8 d/28 d period. Concentration of BUN was significantly higher for HC and with increasing NI. Urea-N excretion was not different between forage levels, but increased significantly and linearly with NI. Urea clearance rate (L/h) did not differ between forage levels and increased, but at a decreasing rate, as NI increased. A significant interaction resulted from urea clearance increasing at a greater rate and obtaining higher values for HF, whereas clearance of urea for heifers fed HC obtained significantly lower maximal values. Like urea-N excretion, daily urinary N excretion was affected only by NI. Retained N responded linearly to increased levels of NI. As a result of a significant interaction between forage level and NI on fecal N excretion and numerical differences in urine N, retained N at maximum NI was greater for HC than HF. In spite of this observation, gross N efficiency (GNE) only tended to be affected by an interaction and was not significantly affected by forage level. Linear and quadratic responses in GNE to increases in NI occurred such that the statistical maximum GNE was achieved when N intake was 1.62 g N/kg $BW^{0.75}$. To conclude, differences in N utilization between HC and HF in this trial were small and were not evident until NI increased to impractical levels.

Key Words: Dairy Heifer, Forage:Concentrate, N Intake

218 Effects of ractopamine HCL on growth performance and carcass characteristics of feedlot heifers. J. W. Himm^{*1}, W. J. Platter¹, M. J. Corbin¹, J. J. Wagner², N. E. Davis², J. S. Drouillard³, and C. E. Walker³, ¹Elanco Animal Health, Greenfield, IN, ²Colorado State University, Ft. Collins, ³Kansas State University, Manhattan.

Two studies were pooled to evaluate the effects of ractopamine hydrochloride (RAC) on growth performance and carcass characteristics in beef heifers. The studies consisted of 2 treatments (0 and 200 mg $hd^{-1} \cdot d^{-1}$ RAC), 16 replications per treatment and 1016 heifers (491.3 kg; 8 to 9 head/pen). Days on feed averaged 172 (CO site) and 186 (KS site), with the RAC diets fed the last 14, 28, and 42 d prior to harvest. Steam flaked corn-based rations met or exceeded National Research Council nutrient requirements and Rumensin[®], Tylan[®], and MGA[®] were fed at label dosages. One way ANOVA was used to estimate treatment effects on live animal performance and carcass characteristics. The statistical model included treatment as a fixed effect with random effects of replicate nested in study site, treatment and replicate nested in study site, study site and the study site by treatment interaction. Repeated measures analysis was used to evaluate live weight response over time. Treatments were pooled into control and RAC, the statistical model included treatment, time, and the treatment by time interaction. The response in live weight gain to feeding RAC was quadratic over the 42 d period with RAC treated heifers having a live weight gain of 5.9, 9.6, and 11.2 kg over controls at 14, 28, and 42 d, respectively. Hot carcass weight tended ($P = 0.12$; 5.5 kg) to increase after 28 d on RAC and was heavier ($P < 0.05$; 8.3 kg) after 42 d. After 42 d ribeye area was larger ($P < 0.05$) for RAC treated heifers. Dressing percentage, marbling score, yield grade,

and dark cutters were similar among treatment groups. USDA quality and yield grade distributions were similar between treatment groups. These data indicate that performance on a live and hot carcass weight basis continues to increase with RAC supplementation throughout a 42 d feeding duration.

Key Words: Ractopamine HCL, Heifers, Growth and Carcass

219 Interaction of growing and finishing production system and sorting by weight. D. R. Adams^{*}, T. J. Klopfenstein, G. E. Erickson, M. K. Luebke, and J. R. Benton, *University of Nebraska, Lincoln.*

Cattle are commonly sorted at weaning into different production systems. Our objective was to determine if sorting cattle by BW decreases variation in HCW and decreases overweight carcasses (431 kg). Steers (n=288) were purchased from a sale barn in the fall. All the cattle were assigned randomly into sorted or unsorted groups (n=144). The unsorted group was then assigned randomly to one of three feeding times: calf-fed, summer yearling or fall yearling. The calf-feds were fed from November to May. The summer and fall yearlings grazed cornstalks together through the winter until spring and then grazed cool season grass until May. The summer yearlings entered the feedlot in May and were fed until October. The fall yearlings grazed pasture until September when they entered the feedlot and were fed until January. In the sorted group, the heaviest 1/3 were fed as calf-feds. When the cattle were brought off of grass in May, the heaviest 1/2 of the remaining sorted group were fed as summer yearlings, while the lightest 1/2 went to pasture and then were fed until January. When entering the feedlot, the cattle were assigned randomly to six pens per group per feeding time and pen was experimental unit. Design was a 2 X 3 factorial. There were interactions ($P < 0.05$) for initial feedlot BW and HCW (by design), and for G:F and percent of carcasses > 431 kg. Sorted cattle had heavier initial feedlot BW and HCW as calf-feds but lighter as fall yearlings compared to controls. Sorted cattle had fewer overweight carcasses as fall yearlings (2.8% vs. 10.5%), but there were few overweight carcasses among either sorted or control cattle fed as calf-feds or summer yearlings. Unsorted calf-feds had higher G:F than sorted with no differences due to sorting within summer or fall yearlings. Sorting decreased variation of HCW (SD=27 vs. 39 Kg) and number of overweight carcasses without effecting fat thickness or quality grade.

Key Words: Carcass Characteristics, Feedlot Cattle, Sorting

220 Effect of the addition of plant extracts (Queen of Calves) to milk and differing levels of milk on gastro intestinal tract development of calves. J. K. Margerison^{*}, G. W. Reynolds, and R. Laven, *Massey University, Palmerson North, New Zealand.*

This research assessed the effect of plant extracts added to milk on the development of the gastro intestinal tract. Using a randomised block design, 18 (Male) dairy calves were randomly selected and allocated (48 h) according to; birth date, breed and live weight to one of three treatments; 4 l/h/d of whole milk (M); 4 l/h/d whole milk 4 l, plus 200 g plant extracts (MP); 2 l/h/d whole milk, plus 200 g plant extracts (0.5MP) and 3 calves per treatment diet were euthanized at 7 and 14 weeks of age to assess the physical and histological development of the gastro intestinal tract. Histological examination of the reticulum: pole and cranial, ventral

and dorsal rumen showed that calves offered plant extracts, at 7 weeks, had greater dorsal rumen papillae thickness (M:0.202^b; MP: 0.295^a; 0.5MP: 0.346^a (0.0294, P<0.05) and height (M: 0.336^b; MP: 0.378^b; 0.5MP: 0.716^a (sem 0.0710 P<0.001) and at 14 weeks (M: 0.334^{ab}; MP: 0.293^b; 0.5MP:0.388^a, sem 0.0710 P<0.05) dorsal rumen (M: 1.02^{ab}; MP: 1.08^a; 0.5MP: 0.810^b, sem 0.0396 P<0.05) and ventral rumen wall thickness (M: 0.631^b; MP:0.791^a; 0.815^a, sem 0.0421 P<0.05), greater full stomach weights (14 weeks: M: 16.6^b; MP: 21.6^a; 0.5MP: 16.9^b, sem 1.09 P<0.05), at 7 weeks had greater small intestine villi height height (M: 0.556^b; MP: 0.763^a; 0.5MP: 0.541^b sem 0.0381, P<0.001) and lower caecum mucularis (M: 0.756^a; MP: 0.586^b; 0.5MP: 0.449^b, sem 0.0541 P<0.001) (μm) compared with calves offered milk. Rumen fluid pH, VFA concentrations of acetic, propionic, isobutyric, butyric, valerate were not significantly different. The addition of plant extracts to milk increased rumen and small intestine development, but did not affect rumen volatile fatty acid concentrations.

Key Words: Gastro Intestinal Tract, Plant Extracts, Calves

221 Determination of the optimal amino acid concentration in milk replacers for calves less than five weeks of age. T. M. Hill*¹, H. G. Bateman, II¹, J. M. Aldrich¹, R. L. Schlotterbeck¹, and K. G. Tanan², ¹Akey, Lewisburg, OH, ²Provimi, Brussels, Belgium.

The amino acid requirements of herd replacement calves less than 5 wk old and fed milk replacers (MR) are not clearly defined. The objective

of these four studies was to investigate the effect of supplementing MR containing 24 to 28% CP (from milk sources) and 17% fat with Lys, Met, and Thr in order to estimate their optimal concentrations for calves less than 5 wk of age. Holstein bull calves (initially 3 and 4 d old, 43 & PLUSMN; 1 kg BW) were fed an 18% CP (as-fed) starter ad libitum and weaned at 31 to 32 d of age (28 d studies). Calves were housed in an unheated, curtain-sided nursery. In Study 1, six MR treatments were fed based on the combination of three CP concentrations (24, 26, and 28% CP) each with or without added Lys and Met. In Studies 2 and 3, 26% CP and 2.34% Lys MR treatments were fed to test the concentration of Met (0.64, 0.68, and 0.72% Met in Study 2, and 0.64, 0.72, and 0.80% Met in Study 3). In Study 4, 26% CP, 2.34% Lys, and 0.72% Met MR treatments were fed to test the concentration of Thr (1.06, 1.43, and 1.80%). There was a 17% improvement (P < 0.05) in ADG in Study 1 from adding Lys and Met that was maximized with 2.34% Lys. The ADG response to added Met in Studies 2 (linear, P < 0.05) and 3 (quadratic, P < 0.05) were 13 and 7%, respectively, with a plateau at 0.72% Met. There was no ADG or efficiency response to added Thr in Study 4. Formulating 17% fat, whey-based MR fed at 0.68 kg/d to 26% CP, 2.34% Lys, and 0.72% Met appeared optimum based on responses of ADG, feed efficiency, and serum concentrations of urea nitrogen. Feeding calves more CP and essential amino acids did not improved ADG and efficiency. Amino acid requirements of calves less than 5 wk old, averaging 48 kg BW, consuming 204 g CP/d, and gaining 0.46 kg BW/d, appeared to be met with 17 g Lys, 0.31 Met to Lys ratio, 0.54 Met+Cys to Lys ratio, and a Thr to Lys ratio less than 0.60.

Key Words: Calf, Amino Acid, Milk Replacer

Symposium: Ruminant Nutrition, and Production, Management & Environment Joint Symposium: Designing Field Studies to Evaluate Nutrition Effects on Production, Reproduction and Health of Dairy Cows

222 Utilizing appropriate statistical designs and techniques for data collected from commercial dairies. R. J. Tempelman*, *Michigan State University, East Lansing.*

Due to increasing constraints placed on conducting large studies at universities, more research is being conducted on commercial dairies thereby raising some implications for experimental designs and data analysis. For example, experimental units are often specified to be pens of animals in on-farm studies, thereby requiring that at least two pens be used per treatment group in a single dairy study. Even when treatments are compared within pens, the precision of inference on treatment differences is still primarily limited by the number of pens in the study, rather than the number of cows per treatment in each pen. Other challenges with on-farm studies include proper blocking and randomization of cows or pens to treatments. On the other hand, multiple farm studies are attractive as they facilitate a broader scope of inference on treatment effects across a wider range of management and/or climatic conditions and genetic backgrounds compared to single-site university studies. Furthermore, studies based on multiple farms or multiple pens within a single large farm can facilitate greater power for treatment comparisons on binary reproduction or health responses than can be achieved at a smaller research herd. Since quantitative geneticists have been analyzing commercial dairy data for decades, they have developed useful data analysis techniques that should be harnessed to facilitate even greater statistical scope and power for on-farm studies, such as accounting for genetic effects, stage of lactation, differences in variability across farms or management groups, and farm-specific covariates such as ambient temperature. Finally, multivariate ANOVA should be used to facilitate greater information recovery on treatment effects when analyzing several different but correlated response variables of interest.

Key Words: Experimental Design, Experimental Unit, Scope of Inference

223 Examples of experimental designs to study production responses. N. R. St-Pierre*, *The Ohio State University, Columbus.*

There are increasing opportunities to conduct field research in commercial herds where cows are invariably grouped in pens. Dedicated research facilities are best suited for determining mechanisms of treatment effects. Field studies on commercial farms are better suited for quantifying the magnitude of the response to dietary treatments over a broader range of environments. In nutrition field experiments, the experimental unit is generally the pen, while cows serve as sampling units. Among the many types of designs available for field studies, the best one depends on many factors, including what production trait is of primary importance. Generally, cows require 6 to 10 weeks to fully express a milk yield response to dietary treatments. This often forces the use of longitudinal designs where pens remain on their assigned treatments throughout the trial. Milk fat and protein contents and yields generally show much quicker responses, typically 2 to 4 wk. When these are the traits of importance, a vast array of rotation designs can

be used with considerably more power. With longitudinal designs the use of an appropriate covariate on the sampling units (cows) generally doubles the efficiency of the experiment. Rotation designs such as the cross-over, Latin square, switchback, and double cross-over estimate treatment effects within the experimental units (pens). This generally results in considerably more power than longitudinal designs of similar size. The optimum pen size is dependent on the variation between pens (V_p) and the variation between cows (V_s). As long as all cows in a pen are participating in the experiment, the variance due to competition is not a factor in determining the optimal pen size. In this instance, $V(Y) = V_p + (V_s/k)$, where k is the number of cows per pen. Estimates of these variances in combination with the cost per cow and the cost per pen can then be used to calculate an optimal pen size. A uniformity trial can be conducted to estimate the variance components. Numerous examples with the appropriate SAS code will be presented.

Key Words: Field Trials, Statistics, Experimental Designs

224 Field studies to study reproduction in dairy cows. J. D. Ferguson*, *University of Pennsylvania, Kennett Square.*

Due to limited power to detect differences within university herds, it is attractive to do reproductive trials on dairy farms. Benefits include the potential to examine effects across multiple locations and diverse management systems. Field trials may examine treatment effects on cattle health which may impact on fertility, management interventions to control reproductive efficiency, and specific therapies to alter reproductive function in cows. Outcomes may comprise effects on uterine involution and endometritis, days to first ovulation, conception rate(s), pregnancy rate and overall reproductive performance, estrus expression, and pregnancy wastage. Categorical data analysis and event time models would be most appropriate to analyze reproductive data. An advantage of field studies is the ability to enroll large numbers of cows in trials; a disadvantage is the loss of control of experimental conditions. Therefore study designs need to control for extraneous variables by collecting data on potential confounders, which may have limitations based on the herd management and cost to collect it. Study designs may include split herd, random assignment of cows to treatment groups, blocked by age and season of calving. A challenge with split herd designs is ensuring similar management of each treatment group and blinding management to treatment. Alternatively, cows may be matched within herd and followed in a prospective, longitudinal trial. Herds may be matched and treatment assigned to one herd and the alternative herd untreated to act as a control. This would be an attractive approach to examine management interventions to alter reproductive performance. Challenges in field trials include ensuring herd compliance with treatment assignments, control of selective management of treatment groups, and loss of meticulousness in control of extraneous variables through study design. Studies need to be larger and more information collected on each cow to control for confounding variables.

Key Words: Field Studies, Dairy Cows, Reproduction

225 Examples of designs to study health responses and the role of meta-analysis. I. J. Lean*¹, A. R. Rabiee¹, and T. F. Duffield², ¹*Bovine Research Australasia, Camden, NSW, Australia*, ²*University of Guelph, Guelph, Ontario, Canada*.

Many diseases are infrequent, rare, or sporadic in incidence, are often poorly defined and pose particular challenges in study design. The best forms of evidence are randomized controlled trials which need many cattle to study effects of interventions on infrequent health disorders. Studies conducted across several farms are more robust and have greater external validity. Other study designs that have been effective in increasing knowledge of disease include prospective cohort and case-control studies. Studies need to account for effects of time in assessing causality. Studies that evaluate surrogate measures of health such as serum chemistry and rumen parameters are helpful in understanding an intervention. These are easier to conduct but cannot be used solely to predict impacts on health.

A powerful tool for evaluating disease is meta-analysis; a formal study design used to provide a synthesis of previous studies. Typically, but not necessarily, randomised clinical trials are used to provide data. Outcomes include a more precise estimate of the effect of a treatment or risk factor on disease. Identifying sources of heterogeneity and determining the generalizability of responses can lead to more effective treatment or modification of management to prevent disease. The pooling of numerous studies allows sample size to be increased and potentially allows the effects of environment, including nutrition, on treatment responses to be evaluated. Recent examples include milk fever risk, disease and monensin treatment and impact of reproductive treatments. Despite a relatively low number of cattle used per trial, publication of disease information from physiological studies will help to evaluate the impact of interventions on health in future meta-analyses.

Key Words: Study Design, Health, Meta-Analysis

226 Collecting research data with dairy management software. L. Jones*, *FARME Institute, Inc, Homer, NY*.

Central to managing a modern dairy farm is an on-farm dairy management database system (on-farm system). Data relating to animal identification and performance are recorded and integrated to provide management information for the dairy farm manager. Data may include real-time milk production, milk quality, reproduction, health information, and general descriptive statistics. These on-farm systems are designed first and foremost to support managerial decisions and not as research data collection tools. Nonetheless, under certain circumstances, they can be used to collect research data. Paramount to collecting research data with on-farm systems is an appropriate experimental design. For a small scale trial, there are three prerequisites to a valid data collection project. First, the trial must be blind. Producer actions and decisions are inherently biased, and knowledge of treatments may result in biased management and biased results. Second, all data required from the producer should be entered through the on-farm system as part of the general course of herd management. Relying on the producer for supplemental data is problematic and unreliable. Third, the researcher must understand generally how data are handled by the specific on-farm system and how the individual producer defines variables on their farm. Variables with the same name can have completely different definitions between farms. The major on-farm systems have the ability to export data in a format that can be utilized by statistical analysis systems. A common feature of on-farm systems is the practical limitation of the number of events that can be recorded for each animal. Some systems have an audit feature which records variables changes, but this is not a common requirement for herd management. Prior to initiating a research trial, the historical records from the on-farm system should be exported and analyzed to ensure they support the experimental design employed. Large scale trials can be performed when the only data of interest are predefined by the on-farm system and the interpretation is unambiguous (e.g., sire identification).

Key Words: On-Farm Systems, On-Farm Research

Symposium: Small Ruminant: The U.S. Goat Meat Industry and Recent Sheep and Goat Activities at the National Research Council of The National Academies

227 Goat meat production, processing, and marketing in the U.S. K. W. McMillin*, *Louisiana State University Agricultural Center, Baton Rouge.*

The goat meat industry is the fastest growing segment of the U.S. livestock industry. Numbers of all goats were 3,015,000 in January of 2008, with an increase of 4% to 2.5 million head of meat and other goats from the previous year. Drought and other conditions contributed to increased total goat slaughter of 828,000 in 2007 compared with 749,300 in 2006. The annual supply of goat meat available to American consumers from domestic and imported sources continues to increase, but the true demand by ethnic and non-ethnic consumers has not been accurately determined. Imports of goat meat, primarily from Australia as frozen carcasses, have increased by about 10% annually over the past decade, with increasing proportions of the goat meat in boxes as frozen primal pieces or cubes each year. Marketing of live goats is mainly through auctions and livestock traders, although direct on-farm and farmer market sales appear to be increasing. Kid goat carcasses have a dressing percentage of 42 to 52%, with the trotters and kidney and pelvic fat left in carcasses until fabrication. Lean yields of 50 to 70% of cold carcass weight depend upon carcass size, fatness, and amount of bone. A Meat Goat Selection, Carcass Evaluation & Fabrication Guide provides information on assigning selection classification conformation scores to live goats and goat carcasses, evaluating goat carcasses, and introducing fabrication procedures of goat carcasses. Goat meat and muscles can be processed with all of the normal unit processing and preservation operations used for the other meat species. However, more convenient or processed goat meat products, such as precooked or cured items, have not become common in wholesale or retail offerings of goat meat or goat meat products. Ethnic retail consumers are driving goat meat demand for raw chilled meat as cubes even though USDA Institutional Meat Purchase Specifications for Fresh Goat provide for consistent cutting, ordering, and merchandising of primal and retail cuts by institutional and retail meat buyers. Populations of the ethnic groups who are primary purchasers of goat meat have increased at more than twice the 5.3% total U.S. population growth since 2000.

Key Words: Goat, Meat, Processing

228 New NRC recommendations for energy and protein requirements of goats and sheep. B. W. Hess*, *University of Wyoming, Laramie.*

Expression of energy and protein values is one of the first items to consider when discussing new recommendations for energy and protein requirements of goats and sheep. The NE system was used for sheep whereas energy requirements of goats were expressed in terms of ME because NE is not as commonly used in evaluating feedstuffs and insufficient data are available on expressing NE requirements of goats. The metabolizable protein (MP) system was viewed as the most appropriate method of defining protein requirements. This system requires information on factors that influence microbial protein synthesis, the extent of ruminal outflow of intact feed protein, and intestinal digestibility of rumen undegraded protein. Whenever possible, databases of treatment mean observations were constructed from the literature to evaluate components of the Cornell Net Carbohydrate and Protein System for

sheep and the previous Sheep NRC. Although the independent evaluation revealed that one method was not appreciably superior to the other, the Cornell Net Carbohydrate and Protein System was used to describe energy and protein requirements of sheep because this method considers energy and protein requirements and supplies in concert and also includes assumptions allowing prediction of negative BW change. Recommendations for energy and protein requirements of goats were based primarily on a special issue published in the journal *Small Ruminant Research*. An independent evaluation of recommendations for energy and protein requirements of goats was not necessary because this was already conducted by authors of the special issue of *Small Ruminant Research*. Recommendations for energy and protein were felt most appropriate given the information available and interpretation possible when the new NRC was drafted. It was recognized that future research will lead to enhancement or substitution of current energy and protein expressions with more appropriate ones.

Key Words: Goats, Sheep, Energy and Protein Requirements

229 The Small Ruminant Nutrition System (SRNS) model for prediction of energy and protein requirements of goats and sheep. A. Cannas*¹, L. O. Tedeschi², A. S. Atzori¹, and D. G. Fox³, ¹*University of Sassari, Sassari, Sardinia, Italy*, ²*Texas A&M University, College Station*, ³*Cornell University, Ithaca, NY*.

In previous NRC publications, simple empirical equations have been used to estimate energy and protein requirements for sheep and goats. This approach has limited the number of variables that could be accounted for and their accuracy when applied over widely varying production situations. To address this problem, the 2007 NRC small ruminant committee decided to utilize recently developed models to predict site-specific nutrient requirements and supply for sheep. The nutrient requirement tables for sheep were based on the Cornell Net Carbohydrate and Protein System (CNCPS) for sheep, as published by Cannas et al. (2004). Recently, a submodel for goats was added to this model and the name was changed to the Small Ruminant Nutrition System (SRNS). The main goals pursued in its development were: (1) to use a mechanistic approach, (2) to integrate accumulated research knowledge published by different research groups, (3) to differentiate the equations used for different species and breed type only when justified by sound biological reasons, and (4) to integrate energy and protein requirements with a nutrient supply submodel. The main differences between the SRNS submodel for sheep and that for goats are: (1) the energy requirements for basal metabolism differ among genotypes and are higher in goats than in sheep; (2) sheep maintenance energy requirements are adjusted to account for the increase in the size of the visceral organs as energy intake increases, but this correction is not applied for goats; (3) body fat content composition and the energy cost of gain is higher in sheep than in goats; and (4) protein requirements for maintenance are higher in sheep than in goats due to the cost of wool production. Robust evaluations, performed with independent research data, indicated the SRNS accurately predicted the energy balance and live weight gains of sheep and goats.

Key Words: Sheep, Goats, Requirements

230 Historic trends in U.S. sheep production and prospects for the future. H. A. Glimp*, *University of Nevada, Reno.*

Sheep were an important component of the food and fiber chain in the early European settlements in the eastern U. S. With settlement of the west and improved transportation systems, the sheep population began migrating to the western U. S., peaking at 54 million sheep and lambs in 1884 and reaching an all-time high of 56 million in 1942. The industry then began declining, dropping to 30 million in 1940 and continuing to decline until some stability has occurred in recent years. Concurrent with the decline in sheep and lamb numbers has been a decline in wool production and the downstream marketing, processing, and support services for the sheep and wool industry. The National Academy of Sciences report analyzes the factors contributing to these historic trends, the current status of the industry, and identifies current challenges and opportunities for the future viability of the industry. Even though numbers have declined to critical levels to maintain a viable industry infrastructure, the report identifies new developments and opportunities for the future of lamb, wool and milk production through improved genetic, management and marketing strategies.

Key Words: Sheep, Production, Trends

231 Marketing of sheep products: situation, challenges, and opportunities. G. Williams*, *Texas A&M University, College Station.*

The U.S. sheep industry is composed of many allied industries linked together along a complex value chain anchored by sheep production

and extending to varied end use markets. Each of the major industries along the value chain (live sheep, dairy sheep, lamb, wool, and sheep by-products) faces unique demand conditions but also are all linked on the supply side of their markets to sheep production. Consequently, the fortunes of each industry are inextricably linked to one another and depend particularly on the economic health and prosperity of the sheep production enterprise. The dominant feature of sheep production in the United States and, thus, the focus of much producer and policy concern over the years, has been the steady decline in sheep and lamb inventories since the mid 1940s. In turn, the decline in sheep and lamb numbers has restricted supplies of sheep and lamb products to the allied industries and created difficulties in the flow of those products through a shrinking marketing system as producers have struggled to respond to market signals while maintaining profitability. Concerns about the future of the industry led to a Congressional request in 2006 to the National Academies to review the development and current status of the sheep industry in the United States and to examine challenges and opportunities for the future. The committee of industry experts charged with the review by the National Academies has been studying all sectors of the sheep and allied industries since early 2007. Although not ready for public release, the committee's report examines the production and marketing side of each segment of the sheep industry value chain and focuses particularly on the challenges and opportunities facing each segment. On the marketing side, the study considers the factors affecting the flow of live sheep, lamb, wool, dairy sheep products, and other sheep products along the chain to consumers and changes needed and in the offing to improve the profitability and competitiveness of the industry.

Key Words: Marketing, Sheep Products, Value Chain

ADSA-SAD (Student Affiliate Division) Undergraduate Competition: Original Research

232 Milk production, calving, and calf health in lines of dairy cattle selected for high versus low dairy form. M. B. Kron* and M. M. Schutz, *Purdue University, West Lafayette, IN.*

Dairy form (DF) comprises body condition and strength, with thinner, narrower cows assigned higher linear scores. Over time, DF has increased as a correlated response to selection for milk yield. Two selection lines of Holstein cows are being developed at Purdue University by mating cows to AI bulls with high (H) or low (L) Standardized Transmitting Abilities for DF. Resulting heifers are mated to sires from the same line to develop the divergent lines, HDF and LDF. This study's aim was to examine line effects on production and calving traits of first generation cows and health and growth of their second generation calves. For production and milk composition in first lactation, mixed models including year-season of calving, days in milk, line, and random sire effects did not reveal significant line differences, although LDF cows had a numeric advantage for all traits except milk yield. Heifers in LDF had numerically less dystocia, and significantly fewer cases of retained fetal membranes ($P < 0.001$). For second generation calves; birth weights, weekly heart girth, hip and wither heights, feed consumption, and scores for appearance, fecal consistency, and respiration, were recorded. The LDF calves had lower birth weights (40.6 ± 1.25 kg) compared to HDF (42.7 ± 1.11 kg) calves. Mean heart girths in wk 1 and 4 were 84.3 ± 1.10 cm and 90.7 ± 0.95 cm for LDF calves versus 83.3 ± 1.25 cm and 89.9 ± 0.38 cm for HDF calves, respectively. Calves in the LDF line averaged 81.3 ± 1.00 cm for hip height in wk 1, 76.8 ± 0.90 cm for wither height in wk 1, 81.9 ± 2.23 cm for hip height in wk 4, and 78.0 ± 0.73 cm for wither height in wk 4; while calves in the HDF line averaged 83.1 ± 1.10 cm, 79.3 ± 1.68 cm, 85.7 ± 0.73 cm and 80.0 ± 0.85 cm for the same traits, respectively. Scores for feed consumption, fecal consistency, general appearance, and respiration did not differ between LDF and HDF calves. Because of the preliminary nature of this study, numbers in each line were small. However, it does not appear that short term directional selection for low DF adversely affects cows or their calves.

Key Words: Dairy Form, Milk Yield, Calf Health

233 The effect of feeding high protein dried distillers grains on milk production. K. J. Hubbard*¹, A. M. Gehman¹, P. J. Kononoff¹, K. Karges², and M. L. Gibson², ¹*University of Nebraska, Lincoln*, ²*Dakota Gold Research Association, Sioux Falls, SD.*

The objectives of this study were to evaluate the effects of feeding a high protein dried distillers grains (HPDDGS) on milk production and components and dry matter intake. Concentration of CP, NDF, and ether extract of HPDDGS was 45.4 ± 0.09 %, 22.5 ± 0.16 %, and 4.0 ± 0.57 %. Ruminal DM digestibility of HPDDGS was evaluated *in situ* by incubating nylon bags containing 1.0 g of sample in the rumen of two steers for 48 h. Ruminal DM digestibility was observed to be 80.7 ± 3.6 %. Sixteen lactating Holstein cows (12 multiparous and 4 primiparous) averaging 80 ± 14 DIM were randomly assigned to one of two dietary treatments in a 2×2 crossover design. A portion of forage and all soy-based protein in the control diet was replaced by HPDDGS (20 % DM). Milk production and dry matter intake were recorded daily and averaged for d 15–21 of each 21-d period. Milk samples were collected on d 20–21 of each period. Milk yield increased ($P = 0.02$) with the

inclusion of HPDDGS (33.4 vs. 31.6 ± 2.11 kg/d), and 3.5% FCM was also higher ($P < 0.01$) for the HPDDGS ration (36.4 vs. 33.1 ± 2.21 kg/d). Percent protein was not affected by treatment (average 3.03 ± 0.08 %), but protein yield increased ($P = 0.01$) with inclusion of HPDDGS (0.95 to 1.00 ± 0.05 kg/d). Milk fat concentration was not different between treatments (average 3.97 ± 0.19 %), but fat yield increased ($P = 0.01$) for the HPDDGS ration (1.36 vs. 1.20 ± 0.08 kg/d). Dry matter intake tended ($P = 0.06$) to be lower for HPDDGS than control (21.2 vs. 22.6 ± 0.7 kg/d). Due to lower dry matter intake and greater milk production, feed conversion was improved ($P < 0.01$) by the addition of HPDDGS (1.47 to 1.73 ± 0.09). Milk urea N was greater ($P < 0.01$) for the HPDDGS ration than the control (14.6 vs. 12.8 ± 0.66 mg/dL). This research suggests the dairy rations may be formulated to contain up to 20% DM of HPDDGS and result in increased milk production and efficiency without negatively affecting milk components.

Key Words: Dairy Cow, High Protein Distillers Grains, Milk

234 The relationship between proinflammatory cytokines levels and onset of milk fever in dairy cows. E. A. Smith*, K. F. Knowlton, C. S. Petersson-Wolfe, I. K. Mullarky, and D. R. Winston, *Virginia Polytechnic Institute and State University, Blacksburg.*

Parturient paresis, or milk fever, is a common and debilitating disease that occurs at the onset of calving and results in paralysis and death if not properly treated. Current treatment protocols include administration of intravenous calcium (Ca). To date, there are few definite prevention strategies outside of altering cation-anion levels in the diet prior to parturition. Levels of parathyroid hormone (PTH) regulate Ca serum concentrations and may in part be responsible for the decrease in Ca associated with milk fever. Inflammatory mediators, such as tumor necrosis factor (TNF)- α have been shown to decrease secretion of PTH and thereby alter Ca levels at parturition. In order to identify a possible link between TNF levels and onset of milk fever, levels of TNF in animals diagnosed with milk fever as compared with control animals that did not exhibit milk fever symptoms were evaluated. Blood plasma TNF levels were measured by ELISA in samples collected at day -7, -3, -1, 0, 1, 3, and 5 relative to parturition. Results indicate lower levels of TNF- α in milk fever animals both prior to and following parturition as compared to animals without milk fever symptoms. TNF- α may be a regulator of blood Ca and an indicator of onset of milk fever at parturition. Ongoing studies will evaluate levels of PTH in milk fever animals and the mechanisms of TNF- α regulation of Ca homeostasis.

Key Words: Milk Fever, Cytokines, Calcium

235 Effects of a non-steroidal anti-inflammatory drug prior to dehorning on growth and physiological measures in calves. A. E. Smith*, A. L. Magliaro, J. R. Werner, and R. S. Kensingler, *The Pennsylvania State University, University Park.*

Dehorning of calves is a routine procedure in the dairy industry; dehorned cattle cause less harm to each other and are safer to handle. Producers are constantly trying to decrease stress in calves in order to improve growth and health while reducing costs. The objective of this

study was to determine whether treatment with Banamine (flunixin meglumine) prior to dehorning would affect growth rate and plasma haptoglobin and cortisol concentrations. Holstein heifer calves ($n = 52$, 40 ± 2.3 d old, 56.9 ± 4.9 kg) were blocked by age and randomly assigned to Banamine (B) or control (C) treatment groups. Calves in group B received 1.1 mg/kg of Banamine intravenously 15 min prior to dehorning. Calves in group C were dehorned without Banamine. All calves were dehorned using an electric hot iron dehorner with a mean contact time of 18.8 s per horn bud. Body weights were measured on d 0, 2, 7, and 14 relative to dehorning using an electronic scale with a weigh-average-hold function. Blood samples were collected on d 0, 2, and 7, and analyzed for hematocrit, plasma protein, haptoglobin, and cortisol. Data were analyzed using PROC MIXED within SAS. Calves exhibited good health, and mortality rate was 0 % during the study. Average daily gains from d 0 to d 2 were 0.68 and 0.52 kg for groups B and C, respectively, and were not affected by treatment ($SE = 0.08$, $P = 0.18$). Average daily gains from d 0 to d 7 for groups B and C were 0.69 and 0.68 kg, respectively, and were not affected by treatment. Mean haptoglobin concentrations were 33.0 and 22.9 $\mu\text{g/ml}$, and mean cortisol concentrations were 2.6 and 2.7 ng/ml for groups B and C, respectively. For all calves, mean hematocrit was 28.7 %, and mean plasma protein was 5.4 %. Blood and plasma measures were not significantly affected by treatment. Treatment with a single dose of Banamine alone 15 min prior to dehorning was not found to be beneficial to growth and did not reduce physiological measures of inflammation in 5-6 week old calves.

Key Words: Dehorning, Banamine, Haptoglobin

236 The effect of milk feeding method on cross-sucking behavior in pasture-based dairy calves fed once daily. K. A. Jackson* and S. P. Washburn, *North Carolina State University, Raleigh.*

Cross sucking among group-managed dairy calves increases concerns of udder malformation and mastitis due to irritation of the sucked area. We investigated whether pasture-raised dairy calves differed in cross-sucking activity when fed milk once daily in an open trough (Group 1, $n = 8$) compared to those allowed to suck from a barrel teat feeder (Group 2, $n = 8$). Calves of both genders were used and balanced across groups among Holsteins, Jerseys, and crossbreeds. Each group received one 30.5 L milk meal a day and had free-choice access to a calf starter and water on adjacent pasture paddocks. The hypothesis was that lack of sucking during eating might lead trough-fed calves to increased cross-sucking behavior. Calves were observed during 13 periods over 8 wk from the time they reached pasture until after weaning. Scan sampling using direct observation began upon delivery of milk and continued at 5-min intervals until 60 min after milk was fed. Additional observations were made during the same time post weaning. Data recorded by visual observation included general postures of calves (standing, lying head up, or lying head down) as well as specific activities such as, drinking or sucking milk, self-grooming, licking another calf, licking or nibbling on object, cross sucking, eating, or inactivity. The average number of observations per calf was 12.3 ± 0.02 per period. Incidence of cross sucking at and just after feeding time within the trough-fed group averaged 2.2 ± 0.4 , whereas the teat-fed group averaged only 0.15 ± 0.05 incidences of cross sucking. This behavior accounted for 18% of total activity for trough-fed calves and 1% of activity for teat-fed calves. In contrast, during post weaning the trough-fed group reduced cross-sucking behavior to 0.8 ± 0.3 incidences but the teat-fed average increased to 0.6 ± 0.3 incidences. Although trough-fed calves had higher cross-sucking behavior before weaning, occurrences of cross sucking

were similar for both trough-fed and teat-fed groups post weaning so long-term effects may be minimal.

Key Words: Calves, Cross-Sucking, Teat-Fed

237 Comparison of circulating progesterone and metabolic profiles in Holstein heifers and lactating cows. W. A. Smith*¹, D. H. Keisler², W. Silvia³, and L. E. Davis Rincker¹, ¹*Eastern Kentucky University, Richmond*, ²*University of Missouri, Columbia*, ³*University of Kentucky, Lexington.*

Reproductive efficiencies in lactating dairy cows have steadily declined during the last several decades while milk production has increased. In contrast, conception rates in dairy heifers have remained fairly constant. Declining fertility in lactating cows is likely due to a combination of genetics, management, and physiological factors. Our objective was to compare concentrations of circulating progesterone and metabolic hormones in one complete estrous cycle of heifers and lactating cows. Postpubertal, nonpregnant heifers ($n = 15$) and lactating, nonpregnant cows ($n = 15$; < 65 DIM) were synchronized using the following protocol: insertion of an intravaginal progesterone device (CIDRTM) with an injection of 100 μg GnRH (Factrel[®]) on d 0, an injection of PGF2 α (Lutalyse[®]) and removal of the device on d 7, and an injection of GnRH on d 9. Starting on d 10 of the synchronization protocol, 10 ml of blood were taken every other day for 24-d. All animals were scored for body condition and milk data was collected for cows. Statistical analysis used the GLM procedure of SAS. Body condition scores were different and averaged 3.19 and 2.37 for heifers and cows, respectively ($P < 0.01$). Progesterone and metabolic hormone analyses are ongoing. Correlations between factors measured for both heifers and cows will be performed to better understand the potential relationships between parameters.

Key Words: Fertility, Progesterone, Leptin

238 Evaluation of rumen microbial digestion of corn stover with cellulose treatment. B. Bosma*, R. Jimenez-Flores, and J. Howard, *California Polytechnic State University, San Luis Obispo.*

The bulk of feed consumed by dairy cattle is digested by microbes in the rumen. The efficiency of microbial digestion has a direct effect on rate and extent of cellulose breakdown from the diets they consume. Microbes begin the process of digestion by attaching to feed particles by secreting a sticky, mucous-like envelope onto the feed. Microbial cells then multiply to form colonies at the site of attachment and begin to release digestive enzymes, such as cellulase, which break down the feed. Previous research has indicated a milk cow ration treated with cellulase has increased the efficiency of cellulose digestion, therefore increasing milk production. For further research in this area, an in-vitro model system was developed in which dried corn stover in rumen fluid was inoculated with *Trichoderma reesei* cellulase and growth as related to CO₂ production was measured. The CO₂ production was doubled with the addition of 50 μL of cellulase and more than tripled with the addition of 500 μL of cellulase. The addition of *Trichoderma reesei* cellulase improved the fermentation profile of corn stover during in-vitro fermentation.

Key Words: Corn Stover, In Vitro Fermentation, *Trichoderma Reesei*

239 Change in the prevalence of mastitis pathogens in an organic dairy farm as it transitioned from a conventional dairy farm. W. M. McMahan* and L. K. Larry, *Washington State University, Pullman.*

The objectives were to collect aseptic composite milk samples from all cows before (Phase I), during (Phase II), and after (Phase III) the transition to organic status on two dairies and to culture milk samples for isolation of mastitis pathogens. Cows enrolled were those at parturition, dry off, and clinical mastitis. During Phase I antibiotics were used in dry cow therapy and were eliminated in Phases II and, III. Staphylococcus species mastitis increased at parturition samples from 31% Phase I, 35%

Phase II, and 49% in phase III. At parturition prevalence of Streptococcus species was 8% in Phase I and 23% in Phase III. The prevalence of Streptococcus species at dry off changed from 6% in Phase I to 4% in Phase III. The prevalence of cows without mastitis pathogens at parturition was 53 percent in Phase I, 39 percent Phase II, and 30 percent Phase III, indicating mastitis at parturition had increased over time in the transition to organic. The data also show that the number of cows without mastitis pathogens is 60% at dry off in all three phases. Data suggests cows under organic management freshen with more mastitis but that the increased prevalence subsides such that at dry off the prevalence is very similar to that of the conventionally managed cows.

Wednesday, July 9, 2008

POSTER PRESENTATIONS

Animal Health: Immunology

W1 Absorption of total immunoglobulin G in dairy calves fed a colostrum replacement. J. A. Elizondo-Salazar*¹, R. F. Leuer¹, J. M. Campbell², and A. J. Heinrichs¹, ¹*The Pennsylvania State University, University Park*, ²*APC, Inc., Ankeny, IA*.

Proper colostrum management is an important step in preventing disease in neonatal calves, but failure of passive transfer of immunity is still a problem in the US dairy industry. It is generally considered that transfer of passive immunity is adequate if serum IgG concentration is > 10 g/L in colostrum-fed calves. Colostrum replacers providing ≤ 125 g of globulin protein have increased in popularity and are designed to be an alternative to colostrum. However, it is important to make sure these products are effective and are capable of providing adequate serum Ig concentrations. The objective of this study was to evaluate the effect of a commercially available serum-based colostrum replacement product on serum total IgG concentration. The study included 28 Holstein calves (14 males and 14 females) from a single dairy. Calves were bottle fed a single package of colostrum replacer (125 g IgG; Acquire, APC, Inc.) mixed in 2 L of warm water. After colostrum replacer feeding, calves were fed whole milk for the second and third feeding at 10% of birth weight daily in 2 feedings. Blood samples from all calves were collected at 24 h after birth and analyzed for total IgG concentration using single radial immunodiffusion. Overall, plasma IgG levels were 10.8 ± 2.4 g/L and indicated successful passive transfer of immunity. There were no significant differences in serum IgG levels attributable to gender (females: 10.3 ± 2.1 g/L; males: 11.1 ± 2.6 g/L), birth weight (> 41.5 kg: 11.1 ± 2.5 g/L; < 41.5 kg: 10.1 ± 2.4 g/L), age at first feeding (> 60 min: 11.4 ± 3.0 g/L; < 60 min: 10.3 ± 2.0 g/L), or time of d at first feeding (a.m.: 11.3 ± 2.7 g/L; p.m.: 10.0 ± 1.9 g/L). Results indicate that the colostrum replacer evaluated in this study provided adequate IgG concentrations for newborn calves when fed according to label directions and thus can be considered an effective alternative to colostrum in dairy calves.

Key Words: Colostrum Replacer, Dairy Calf, Immunoglobulin G

W2 Feeding heat-treated colostrum does not affect growth parameters in pre-weaned heifer calves. J. A. Elizondo-Salazar*, R. F. Leuer, and A. J. Heinrichs, *The Pennsylvania State University, University Park*.

Colostrum not only provides nutrients and passive immunity for the newborn calf, but it can also have profound effects on their development. Heat-treatment of colostrum reduces IgG concentrations yet increases IgG absorption, but effects on short- and long-term calf performance are unknown. For this reason, a study was conducted to evaluate effects of feeding heat-treated colostrum on calf growth. First milking colostrum with > 50 g IgG/L (measured by colostrometer) was collected from Holstein cows and frozen at -20°C until a total of 106 L were accumulated. Once collected, colostrum was thawed at 4°C and pooled in a commercial batch pasteurizer to create a uniform batch. Colostrum was mixed at 4°C for about 20 min. 53 L of colostrum were transferred to 1.89 L containers and frozen at -20°C until feeding. The remaining 53 L were heated at 60°C for 30 min, transferred to 1.89 L containers, and then frozen at -20°C until feeding. A total of 28 calves weighing ≥ 35 kg at birth were systematically enrolled into 1 of the 2 treatment groups. Calves were separated from their dams at birth before suckling occurred. For the first feeding, 3.8 L of colostrum were bottle fed by 1 to 2 h of age. To ensure that all calves received an equal amount of colostrum, an esophageal feeder was used in calves with reduced appetite. For the second and third feeding, pasteurized whole milk was fed at 5% of birth BW. Subsequently, calves were fed milk replacer (20% CP, 20% fat) at 10% of birth BW in 2 daily feedings until week 5. Growth measures including heart girth, hip height, BW, and withers height were taken at birth and weekly 4 h post a.m. feeding. Total serum protein at 24 h of age was 5.6 and 5.5 g/L for the heated and unheated colostrum, respectively. No differences were detected between treatment groups for any of the variables. Weight at 2, 4 and 6 wks of age was 191.0, 235.6, and 288.2 kg for calves receiving heat-treated colostrum and 196.7, 242.9, and 297.8 kg for calves receiving untreated colostrum. The results of this study indicate that feeding heat-treated colostrum did not negatively impact growth in pre-weaned heifer calves.

Key Words: Colostrum, Growth, Heifer Calves

W3 The use of a mini-batch pasteurizer is a suitable system for small farms. J. A. Elizondo-Salazar*, R. F. Leuer, B. M. Jayarao, and A. J. Heinrichs, *The Pennsylvania State University, University Park*.

The adoption of commercial on-farm pasteurization systems for the purpose of pasteurizing non-saleable milk and colostrum has resulted

in significant health and economic benefits for calves and producers, respectively. However, these systems are expensive and not suitable for small farms. With this in mind, a Mini-Batch Colostrum/Milk pasteurizer is available in the market and we wanted to determine its performance on different liquid calf feeds. A 3 × 2 factorial design with 3 replicates was used. Three different liquid feeds (first milking colostrum, transition milk, and waste milk) at 2 different volume levels (full capacity = 12 L and half capacity = 6 L) were pasteurized at 63°C for 30 min. 10 mL samples were taken before and after pasteurization and frozen to -20°C. All samples were thawed at 4°C and evaluated for standard plate count (SPC), coagulase-negative staphylococci (CNS) count, environmental streptococci (ES) count, coliform (CC) count, gram-negative noncoliform (NC) count, *Streptococcus agalactiae* (SAG) count, and *Staphylococcus aureus* (SA) count. Total IgG levels were determined in all colostrum samples using radial immunodiffusion. Viscosity was also measured using a digital viscometer. The mini-batch pasteurizer effectively reduced SPC, CC, NC, ES, CNS, and SA ($P < 0.01$). However, pasteurization denatured IgG ($P < 0.01$) and increased the viscosity in colostrum samples. The effects were greater when small batches were used. The findings of the study suggest that a mini-batch pasteurizer can be used as an on-farm pasteurization system to effectively pasteurize transition milk and waste milk. However, for colostrum only full batches should be used and a lower temperature could help reduce the denaturing of immunoglobulins.

Table 1.

Liquid feed	Period	SPC (CFU/mL)	CC (CFU/mL)	Viscosity (Pa•s)	Total IgG (g/L)
Colostrum Full	Pre	215,444 ^a	200,000 ^a	0.464 ^a	123.1 ^a
Colostrum Full	Post	115 ^b	0 ^b	4.642 ^b	96.3 ^b
Colostrum Half	Pre	200,000 ^a	175,000 ^a	0.215 ^a	119.2 ^a
Colostrum Half	Post	54 ^b	10 ^b	100.000 ^b	45.2 ^b
Transition Full	Pre	1,841 ^a	120 ^a	0.022	—
Transition Full	Post	4 ^b	0 ^b	0.022	—
Transition Half	Pre	53,133 ^a	62,145 ^a	0.046	—
Transition Half	Post	9 ^b	0 ^b	0.046	—
Waste Full	Pre	45,788 ^a	642 ^a	0.022	—
Waste Full	Post	3 ^b	0 ^b	0.022	—
Waste Half	Pre	6,240 ^a	71 ^a	0.010	—
Waste Half	Post	3 ^b	0 ^b	0.010	—

$P < 0.01$

Key Words: Pasteurization, Immunoglobulin, Liquid Calf Feeds

W4 Animal performance and blood gas variables of steers pulled and/or treated for Bovine Respiratory Disease. K. M. Bischoff*, L. Carlos-Valdez, B. P. Holland, L. O. Burciaga-Robles, D. L. Step, and C. R. Krehbiel, *Oklahoma State University, Stillwater.*

Bovine Respiratory Disease (BRD) is the most economically important disease in cattle. The objective was to characterize performance, blood gases and metabolites of high-risk steers diagnosed with BRD. Steers were evaluated daily for clinical signs associated with BRD (depression, appetite, respiratory stress, and temperature). Steers identified as morbid were assigned a depression score (1=mild to 4=moribund) and pulled to a processing facility where rectal temperature and BW were recorded. Two blood samples were collected; one for blood gas and the second for serum haptoglobin analysis. If a steer had a rectal temperature greater than 40°C, an antimicrobial was administered. If a steer did not meet the

rectal temperature criteria, no antimicrobial was administered unless the animal had a depression score of 3 or 4. During the first 21 d, a total of 89 out of 240 steers were enrolled in the study. For data analysis, steers were grouped based on whether they were pulled but not administered an antimicrobial (PULL), or had received one (TX1), two (TX2), or three (TX3) antimicrobial treatments. From the 89 animals enrolled, there were 19 PULL, 23 TX1, 29 TX2, and 17 TX3. Depression scores were lower ($P < 0.001$) for PULL compared with TX1, TX2 and TX3. Arrival BW was greatest ($P = 0.005$) for PULL and TX1, intermediate for TX3, and lowest for TX2. Average daily gain tended ($P = 0.09$) to be greatest for PULL steers. Rectal temperature was lowest ($P < 0.001$) for PULL as fever ($> 40^\circ\text{C}$) was prerequisite for the remaining groups. Haptoglobin concentration at arrival was not different ($P = 0.57$) among treatments. Blood variables including pH, pO₂, glucose, lactate, hematocrit, sodium, and SO₂ were not affected ($P > 0.10$) due to number of antimicrobials administered. Calcium concentrations were lowest ($P = 0.02$) for PULL, intermediate for TX1 and TX2, and greatest for TX3. In addition, K was greater ($P < 0.001$) for TX1 vs. PULL; TX2 and TX3 were intermediate. Bicarbonate and pCO₂ were lower ($P < 0.03$) in TX1 and TX2 steers. Our results suggest that some blood gases and metabolites are altered by BRD, and may be useful indicators of disease.

Key Words: Blood Gas, Bovine Respiratory Disease, Cattle

W5 Relationship between total microbial colostrum contamination and IgG absorption in newborn dairy calves. M. Terre*¹ and A. Bach^{1,2}, ¹IRTA-Unitat de Remugants, Barcelona, Spain, ²ICREA, Barcelona, Spain.

Fifteen newborn Holstein calves (41.2 ± 6.15 kg BW) from 5 different farms were used to study the relationship between colostrum microbial contamination and IgG absorption 6 h after colostrum consumption. Furthermore, colostrum bacteria contamination from the udder to different colostrum containers was also studied. Within 5 h after each calf birth, an initial blood sample was obtained before colostrum was fed, and calves were weighed to estimate plasma volume concentration (assuming plasma represented 8% BW). After that, a first-milking colostrum sample was collected directly from the udder. Then, a second colostrum sample was obtained from the milking bucket, and a third sample was taken from the bucket or teat-feeder where calves were fed to perform total bacterial counts in Nutrient Agar plates and total Enterobacteria counts in MacConkey Agar plates. Then, 1.7 ± 0.64 L of colostrum were fed to calves, and 6 h after the first colostrum consumption another blood sample was harvested. Colostrum IgG concentration from the third colostrum sample, and serum IgG concentration at 0 and 6 h after the colostrum was fed were determined to calculate IgG absorption 6 h after the first colostrum consumption. Total bacteria and Enterobacteria counts increased ($P < 0.001$) from the udder to the milking bucket (from 3.66 to 5.39 ± 0.209 log total bacteria counts, and from 2.45 to 4.69 ± 0.231 log total Enterobacteria counts), but they did not increase from the milking bucket to calf bucket. Furthermore, a negative relationship was observed between log total bacteria counts in colostrum from calf buckets and IgG absorption 6 h after colostrum was fed ($R^2 = 0.26$; $P = 0.05$). However, there was no relationship between log total Enterobacteria counts and IgG absorption 6 h after colostrum consumption. Although there exist many factors that affect IgG absorption (time elapsed from birth to colostrum consumption, IgG colostrum quality) keeping colostrum with low bacteria contamination may help to improve IgG absorption and calf health.

Key Words: Calves, Colostrum, IgG Absorption

W6 Comparison of growth, feed intake, and feed efficiency of female calves fed aureomycin plus lasalocid or monensin. G. E. Higginbotham*¹, R. C. Chebel², and L. Pereira³, ¹University of California, Fresno, ²University of California-Davis, Tulare, ³California State University, Fresno.

Objectives were to evaluate growth, feed intake, and feed efficiency of female Holstein calves fed aureomycin and lasalocid (AL) compared to those fed monensin (M). Holstein female calves from a commercial dairy herd located in the central valley of California were enrolled in the study within 12 h after birth. At enrollment, blood was sampled for evaluation of concentration of total proteins and calves were weighed and allotted randomly into 1 of 2 treatments: monensin (M) or aureomycin plus lasalocid (A+L). Feed supplements were mixed into their respective grain starters to provide 60 g/T of monensin and 350 g/T of aureomycin and 60g/T of lasalocid for M and A+L treatments, respectively. During the first 3 wk of life, calves were fed reconstituted commercial non-medicated milk replacer. After 3 wk of age, calves were fed pasteurized waste milk in addition to or as a replacement for milk replacer. From birth to 12 wk of age, calf starter was fed once daily and no hay was offered, feed intake was measured and feces were scored for its consistency (1 = firm, 2 = soft, 3 = runny) daily, and calves were weighed weekly. Feed analysis demonstrated that the amounts of monensin, aureomycin and lasalocid added to the grain starters were actually 44.2, 222.8, and 42.7g/T, respectively. Treatment did not affect average daily weight gain (M = 0.66 ± 0.03, A+L = 0.68 ± 0.03 kg/d; P = 0.59) or average body weight (M = 60.20 ± 0.90, A+L = 60.38 ± 0.92 kg; P = 0.88) during the study. Similarly, there was no effect of treatment on grain intake (M = 648.2 ± 0.04, A+L = 663.4 ± 0.04 g/d; P = 0.79) or feed efficiency (M = 0.76 ± 0.06, A+L = 0.72 ± 0.06; P = 0.49). Fecal score during the study period also was not affected (P = 0.25) by treatment (M = 1.73 ± 0.04, A+L = 1.66 ± 0.04). Treatment did not affect the proportion of calves diagnosed with at least one event of diarrhea (M = 79.5, A+L = 65.0%; P = 0.16) or pneumonia (M = 30.8, A+L = 25.0%; P = 0.53). Supplementation with aureomycin and lasalocid did not improve performance of calves compared to those supplemented with monensin.

Key Words: Calves, Aureomycin, Lasalocid

W7 An international survey on the occurrence of mycotoxins in dried distillers grains with solubles (DDGS). U. Hofstetter*¹ and E. Pichler², ¹Biomim GmbH, Herzogenburg, Austria, ²Quantas Analytics GmbH, Tulln, Austria.

Bioethanol production is booming especially in North America. The inclusion of the resulting by-product DDGS – dried distillers grains with solubles – is becoming popular in the global raw material market. However the mycotoxin menace is not eliminated by the fermentation processes during ethanol production. Mycotoxins are toxic metabolites formed by fungi species that colonize crops and thus pose a potential threat to animal health. Mycotoxin contamination of crops may cause economic losses at all levels of food and feed production. Raw material contamination is augmented during the bioethanol production. This study was initiated to provide customers insights in the occurrence of mycotoxins in DDGS samples worldwide thereby enabling better feed management. A total number of 191 samples were analyzed for the major mycotoxins of interest (aflatoxins, zearalenone, deoxynivalenol or vomitoxin, T-2 toxin and fumonisins). The tests have been conducted by Quantas Analytics, Austria, and Romer Labs, Singapore. Aflatoxins, ZON and total FUM were analyzed by HPLC (High Pressure Liquid

Chromatography) whereas DON values were obtained by TLC (Thin Layer Chromatography). From all samples analyzed, zearalenone accounted for a 87% contamination rate; 70% of tested DDGS were positive for vomitoxin and 88% for fumonisins. The presence of so-called field mycotoxins (ZON, DON, FUM) produced by different *Fusarium* sp. which – despite Good Agricultural Practice – cannot be avoided totally is very frequent. Almost no aflatoxins and T-2 toxin were found in the DDGS samples collected. Only 13% of the samples were positive for aflatoxin with an average contamination level of 1 µg/kg and only 12% for T-2 toxin with an average contamination level of 11 µg/kg. 96% were tested positive for at least one mycotoxin whereas only 8 samples (4%) of the analyzed DDGS didn't show mycotoxin levels above the detection limit. More interesting was the fact that 97% of the positive samples have shown a co-occurrence of 2 or more mycotoxins. This study confirmed previous literature stating the high levels of mycotoxins in distillers grains.

Table 1. Occurrence of mycotoxins in a total number of 191 DDGS samples

	AfB1	ZON	DON	FUM	T-2
% positive	13	87	70	88	12
Avg. level [µg/kg]	1	208	1504	767	11
Max. level [µg/kg]	89	8107	12000	9042	226

Key Words: DDGS, Mycotoxins

W8 Incubation temperatures affect secretion of TNF-alpha and IL-6 by peripheral blood mononuclear cells from Brown and Holstein cows. N. Lacetera*¹, M. Amadori², U. Bernabucci¹, and A. Nardone¹, ¹Dipartimento di Produzioni Animali, Viterbo, Italy, ²Istituto Zooprofilattico Sperimentale Lombardia-Emilia Romagna, Brescia, Italy.

This study aimed at evaluating spontaneous and concanavalin A (ConA)-stimulated secretion of tumor necrosis factor alpha (TNF-alpha) and interleukin 6 (IL-6) by peripheral blood mononuclear cells (PBMC) from Brown (Br) and Holstein (Ho) cows exposed to different treatments (T). PBMC from 7 Br and 7 Ho cows were alternatively subjected to each of the following T: T39) 39°C continuous, T40) 40°C for 39 h and 39°C for 26 h, T41) 41°C for 39 h and 39°C for 26 h, T42) 42°C for 39 h and 39°C for 26 h, and T43) 43°C for 39 h and 39°C for 26 h. Under T40, 41, 42 and 43, three 13 h cycles at 40, 41, 42 or 43°C were alternated with two 13 h cycles at 39°C. T39 mimicked normothermia; T40, 41, 42 and 43 mimicked conditions of hyperthermia alternated with normothermia, which may occur in dairy cows in hot seasons. TNF- alpha and IL-6 were evaluated in supernatants collected at the end of the incubation period by MTT biological assays on WEHI164 and 7TD1 cells, respectively. In both breeds, compared to T39, cultivation of PBMC under T40, 41, 42 and 43 reduced both spontaneous and ConA-stimulated secretion of TNF-alpha. Furthermore, spontaneous secretion of TNF-alpha under T39, was higher in Ho compared to Br cows. In both breeds, IL-6 tended to be higher in PBMC cultured under T40, 41 and 42 compared to T39. Only in Ho cows, IL-6 secretion was reduced in PBMC cultured under T43 compared to T39. Finally, under T39, secretion of IL-6 in ConA-stimulated PBMC was higher in Ho compared to Br cows. Differential regulation of proinflammatory cytokines has been already reported for mammalian cells exposed to stimuli other than temperature. Changes of both TNF-alpha and IL-6 reported

herein may be conducive to a successful adaptation to the perturbation caused by high temperatures. Different responses of the two breeds to temperatures simulating normothermia may reflect differences of the steady state endogenous inflammatory response associated with different levels of production stress.

Key Words: Temperature, Peripheral Blood Mononuclear Cells, Cytokines

W9 Association of tumor necrosis factor- α (*TNF- α*) gene promoter polymorphisms with *TNF- α* response to endotoxin (LPS) in calves. S. Kahl*, M. Proszkowiec-Weglarz, E. E. Connor, and T. H. Elsasser, *USDA, Agricultural Research Service, Beltsville, MD, USA.*

Attenuation of *TNF- α* gene expression is a NF- κ B-mediated regulatory process essential to avoid deleterious effects of excessive or prolonged synthesis of *TNF- α* , especially in response to gram-negative bacterial infection or LPS. An uncommon G to A transition polymorphism in the promoter region of *TNF- α* gene (designated the *TNF- α 2* allele) was shown to be highly associated with excessive *TNF- α* production and *TNF- α* -mediated pathologies in humans. We performed a preliminary survey to determine if similar polymorphisms exist in Angus \times Hereford calves that might suggest a potential for particular animals to have excessive *TNF- α* responses to LPS challenges. A 574-bp *TNF- α* gene promoter fragment was generated by PCR from bovine genomic DNA and evaluated by bi-directional automated fluorescent sequencing. Two linked single nucleotide polymorphisms were located between NF- κ B binding sites at positions -701 (C/T) and -526 (A/G). Calves ($n=17$; 279 \pm 10 kg) were assigned to groups by genotype (4 TT-AA, 5 CT-AG, 8 CC-GG), fed a TMR diet (15% CP) to appetite, and challenged with two consecutive LPS injections 4 d apart (LPS1, LPS2; 0.2 μ g *E. coli* 055:B5/kg BW, i.v.). Jugular blood samples were obtained at 0, 1, 2, and 4 h relative to each LPS injection. Plasma *TNF- α* was measured by RIA and *TNF- α* response was calculated as area under the time \times concentration curve (AUC; ng/mL \times h). After LPS1, mean *TNF- α* responses were greater in TT-AA than CT-AG and CC-GG calves (4.9, 2.2, and 3.0, respectively; $P < 0.05$). While for each calf the *TNF- α* response to LPS2 was numerically lower than that calculated for LPS1 (indicating LPS tolerance attenuation was achieved), mean *TNF- α* responses to LPS2 were still greater in TT-AA than CT-AG and CC-GG calves (3.3, 1.0, and 1.1, respectively; $P < 0.01$). The magnitude of the attenuation was less in TT-AA than in CC-GG calves ($P < 0.05$). The results suggest that polymorphisms in the *TNF- α* gene promoter may play a role in the intensity of the *TNF- α* response to proinflammatory stimuli in cattle.

Key Words: Cattle, SNP, Tumor Necrosis Factor- α

W10 Efficacy of a polyclonal antibody preparation against respiratory disease pathogens on cattle morbidity and performance during the step-up period. C. R. Dahlen*, N. DiLorenzo, and A. DiCostanzo, *University of Minnesota, St. Paul.*

A polyclonal antibody preparation (PAP) against respiratory pathogens including *Mycoplasma bovis*, *Haemophilus*, *Pasteurella multocida* and *Mannheimia haemolytica* reduced morbidity and mortality during the first 32 d on feed in lightweight, high morbidity (212 kg and 29%, respectively) calves. However, it is not known whether PAP reduces morbidity in heavier, lower risk ($> 15\%$ morbidity) calves, or its effects

on intake and gains during the step-up period. Thus, the current study was designed to determine the efficacy of PAP in heavier, lower risk calves. One hundred thirty six Angus and Angus crossbred steer calves (276 kg) were randomly assigned to one of two treatments (Control or intranasal dosing 1.5 mL PAP/nostril on arrival and 7 d later) on arrival at the NWROC research feedlot. Within treatment, calves were then allocated (9 or 10/pen) to one of each of 12 pens for a 27-d diet step-up period. On arrival, at d 7 and 27, rectal temperatures were measured. Calves were considered morbid if rectal temperature recorded $> 39.7^{\circ}\text{C}$. Body weights, pen and intakes were measured from d 7 to d 27 of the step-up period. Dosing cattle on arrival and 7 d later with PAP reduced ($P = 0.01$) morbidity (5% vs 14%) detected 7 post-arrival. Rectal temperatures did not differ on arrival or at day 27 (38.8 vs 38.9 $^{\circ}\text{C}$ and 38.6 vs 38.7 $^{\circ}\text{C}$ for Control and PAP, respectively). At day 7 rectal temperatures were lower ($P < 0.05$) for cattle dosed with PAP (39.0 vs 38.8 $^{\circ}\text{C}$ for control and PAP, respectively). No effects ($P > 0.10$) of PAP dosing were observed on DMI, ADG or feed conversion during the step-up period. A reduction in morbidity of 9 percentage units represents economic savings in medication and labor costs.

Key Words: Antibodies, Health, Cattle

W11 Effect of rubber flooring on leukocyte activation during the periparturient period. K. O'Driscoll^{1,2}, M. M. Schutz³, and S. D. Eicher^{*4}, ¹Teagasc, Fermoy, Ireland, ²NUI Dublin, Dublin, Ireland, ³Purdue University, West Lafayette, IN, ⁴USDA-ARS, West Lafayette, IN.

This study aimed to evaluate the effect of 2 dairy cow housing systems on innate immune status during the peri-parturient period. Leukocyte counts, phagocytic ability and neutrophil and monocyte differentiation were examined. Cows were assigned to free-stall housing with either rubber (RUB; $n=13$) or concrete (CON; $n=14$) at the feed-face immediately after their first calving, and managed on this system during all subsequent lactations. Between lactations cows remained in a straw bedded-pack dry cow pen. A year-round calving system was utilized. Cows entered the experiment at the end of either their 1st ($n=16$) or 2nd ($n=11$) lactations. Blood samples were obtained approximately -60, -30, 0, +7 and +14 d relative to calving. Differential leukocyte counts were obtained using an automated cell counter. Phagocytic activity, and cells positive for CD14 and CD18 expression were measured by flow cytometry using labelled micro-beads and antibodies. Treatment effects were determined using repeated measures ANOVA. An interaction of treatment and d ($P < 0.05$) on neutrophil and lymphocyte counts ($P < 0.05$) was found. RUB cows had higher neutrophil and lower lymphocyte numbers post calving than CON. Neutrophil to lymphocyte ratio tended ($P = 0.1$) to be higher for RUB than CON cows post calving. There was no effect of treatment on phagocytosis or percentage of cells positive for CD14 or CD18. However, d tended ($P = 0.1$) to have an effect on phagocytic events, with the highest value at d -60. Cells positive for CD14 were greatest on d 0 ($P < 0.05$), and a treatment by d effect was found for cells positive for CD14. CD14 percentages were greater for RUB than CON cows post calving. A high neutrophil to lymphocyte ratio is associated with physiological stress, but suppressed leukocyte function is associated with peri-parturient period. Thus, the ability of RUB cows to activate neutrophils and monocytes is indicative of an improved immune response.

Key Words: Rubber Flooring, Cow Locomotion, Innate Immune Activation

W12 Functional evaluation of polymorphisms in the bovine IL-8 gene promoter. S. Kandasamy*, K. L. Haddock, and D. E. Kerr, *University of Vermont, Burlington.*

An early event in the response of the host to infection is the release of chemokines to attract neutrophils and other immune cells to the site of infection. An early robust response may be critical in containing and eliminating the pathogen, but the potential exists for an exaggerated response leading to collateral tissue damage. Our objectives were to determine if SNPs exist in the 5'-regulatory region of the bovine IL-8 gene and if so to determine if they affected functionality of the gene in response to LPS treatment. We located 5 SNP sites through individual sequencing of PCR products (extending 1 kb upstream from the translation start site) from DNA of 28 Holstein cattle. In all cases the 5 SNPs were linked resulting in two haplotypes (A or B). We have now genotyped an additional 10 animals by PCR-RFLP giving a total of 14 AA, 16 AB, and 6 BB genotypes (61%A, 39%B). The two haplotypes were cloned into luciferase expression vectors (pGL-3 basic), with subsequent transfection into bovine mammary epithelial cells (Mac-T). Cells were also co-transfected with a GFP expression plasmid (pCMV-GFP) as a transfection control. Following LPS exposure (100ng/ml, 24h), cell extracts were prepared and assayed for fluorescence then combined with Bright-Glo Reagent (Promega) and assayed for luminescence. Substantial levels of luciferase activity were recorded from both haplotypes under control and LPS-stimulated conditions. However, the A haplotype generated more luciferase activity (1.25 vs 0.85 relative units) although there was no direct effect of LPS nor an LPS*haplotype interaction in this model. In a second experiment, heparinized whole blood from homozygous AA or BB animals (n=3) was stimulated with LPS (1, 10, and 100 ng/ml, or vehicle) for 3h or 6h. The concentration of IL-8 in the subsequently obtained plasma was highest following 6 h exposure to 100 ng/ml dose of LPS (157±13 pg/ml vs 42±14 in control). Overall the concentration of IL-8 was significantly (P<.01) affected by LPS, by exposure time, and was greater in blood from AA animals. It remains to be determined if differences exist between AA and BB animals in their response to infectious pathogens.

W13 Genomic response of immune associated genes to LPS challenge in bovine mammary gland and epithelial cells. D. E. Kerr*, M. Latshaw, and R. Parik, *University of Vermont, Burlington.*

The innate immune response to bacterial entry into the mammary gland is critical in determining the outcome of mastitis. Our goal was to profile the transcriptional response of mammary tissue and epithelial cells to an LPS challenge to further our understanding of the bovine innate immune system. Sources of RNA applied to Affymetrix GeneChips included biopsy samples from LPS-challenged (1 ug/gland) and contralateral control mammary glands of 3 lactating cows 4 h post-LPS challenge (COW); and from LPS-stimulated (100 ng/ml) or control cultures of primary mammary epithelial cells from different cows 3 h (C3), 8 h (C8), and 24 h (C24) post-LPS exposure. Filtering the data at a fold change ≥ 2.0 or ≤ -2.0 , and P<.05 revealed differential expression of 3.0%, 0.6%, 1.5%, and 1.6% of the 24,128 probe sets contained on the chip for COW, C3, C8, and C24, respectively. A common core of 47 induced probe sets included 3 of 26 genes on the GeneChip associated with the TLR4 signaling pathway (NFKB1, NFKBIA, and NFKBIZ), 4 members of the neutrophil attracting, ELR positive CXC chemokines (CXCL1,

CXCL2, CXCL6, and IL-8), 2 additional chemokines (CX3CL1, CCL2) and inflammatory associated proteins (IL6, LTF, SAA3, PLAU, SOD2, S100A8). Key differences between cells and biopsies in the TLR4 signaling pathway included induction of CD14 by cells and of TLR4 in the tissue. Additional differences between cells and tissue included marked induction (>5 fold) of IL1B, CCL5, and CCL20 in the cells and marked induction of CCL4, CCL8, CCL23, and IL1RN in the tissues. Notable time dependent changes in the cell response included a continual increase (P<.01) in the fold change response of SAA3 and S100A8 and the delayed induction of interferon regulated proteins MX1, MX2, IFI6, and ISG15. These studies have revealed a rapid, robust response of the bovine mammary gland and epithelial cells to LPS. The genomic response includes a core of common genes and distinct time and source differences, yet appears dominated by activation of the NF-kB complex leading to upregulation of inflammatory cytokines and multiple members of the chemokine gene family.

W14 Genetic analysis of dairy calf health traits and survival. L. Henderson*¹, F. Miglior^{2,3}, D. Kelton¹, J. Robinson⁴, J. Wormuth⁵, A. Sewalem^{2,3}, and K. Leslie¹, ¹*University of Guelph, Guelph, ON, Canada*, ²*Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada*, ³*Canadian Dairy Network, Guelph, ON, Canada*, ⁴*University of Guelph, Guelph, ON, Canada*, ⁵*CY Heifer Farms, Batavia, NY.*

Genetic selection for improved health and longevity is a major initiative of dairy cattle breeding programs. Recently, extensive efforts have been made to improve selection indices for calf survival at birth in Canadian dairy cattle. To date, little effort has been put into exploring the genetic components of measures of calf health, survival and performance from birth until the post-weaning period. The objective of this study is to evaluate the heritability and genetic correlations of calf health traits based on measures of passive transfer of immunity, disease occurrence, survival and growth from birth to weaning for a large population of Holstein calves. Health and performance records were available from approximately 10,000 dairy heifer calves from a commercial heifer raising facility in western New York. Data was recorded from arrival of the calf at 2-5 days of age for the duration of stay at the facility. At enrollment, calves were weighed and evaluated for passive transfer of immunoglobulins from colostrum feeding. A standard protocol was followed for health management practices, disease recording and therapy throughout the growing period. All disease occurrences, treatments, management events and weight measurements were recorded in DairyComp 305 to create a complete record for each animal. In a subset of these data, 650 calves from 20 Holstein sires have been analyzed. The number of calves per sire ranged from 16 to 82, with an average of 35 per sire. The average serum total solids in calves by specific sire group ranged from 6.2 to 7.2 g/dL. The average daily gain for the growing period by sire group ranged from 650 to 900g/day. These data along with mortality rates suggest that there may be significant genetic differences among Holstein calves for health status in the early neonatal period, susceptibility to neonatal disease problems, and for survival to weaning.

Key Words: Genetics, Calf-Health, Survival

Beef Species

W15 Performance and carcass alteration of Nellore and F1 Brangus × Nellore steers supplied with organic chromium finished on grass. A. Polizel Neto*¹, A. M. Jorge¹, P. S. A. Moreira², H. F. B. Gomes¹, and R. D. O. Roça¹, ¹São Paulo State University, Botucatu, São Paulo, Brazil, ²Federal University of Mato Grosso, Sinop, Mato Grosso, Brazil.

Chromium works as Glucose Tolerance Factor – GTF, which causes muscle glucose input stimulus. The present work aimed to evaluate the effect of breed and mineral protein supplementation with organic chromium addition on performance and carcass traits in steers finished on grass. 18 Nellore and 18 F1 Brangus × Nellore steers with initial age of 16 months and live weight of 77.31±18.15 kg were used. Two treatments of mineral protein supplementation (22% crude protein, with 0.25 cottonseed meal, 0.25 grind corn and 0.50 commercial mineral supplement) with and without organic chromium addition (2 mg/animal/day of chromium), finished on *Brachiaria sp* grass were assigned. After 14 hours of solid fasting, at initial and final moment, cattle were weighed and calculated the daily weight gain (ADG), on 190 days of experiment. Carcass traits were evaluated by means of ultrasound measurements: rib eye area (REA), subcutaneous fat thickness at the back (between 12th and 13th rib) and at the rump (SFTB and SFTP8). A randomized design was used and all data were analyzed using analysis of variance with two variance source (breed and chromium) using Statistical Analysis System. Regarding ADG, no difference was observed (P≥0.05) between breeds (means of 457 g/day). On the other hand, animals supplied with chromium showed better ADG (494 g/day) than control animals (420 g/day). Once again, there were no observed differences (P≥0.05) among experimental treatments in carcass traits measured by ultrasound, reaching final average values of 63.42 cm², 5.46 mm and 5.58 mm, respectively to REA, SFTB and SFTP8. The Nellore and F1 Brangus × Nellore show similar production potential and the mineral protein supplementation with the organic chromium increasing the weight gain, but not influencing the carcass traits.

Key Words: Crossbreed, Mineral, Ultrasound

W16 Carcass and beef traits of Nellore and F1 Brangus × Nellore steers supplied with organic chromium finished on grass. A. Polizel Neto*¹, P. S. A. Moreira², A. M. Jorge¹, H. F. B. Gomes¹, and R. D. O. Roça¹, ¹São Paulo State University, Botucatu, São Paulo, Brazil, ²Federal University of Mato Grosso, Sinop, Mato Grosso, Brazil.

Chromium works as Glucose Tolerance Factor – GTF, which causes muscle glucose input stimulus. This project aimed to evaluate the effect of organic chromium supplementation and of breed on productive carcass traits and some beef quality parameters of steers finished on grass. For this purpose, 18 Nellore and 18 F1 Brangus × Nellore steers were raised on *Brachiaria sp* grass, distributed equally in mineral protein supplementation (22% crude protein, with 0.25 cottonseed meal, 0.25 grind corn and 0.50 commercial mineral supplement) with and without organic chromium addition (2 mg/animal/day of chromium); and were slaughtered at 22 months of age and 451.22±13.22 of shrunk weight. Hot carcass was measured (HCW), and the carcass yield (YC) was calculated by relation of HCW:shrunk weight. Longissimus dorsi muscle pH was measured at 2, 10 and 24 hours post-mortem. After 24 hours of chilling, L. dorsi muscle samples (between 12th and 13th rib)

were collected in order to evaluate the cooking loss, shear force and chemical composition. A randomized design was used and all data were analyzed using analysis of variance with two variance source (breed and chromium), using SAS. Means of 235.01 kg to HCW and 52.09% to YC, with a superiority (P≤0.05) to chromium treatment (238 kg) versus control (231 kg) were observed, but without difference (P≥0.05) to YC; neither difference between breeds to HCW and YC. No treatment differences were detected in carcass pH and some quality beef parameter (P≥0.05) with means of 6.8, 6.2 and 5.7 to pH after 2, 10 and 24 hours, respectively, and cooking loss of 22% and shear force of 6.53 kg/F. The chemical composition was close to normal reference values, with means: 74.01% to moisture, 1.19% to ash, 23.89% to crude protein, 0.9% to ether extract. The Nellore and F1 Brangus × Nellore steers show equal production potential of quality beef on grass. Organic chromium increases the carcass weight, but does not influence the carcass yield or the beef quality parameters evaluated.

Key Words: Crossbreed, Mineral, Supplementation

W17 Estimation of some effects on longevity of beef cows using survival analysis. F. Szabó* and I. Dákay, *University of Pannonia, Keszthely, Hungary.*

Longevity of beef cows measured with the length of productive life from first calving to culling was estimated in this study. Data of 1800 cows belonging to Hereford, Angus, Simmental, Charolais, Limousin and Blonde d'Aquitaine breeds were estimated using Cox regression survival model. The results indicate significant (P<0.05) effect of calving season, calving difficulty, and breed on longevity, however age at first calving of the cows, sex and weaning weight of their calves did not affect (P>0.05) the length of productive life. Hereford had significantly highest (10.28 years) estimated longevity than the other breeds, following by Angus (8.14 years), Simmental (7.88 years), Charolais (7.13 years), Limousine (5.93 years) and Blonde d'Aquitaine (5.2 years). However either Angus, Simmental and Charolais or Limousin and Blonde d'Aquitaine did not differ significantly. Higher productive life (6.23 years) was estimated for cows whose calving took place without assistance or with a little assistance (6.96 years) than those needed veterinary assistance (2.75 years) or had stillbirth (4.63 years). Cows that firstly calved in spring or summer were estimated to reach higher productive life (7.22 years and 9.93 years) and less risk to early culling, then those calving in autumn (5.69 years) and in winter (5.05 years).

Key Words: Breed, Calving Season, Calving Difficulty

W18 Evaluation of MultiMin™ to enhance weaned calf productivity. A. E. Fisher*¹, W. W. Gill³, C. D. Lane, Jr.¹, R. L. Ellis², S. B. Blezinger⁴, and G. M. Pighetti¹, ¹University of Tennessee, Knoxville, ²University of Tennessee, Greeneville, ³Middle Tennessee State University, Murfreesboro, ⁴MultiMin USA, Inc., Sulphur Springs, TX.

This 56-day trial utilized 131 weaned heifers to evaluate the effectiveness of MultiMin™, Ralgro™ and their interaction to overcome mineral deficiencies and poor growth/health status of weaned beef calves in fall 2006. Heifers were randomly allotted to one of four treatments

including 1) Control, no mineral injection, no implant; 2) injection of MultiMin™ (no less than 40 mg/ml zinc, 10 mg/ml manganese, 5 mg/ml selenium and 15 mg/ml copper), no implant; 3) no mineral injection, Ralgro™ (36 mg zeranol) growth promotant; and 4) injection of MultiMin™, Ralgro™ growth promotant. All injections were administered subcutaneously in the neck. Cattle grazed tall fescue dominated pasture and were supplemented with pelleted corn gluten feed at 0.5% average initial body weight. Individual animal weights were recorded on days 0, 1, 28, 55 and 56 and blood was drawn via jugular venapuncture on days 1 and 56 for glutathione peroxidase (GSH-Px) activity analysis. All data were analyzed using the mixed procedure of SAS, with differences determined at $P < 0.05$. Initial weights did not differ among treatments. Average daily gain for MultiMin™ supplemented calves was not different from unsupplemented calves (0.52 vs. 0.52 kg/d, respectively; $P > 0.05$). Ralgro™ administered calves gained more weight than unsupplemented calves (0.55 vs. 0.48 kg/d, respectively; $P < 0.03$). No MultiMin™ by Ralgro™ interaction was observed as any differences can be related to implant. There was no difference in initial GSH-Px activity between groups; however MultiMin™ supplemented calves had higher final GSH-Px activity values than unsupplemented calves (71.8 vs. 54.7 nmol/min/ml; $P < 0.02$). Additionally, the change in GSH-Px activity from day 1 to day 56 was higher for MultiMin™ supplemented calves than unsupplemented calves (29.9 vs. 14.2 nmol/min/ml, respectively; $P < 0.01$).

Key Words: Beef Cattle, Weaning, MultiMin™

W19 Variation of MUFA ratio in several muscles of Japanese Black cattle cloned from somatic cells. Y. Nakahashi*¹, T. Okumura², M. Hada², Y. Fujishima³, K. Yamauchi², S. Hidaka¹, and K. Kuchida¹, ¹Obihiro University of A & VM, Obihiro-Shi, Hokkaido, Japan, ²National Livestock Breeding Center Tokachi Station, Otofuke-Cho, Hokkaido, Japan, ³The Ministry of Agriculture, Forestry and Fisheries of Japan, Chiyoda-Ku, Tokyo, Japan.

Many studies have been performed on the topic of monounsaturated fatty acids (MUFA) because of the positive correlation with the flavor of marbling. However, few studies have investigated the fluctuation of MUFA ratios within finely sliced muscles, especially in Japanese Black (JB) cattle. Our objective was to investigate the changes in fatty acid composition of muscles and specific cuts from JB cloned steers. Five JB steers were cloned from 2 animals and were fed in the same environment until slaughter at 20 mo of age. The following muscles were taken from each animal and sliced at 2cm intervals from the cranial to caudal side: *M.semimembranosus* (SE), *M.quadriceps femoris* and *M.tensor fasciae latae* (QU & TE), *M.supraspinatus* (SU), *M.psoas major* (PS), *M.gluteus medius* and *M.biceps femoris* (GL & BI), *M.longissimus* (LO). LO was classified into 3 parts (Chuck eye: cranial part from the 6-7th rib, Rib roast: from 6-7th to 10-11th rib, Sirloin: caudal part from the 10-11th rib). Carcasses were graded at the 6-7th rib in Japan, and rib roast and sirloin were separated at the 10-11th rib in the meat market. Adipose samples were taken from all slices and analyzed using gas chromatography. The tendencies of fluctuation for the ratios of MUFA and oleic acid differed by muscle, as some increased toward the caudal side while others decreased or remained. GL & BI had the highest ratios of MUFA and oleic acid (54.01 and 49.14%, respectively), whereas PS had the lowest (48.90 and 45.57%, respectively). For each part of LO, sirloin revealed the highest oleic acid and MUFA ratio, but the 6-7th cross section was the lowest. Simple correlations between the 6-7th and the average of all the slices in each muscle were 0.92-0.98 in MUFA.

This may suggest that the MUFA ratio at the 6-7th rib-eye represented the MUFA of the whole carcass.

Key Words: Japanese Black, MUFA Ratio, Muscles

W20 Influence of feed efficiency on profitability of individually fed feedlot cattle. A. L. Shreck*¹, C. O. Trejo¹, J. W. Homm², L. L. Berger¹, and D. B. Faulkner¹, ¹University of Illinois, Urbana, ²Elanco Animal Health, Greenfield, IN.

Data from 828 steers by Simmental or Angus sires (n=47) were analyzed to evaluate effects of feed efficiency on profitability. Cattle were fed corn or corn-byproduct based diets (n=11), and marketed on three strategies: live price, quality based grid (Quality grid), and yield based grid (Yield grid). Cattle were harvested in three groups based on ultrasound data to optimize carcass value. Cattle were stratified by weight and sire then randomly assigned to diets. Individual daily intakes were obtained using the GrowSafe® feeding system (GrowSafe Systems Ltd., Airdrie, Alberta, CA). Five year average price data were collected for feedstuffs, live cattle price (\$85.75/45.4 kg), dressed beef price (\$138.18/45.4 kg), and grid premiums and discounts. Corn price was \$2.63/25.5 kg. Wet corn-byproduct prices were calculated at 90% the value of corresponding dry corn-byproducts (DM basis). Choice-select spread was \$15/45.4 kg for Quality grid and \$12.72/45.4 kg for Yield grid. Discounts were given for hot carcass weight extremes (<250 kg -\$15.82; 432 to 454 kg -\$4.73; >454 kg -\$19.17). Input costs included steer purchase price and feed markup (\$24.2/mt). Veterinary, medical, labor, and transportation costs were \$50/per animal and yardage was \$0.25/d per animal. Steer purchase price was \$121.00/45.4kg based on a 227 kg animal with a \$1.50 slide per 11.3 kg. Days on feed averaged 163.5±22.7 d. Marbling score (MS), hot carcass weights (HCW), and yield grade (YG) were similar across the range of F:G ratios. These data show that small improvements in feed efficiency dramatically improve profitability in feedlot steers

Table 1. Effect of feed efficiency on profitability of feedlot cattle

F:G	n	MS	HCW (kg)	YG	Live*	Quality Grid*	Yield Grid*
<4.50	5	544	370	2.96	103.38	104.56	107.13
4.51-5.0	32	529	381	2.81	90.08	114.59	114.07
5.01-5.50	180	535	381	2.76	65.79	82.13	83.21
5.51-6.0	259	537	384	2.84	45.23	67.26	68.06
6.01-6.50	208	537	384	2.89	20.94	49.02	48.48
6.51-7.0	90	545	381	2.90	-4.19	26.30	24.13
7.01-7.50	40	566	378	2.95	-31.59	-4.71	-7.82
>7.51	14	528	363	2.69	-87.50	-69.24	-66.50

*Profit on a \$/hd basis

Key Words: Feed Efficiency, Steers, Profitability

W21 Characterization of intracellular copper homeostasis regulatory genes in bovine liver. H. Han, T. E. Engle, J. K. Sakugawa, S. L. Archibeque, and K. Partyka*, Colorado State University, Fort Collins.

Copper is an essential trace mineral for growth and development. Copper serves as a cofactor for enzymes involved in a variety of biological

functions. Copper homeostasis within the cell is mediated by the expression of the copper transporter protein (CTR1), ATPase7A (ATP7A), ATPase7B (ATP7B), and Cox17, which help to regulate copper uptake, export and intracellular compartmentalization in non-ruminants. Liver tissue from six Holstein bull calves (average BW 201kg, 7 mo. old) from a previous experiment (25.2mg Cu/kg diet) was utilized to examine the relationship of CTR1 mRNA to ATP7A, ATP7B and Cox17 mRNA expression. Liver samples were collected at the time of harvest and snap frozen. Liver copper concentration was determined via flame atomic absorption and total RNA was extracted from 100mg of liver tissue using TRI reagent and purified using RNeasy. Primers for CTR1, ATP7A, ATP7B and Cox17 were designed for real time PCR analysis. Liver copper concentrations were: 290, 312, 351, 354, 611, and 801 mg of Copper/kg DM. Real time PCR analysis of these genes revealed that relative expression of CTR1, was positively correlated with ATP7A ($r=0.90$; $P < 0.02$), ATP7B ($r=0.98$; $P < 0.01$) and Cox17 ($r=0.94$; $P < 0.01$) gene expression at all copper concentrations. These data indicate that genes involved in bovine liver copper homeostasis, ATP7A, ATP7B and Cox17 are correlated with CTR1 gene expression in the bovine liver which is similar to those reported for non-ruminants.

Key Words: Copper, Liver, Gene Expression

W22 Evaluation of methods to estimate individual intakes of cattle fed in group pens. G. D. Cruz*, J. W. Oltjen, and R. D. Sainz, *University of California, Davis.*

Feed efficiency measures such as residual feed intake (RFI) require individual determination of intake, a laborious and expensive process. Several methods developed to predict individual intakes in group pens were evaluated with a dataset of 60 Angus x Hereford steers. Models 1 (Perry and Fox (1997) *J. Anim. Sci.* 75:300) and 2 (Guiroy et al. (2001) *J. Anim. Sci.* 79:1983) are based on growth, carcass composition and nutrient requirements. Model 3 is based on solution of simultaneous equations and the heterogeneity of subgroups through a rotational system (Trovo et al. (2006) *Proc. Soc. Bras. Zootec.*). Steers (296 kg initial BW) were fed a corn-based ration (1.68 Mcal NEm/kg, 13% CP on a DM basis) twice daily and refusals were measured daily. Animals were stratified by BW and placed in 30 individual pens and five group pens (six animals each). Every day three steers from each group pen were randomly transferred to another group pen. After 60 days, animals were switched from group to individual pens and vice versa for another 60 days. Average daily individual intakes (in group pens) were estimated by multiplying each animal's average daily individual intake (in individual pens) by an adjustment factor which was calculated as the ratio between the mean intakes in individual and group pens for the same group of animals. Models 1 and 2 used the combined pen data as input, and Model 3 used the daily rotation data. The Mean Square Errors of Prediction (MSEP) were 4.56, 3.71 and 3.29 kg/d for Models 1, 2 and 3, respectively. The decomposition of the MSEP indicated different patterns in the errors of prediction between models. For Model 3, random error accounted for nearly 60% of the MSEP, whereas for Models 1 and 2 the slope bias accounted for more than 50% of the errors of prediction. Considering that mean RFI values for high and low RFI groups are typically around 1 kg/d above or below zero respectively, none of these models predicted intake with the precision required for estimation of RFI. At present there is no substitute for measuring individual intakes.

Key Words: Cattle, Feed Intake, Models

W23 Carcass characteristics of Alabama calves fed in four regions of the United States. W. C. Rutherford, J. B. Elmore, S. V. Free, J. K. Grubbs*, M. Hittle, and L. A. Kriese-Anderson, *Auburn University, Auburn.*

Carcass data were collected from 10,778 calves enrolled in the Alabama Beef Connection Program (ABC) from 2003 to 2007. Calves were enrolled by 78 different producers. Calves were fed in Midwestern ($n=2116$), Northern High Plains ($n=6033$), Southern High Plains ($n=2140$) or Western ($n=487$) commercial feedyards. Calves were fed diets traditional to the feedlot and region. All traits were analyzed using the generalized linear models procedure in SAS. Traits analyzed included average daily gain (ADG), hot carcass weight (HCW), 12th rib backfat (BF), longissimus dorsi area (REA), USDA marbling score (MS) and USDA yield grade (YG). Independent variables in the model included year, feeding region and year by feeding region interaction. The interaction was non-significant ($P>0.05$). Compared to the 2000 Beef Quality Audit, Alabama calves were similar to audit values for HCW and BF. Alabama calves had more muscle, which translated into lower YG. MS averages for Alabama calves were lower (489 vs. 523) than 2000 audit averages. However, of Alabama calves grading USDA choice, 43% ($n=2167$) qualified for quality branded beef programs. Since 2003, HCW of Alabama calves trended down ($P<0.10$) with less BF and more MS. Additionally YG held constant from 2003 to 2007 while REA trended upward.

Table 1. Growth and carcass LSMeans by feeding region

Trait	Midwest	No. High Plains	So. High Plains	Western
ADG (kg/d)	1.27 ^b	1.27 ^b	1.33 ^a	1.24 ^c
HCW (kg)	360 ^a	358 ^a	372 ^b	367 ^b
BF (mm)	12.2 ^c	11.9 ^c	9.4 ^a	11.2 ^b
REA (cm ²)	85.2 ^d	87.1 ^c	94.2 ^a	91.6 ^b
MS ¹	480 ^b	489 ^a	458 ^c	490 ^a
YG	2.5 ^b	2.5 ^b	2.2 ^a	2.4 ^b

¹ 400 = Select; 450 = Select; 500 = Choice. Rows with different subscripts are significantly different at $P<0.05$ level

Key Words: Beef, Carcass, Beef Quality Audit

W24 Relationship between residual feed intake and reproductive performance in Brangus heifers. P. A. Lancaster*¹, G. E. Carstens¹, P. Chen¹, D. W. Forrest¹, T. H. Welsh, Jr.¹, R. D. Randel², and T. D. A. Forbes², ¹Texas A&M University, College Station, ²Texas AgriLife Research, Overton, TX, ³Texas AgriLife Research, Uvalde, TX.

The objective of this study was to examine the relationships between residual feed intake (RFI) and reproductive traits in heifers. Average (\pm SD) initial age and BW of Brangus heifers (Camp Cooley Ranch) were 225.8 \pm 9.1, 236.0 \pm 10.7 and 235.6 \pm 14.6 d, and 285.1 \pm 28.0, 268.5 \pm 23.8 and 267.8 \pm 25.8 kg for year 1 (N = 114), 2 (N = 115) and 3 (N = 119), respectively. Heifers were individually fed a roughage-based diet (ME = 1.98 Mcal/kg DM) for 70 d. RFI was calculated as the difference between actual DMI and expected DMI from linear regression of DMI on mid-test BW^{0.75} (MBW), ADG, year and year by MBW and ADG interactions (year and year by MBW and ADG interactions were considered random effects). Weekly blood samples were assayed in duplicate for progesterone by RIA (Diagnostic Systems Laboratories). Heifers exhibiting a progesterone concentration \geq 2 ng/mL for one wk or \geq 1 ng/mL for two consecutive wk were considered pubertal. Overall

ADG, DMI and RFI were 0.90 ± 0.15 , 9.10 ± 1.11 and 0.00 ± 0.75 kg/d, 1.06 ± 0.16 , 9.47 ± 1.04 and 0.00 ± 0.68 kg/d, and 1.00 ± 0.13 , 9.92 ± 1.06 and 0.00 ± 0.70 kg/d for year 1, 2 and 3, respectively. Heifers with low RFI (< 0.5 SD) had 16% less ($P < 0.01$) DMI and 15% lower ($P < 0.01$) feed conversion ratio than heifers with high RFI (> 0.5 SD), even though ADG and final BW were similar. RFI was correlated with gain in fat thickness (0.27). Across the 3 years, 30% of the heifers were pubertal by d 70. Chi-square analysis revealed that the percentage of pubertal heifers by d 70 within low (32.1%), medium (28.3%) and high (29.6%) RFI phenotypes was similar ($P = 0.80$). Of those heifers that were pubertal by day 70, age at puberty was similar ($P > 0.20$) between low (279 d), medium (273 d) and high (271 d) RFI phenotypes. After returning to Camp Cooley Ranch 18, 18 and 16 heifers with low, medium and high RFI were sold prior to the breeding season. Rectal palpation results indicated that pregnancy rates were similar ($P = 0.17$) for heifers with low (89.4%), medium (85.7%) and high (79.3%) RFI. These results indicate that postweaning RFI was not phenotypically associated with age at puberty or pregnancy rate in Brangus heifers.

Key Words: Residual Feed Intake, Reproduction

W25 Fatty acid profile, meat cholesterol and total lipids of *Bos indicus* based types bullocks fed monensin or polyclonal antibodies against lactate-producing rumen bacteria. M. V. Fossa^{1,2}, R. D. L. Pacheco^{*1,2}, D. D. Millen^{1,2}, T. M. da Cunha Leme¹, M. P. de Oliveira¹, C. R. de Oliveira¹, A. E. Mathias¹, J. C. Hadlich¹, A. DiCostanzo³, N. DiLorenzo³, M. De Beni Arrigoni¹, C. L. Martins¹, M. Parrili¹, and S. A. Matsuhara¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Supported by FAPESP, São Paulo, São Paulo, Brazil, ³University of Minnesota, Saint Paul.

Our objective was to study the effect of biotype [GG; Nellore (NE), Canchim (CC- 5/8 Charolais, 3/8 Nellore) and 3-way cross (1/2 Brangus, 1/4 Nellore and 1/4 Angus)] and feed additive [FA; 300 mg of monensin/day (MO) or 10ml of polyclonal antibody preparation against lactate-producing rumen bacteria/day (PAP)] on fatty acid profile of subcutaneous fat (FP) and cholesterol (CO) and total lipids (TL) of *Longissimus dorsi* muscle. Two bullocks (260 kg) were randomly selected from a population of four in each of 18 pens allocated to the 2 X 3 factorial arrangement of FA and GG. Samples were collected from the longissimus dorsi muscle between the 12th and 13th rib. The fatty acid profile of subcutaneous fat was from total lipids and determined by gas chromatography. No difference ($P > 0.05$) was found for miristic acid between all treatments. Palmitic acid (C16:0) was found in greater concentrations ($P < 0.05$) in steaks from bullocks fed MO (255.95 vs 243.76 mg/g) and in lower concentrations in NE bullocks (229.82 vs. 264.30, 255.44 mg/g for NE, CC, and TC). No differences ($P > 0.05$) were found for stearic acid due to either GG or FA. Oleic acid (C18:1) was affected ($P < 0.05$) by GG (474.37 vs. 423.11, 420.43 mg/g for NE, CC, and TC, respectively) but not by FA ($P > 0.05$). Linoleic (C18:2) acid was not affected ($P > 0.05$) by GG or FA. Steaks from NE had greater concentration ($P < 0.01$) of CLA (C18:2, c-9, t-11; 5.79 vs. 3.23 and 3.68 mg/g for NE, CC and TC). Linolenic acid (C18:3, Ω 3) did not differ ($P > 0.05$) due to GG or FA. Steaks from NE had lower ($P < 0.01$) saturated fatty acid concentration (414.86 vs. 479.49, 485.65 mg/g or 42.09% vs 48.48%, 49.13% for NE, CC and TC). There was no FA or GG effects ($P > 0.05$) for CO and TL in meat. Steaks from NE had greater concentrations of (C18:1), (CLA) and lower concentrations of saturated fatty acids and (C16:0).

Key Words: PAP, Fatty Acid Profile, Cholesterol

W26 Evaluation of growth, carcass characteristics and meat tenderness of bullocks fed monensin or polyclonal antibodies against lactate-producing rumen bacteria. R. D. L. Pacheco^{*1,2}, D. D. Millen^{1,2}, T. M. da Cunha Leme¹, C. R. de Oliveira¹, A. E. Mathias¹, J. C. Hadlich¹, A. DiCostanzo³, N. DiLorenzo³, M. De Beni Arrigoni¹, C. L. Martins¹, S. A. Matsuhara¹, M. Parrili¹, M. V. Fossa¹, J. P. S. T. de Bastos¹, T. M. Mariani¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Supported by FAPESP, São Paulo, São Paulo, Brazil, ³University of Minnesota, Saint Paul.

The objective of this study was to evaluate effects of feed additive (300 mg of monensin/day, MO, vs 10 mL of polyclonal antibody preparation against lactate-producing bacteria/day, PAP) or biotype (Nellore, NE, Canchim cross, 5/8 Charolais, 3/8 Nellore, CC, or a 3-way cross, 1/2 Brangus, 1/2 Nellore and 1/2 Angus, TC) on ultrasound (US)-assessed measures of fat and ribeye area, carcass characteristics, and *Longissimus dorsi* tenderness (shear force, SF, and myofibrillar fragmentation index, MFI) of bullocks fed high-concentrate diets. Two bullocks (259.6±26.39 kg) were randomly selected from a population of four in each of 18 pens allocated to the 2 X 3 factorial arrangement of feed additive (FA) and biotype (GG), and monitored monthly for a 107-d (CC and TC) or 147-d (NE) feeding period. Analyses of variance included the initial measurement covariate when appropriate ($P < 0.05$) were used. Final (BW) and hot carcass weight (HCW) were unaffected ($P < 0.05$) by FA, but were lower ($P < 0.05$) for NE than CC and TC. Dressing percentage (DP) was lower ($P < 0.05$) for TC than NE and CC bullocks. An interaction between FA and CC ($P < 0.05$) revealed that TC bullocks fed MO had greater ($P < 0.05$) DP than TC bullocks fed PAP (51.6% vs 54.0% TC bullocks fed MON vs those fed PAP). There was no effect ($P > 0.05$) of FA on monthly measurements of fat depth (BFT), rump fat (P8), ribeye area (REA), or visceral fat (VF), SF and MFI. Bullocks of CC biotype were leaner ($P < 0.05$; less BFT and P8) than those of TC and NE biotypes. Bullocks of NE biotype had smaller ($P < 0.05$) REA than those of CC and TC biotypes. Steaks of TC biotype had lower ($P < 0.05$) SF values than those of the other biotypes. There were no differences ($P > 0.05$) in MFI or VF due to biotypes. Other than effects of PAP on TC biotype, PAP did not affect carcass fat, REA or tenderness.

Key Words: Antibodies, Growth, Tenderness

W27 Evaluation of the acute phase response in the neonate bovine model following vaccination against bovine respiratory disease complex. W. J. Horne^{*1}, K. S. Barling², J. A. Carroll³, A. D. Herring¹, G. A. Holub¹, and J. E. Sawyer¹, ¹Texas A&M University, College Station, ²Novartis Animal Health US, Inc, Larchwood, IA, ³USDA-ARS, Lubbock, TX.

A study using 7-d old Holstein calves was conducted to determine the effects of viral vaccination on febrile and pro-inflammatory cytokine responses in the neonate. Calves were treated with a multi-valent modified live virus vaccine (Arsenal 4.1[®], n = 3; **ML**) or a multi-valent killed virus vaccine (ViraShield 6[®], n = 3; **KV**) within a week of birth at label dosage. Blood samples and rectal temperatures (**RT**) were collected 1 h before, hourly for 12 h, at 18, 24, 30, 36, 48, 60, and 72 h after vaccines were administered. Serum was analyzed for tumor necrosis factor- α (**TNF- α**), interferon- γ (**IFN- γ**), interleukin 1- β (**IL-1**), **IL-2**, **IL-4**, and **IL-6**. Responses were evaluated as difference from baseline within calf. Data were analyzed as repeated measures with calf as the subject. Time influenced ($P < 0.1$) all responses except serum IL-4 ($P = 0.18$). Peak increases in TNF- α , IL-6, and IFN- γ occurred at 24 h, with IFN- γ

falling below baseline at 48 h; IL-6 remained elevated through 60 h. Increased IL-2 was observed at 0, 30, 36, 60, and 72 h after vaccination. Treatment by time interactions occurred for RT ($P = 0.04$) and IL-1 ($P = 0.05$). After 6 h, all calves had elevated RT, but the magnitude of increase was greater for calves receiving ML than those receiving KV. Increase in IL-1 was of greater magnitude in the first 12 h for calves receiving KV, but returned to baseline after 24 h. For those receiving ML, IL-1 increased at 5 and 6 h, returned to baseline, then increased after 30 h. Animals receiving ML had greater increases ($P = 0.07$) in serum IL-4

concentrations than those receiving KV. However, KV induced greater ($P = 0.02$) increases in IL-6. While both vaccines stimulated cytokine production, the associated febrile response was not strongly correlated with the release of any specific cytokine. Our results demonstrate that different vaccines have differential effects on the magnitude and timing of release of various cytokines. Understanding these differences and immunological sequelae to cytokine release may enhance development of vaccination strategies.

Key Words: Cattle, Acute Phase Response, Vaccine

Breeding and Genetics II

W28 Analysis of some environmental factors for growth parameters obtained from Gompertz nonlinear model in Kurdi sheep breed of Iran. H. Farhangfar^{*1}, D. A. Saghi², and M. H. Fathi Nasri¹, ¹*Birjand University, Birjand, Iran*, ²*Agricultural Research Centre, Mashhad, Iran*.

The main objective of the present research was to analyse some environmental factors for growth parameters in Kurdi sheep breed of Iran. The data consisted of 16949 weights recorded at different ages (0, 3, 6, 9 and 12 months) belonging to 4353 Kurdi sheep breed. The data were obtained from a large-size flock of Kurdi sheep (located at northern Khorasan province) during 1990-2005. All lambs were born in winter. Gompertz nonlinear model defined as $W = (z/b) \cdot \exp(-\exp(g_0 - b \cdot t))$ was initially fit to individual lambs to estimate corresponding parameters (z , b and g_0). Moreover, estimated parameters z/e ($e=2.71828$) and A (z/b) were also calculated for individual lambs. The estimated parameters z/e and A are associated with maximum daily growth rate and mature weight respectively. All estimated parameters were subsequently analysed by a general linear statistical model. In the model, fixed environmental factors of birth year, birth type, lamb sex, ewe lambing order, two way interactions between lamb sex and birth type, between lamb sex and ewe lambing, between birth type and ewe lambing and between birth year and lamb sex. The sire random effect was not considered in the analysis due to lack of sire identification in the data file. The analyses were carried out by SAS programme using nonlinear procedure. The results indicated that for all estimated parameters (z , b , g_0 , z/e and A) were significantly ($p < 0.05$) affected by year of birth, lamb sex and birth type. Ewe lambing had only a significant affect ($p < 0.05$) on estimated parameters z and z/e . The interaction between birth year and lamb sex was found to significantly ($p < 0.01$) affect on all estimated parameters. The results also revealed that the interactions between ewe lambing and birth type, between ewe lambing and lamb sex as well as between lamb sex and birth type had no significant ($p > 0.05$) influence on the estimated parameters.

Key Words: Kurdi Sheep, Growth, Gompertz

W29 Response surface regression analysis to locate optimal minimum age at sexual maturity based on body weights at weeks 8 and 12 for indigenous chicken in Khorasan province of Iran. H. Farhangfar^{*}, M. E. Hosseini, and S. M. Navidzadeh, *Birjand University, Birjand, Iran*.

An analysis using response surface regression statistical methods was carried out to locate optimal minimum age at sexual maturity (ASM) based on weight at weeks 8 (W8) and 12 (W12) for indigenous chicken in Khorasan province of Iran. The data used in this study consisted of 1617 weight and ASM records collected from 1617 indigenous chicken belonging to the same generation and sex (female) during year 2006. The arithmetic means W8, W12 and ASM were 513, 865 g and 162 days ($SD=10.45$ days) respectively. In the data file, the ASM ranged from 138 to 209 days. A response surface regression in which ASM was dependent and W8 and W12 were independent variables was fitted to the data set. In the model, linear, quadratic terms of the independent variables as well as interaction between W8 and W12 were included. The model was fitted using RSREG procedure of SAS programme. The results obtained in the present research indicated that except the intercept

term fitted in the model, all the independent variables (linear, quadratic and interaction terms) had no statistical significant ($p > 0.05$) effects on ASM variation suggesting that other possible environmental factors could affect sexual maturity age of the indigenous chicken studied in this research. However, the predicted value of the minimum ASM was found to be approximately 161 days (close to the simple average of ASM in the data set) as the chicken weight at W8 and W12 were 504 and 997 g respectively.

Key Words: Age at Sexual Maturity, Weight, Indigenous Chicken

W30 Estimates of genetic parameters for direct and maternal effects on growth traits and fleece weight of Angora goat (Markhoz) in Iran. M. B. Zandi^{*1}, S. R. Miraei Ashtiani¹, M. Moradi Shahrabak¹, and A. Rashidi², ¹*Tehran University, Karaj, Tehran, Iran*, ²*Kurdistan University, Sanandaj, Iran*.

The aim of the current study was to estimate additive and non-additive parameters for birth weight (BW), weaning weight (WW), 6-month weight (W6), 9-month weight (W9), yearling weight (YW), and fleece weight at first shearing (FW), which are essential to design a selection programme for Kurdish Angora goat (Markhoz). Data and pedigree information which were used in this study were collected at the Sanandaj and Saqez Animal Breeding Research Institute during 1993 to 2007. Data contains of 2950 to 4008 records for this traits and total number of sires and dams in the study was 364 and 1391 respectively. Genetic parameters were estimated using univariate and multivariate traits animal model analyses with restricted maximum likelihood (REML) method by ASREML software. Estimates of direct heritability were 0.25 for BW, 0.26 for WW, 0.30 for W6, 0.21 for W9, 0.14 for YW and 0.12 for FW. Estimates of maternal heritability were 0.120, 0.110, 0.034, 0.030, 0.036 and 0.046 for BW, WW, W6, W9, YW and FW, respectively. Estimates of direct genetic correlations among growth traits were positive and ranged from 0.28 to 0.89. FW had a moderate to high positive direct genetic correlation with BW, WW and YW but had a negative direct genetic correlation with W6 (-0.22) and W9 (-0.202). The results of this study showed that maternal heritability was higher for pre-weaning than for post-weaning traits and the magnitude of the heritability estimates for those traits indicate possibility of an effective selection.

Key Words: Markhoz Goat, Heritability, REML

W31 Comparison and estimation factors affected body weight traits in the Markhoz breed of goats. M. B. Zandi^{*1}, M. A. Syed Reza¹, M. Moradi Shahrabak¹, and R. Amir², ¹*Tehran University, Karaj, Tehran, Iran*, ²*Kurdistan University, Sanandaj, Iran*.

Data from 4008 Kids of the Markhoz breed were used to estimate genetic parameters. Traits analyzed were weights at birth (BW), 90 days (Ww), 6-month weight (W6), 9-month weight (W9), yearling weight (YW), and fleece weight at first shearing (FW). REML estimates of variance and covariance components were obtained assuming animal models that included the fixed effects of sex, age of dam, effect of year of birth and types of birth or rearing, and the animal random effects for the direct, maternal genetic and permanent environmental

effects. Results showed that an important direct additive and maternal genetic effects were observed. Estimates of the direct heritability, maternal and permanent environmental heritability with standard errors were respectively 0.32(0.046), 0.085(0.036), 0.085(0.028) for BW; .30(0.044), 0.15(0.034), 0.024(0.013) for WW; 0.35(0.046), 0.12(0.033), 0.014(0.012) for W6, 0.37(0.043), 0.12(0.026) 0.00(0.00) for W9, and 0.43(0.043), 0.10(0.024) 0.00(0.00) for YW. Estimates of additive direct-maternal correlations were important and negative ranged from -0.57 to -0.80 for pre-weaning weights, and from -0.80 to -0.89 for post- weaning weights. Results suggest that estimates of additive and maternal heritability were important but permanent environmental maternal effect had some influence on body weights at pre-weaning that we must selection goats for this trait. These results indicate that goats have maternal ability for single, twins and triple kids (litter size) and we must considering these traits in the selection programs.

Key Words: Markhoz Goats, Maternal Ability, Heritability

W32 Weaning results of Simmental beef calves. F. Szabó* and S. Bene, *University of Pannonia, Keszthely, Hungary.*

Weaning weight, preweaning daily gain and 205-day weight of Simmental calves (n = 8929, male = 4539, female = 4390) born from 232 sires between 1980-2003 were examined. Farm, age of cows, year of birth, season of birth and sex of calves as fixed, while sire as a random effect was treated. Data were analysed with Harvey (1990) Least Square Maximum Likelihood Computer Program, moreover two animal models were used for breeding value estimation. Variance, covariance components and heritability values and correlation coefficients and the effect of the maternal permanent environment on genetic parameters and breeding values were examined.

The overall mean value and standard error of weaning weight, preweaning daily gain and 205-day weight were 217±4.5 kg, 1009±19.8 g/day and 242±4.1 kg, respectively. Calving year and season, sire, age of dam and herd had significant (P<0.05) effect on the evaluated traits.

The direct heritability (h²_d) of weaning weight, preweaning daily gain and 205-day weight was between 0.37 and 0.42. The maternal heritability (h²_m) of these traits was 0.06 and 0.07. The direct-maternal correlations (rdm) were medium and negative -0.52 and -0.74. Contribution of the maternal heritability and maternal permanent environment to phenotype is smaller than that of direct heritabilities (h²_m + c² < h²_d). The proportion of the variance of maternal permanent environment in the phenotypic variance (c²) changed from 3 to 6 %. Estimated breeding values changed whether the permanent environmental effect of dam was not taken into consideration but the rank of the animals was not modified. The genetic value for weaning results of Simmental population has increased since 1997.

Key Words: Breeding Value, Heritability, Weaning Weight

W33 Genotype and environment interaction of weaning results of Simmental calves. A. Fördös and F. Szabó*, *University of Pannonia, Keszthely, Hungary.*

The interaction of sire and population in the Simmental breed of cattle was examined on data from the Hungarian Simmental Breeders Association. Data of 2345 progeny (1260 male and 1085 female), born between 1992-2003, of thirty five sires from two populations were

evaluated. Preweaning daily gain (PDG) and 205-day weight (205dW) were analysed. Population, age of cows, year of birth, season of birth and sex of calves were treated as fixed, while sire and sire x population were treated as random effects. Genetic (rg) and rank (rrank) correlations were calculated for sires represented in the two populations (A,B). Data were analysed according to Harvey (1990) Least Square Maximum Likelihood Computer Program and SPSS 9.0 for Windows. Results were as follows: rg= PDGA -PDGB: 0.31(P<0.01); 205dWA-205dWB: 0.22(P<0.01) and rrank= PDG: -0.04 (P>0.05); 205dW: 0.078 (P>0.05). According to the result of examination important and significant (P<0.001) sire x population interaction were found in case of the two traits in Simmental population.

Key Words: 205-Day Weight, Genetic Correlation, Rank Correlation

W34 Genetic association between age and litter traits at first farrowing in a commercial Pietrain-Large White population raised in an open-house system in Thailand. P. Pholsing¹, S. Koonawootrittriron¹, T. Suwanasopee¹, and M. A. Elzo*², ¹*Kasetsart University, Bangkok, Thailand,* ²*University of Florida, Gainesville.*

The Thai swine industry is becoming an increasingly competitive business. Producers are striving to increase productivity and decrease costs. A trait of interest is age at first farrowing. The goal is to reduce costs by lowering age at first farrowing without detrimental effects to economically relevant litter traits. The objective here was to evaluate genetic associations between age at first farrowing (AFF) and 3 litter traits: total born alive (TBA), still born and mummy (LOST), and total birth weight of live piglets (TBW), in a negative halothane gene swine commercial population composed of Pietrain (PT) and Large White (LW) pigs. Data consisted of pedigree, and first-farrowing traits (AFF, TBA, LOST, and TBW) from 1,777 PT and 450 LW sows gathered from 1999 to 2006. Pigs were raised in an open-house system and received the same nutrition, management, and health care. Restricted maximum likelihood estimates of variance and covariance components for AFF, TBA, LOST, and TBW were used to calculate heritabilities and genetic correlations. A 4-trait animal model (AFF-TBA-LOST-TBW) that accounted for contemporary group (year-month) and breed as fixed effects, and animal and residual as random effects was used. Computations were performed with the ASREML program. Large White had shorter AFF (10.00 ± 2.34 d; P < 0.01), higher TBA (1.20 ± 0.22 piglets; P < 0.01), lower LOST (0.20 ± 0.11 piglets; P < 0.01), and smaller TBW (1.11 ± 0.30 kg; P < 0.01) than PT. Heritability estimates were 0.07 ± 0.03 for AFF, 0.11 ± 0.04 for TBA, 0.08 ± 0.04 for LOST and 0.08 ± 0.03 for TBW. Genetic correlations between AFF and TBA (0.19 ± 0.26), LOST (-0.12 ± 0.33), and TBW (0.14 ± 0.32) were low and had high standard errors. These low correlation estimates indicate that selection for AFF may be carried out in this commercial swine population without severe undesirable effects on litter traits.

Key Words: Farrowing, Pig, Tropical

W35 Factors affecting plasma cholesterol, lipoproteins, and triglycerides in growing pigs of various breed compositions raised under Thai tropical conditions. S. Koonawootrittriron¹, T. Suwanasopee¹, and M. A. Elzo*², ¹*Kasetsart University, Bangkok, Thailand,* ²*University of Florida, Gainesville.*

Concentration of plasma cholesterol (CHOL), high density lipoproteins (HDL), low density lipoproteins (LDL), and triglycerides (TRIG) may vary in pigs of different breed composition under tropical conditions. Selection of pigs for low plasma CHOL, LDL, and TRIG, and high HDL could be beneficial for their health and for human consumption. The objective was to evaluate factors that may affect plasma CHOL, HDL, LDL, and TRIG in growing pigs from 5 breed groups: Pietrain (P), Large White (W), WP, Landrace-Pietrain (LP), and WLP, under tropical conditions in Western Thailand. Ten hogs and 10 gilts of the same age (85 d) and similar weight (30.03 ± 7.07 kg) from each breed group were assigned randomly to each cell of a 5×2 factorial design (5 breed groups \times 2 sexes). Pigs in each factorial group were kept in a 4.5 m by 7.5 m pen throughout the 90-d trial. All pigs were raised in an open barn, and received the same nutrition, management, and health care. Weights, ultrasound backfat thickness and lean percent were measured at 3 ages (89 d, 136 d and 178 d). Blood samples were drawn from the 3 fastest and the 3 slowest growing pigs within each factorial group at each age. Plasma was analyzed for concentration of CHOL, HDL, LDL, and TRIG by an enzymatic-colorimetric method. The statistical model considered breed group, sex, and age, the interactions breed group \times sex, breed group \times age, and sex \times age, and the covariates backfat thickness and lean percent, and residual. Computations were performed using the mixed procedure of SAS. Breed group was important for CHOL, HDL, and LDL ($P < 0.001$), but not for TRIG. Pietrain had the lowest least squares means (LSM) for CHOL (71.21 ± 3.04 mg/dL) and LDL (40.61 ± 2.45 mg/dL), WLP had the lowest LSM for TRIG (45.18 ± 4.24 mg/dL), and LP had the largest LSM for HDL (40.78 ± 1.29 mg/dL). Ultrasound lean percent was negatively associated with LDL ($P < 0.01$).

Key Words: Cholesterol, Lipoprotein, Pig

W36 Multibreed beef cattle breeding value estimation based on weaning results. Sz. Bene¹, I. Komlósi², Zs. Fekete¹, Z. Lengyel¹, and F. Szabó^{*1}, ¹University of Pannonia, Keszthely, Hungary, ²University of Debrecen, Debrecen, Hungary.

Weaning results of 603 calves (297 male and 306 female; 388 purebreed and 215 crossbreed) born from 9 dam breeds (Hungarian Fleckvieh, Hereford, Aberdeen Angus, Red Angus, Lincoln Red, Limousin, Charolais, Blonde d'Aquitaine, Shaver), kept among the same condition on peat-bog soil pasture at Keszthely were evaluated between 1997 - 2006. Variance, covariance components, heritability values and correlation coefficients were estimated. Three different animal model were used for the estimation.

Different models had different fixed effects of genotype: model 1 genotype of calf; model 2 genotype of calf and dam; model 3 genotype of sire and dam

The direct heritability of weaning weight, preweaning daily gain and 205-day weight was between 0.30 and 0.51, the maternal heritability of these traits was 0.07 and 0.15. The direct-maternal correlations in weaning weight and preweaning daily gain were -0.12 and -0.27. Contribution of the maternal heritability and maternal permanent environment to phenotype is smaller than that of direct heritabilities. The total heritability was between 0.37 and 0.47.

The results obtained with three different animal models were similar with very small difference. The rank-correlation between the three models was strong and positive ($r = 0.93 - 0.99$; $P < 0.01$), accordingly the simpler models adaptable successfully.

Key Words: Beef Cattle, Multibreed, Breeding Value

W37 Effect of breed composition, temperament, and ELISA scores for paratuberculosis on phenotypic residual feed intake and growth in an Angus-Brahman multibreed herd. M. A. Elzo^{*1}, D. G. Riley², G. R. Hansen³, D. D. Johnson¹, R. O. Myer⁴, D. O. Rae¹, J. G. Wasdin¹, and J. D. Driver¹, ¹University of Florida, Gainesville, ²USDA-ARS STARS, Brooksville, FL, ³North Carolina State University, Plymouth, ⁴North Florida Research and Education Center, Marianna, FL.

Breed composition, temperament, and subclinical paratuberculosis in dams are factors that may have an effect on growth and feed efficiency in beef cattle. The objective of this research was to assess the effect of breed group (Angus (A), Brahman (B), Brangus, 3/4 A 1/4 B, 1/2 A 1/2 B, and 1/4 A 3/4 B), chute score (CS), exit velocity (EV), and ELISA scores for paratuberculosis in dams of calves (ES) on 5 feed intake and growth traits in bulls, heifers, and steers ($n = 461$) ranging from 100% Angus to 100% Brahman. Traits were post-weaning phenotypic residual feed intake (RFI), daily feed intake (DFI), feed conversion ratio (FCR), average daily gain (ADG), and weight gain (WG). Calves were assigned to pens in a GrowSafe automated feeding facility by sire group and sex, and fed a concentrate diet (cottonseed hulls, corn, molasses, and a protein, vitamin, and mineral supplement). The pre-trial adjustment period lasted 21 d. Individual daily feed intake was collected during the 70 d feeding trial. Weights and temperament traits were recorded every 2 weeks. Phenotypic RFI was computed as the difference between actual and expected feed intakes. Traits were analyzed using mixed models. Fixed effects were contemporary group (year-pen), RFI group (except when trait was RFI), age of dam, sex of calf, age of calf, B fraction of calf, heterozygosity of calf, mean CS, mean EV, ES, and residual. The RFI groups were high (RFI $>$ mean + 0.5 SD), medium (RFI between mean \pm 0.5 SD), and low (RFI $<$ mean - 0.5 SD; SD = 5.4 kg). Random effects were sire and residual. Brahman had lower ($P < 0.01$) RFI, DFI, and WG than Angus. Calves with higher mean EV had lower ($P < 0.04$) DFI and ADG than calves with lower mean EV. Neither mean CS nor ES were important for RFI, DFI, FC, ADG, and WG.

Key Words: Cattle, Feed Intake, Temperament

W38 Association between breed composition, phenotypic residual feed intake, temperament, ELISA scores for paratuberculosis, and ultrasound carcass traits in an Angus-Brahman multibreed herd. M. A. Elzo^{*1}, D. G. Riley², G. R. Hansen³, D. D. Johnson¹, R. O. Myer⁴, D. O. Rae¹, J. G. Wasdin¹, and J. D. Driver¹, ¹University of Florida, Gainesville, ²USDA-ARS STARS, Brooksville, FL, ³North Carolina State University, Plymouth, ⁴North Florida Research and Education Center, Marianna, FL.

Ultrasound carcass measurements are an important tool for preliminary assessment of carcass worth in beef cattle. Breed composition, phenotypic residual feed intake (RFI), temperament, and subclinical paratuberculosis in dams may affect calf ultrasound traits. The objective was to evaluate the association between breed group (Angus (A), Brahman (B), Brangus, 3/4 A 1/4 B, 1/2 A 1/2 B, and 1/4 A 3/4 B), RFI, chute score (CS), exit velocity (EV), ELISA score for paratuberculosis (ES), and ultrasound longissimus muscle area (ULMA), subcutaneous fat thickness (UFT), percent intramuscular fat (UPIF), and tenderness score (UTS) in calves ($n = 461$) ranging from 100% Angus (A) to 100% Brahman (B). Calves were allotted to pens (by sire group and sex) in a GrowSafe automated feeding facility (adjustment period = 21 d; feeding trial = 70 d), and fed a ration of corn, cottonseed hulls, molasses, and

a protein, vitamin, and mineral supplement. Individual feed intake was recorded daily, CS and EV biweekly, and ultrasound measurements at the end of the feeding trial. Phenotypic RFI was estimated as actual minus expected feed intake. Statistical analyses used homoscedastic mixed models. Fixed effects were contemporary group (year-pen), age of dam, RFI group (high: RFI > mean + 0.5 SD; medium: RFI between mean \pm 0.5 SD; low: RFI < mean - 0.5 SD; SD = 5.4 kg), sex of calf, age of calf, B fraction of calf, calf heterozygosity, mean CS, mean EV, and ES. Sire and residual were random effects. Brahman had lower ($P < 0.001$) ULMA, UFT, UPIF, and higher ($P < 0.001$) UTS values than Angus. Low RFI calves had lower UPIF ($P < 0.001$) than high and medium RFI calves. High ULMA was associated with low mean EV ($P < 0.015$). Mean CS and ES were non-significant for all ultrasound traits.

Key Words: Cattle, Feed Intake, Ultrasound

W39 Relationship between carcass traits and phenotypic residual feed intake, breed composition, temperament, and ELISA scores for paratuberculosis in an Angus-Brahman multibreed herd. M. A. Elzo*¹, D. D. Johnson¹, D. G. Riley², G. R. Hansen³, R. O. Myer⁴, D. O. Rae¹, J. G. Wasdin¹, and J. D. Driver¹, ¹University of Florida, Gainesville, ²USDA-ARS STARS, Brooksville, FL, ³North Carolina State University, Plymouth, ⁴North Florida Research and Education Center, Marianna, FL.

Identification of factors that permit animals to grow quickly and efficiently, and have desirable carcass characteristics remains a primary goal in beef production. The objective was to evaluate the relationship between 7 carcass traits and breed group (Angus (A), Brahman (B), Brangus, 3/4 A 1/4 B, 1/2 A 1/2 B, and 1/4 A 3/4 B), residual feed intake (RFI) group (high: RFI > mean + 0.5 SD; medium: RFI between mean \pm 0.5 SD; low: RFI < mean - 0.5 SD), chute temperament score (CS), exit velocity (EV), and dam ELISA score for paratuberculosis (ES) in 84 steers ranging from 100% A to 100% B. Carcass traits were hot carcass weight (HCW), longissimus muscle area (LMA), fat thickness (FT), kidney, pelvic, and heart fat (KPH), marbling score (MS), Warner-Bratzler shear force (SF), and tenderness score (TS). Records of ES were taken preweaning, and CS, EV, and RFI (actual minus expected feed intake) were obtained post-weaning during a 70-d feeding trial at a GrowSafe automated feeding facility. Subsequently, animals were sent to a South Texas feedlot, and commercially slaughtered at approximately 14 mm of FT. Carcass traits were collected at the slaughter facility, and SF and TS were obtained at the Florida Meat Processing Lab. Traits were analyzed using mixed models. Fixed effects were pen, RFI group, age of dam, age of calf, B fraction of calf, calf heterozygosity, mean CS, mean EV, and ES. Random effects were sire and residual. Brahman had lighter HCW ($P < 0.05$), smaller LMA ($P < 0.001$), lower MS ($P < 0.02$), higher SF ($P < 0.03$), and lower TS ($P < 0.001$) than Angus. High KPH was associated with high mean EV ($P < 0.03$). Mean CS, RFI group, and ES were non-significant for all carcass traits.

Key Words: Carcass, Feed Intake, Multibreed

W40 Genotype x environmental interaction to Nelore cattle raised in two Brazilian regions. J. C. DeSouza*¹, L. O. C. DaSilva², J. A. DeFreitas¹, C. H. M. Malhado³, A. Gondo², P. B. Ferraz Filho⁴, R. L. Weaber⁵, and W. R. Lamberson⁵, ¹Parana Federal University, Palotina Campus, PR, Brazil, ²Embrapa Beef Cattle Research Company, CNPGC,

Campo Grande, MS, Brazil, ³South East of Bahia University, Jequeia, BA, Brazil, ⁴State University of Mato Grosso do Sul, Tres Lagoas, MS, Brazil, ⁵University of Missouri, Columbia.

The objective this paper was to estimate genotype \times environment interaction between progeny of Nelore bulls in two different regions and estimate correlations of traits. Records were from calves raised in two Brazilian regions, Pará State (Region one) in North of Brazil and Bolsão (Region two) in Mato Grosso do Sul State. The regions were characterized by ARRUDA and SUGAI (1994) and differed by one or more of the following: production system, technology level, and natural resources such as climate, rain, topography and quality of the soil. The data were provided by the Brazilian Zebu Breeders Association (ABCZ) and by the National Beef Cattle Research Center (CNPGC) of the Brazilian Agricultural Research Corporation (Embrapa). The traits analyzed were: gain between birth and 120 d (GBWT_WT120, kg); weight at 120 days of age (W120, kg); gain between 120 d and 205 d (GWT120_WT205, kg); weight at 205 d (WT205, kg); gain from birth to weaning (GBWWT205, kg); weight at 365 d (WY, kg); and gain between 205 d and 365 d (GWT205WY, kg). The G \times E interaction was calculated using an animal model in the MTDFREML program. The variation accounted for by G \times E was between 0.42 (GWT205WY) and 0.93 (GW120_205, WT205, GBWWT205). The change in environment calculated using MME solutions of fixed effects (contemporary group) were 17.4 kg, and 20.7 kg; 37.3 kg, 26.9 kg; 59.1 kg and 25.5 kg, respectively, for weight 120 d, WT205 and WT365, for Pará and Bolsão. For WT120 the better trend was in Bolsão, but for others weights, in Pará. The genotype \times environment interaction (co)variance components resulted in an improved fit of the model for all traits. However, the large genetic correlations between regions or management systems (greater than 0.80) provides evidence for combining the production data of Nelore cattle from different regions and management systems across Brazil. In this case, specifically using sires in both regions should yield similar results. The result of evaluation of the environments showed a positive trend.

Key Words: Gain, Weight, Zebu

W41 Comparison of different nonlinear functions to describe beef cattle growth. L. G. Albuquerque*^{1,7}, S. Forni¹, M. Piles², A. Blasco³, L. Varona⁴, H. N. Oliveira^{5,7}, and R. B. Lobo⁶, ¹Universidade Estadual Paulista, Jaboticabal, Sao Paulo, Brazil, ²IRTA, Unidad de Cunicultura, Caldes de Montbui, Spain, ³Universidad Politécnica de Valencia, Valencia, Spain, ⁴Centre UdL-IRTA, Lleida, Spain, ⁵Universidade Estadual Paulista, Botucatu, Sao Paulo, Brazil, ⁶Universidade de Sao Paulo, Ribeirao Preto, Sao Paulo, Brazil, ⁷National Counsel of Technological and Scientific Development - CNPq, Brasilia, DF, Brazil.

The aim of the present work was to compare different nonlinear models for the prediction of adult weight of Nelore females. The growth curve parameters, their (co)variance components and environmental and genetic effects acting on these parameters were estimated jointly in a Bayesian hierarchical model. In the first stage of the hierarchy, four nonlinear equations were employed: Brody, Von Bertalanffy, Gompertz and Logistic. The analyses were carried out using three different data files to determine the consequences of having animals with few records. Three approaches were considered to describe the fitting errors standard deviations: constancy throughout the trajectory, linear increasing until 3 years of age and constancy thereafter, and nonlinear variation following the same function applied in the first stage of hierarchy. Models were

compared using Akaike's Information Criterion, Bayesian Information Criterion and Deviance Information Criterion. The fit at different points of the growth curve were compared applying the Gelfand's check function. The mean estimates of adult weight ranged from 531.78 to 586.89 kg. The Brody model provided higher estimates of asymptotic weight than the other models. Considering the same growth function, higher adult weight mean estimates were obtained when the fitting error variance was constant along the trajectory. None of the models was suitable to describe the fitting errors standard deviations at the beginning of the growth curves. All functions provided less accurate predictions at the beginning and predictions were more accurate after 48 mo of age. An increase in the number of animals that did not reach maturity did not impair the prediction of adult weights since growth curve parameters and their (co)variance components were estimated jointly. The Gompertz, Von Bertalanffy and Brody models were adequate to establish mean growth patterns and to predict the adult weight of Nelore females. The Brody model was more accurate in predicting the birth weight of these animals and presented the best overall goodness of fit.

Key Words: Bayesian Analysis, Longitudinal Data, Model Choice

W42 Principal component analysis of body measurements of Hanwoo. J. J Lee* and N. S Kim, *Chungbuk National University, Republic of Korea.*

Unlike carcass traits, body size measurements are composed of more than ten traits that are highly phenotypically correlated. The technique of principal component analysis was used to reduce a large number of variables to a smaller number of new variables (PCs) and characterizing cattle according to body shape. The objective of this study was to estimate and identify the combination values of principal components calculated using body measurements of Hanwoo (Korean Cattle). During 2004 to 2007, ten body measurements were collected by Korean Animal Improvement Association using 744 cattle records at yearling (12 months of age) and 411 cattle records at the end of test (30 months of age). These measurements included wither height (WH), rump height (RH), body length (BL), chest depth, chest width, rump length, hip width, thurl width, pin bone width and chest girth (CG). Phenotypic correlations among body measurements were estimated ranging from 0.23 to 0.97 at 1 year of age and from 0.25 to 0.93 at the end of test. The first principal component (PC1) indicated a weighted average of overall body measurements, accounting for 71.3% and 55.7% of the total variation for yearling and end of test, respectively. The two first PC had positive coefficients for all body measurements. The major sources of PC1, such as CG, BL, RH and WH, were similar for both periods of test. The second principal component (PC2) included withers height, rump height and body length with chest girth for both periods of test. PC2 accounted for slightly less than 20% of total variation for both periods of test. Further studies are needed to estimate genetic principal components through the simple reparametrization for animal breeding purposes.

Key Words: Hanwoo, Principal Component Analysis, Body Measurement

W43 Analysis of growth trait in Brazilian Simmental. M. G. Dib*¹, F. R. Araujo Neto², L. F. A. Marques³, and H. N. de Oliveira¹, ¹*Faculdade de Medicina Veterinária e Zootecnia - UNESP, Botucatu,*

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Estimates of variance components were obtained from a sample of 22,000 records of weaning weight (WW) and weight gains from weaning to yearling (GWY), yearling to 550-day (GY5), and 550 to 730-day (G57) of Simmental cattle raised in Brazilian farms. Data were collected by Brazilian Simmental Breeders Association. The pedigree data included information from 60000 animals. Variance components were estimated within a Bayesian context considering a multiple trait animal model with the fixed effects of contemporaries groups and age of dam and random direct and maternal genetic effects of animal, and maternal permanent environmental effect. Maternal (genetic and permanent) effects were included in the model only for WW. Analysis was performed using GIBBS2F90 (Misztal, 2006). Flat priors were assumed for variance components and fixed effects. Marginal densities of the variance components and other genetic parameters were estimated from the Gibbs output. Graphical inspection and the Gibanal program (Van-Kaam, 1998) were used for assessing convergence to the equilibrium distribution, the joint posterior. A burn-in period of 20,000 iterations was adopted, followed by 550,000 iterations with a thinning interval of 100 iterations. Hence, nominal sample size for post-Gibbs analyses was 5,500. Posterior means of heritability estimates were low: 0.16 (WW); 0.12 (GWY); 0.11 (GY5) and 0.16 (G57) for the direct effects and 0.05 for maternal effect (WW). For the environmental correlations the posterior means were near to zero, except for the between GY5 and G57 (0.20). For the genetic correlations values were high and positive ranging from 0.39 (between GWY and GY5) to 0.72 (GWY and G57). For yearling, 550 days and 730 days heritabilities calculated from the estimates were, respectively, 0.21; 0.26 and 0.34. Results confirm that under Brazilian conditions, selection for growth on Simmental cattle should be effective. Although Simmental cattle are recognized among beef breeds by their good maternal ability, genetic variation among cows plays minor role on purebred calf growth in Brazil.

Key Words: Heritability, Correlations, Variance Components

W44 Relationship between ultrasonically-measured beef cow carcass traits and lifetime productivity. L. A. Pacheco*, J. R. Jaeger, D. W. Moser, and K. C. Olson, *Kansas State University, Manhattan.*

The objective of our study was to determine if ultrasonically-measured intramuscular fat (IMF) and longissimus muscle depth (LMD) of replacement heifers was related to lifetime cow productivity, cow longevity and progeny performance. Angus heifers (n=160) were managed as a contemporary group and developed in a dry lot until breeding at 14 months of age. Heifer IMF and LMD were measured at approximately 205 d of age. Each year females were mass-mated following estrus synchronization and exposed to bulls 10 days later for the remainder of the 45 d breeding season. Following first breeding, heifers were managed in a spring-calving, native range-based production system with a 12-mo calving interval for the duration of the study (2004-2007). Animals were examined for pregnancy during August each year. Following pregnancy determination, non-pregnant females were removed from the herd. Calves were weighed at birth; weaning weights were adjusted for age of calf, age of dam, and sex of calf. Pregnancy rate as heifers was not related to IMF or LMD (P=0.12 and P=0.18, respectively) measured at 205 d of age. As mature cows pregnancy rate was not related to IMF or LMD (P=0.12 and P=0.18, respectively). Similarly, calf birth weights

were not related to dam IMF; however, calf birth weights increased ($P < 0.06$) as dam LMD increased. A 1 mm increase in dam LMD was associated with an increase of 0.15 kg in calf birth weight. Calf adjusted weaning weights were not related ($P = 0.13$) to dam IMF. Conversely, calf adjusted weaning weights increased ($P < 0.04$) as dam LMD increased. A 1 mm increase in dam LMD was associated with an increase of 0.78 kg in calf adjusted weaning weight. Calving date was not related to dam IMF or LMD ($P = 0.3$ and $P = 0.08$, respectively). These data were interpreted to suggest that increases in cow LMD were associated with greater birth weights and weaning weights of progeny. In contrast, cow IMF measured at 205 d of age was not related to pregnancy rate, calf birth weights, calf weaning weights, or calving dates.

Key Words: Intramuscular Fat, Longissimus Muscle, Beef Cows

W45 Estimates of genetic parameters for reproductive traits in Nelore cattle females. M. J. Yokoo^{*1}, L. G. Albuquerque¹, C. U. Magnabosco², J. F. H. Rodrigues¹, R. B. Lobo³, L. A. F. Bezerra³, and G. J. M. Rosa⁴, ¹São Paulo State University, Jaboticabal, São Paulo, Brazil, ²Embrapa Cerrados, Planaltina-DF, Brazil, ³University of São Paulo, Ribeirão-Preto-SP, Brazil, ⁴University of Wisconsin, Madison.

This study aimed to estimate genetic parameters of female reproductive traits (RTs) in Nelore cattle, including age at first calving (AFC), first calving interval (FCI), average calving interval (ACI), gestation length (GL), and days to conception (DC). Data on 3,203 females were analyzed using univariate animal models, and Bayesian inference was utilized for inferring variance components (VC). The models included the fixed effect of contemporary groups and the random effect of animals. Permanent environment was also included in the models as a random effect, except for the traits AFC and FCI. The table below shows the means of the posterior distributions of VC and heritability. Heritability estimates were relatively low, indicating that these RTs will respond slowly to individual selection. Therefore, considering that these traits are highly influenced by environmental factors, improvements on females' management will probably enhance reproductive indices more effectively. In Zebu breeds selection has been made primarily for growth traits and the only RT widely used in the selection indexes is scrotal circumference. Female RTs are also highly influenced by the producer management decisions and, consequently, are difficult to select. However, these RTs present a significant impact in the production system profitability. As the gains obtained by selection are permanent, selection indexes including one or some of these female RTs could be developed. For that, further studies considering the genetic correlation between these RTs and other economic important traits are necessary.

Table 1. Posterior distributions of variance components and heritability for reproductive traits in Nelore cattle females

VC \ Trait	DC	GL	AFC	FCI	ACI
Direct additive genetic	657.4	2.1	372.8	691.0	555.3
Permanent environment	748.4	3.8	—	—	307.2
Residual	4749.8	56.9	3681.7	8410.2	7870.3
Heritability (SEM)	.11 (.02)	.03 (.02)	.09 (.05)	.08 (.02)	.08 (.02)

SEM = standard error of the mean

Key Words: Bayesian, Heritability, Zebu

W46 An approach for considering genotype × environment interaction in the genetic evaluations of Zebu beef cattle in Brazil. L. O. C. Silva^{*2,3}, S. Tsuruta¹, J. K. Bertrand¹, A. Gondo², P. R. C. Nobre⁴, R. A. A. Torres, Jr.³, and C. H. C. Machado⁵, ¹University of Georgia, Athens, GA, ²EMBRAPA Beef Cattle, Campo Grande, Brazil, ³National Council for Scientific and Technological Development, Brasilia, Brazil, ⁴Foundation for Agric. and Environment Research, Campo Grande, Brazil, ⁵Brazilian Association of Zebu Breeders, Uberaba, Brazil.

The objective of this study was to evaluate the importance of genetic × environment interaction when doing genetic evaluations of Zebu beef breeds in Brazil. The data set of Tabapua breed included 72,331 actual weights at weaning (WW) and 43,567 at yearling (YW) from 94,612 animals in the pedigree file. These data were collected between 1979 and 2007 by the Brazilian Association of Zebu Breeders and sent to National Center for Research on Beef Cattle from EMBRAPA. The observed weights (WW and YW) were analyzed using AIREMLF90 under an animal model. Fixed effects included contemporary group (CG); difference of ages within the CG (linear covariable), performance group (PG), age group of cows (AGC: young and mature), age of cow at calving within AGC (fit as linear and quadratic), and the actual age of the animals at weighing were included in the model. CG, included a minimum of five animals, was defined by sex, farm, year, season, and feeding management. Random effects in the model were direct, maternal, maternal permanent environment, and sire × performance group interaction (SxPG). PG was created based on the average of CG for adjusted WW and YW. The population was divided in three performance groups (1-low; 2-medium; 3-high performance), each including 33% of the CG numbers. Preliminary results showed values of variance components for SxPG of 2.48 ± 0.66 (0.84% of residual variance-RV) for WW and 6.79 ± 1.84 (1.27% of RV) for YW. Correlations direct effect for sires with at least 20 progeny in high and low PG were 0.992 for WW and 0.978 for YW. Results are indication of no substantial reranking of sires in environments with different level of production.

Key Words: Zebu Beef Cattle, Growth Weight, GxE Interaction

W47 Phenotypic correlations between the ratio of body measurements and economic traits in Korean native beef cattle. S.-H. Oh^{*1}, T. White¹, and S.-D Kim², ¹North Carolina A&T State University, Greensboro, ²National Institute of Animal Science, South Korea.

The objective of this study is to investigate if there are any correlations between the ratio of body measurements and economic traits in the population of Korean native beef cattle. The data has been collected at the National Institute of Animal Science in South Korea. The body was measured every six months from 6 months of age to 24 months of age. The number of animals measured was 183 at 6, 12, and 24 months, and 663 at 18 months. The collected data included height at wither(BH), height at rump(RH), horizontal distance between top of shoulder and pins(BL), depth at chest(CHD), width of chest(CHW), horizontal distance between top of hips(HW), horizontal distance between projecting part of pelvises(TW), horizontal distance between pins(PW), distance in straight line between front of hipbone to pinbone(RL), and girth of chest(CHG) as body measurements. In the meantime, the number of animals having the economic traits was 2706. The economic traits consisted of body weight(BW), backfat(BF), carcass weight(CW), index of yield(YGI), and the percentage of dressing(DP), which were measured at slaughter. Pearson correlations in SAS 9.1.3 were used to analyze the data. Some of the ratio of body measurements showed

30-40% of phenotypic correlation with economic traits. The ratio of BH/CHD had negative correlations with BW, BF, CW, and DP, which were -0.29, 0.24, -0.31, and -0.20, respectively. The ratio of RH/CHD also showed negative correlations with BW, BF, CW, and DP, which were -0.35, -0.27, -0.38, and -0.22, respectively. As a result, there were phenotypic correlations between the ratio of body measurements and economic traits, which means that producers may use the ratios as a selection tool for better individuals. Further study will be needed to investigate if there are genetic correlations among them.

Key Words: Correlation, Body Measurement, Economic Trait

W48 Polymorphism of IGF-I gene and its association with growth traits in chicken. B. W. Wang^{*1}, X. X. Wei¹, M. A. Zhang¹, B. Yue¹, L. Wang¹, Z. G. Yang^{1,2}, S. H. Yu¹, Y. C. Wang¹, L. Z. Jing¹, and G. L. Liu¹, ¹Qingdao Nongye University, Qingdao, Shandong Province, China, ²Feed Research Institute of Chinese Academy of Agricultural Sciences, Beijing, China.

In order to study the polymorphism of 5' region of the insulin like growth factor I (IGF-I) gene in chicken and the association with growth traits, the genetic polymorphism of IGF-I gene in 372 Luxi game chicken (12 weeks) and 423 Langya Chicken (12 weeks) was detected by PCR-RFLP, the relationships between genotypes and meat traits, egg traits, belligerence were analyzed with linear model. Frequencies of IGF-I genotypes (AA, AB, BB) were 0.3688, 0.4965, 0.1348 in Langya Chicken and 0.4516, 0.3710, 0.1774 in Luxi game chicken respectively after PCR products had been cut by Pst I enzyme. The A to G transition was detected at the 5' region of IGF-I gene by sequencing the homozygotes (GenBank accession number: EF198877, EF488284). The observed genotype distribution was not different from the expected distribution under the assumption of the Hardy-Weinberg equilibrium for the IGF-I allele of two kinds (Langya Chicken, $\chi^2 = 0.359$, $P > 0.05$; Luxi game chicken: $\chi^2 = 2.422$, $P > 0.05$). For Langya Chicken, AA genotype had the highest least square means of meat traits indexes such as body weight (1080±34 g), eviscerated weight with giblet (761.1±10.5g), leg muscle weight (126.1±7.6g) and chest muscle weight (104.1±6.0g); AB genotype had the highest least square means of egg traits indexes. For Luxi game chicken, AA genotype had the highest least square means of stronger belligerence indexes such as neck length (17.93±1.82cm) and shank length (9.01±0.69cm); BB genotype had the highest least square means of meat traits index such as body weight (2.41±0.06kg). The results showed that the genetic polymorphism of the 5' region of IGF-I gene had different genetic effects in different breeds. The experiment provided theoretical foundation for IGF-I gene's distribution state and further utilization of local chicken breeds in China.

Key Words: Chicken, IGF-I Gene Polymorphism, Growth Traits

W49 Genetic and non-genetic factors affecting broiler chick weight at hatch in South West Nigeria. O. T. F. Abanikannda¹, A. O. Leigh¹, O. N. Coker³, O. T. Adeseko^{*1}, O. Orunmuyi⁴, A. L. Dare², I. S. Okoya¹, and I. O. Ola-Gbadamosi¹, ¹Lagos State University, Ojo, Lagos State, Nigeria, ²Obasanjo Farms Nigeria Limited, Igboora, Oyo State, Nigeria, ³S & D Farms Nigeria Limited, Odeda, Ogun State, Nigeria, ⁴Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

Measurable productivity traits of animals are influenced by both genetic and non-genetic components. Most performance traits of broilers like

other animals are also quantitative in nature. The broiler breeds investigated were Anak, Marshall and Ross, and the eggs were sourced from reputable parent stock farms. The effects of the following factors on chick weight were investigated; chick sex (X), breed (B), hen's age (A), egg weight (E), egg length (L), egg width (W), egg weight at candling (C). The statistical model describing this study is given as $Y_{ijklmno} = \mu + X_i + B_j + A_k + L_l + W_m + C_n + \epsilon_{ijklmno}$. With the exception of chick sex, egg length and egg width which were not significant ($P > 0.05$), all other factors were highly significant ($P < 0.001$) on chick weight. All the factors studied exhibited similar trend across the three breeds, with Anak breed having the least and Ross breed the highest. Breed alone accounted for 48.32 percent of total variation explained, while egg weight and hen's age contributed 32.40 and 16.53 percent respectively. The Ross breed significantly had the highest values for all the measurements taken, while the Marshall breed was intermediate between the Ross and the Anak breeds. Considering the direct relationship that exist between the chick's initial weight, average daily gain and final weight, the Ross breed promises to be a better breed in terms of meat yield.

Table 1. Effect of breed on some egg measurements[†]

Breed	N	Egg Weight (g)	Egg Length (mm)	Egg width (mm)	[‡] Weight at Candling (g)	Chick Weight (g)
Anak	361	58.66±0.28 ^c	57.38±0.14 ^b	42.93±0.08 ^c	50.60±0.27 ^c	39.19±0.24 ^c
Marshall	361	60.33±0.34 ^b	57.40±0.17 ^b	43.62±0.09 ^b	52.56±0.31 ^b	41.29±0.26 ^b
Ross	282	66.02±0.30 ^a	59.65±0.15 ^a	45.41±0.10 ^a	58.27±0.30 ^a	45.45±0.30 ^a
Combined	1004	61.33±0.21	58.02±0.09	43.87±0.86	53.46±0.20	41.71±0.17

[†]Means differs significantly ($P < 0.05$). [‡]Candling done at 18th day

Key Words: Egg Weight, Weight at Candling, Chick Weight

W50 Boar fertility and semen quality characteristics in lines of pigs selected for component traits of female reproduction. B. A. Freking^{*1}, P. Purdy², C. Welsh², S. Spiller², and H. Blackburn², ¹USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE, ²National Animal Germplasm Program, Fort Collins, CO.

Selection for 11 generations for ovulation rate (OR) or uterine capacity (UC) resulted in significant changes in component traits of litter size. Our objective was to characterize male fertility as a correlated response to selection compared to an unselected control line (CO). Each boar (n=60) from two replicate seasons was collected twice. The sperm-rich fraction was obtained and volume and concentration of sperm cells was measured to estimate total sperm production. Each ejaculate was extended 1:3 v/v with Androhep Plus (Minitube, Verona, WI) and packed for shipping to the NAGP lab for processing into frozen straws. Semen quality was measured by computer assisted semen analysis at three time points: fresh (F), 24 h after extender added (E), and post-thaw (PT). A mixed model analysis of variance was applied to the data. Fixed effects of replicate, line and two-way interactions were fitted. The random effect of boar within line × replicate was used to test line differences. Sperm concentration was not different ($P = 0.18$) among the lines (0.594, 0.691, and 0.676 *10⁹ cells/ml) for CO, OR, UC lines, respectively. Significance ($P < 0.05$) was detected for volume of the sperm-rich fraction, greatest for OR (86.4 ml), intermediate for UC (75.6 ml), and lowest for CO (70.2 ml). Line differences were thus detected ($P < 0.02$) for total sperm production, greatest for OR (54.9 *10⁹), intermediate for UC (48.7 *10⁹) and lowest for CO (40.5 *10⁹). A higher percentage of progressively motile sperm and also higher estimates of sperm velocity only at time point E ($P < 0.01$) were detected in favor of CO. Estimates of motility,

velocity, and activity measured on F and E time points were moderately and positively correlated with estimates obtained PT. Selection for component traits of female reproduction has had a favorable effect on total sperm production of boars.

Key Words: Fertility, Pigs, Semen Quality

W51 Association analysis of candidate SNPs on reproductive traits in swine. L. A. Rempel*, J. W. Holl, and G. A. Rohrer, *USDA, ARS, US Meat Animal Research Center, Clay Center, NE.*

Being able to identify young females with superior reproduction traits would have a large financial impact on commercial swine producers. Previous studies have discovered SNPs associated with economically important traits such as litter size, growth rate, fat deposition, and feed intake. The objective of this study was to test candidate SNPs for sow prolificacy production traits, including: age at puberty (AGEP, n = 963), ovulation rate (OR, n = 1,122), weaning to estrus interval (WEI, n = 744), total pigs born (TB, n = 1,924), number born alive (NBA, n = 1,924), number born dead (NBD, n = 1,924), and number mummified (MUM, n = 1,924) and determine association of these traits in gilts and sows of a Landrace-Duroc-Yorkshire composite population. Candidate SNPs included estrogen receptors (ESR) 1 and 2; prolactin receptor (PRLR); alpha-D-mannosidase (MAN); leptin (LEP); and melanocortin 4 receptor (MC4R). Genotypes were verified using GenoProb. Association analyses regressed additive (A), dominant (D), and imprinting (I) SNP effects on each trait. ESR2 A949G was associated with AGEP (A = 2.18 d; P < 0.025). PRLR T1528A was associated with AGEP (I = 3.62 d; P < 0.001). PRLR C1217T was associated with TB (A = -0.31 piglets; P < 0.017). An association was identified between MUM and PRLR G1439A (A = -0.09 piglets; P < 0.003). Age of puberty was also associated with MAN A1426G (A = -2.47 d; P < 0.008 and I = 1.99 d; P < 0.06). MC4R A1426G was associated with WEI (A = 0.86 d; P < 0.003) as well as MUM (D = -0.130 piglets; P < 0.001 and I = -0.06 piglets; P < 0.046). No significant associations were detected for ESR1 or LEP SNPs. These results indicate that SNPs previously linked to more traditional production and growth traits may also serve in the capacity to assist with selection of young females for superior reproductive performance.

Key Words: Pig, SNP, Reproductive Traits

W52 Analysis of founder-specific inbreeding depression on Landrace sow longevity. J. Casellas*, L. Varona, N. Ibáñez-Escriche, and J. L. Noguera, *Genética i Millora Animal, IRTA-Lleida, Lleida, Spain.*

Inbreeding depression is a biological aspect mainly related to the recessive genetic load carried by a population. When this genetic load is unevenly distributed among founder genomes, heterogeneity of founder-specific inbreeding depression (FSID) could be anticipated, although this phenomenon has never been evaluated on sow longevity (SL). The objective of this study was to ascertain whether FSID impairs SL. Longevity data of 4,226 hyperprolific Landrace sows (13.28 ± 0.06 piglets per litter) were recorded in a selection herd registered in the Pig Spanish Data Bank (BDporc) between years 1988 and 2006. Sow longevity was measured as the time interval between the first mating

until culling or death (complete records), whereas records from sows still alive at the end of data collection were considered as censored. Full pedigree included 1,082 founders and 5,273 descendants, and only 35 founders contributed inbred descendants. Sow longevity was analyzed under a Weibull piecewise proportional hazard model solved through Bayesian inference. Prior distribution for FSID effects was modeled as asymmetric Gaussian to allow for skew patterns. Modal (and highest posterior density region at 95%) estimates for ρ and λ baseline parameters were 0.927 (0.881 to 0.973) and 0.00008 (0.00006 to 0.00011), with three cut points placed at 296 d (289 to 300), 492 d (477 to 499) and 1,012 d (1,008 to 1,017). Additive genetic variance for SL was 0.312 (0.248 to 0.384; $h^2 = 0.159$), whereas the variance component for the FSID effects was 0.005 (0.001 to 0.009), revealing a substantial degree of between-founders heterogeneity. Posterior distribution for FSID effects was asymmetric with an over-expressed right-tail, where founder-specific modal estimates for FSID effects ranged between -0.006 (-0.084 to 0.076) and 0.076 (0.005 to 0.148) for each 1% inbreeding. These results corroborated a wide and skew distribution of FSID effects, with null or negative effects on SL.

Key Words: Asymmetry, Inbreeding Depression, Sow Longevity

W53 SNPs of LEP and FABP4 genes in *Bos indicus* and crosses: Segregation and association with meat traits. M. G. Dib*¹, R. A. Curi¹, L. A. L. Chardulo², A. C. Silveira¹, M. D. B. Arrigoni¹, and H. N. de Oliveira¹, ¹Faculdade de Medicina Veterinária e Zootecnia - UNESP, Botucatu, SP, Brazil, ²Instituto de Biociências - UNESP, Botucatu, SP, Brazil.

Fat deposition is one of the most important factors affecting carcass and meat quality in beef cattle. Leptin and fatty acid binding protein 4 play important roles on fat metabolism. The objectives of this study were to estimate, in beef cattle of different genetic groups, the allele and genotype frequencies of SNPs located in the Leptin (LEP) and the fatty acid binding protein 4 (FABP4) genes and to evaluate associations between the polymorphisms and meat traits. One hundred and forty seven animals (46 Nellore (*Bos indicus*), 41 Canchim (5/8 *Bos taurus* + 3/8 *B. indicus*), 26 Rubia Gallega x Nellore crossbred (1/2 *B. taurus* + 1/2 *B. indicus*), 19 three-way cross Brangus (9/16 *B. taurus* + 7/16 *B. indicus*) and 15 three-way cross Braunvieh (3/4 *B. taurus* + 1/4 *B. indicus*)) were genotyped by PCR-RFLP and recorded for backfat thickness, total lipids, marbling score, ribeye area and shear force. Data analyses were performed with a linear model that included combined effect of contemporary and genetic group and genotypes effect. The A and G alleles of the LEP/BsaAI polymorphism (Y11369.1: G1620A) presented homogeneous distribution in all of the genetic groups but no association with the phenotypes were found. The FABP4/MspAII locus (AAFC01136716.1: G7516C) was found to be fixed for the C allele in *B. indicus* and in the crossbreed animals the C allele was found in very high frequency. Besides not being informative in *B. indicus* animals, the FABP4/MspAII polymorphism didn't show relevant association with the studied traits in the crossbreed animals. In spite of the importance of the studied genes in fat metabolism, it was not possible to find evidences supporting association between the studied polymorphisms and meat traits.

Financial support: Fapesp and CNPq

Key Words: Polymorphisms, Candidate Gene, Fat Deposition

W54 Markers on bovine chromosome 20 associated with fat related traits and incidence of contracting bovine respiratory disease. M. D. Garcia*¹, L. Matukumalli², T. L. Wheeler¹, S. D. Shackelford¹, M. Koohmaraie¹, T. P. L. Smith¹, and E. Casas¹, ¹USDA-ARS, U.S. Meat Animal Research Center, Clay Center, NE, ²USDA-ARS, Beltsville Animal Research Center, Beltsville, MD.

The objective of this study was to assess the association of single nucleotide polymorphism (SNP) markers with incidence of bovine respiratory disease (BRD) and fat related traits. Steers from the Cycle 7 of the Germplasm Evaluation Program (GPE7; n=565) were used. The GPE7 population comprises animals derived from 7 breeds: Angus, Charolais, Gelbvieh, Hereford, Limousin, Red Angus, and Simmental. Markers were located between centimorgan 14.5 and 20.3 on bovine chromosome 20 (BTA20). One SNP was associated with incidence of BRD and yield grade ($P < 0.008$). Animals inheriting the CT genotype had the lowest yield grade (2.82 ± 0.09), and the highest incidence of BRD (0.33 ± 0.04) when compared to those inheriting the CC genotype (3.12 ± 0.19 , and 0.17 ± 0.02 for yield grade and incidence of BRD, respectively). Animals inheriting the TT genotype were observed in low frequency (n=11) and were excluded from the analysis. A second SNP was associated ($P < 0.007$) with incidence of BRD, dressing percentage and estimated kidney, pelvic and heart fat percentage (KPH). Steers inheriting the AG genotype had the lowest incidence of BRD and KPH (0.15 ± 0.03 and 2.22 ± 0.05 , respectively) when compared to animals inheriting the AA genotype (0.28 ± 0.03 and 2.39 ± 0.05 , respectively). Animals inheriting the GG genotype had an intermediate incidence of BRD (0.21 ± 0.03), when compared to animals inheriting the AA and AG genotypes, and similar KPH as those inheriting the AA genotype (2.35 ± 0.05). Animals inheriting the AG and GG genotypes had lower dressing percentages (62.2 ± 0.13 and 62.2 ± 0.12 , respectively) when compared to animals inheriting the AA genotype (62.8 ± 0.13). Further evaluation of SNP markers in this region of BTA20 is needed to identify optimal marker combinations associated with BRD and fat related traits.

Key Words: Bovine Respiratory Disease, Carcass Traits, SNP

W55 Identification and comparison of a second stearoyl-CoA desaturase gene in pigs, sheep, and chickens. A. J. Lengi and B. A. Corl*, *Virginia Polytechnic Institute and State University, Blacksburg.*

Stearoyl-CoA desaturase (SCD) is an important enzyme of lipid metabolism controlling the ratio of monounsaturated to saturated fatty acids in body tissues. SCD catalyzes the addition of a *cis*-9 double bond to several saturated fatty acid substrates. Multiple isoforms have been described in some species, especially in mice which have four. Humans have two isoforms: SCD1 with homology to the SCD isoforms present in rodents, and SCD5 which appears to be a distinct gene not found in the mouse. We recently identified SCD5 in the cow. Here we report the identification of SCD5 in pigs, sheep, and chickens. We used 5' and 3' rapid amplification of cDNA ends to identify and sequence SCD5 transcripts. Sequencing revealed that the SCD5 gene has greater guanine and cytosine content than SCD1, especially in the 5' region. Aligning the amino acid sequences of human, cow, sheep, pig, and chicken SCD5 reveals high homology among the sequences, but less homology with SCD1 amino acid sequences. The amino acid sequence includes characteristic histidine motifs present in desaturase enzymes. Interestingly, the PEST-find algorithm showed that SCD5 lacks the PEST sequences present in the SCD1 protein that control its rapid degradation. We compared the

tissue specific mRNA expression of SCD1 and SCD5 by real-time PCR. Tissue expression of SCD1 was greatest in lipogenic tissues: adipose tissue of sheep and pigs and the liver of chickens. SCD5 had a different expression profile with consistently high expression in the brain of pigs, sheep, and chickens. This report expands the number of species known to have the SCD5 gene and is the first report of the SCD5 gene outside of mammals. These data tend to indicate that SCD1 and SCD5 are the result of a gene duplication event early in evolution.

Key Words: Stearoyl-CoA Desaturase, Brain, Fatty Acids

W56 Differential expression of cyclic AMP-responsive element modulator (CREM) transcription factor isoforms during boar spermatogenesis and in transcriptionally silent boar spermatozoa. S. Green* and B. L. Sartini, *University of Rhode Island, Kingston.*

Identifying the origins of male fertility variation can lead to greater reproductive efficiency in livestock. Recent studies have demonstrated that temporal regulation of functional isoform expression by alternative splicing and polyadenylation is necessary for development of the male germ cell. Specifically, differential expression of the CREM (cAMP-responsive element modulator) transcription factor isoforms occurs in spermatogonia, spermatocytes and spermatids. Aberrant CREM isoform expression has been correlated with subfertility and infertility in humans, mice, and horses. Although species variation in developmental CREM isoform expression has been reported, CREM gene expression during boar spermatogenesis has not been investigated. Using RT-PCR and 3' rapid amplification of cDNA ends (RACE) primers designed from the reported human CREM sequence, we amplified CREM in boar testis from different developmental stages. The predicted full-length mRNA transcript size of adult boar CREM is 1090 bp while prepubertal boar testis contains a predominant CREM mRNA transcript that is 690 bp in length. From these results, alternative isoforms of CREM are expressed in boar testis at different developmental ages. Additionally, we have amplified a 690 bp CREM transcript from the pool of mRNA in transcriptionally silent boar spermatozoa. The boar spermatozoa CREM transcript contains a poly(A) tail and further analysis will determine if the spermatozoa CREM transcript is a remnant from spermatogenesis or translated at a further stage. Understanding the regulation of gene expression during boar spermatogenesis will identify sources of male fertility variation in livestock.

Key Words: Boar, Spermatogenesis, mRNA

W57 Molecular analysis of the Mexican hairless pig in the Yucatan Peninsula. F. Cetz-Solis², A. Sierra-Vasquez*¹, A. Da Silva-Mariante⁴, S. Rezende-Paiva⁴, C. Cruz-Vazquez², and C. Lemus-Flores³, ¹Instituto Tecnológico de Conkal, Conkal, Yucatan, Mexico, ²Instituto Tecnológico el Llano, Aguascalientes, Mexico, ³Universidad Autónoma de Nayarit, Tepic, Nayarit, Mexico, ⁴Embrapa Cenargen, Brasília, DF, Brasil.

Mexican hairless pig (MHP) is a descendant of introduced breeds from Spain about 500 years ago, and it is in danger of extinction at the present time. The objective of this study was to characterize at molecular level the genetic variability of MHP in the Peninsula of Yucatan. Ten loci microsatellites were used in 52 unrelated pigs from ten location distrib-

uted in three states, Yucatan (n=31), Campeche (n=10) and Quintana Roo (n=11). Genetic diversity for animals in each state was estimated by the unbiased average heterozygosity values (H_o and H_e) and the allele number. Polymorphic information content (PIC) was estimated based on allelic frequencies. Nei's standard genetic distances were used to reveal the genetic relationship among state populations. Campeche pigs presented the highest H_o and H_e values (0.59 ± 0.05 and 0.64 ± 0.17), whereas Yucatan pigs had the lowest values (0.50 ± 0.03 y 0.52 ± 0.26). Eight microsatellites loci (considering all animals) were polymorphic, ranging from 0.42 to 0.88; SO355 and SO227 had low polymorphic

values (0.15 and 0.29, respectively). The average PIC for animals in the Peninsula of Yucatan was 0.54. A genetic relation among pigs from the three states was found, with pigs from Yucatan and Quintana Roo being more closely related. This evaluation found a lower genetic diversity than other related studies in México. This work should be considered in order to design conservation programs for MHP; especially for pigs from the Campeche and Quintana Roo regions.

Key Words: Microsatellites, Mexican Hairless Pig, Genetic Diversity

Companion and Exotic Animal Biology

W58 *Ancylostoma* spp. in dogs of beaches and fishing villages of Navolato, Sinaloa, Mexico. M. C. Rubio Robles*, F. G. Torres N, I. Sánchez A, J. Gaxiola M, G. Estrada S, M. López V, G. Silva H, S. M. Gaxiola C, and N. Castro del C, *FMVZ Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico.*

Ancylostoma spp. represents a serious health problem for animals and humans. These blood-feeding parasites produce Larva migrans, also known as creeping eruptions or sandworm eruptions. These are characterized by tortuous migratory lesions of the skin and occur when the larvae of dog hookworm penetrate the intact exposed skin and migrate through the epidermis progressing at the rate of few millimeters to about 3 cm/day. It is seen in tropical and subtropical areas. International travel and increasingly exotic diets have resulted in an increase in cases of cutaneous larva migrans in industrialized countries.

The objective of this work was to determine the prevalence of *Ancylostoma* spp. in dogs of beaches and fishing villages of Navolato, Sinaloa, Mexico. This was determined for a representative sample (both sexes, breeds and sizes of dogs) described by the technique of Thrusfield (1995) : $n=[t*SD/L]^2$. Where n = sample size, t = value of the normal distribution (Student t) for a 95% confidence level (t = 1.96), L = accepted error or precision (5%), and SD = weighted disease prevalence (%). On the basis of the technique described, the total number of sample animals determined for random sampling was 134. For each, dog feces were collected rectally by digital stimulus into previously identified plastic bags. The samples were transported under refrigeration at 4°C to the unit Laboratories of the FMVZ-UAS, and processed by the flotation technique with sugar solution. The results indicate that of the 134 dogs analyzed 55 (41.04%) were positive for *Ancylostoma* spp. This is a considerable number and the proportion of animals testing positive continues to be an issue of importance in the community. Frequently these dogs roam in and around the town and can distribute parasites. Residents and visitors are not well informed or ignore the risk of diseases that dogs can transmit to them.

Key Words: *Ancylostoma*, Dogs, Prevalence

W59 The prevalence of fleas in dogs of beaches and fishing villages from Navolato, Sinaloa, Mexico. M. C. Rubio Robles*, J. Gaxiola M, G. Estrada S, M. López V, G. Silva H, I. Sánchez A, F. G. Torres N., S. M. Gaxiola C, and N. Castro del C, *FMVZ Universidad Autonoma de Sinaloa., Culiacan, Sinaloa, Mexico.*

Adult fleas are a nuisance to humans and their pets, and can cause medical problems including flea allergy dermatitis, secondary skin irritations and, in extreme cases, anemia. Although bites are rarely felt, it is the resulting irritation caused by the flea salivary secretions that varies among individuals. Some may witness a severe reaction (general rash or inflammation) resulting in secondary infections caused by scratching the irritated skin area. Also, fleas may transmit tapeworms (more common infection is *Dipylidium caninum*) which normally infest dogs and cats but may appear in children if parts of infested fleas are accidentally consumed. The objective of this work was to determine the prevalence of fleas in dogs of beaches and fishing villages of Navolato, Sinaloa, Mexico. This was determined for a representative sample (with both sexes, breeds and sizes of dogs) described by the technique of Thrusfield (1995) : $n=[t*SD/L]^2$. Where n = sample size, t = value

of the normal distribution (Student t) for a 95% confidence level (t = 1.96), L = accepted error or precision (5%), and SD = weighted disease prevalence (%). On the basis of the technique described, the total number of sample animals determined for random sampling was 264. For each dog, fleas were collected with cotton and placed into previously identified plastic bags. The samples were transported to the unit Laboratories of the FMVZ-UAS, and observed microscopically. The results indicate that of the 264 dogs analyzed 211 (79.92 %) were positive for fleas. It is concluded that this is a considerable number of positive animals and if the present condition continues, it can pose serious problems for the community since frequently these dogs are at different parts of the town and can pass the infection to other healthy animals, visitors and family members.

Key Words: Fleas, Dogs, Prevalence

W60 Diagnostic potential of serum proteomic patterns in canine *Fusarium* mycotoxicosis. M. C. K. Leung* and T. K. Smith, *University of Guelph, Guelph, ON, Canada.*

The clinical symptoms of canine *Fusarium* mycotoxicosis such as anorexia, growth inhibition, lethargy, and immunosuppression are often not specific enough for veterinarians to diagnose the mycotoxicosis. The low molecular mass range (1 - 10 kDa) of serum proteome holds great potential as a source of diagnostic biomarkers. Surface-enhanced laser desorption/ionization - time of flight - mass spectrometry (SELDI-TOF-MS) is a novel technique which generates a mass spectrum of a selected protein fraction in a biological sample. In the current experiment, SELDI-TOF-MS as well as conventional blood chemistry analyses were used to investigate the effects of a combination of foodborne *Fusarium* mycotoxins on the serum proteome of 12 beagle dogs. A control diet was prepared with corn, poultry by-product, and wheat as the main ingredients. A mycotoxin-contaminated diet was prepared by replacing control corn and wheat with naturally contaminated grains and contained deoxynivalenol (2.7 ppm), 15-acetyl deoxynivalenol (0.2 ppm), zearalenone (0.3 ppm), and fusaric acid (8.4 ppm). The animals was fed the experimental diets for a 14 day period and blood samples were taken. Blood chemistry analyses revealed an inhibitory effect of foodborne mycotoxins on serum concentration of fibrinogen and serum activities of alkaline phosphatase and amylase (P < 0.05%), but the other effects on blood hemoglobin concentration, serum protein concentrations, and serum enzymes activities were insignificant (P > 0.05). Serum samples were analyzed using cation exchange ProteinChip arrays and immobilized metal affinity capture ProteinChip arrays, producing 64 peaks at the mass range of 1 - 30 kDa. Intensities of 27 peaks were significantly down-regulated in response to the contaminated diet as compared to controls, while intensities of 11 peaks were up-regulated (P < 0.05). It was concluded that the foodborne *Fusarium* mycotoxins could affect the canine serum proteome. Further experiments are needed to identify, quantify, and validate these changes in order to discover applicable biomarkers of foodborne exposure to *Fusarium* mycotoxins.

Key Words: *Fusarium* Mycotoxins, Dog, Proteomics

W61 Dietary lysine: Calorie ratios and their influence on nitrogen metabolism and digestibility in overweight mature dogs. G. Hibbard*¹, K. R. McLeod¹, D. L. Harmon¹, R. Yamka², and K. G. Friesen², ¹University of Kentucky, Lexington, ²Hill's Pet Nutrition, Inc., Topeka, KS.

Two experiments were conducted to determine the effects of altering dietary lysine:calorie ratio on nitrogen metabolism and protein turnover in moderately overweight dogs. Exp. 1 used 8 moderately overweight female crossbred hounds fed four diets with varying lysine:calorie ratios (2.2, 3.0, 3.8, and 4.6 g lysine/Mcal ME) in a replicated 4x4 Latin square design experiment. Dietary lysine:calorie ratio was altered by adding crystalline lysine. Each of the four periods was 28 days in length, 14 days of which the dogs were fed ad libitum followed by 14 days of calorie restriction at 0.75 of maintenance for ideal weight. Collections took place the last seven days of each period, in which fecal, urine, and blood samples were acquired and protein metabolism was monitored using an oral dose (7.5 mg/kg) of 15N-glycine. Increasing the lysine:calorie ratio of the diet did not affect absorbed or retained nitrogen, however, plasma urea increased linearly ($P = 0.04$). Plasma total protein and creatinine concentrations were not affected by treatment. Protein synthesis, degradation and turnover were unaffected by treatment. Exp. 2 used 6 dogs in a design similar to above but they were fed at maintenance energy throughout either the 2.2 lysine:calorie diet from above (2.2), the 3.0 (3.0C) from above or a 3.0 lysine:calorie diet containing additional amino acids to provide an ideal amino acid profile based on published values (3.0I). Both 3.0 diets decreased ($P < 0.05$) urinary N, and N absorbed, and tended to increase N retained ($P = 0.11$), and % N retained ($P = 0.09$). These studies suggest that N metabolism can be altered by altering the lysine:calorie ratio of the diet but perhaps not during nutrient restriction.

Key Words: Lysine, Requirement, Amino acid

W62 Effect of added total sulfur amino acids and threonine on nitrogen balance in dogs. R. E. Bohaty*¹, M. R. C. de Godoy¹, K. R. McLeod¹, D L. Harmon¹, R. M. Yamka², N. Z. Frantz², and K. G. Friesen², ¹University of Kentucky, Lexington, ²Hill's Pet Nutrition, Inc., Topeka, KS.

Previously, we have shown that formulating foods to provide an optimal ratio of 3.0 g lysine/Mcal ME results in increased N retention in mature overweight dogs. Therefore, the objective of this study was to further investigate whether increased levels of essential amino acids in conjunction with a dietary lysine:calorie of 3.0 would further improve N metabolism in mature overweight dogs. Four isonitrogenous and isocaloric foods all with 3.0 lysine/Mcal ME ratios were formulated. The control food levels of all essential amino acids to provide an ideal profile based on literature values (EAA). Additional foods had increased concentrations of total sulfur amino acids (TSAA), or a combination of TSAA and threonine (TT). Foods were fed to eight overweight, mature, female crossbred hounds in a replicated 4 x 4 Latin Square design experiment. Experimental periods were 28 days in length. Dogs were fed to maintain their current body weight days 1-14 of each period then reduced to 75% of maintenance for their individual ideal weight for days 15-28 of each period. Total feces and urine were collected 2 times daily for the final 6 days of each period for N balance. Urine and feces were composited by dog within each period and analyzed for N. Daily food intakes were similar across treatments whereas nitrogen intake was higher ($P < 0.05$) for animals on the control and TSAA diet

than for animals on the TT diet. There was no difference in fecal DM output, DM digestibility, fecal N excretion, N retained or N digestibility. Based on the measurements made in the present study we see no benefit for additional TSAA, TT or formulation for additional EAA in foods formulated to provide a 3.0 lysine/Mcal ME ratio.

Key Words: Amino Acid, Dog, Nitrogen Metabolism

W63 Effect of dietary protein level on urea production and protein turnover in the adult cat (*Felis catus*). T. J. Wester*¹, K. Weidgraaf¹, C. E. Ugarte¹, and M. H. Tavendale², ¹Massey University, New Zealand, ²AgResearch Ltd., Palmerston North, New Zealand.

Cats are unique among domestic animals as they are obligate carnivores and have a high protein requirement. However, little is known about how they regulate amino acid (AA) metabolism. This study was undertaken to examine the effect of dietary protein level on urea production and AA metabolism in cats. Cats ($n = 18$) were allocated to three treatments (15, 40 or 65% ME intake as CP), fed at maintenance for 3 wk, and then fitted with saphanous and cephalic vein catheters. On the following day, they received primed continuous infusions of [¹³C]bicarbonate (to measure basal CO₂ production), [1-¹³C]Leu and [¹⁵N₂]urea from 0 to 120, 120 to 480 and 0 to 480 min, respectively. Cats were fed hourly during infusion and Leu entry rate from diet was calculated. Breath was sampled at 0, 100, 110, 120, 440, 460, and 480 min to measure ¹³CO₂, with blood sampled at 0, 440, 460, and 480 min to measure ¹³C enrichments in Leu and ketoisocaproate, and [¹⁵N₂]urea. Values for Leu flux, non-oxidative Leu disposal (NOLD, an indicator of protein synthesis), Leu rate of appearance in plasma (Ra, an indicator of protein degradation), Leu oxidation, and urea production rate (an indicator of net protein catabolism) are shown in Table 1. Cats fed the diet with 15% of ME intake as CP had the lowest rate of whole body AA catabolism and oxidation, whereas protein synthesis was only different between the highest and lowest CP diets. This study showed that cats modulated protein turnover mainly by altering rates of AA oxidation and catabolism. (Supported by the Massey University Research Fund)

Table 1.

	Diet (%ME as CP)			SEM
	15	40	65	
Leu flux, $\mu\text{mol}/(\text{kg}\cdot\text{h})$	201.4 ^a	267.7 ^b	345.3 ^c	8.21
Leu NOLD, $\mu\text{mol}/(\text{kg}\cdot\text{h})$	121.5 ^a	141.6 ^{ab}	154.6 ^b	8.55
Leu Ra, $\mu\text{mol}/(\text{kg}\cdot\text{h})$	147.5	151.8	121.6	10.26
Leu oxidation, $\mu\text{mol}/(\text{kg}\cdot\text{h})$	80.0 ^a	126.7 ^b	191.8 ^c	10.62
Urea production, $\mu\text{mol}/(\text{kg}\cdot\text{h})$	456.6 ^a	713.0 ^b	1,321.0 ^c	73.68

^{a,b,c}Values in a row with different superscripts are different ($P < 0.05$)

Key Words: Feline Nutrition, Protein Turnover, Urea Production

W64 Microbiological and immunological effects of two yeast-based complex fermentation ingredients on adult dogs. D. C. Hernot*¹, G. C. Fahey, Jr.¹, S. Reeves², and M. Scott³, ¹University of Illinois, Urbana, ²Embria Health Sciences, Ankeny, IA, ³Diamond V Mills, Cedar Rapids, IA.

Nine female hound-mix dogs were used in a replicated 3x3 Latin square design to evaluate microbiological and immune responses of

two complex fermentation ingredients derived from a proprietary process consisting of *Saccharomyces cerevisiae* and the media on which they are grown. Dogs were given 400 g of food daily with one of 3 gelatin capsule treatments: 1) control (empty capsule), 2) 0.143 g yeast fermentate (Embria Health Sciences, Ankeny, IA), and 3) 1.0 g yeast culture (Diamond V Mills, Cedar Rapids, IA). Blood concentrations of lymphocytes positive for CD3, CD4, CD8 α , and CD21 cell surface markers and serum immunoglobulin concentrations were measured. Gene expression of cytokines TNF- α , IL-6, IFN- γ , and TGF- β also was determined by quantitative real-time PCR (qRT-PCR). Lactobacilli, bifidobacteria, *Escherichia coli*, and *Clostridium perfringens* populations were quantified in feces using qRT-PCR. Population changes within the predominant fecal microflora were evaluated using parallel DGGE. Immune indices measured in this study were not affected by treatment. No differences were found among treatments for any of the cell surface markers analyzed, or any of the serum immunoglobulins measured. Yeast fermentate decreased lymphocytes compared to the control. The two yeast-based complex fermentation ingredients decreased ($P < 0.05$) *Cl. perfringens* fecal populations compared to the control. Yeast culture had a more significant ($P < 0.05$) effect than yeast fermentate. In conclusion, the yeast-based complex fermentation ingredients had a beneficial effect on microbial ecology by reducing *Clostridium perfringens* populations.

Key Words: Yeast, Dogs, Microbiology

W65 Nutrient levels in crop milk and plasma as an indicator of free-ranging American flamingo (*Phoenicopterus ruber ruber*) nutrient status. A. S. Hunt* and A. M. Ward, Fort Worth Zoo, Fort Worth, TX.

Crop milk and plasma samples were collected from six to eight week old juvenile American flamingos (*Phoenicopterus ruber ruber*) to evaluate nutrient availability and status in a free-ranging population. These samples were gathered with the goal to establish a database to assess the appropriateness of captive hand rearing formulas and nutrient status of captive and hand reared chicks. Samples were obtained in August

of 1999, 2000, 2001, 2003, and 2005 at the Ria Lagartos Biosphere Reserve (El Cuyo, Mexico) and analyzed for minerals, vitamins and carotenoids. The majority of the results were not normally distributed within and among years ($P < 0.05$, Shapiro-Wilkes), therefore coefficients of dispersion were calculated to describe the variability of medians across years. The dispersion coefficients were greater for crop milk than plasma ($P < 0.001$, paired t-test) for 11 of the 13 nutrients (Table 1). Minerals, vitamins, and carotenoids in crop milk samples collected at a single point during lactation are highly variable and therefore a poor indicator of nutrient requirements and status. Plasma nutrient parameters may present a more viable option for evaluating the status and requirements of growing flamingos.

Table 1: Nutrient median (M) levels (dry matter) and dispersion factor (DF) in *Phoenicopterus ruber ruber* crop milk (CM) and plasma (P) samples.

ppm	CM (n \approx 135)		P (n \approx 103)	
	M	DF	M	DF
Calcium	65	0.10	118	0.20
Phosphorus	500	0.62	216	0.07
Sodium	1650	0.71	1394	0.14
Potassium	200	0.52	67	0.56
Magnesium	20	0.20	17	0.13
Zinc	21	0.98	1.08	0.34
Iron	174	0.77	3.19	0.35
Retinol	5.75	0.77	0.26	0.56
α Tocopherol	17	1.0	6.16	0.49
β Carotene	1.62	0.99	0.05	0.41
Echinenone	2.24	0.99	0.57	0.40
Canthaxanthin	6.46	0.85	2.21	0.23
Lutein	1.21	0.99	0.13	0.71

Key Words: Crop milk, Flamingo, Nutrients

Dairy Foods: Milk, Dairy Food Chemistry and Microbiology

W66 Inactivation of *Clostridium botulinum* type A neurotoxin in milk by high pressure processing. J. E. Schlessner¹, R. Gerdes², G. E. Skinner¹, N. R. Reddy¹, and B. Parisi², ¹FDA, National Center for Food Safety, Summit, IL, ²Illinois Institute of Technology, National Center for Food Safety, Summit, IL.

The threat of terrorist attacks against the nation's food supplies has created the need to study food toxins that may be potential threats to the safety and security of the food supply. There is a need for the development of prevention and mitigation technologies/strategies to reduce this potential food defense threat. Non-thermal technologies such as high pressure processing have been proposed as a potential pasteurization method for milk. No data exist regarding the high pressure resistance of *C. botulinum* type A neurotoxin. The objective of the present work was to determine the high pressure resistance of *C. botulinum* type A neurotoxin in ultra-high temperature (UHT) 2% fat pasteurized milk. Samples of UHT 2% fat pasteurized milk were spiked with acid mud preparation of *C. botulinum* type A neurotoxin at a level of 10⁶ mouse lethal dose (MLD)/ ml. Spiked samples (10 ml each) were placed in high barrier film pouches, heat sealed, and pressure-treated in a Quintus Model QFP-6 High Pressure Food Processor at 400 or 600 MPa and an initial temperature of either 4 or 25°C for holding times of 3 min. After pressure treatment, samples were stored at 4°C until analysis. High pressure treated spiked samples were diluted with gel phosphate buffer and centrifuged. Supernatants were serially diluted with skim milk buffer and analyzed for presence of type A neurotoxin levels using the DIG-ELISA. Dilutions of 3:1, 1:3 and 3:37 of the last positive DIG-ELISA sample were further confirmed for type A neurotoxin by mouse bioassay. In general, the MLD determined by mouse bioassay was 10 times more sensitive than the MLD determined by DIG-ELISA. No inactivation of type A neurotoxin was observed in the untreated spiked samples by DIG-ELISA. A 3 log₁₀ MLD inactivation of type A neurotoxin was achieved in the UHT 2% fat milk samples when they were processed at a pressure of 600 MPa, initial temperature of 25°C for 3 min. High pressure denaturation of *C. botulinum* type A neurotoxin may result in a change of the structure and the toxin's activity.

Key Words: *Clostridium botulinum*, Type A Neurotoxin, High Pressure Processing

W67 Changes in fatty acid profiles of Awassi ewe and Damascus goat colostrums during ten days postpartum. Z. Guler¹, M. Keskin¹, S. Gül¹, and Y. W. Park², ¹Mustafa Kemal University, Antakya, Hatay, Turkey, ²Fort Valley State University, Fort Valley, GA.

Awassi sheep and Damascus goats are the most productive small ruminants in the Mediterranean countries including Turkey, Syria, Lebanon, and Israel. The study was conducted to characterize fatty acid profiles of colostrum milks during ten days postpartum from randomly selected 10 animals each (3-yr old) of Damascus (Shami) goat and Awassi sheep at Research Farm of Mustafa Kemal University, Hatay, Turkey. Fatty acids in colostrums were determined using GC-MS (Model 6890/5973N, Agilent, Palo Alto, CA, USA) equipped with fused silica capillary column coated with free fatty acid phase. The major fatty acids in the ewe and goat colostrums were C18:1, C16:0, C18:0, C14:0 and C10:0, which accounted for about 75 % total fatty acids. Anteiso-C15 and anteiso-C17 were the prominent branched chain fatty acids (BCFA) in both species.

C18:3 acid was found only in ewe colostrum, while trans-C18:1 was detected only in goat colostrum. For the last two days of experimental period, cis-9-octadecenoic acid was predominant in goat colostrum milk, while hexadecanoic acid was high in ewe milk. The relative concentrations of fatty acids in colostrum milks of both species were unchanged during the 8 days postpartum. The average percentages (%) of short, medium and long chain fatty acids in both species colostrums were 4.94, 15.5, and 79.4, respectively. However, for the last two days, short chain acids remained unchanged, medium chain acids decreased from 15.6 to 12.3%, and long chain acids increased from 79.4 to 83.3% in goat milk, whereas ewe milk increased in short chain acids from 4.45 to 5.86% and medium chain acids from 14.8 to 19.5%, but decreased in long chain acids from 80.7 to 74.2%. These changes in fatty acid profiles in colostrum milks during the 10 days postpartum may indicate that there are certain differences in metabolism and secretory processes between the two species.

Key Words: Damascus Goat, Colostrum, Fatty Acids Profile

W68 Interaction between β -lactoglobulin and dextran sulfate at near neutral pH and their effect on thermal stability. B. Vardhanabhuti¹, E. A. Foegeding¹, U. Yucel², and J. Coupland², ¹North Carolina State University, Raleigh, ²Pennsylvania State University, University Park.

Proteins and polysaccharide interactions play a major role in the structure and stability of many foods. Understanding their interactions and the effects on thermal stability could aid processors in product development. In this study, thermal stability of β -lactoglobulin (BLG) in the presence of dextran sulfate (DS) and their interactions were investigated. Samples containing 6% w/w BLG and DS (M_w 5k to 500k) at different biopolymer weight ratios, pH (5.6-6.2), and NaCl concentrations (0-30 mM) were heated at 85°C for 15 min. Thermal stability was evaluated by turbidity measurement. Protein stability was characterized by differential scanning calorimetry. Interactions between BLG and DS were characterized by size exclusion chromatography coupled with multi angle laser light scattering (SEC-MALLS) and zeta potential measurement. Turbidity results showed that the degree of BLG aggregation increased with decreasing pH. The presence of DS at appropriate molar ratios significantly lowered the turbidity of heated BLG (P ≤ 0.01). Low Mw DS had broader range of effective weight ratios in decreasing the turbidity than the highest Mw DS. Data showed that DS lowered the denaturation temperature of BLG. Interaction between BLG and DS was confirmed by SEC-MALLS. Higher amount of BLG-DS complex formation was found with increasing amount of DS. Addition of 30 mM NaCl inhibited complex formation and the effect of DS on inhibiting aggregation, suggesting that the interaction was electrostatic driven. Zeta potential results revealed that samples with DS were more negatively charged compared to the BLG control. These results indicated that electrostatic interactions between BLG and DS led to a decrease in denaturation temperature of BLG, formation of higher negatively charged complex, and a different type of aggregates after heating. At appropriate conditions, DS improves thermal stability of BLG. The results provide information that will facilitate the application of whey proteins and polysaccharides as functional ingredients in foods and beverages.

Key Words: β -Lactoglobulin, Thermal Stability, Dextran Sulfate

W69 Using lactic acid bacteria to detect chemical substances in milk. A. AbuGhazaleh*¹ and S. Ibrahim², ¹*Southern Illinois University, Carbondale*, ²*North Carolina A&T University, Greensboro*.

The U.S. food system—from farms to processing and distribution to retail food service presents an array of vulnerable targets for terrorist attack. Intentional contamination of agricultural or food products with biological, chemical, or radiological agents could lead to potentially devastating effects on human health, as well as major economic losses to a critical sector of the economy. Therefore, there is an urgent need to develop a practical and sensitive approach to monitor food supplies, in case of a bioterrorist attack. The objective of this work was to determine the effect of cadmium and sodium cyanide on the growth of lactic acid bacteria in MRS broth. A total of 12 lactic acid bacteria were used in this study. A stock solution of each chemical was prepared and added to fresh batches of 10 mL MRS broth tubes to obtain final concentrations within the LD50 concentration assuming a 200 mL consumption (cadmium, 0.64 mg/mL; cyanide 7.0 mg/mL). MRS tubes were inoculated with individual strains, mixed and incubated at 37°C. Bacterial growth was monitored by measuring the optical density. At the end of the incubation period; the pH values of each sample were measured. Our results showed that at concentrations of 0.5 mg/mL and 1.4 mg/mL, cadmium and cyanide respectively, completely inhibited the growth of all 12 strains. The pH of those cultures that had strong inhibition remained relatively unchanged during the incubation period. These preliminary results suggest that typical dairy cultures could be a useful indicator of the presence of these chemical compounds. Further work will continue to expand the diversity of potential bioterror substances

Key Words: Lactic Acid Bacteria, Milk, Safety

W70 Development of symbiotic low fat buffalo milk yogurt. X. Han*² and M. Guo¹, ¹*University of Vermont, Burlington*, ²*Harbin Institute of Technology, Harbin, China*.

Buffalo milk represents an important animal product in South and East of Asia. As a specialty product, buffalo milk yogurt has become popular and has its own niche market in the US. In present study, symbiotic (containing both prebiotics and probiotics) low fat buffalo milk yogurt prototypes (plain and blueberry) were manufactured using 1% fat natural buffalo milk, inulin (a prebiotic ingredient), and probiotic cultures including *Bifidobacterium spp.*, *L. casei*, and *L. acidophilus* in a local commercial factory. Samples were analyzed for physicochemical and microbiological properties, and the survivability of probiotics during ten week storage. Gross composition results were: total solids 11.60 ± 0.58% and 17.12 ± 0.36%, ash 0.82 ± 0.06% and 0.78 ± 0.02, protein 4.49 ± 0.31% and 4.16 ± 0.11%, fat 0.68 ± 0.03% and 0.55 ± 0.05%, carbohydrates 5.68% and 11.38% for plain and blueberry flavors, respectively. Mineral contents were: calcium 1.97 ± 0.20 and 1.72 ± 0.06, magnesium 1.63 ± 0.02 and 1.69 ± 0.01, zinc 0.07 ± 0.01 and 0.07 ± 0.003, sodium 0.87 ± 0.15 and 0.94 ± 0.12 mg/g for the plain and blueberry flavored yogurt, respectively. The values of pH, titratable acidity and viscosity ranged from 4.34-4.01 and 4.42-3.70, 0.96-1.13 and 0.94-1.30%, 1.395-1.665 and 2.146-1.564 Pa.s for the plain and blueberry flavored yogurts, respectively. The initial population of *Bifidobacterium spp.* and *L. casei* were above 10⁸ cfu/g for both of plain and blueberry flavored yogurts. Both *bifidobacterium spp* and *L. casei* remained stable during the 10 weeks of storage (>10⁶cfu/g). However, population of *L. acidophilus* decreased sharply during the first a few

weeks and then dropped below 10⁶cfu/g. The results indicated that low fat buffalo milk may be a good vehicle for developing symbiotic yogurt. Improvement of the survivability of *L. acidophilus* in this matrix needs to be further studied.

Key Words: Buffalo Milk, Symbiotics, Yogurt

W71 Presence of geraniol in bovine milk following topical application as a natural insecticide. D. M. Watson*, J. P. Evans, R. E. Miracle, M. A. Drake, S. P. Washburn, and D. W. Watson, *North Carolina State University, Raleigh*.

Geraniol is a plant derived monoterpene found naturally in many plants with demonstrated insect repellency properties. Geraniol is listed as a minimal risk active ingredient exempt from the Federal registration requirements and this “generally recognized as safe” (GRAS) repellent could benefit organic or other producers wishing to reduce or eliminate reliance on insecticides. However, the effect of geraniol on milk flavor was not known. This study was conducted to determine if topical application of geraniol influenced milk flavor. Dairy cows at the Center for Environmental Farming Systems in Goldsboro, NC were divided into 4 groups of 3 cows each in 2 replicates: a control group (no geraniol treatment), and 3 treatment groups of topically applied 30% geraniol (60 mL geraniol; 120 mL geraniol; 180 mL geraniol) for 6 treatments at 2-wk intervals. Milk was collected from each cow at 8 h, and at 1, 3, 7, 10, and 13 d after each treatment. Milk from cows within each treatment group at each sample period was combined into a composite sample. Milks were analyzed for total solids non-fat (w/w) and percent fat using the CEM Smart Trac System. Headspace solid phase micro-extraction with gas chromatography mass spectrometry (SPME GC-MS) was used to screen for the presence of geraniol in the milks. The sensory threshold for geraniol in whole milk was determined using an ascending forced choice (AFC) method with 35 consumers. A trained sensory panel evaluated the flavor profile of vat-pasteurized whole milks. The instrumental detection limit for geraniol was 125 ppb (signal to noise ratio of 8:1) while the orthonasal sensory threshold in milk was 333 ppb. Geraniol was not detected instrumentally in any milk samples throughout testing. Similarly, trained panel flavor profiles of milk from geraniol-treated cows were not different from milk from control cows. Geraniol did not affect milk flavor when used as a topical insect repellent and may be viable for use with organic milk production.

Key Words: Geraniol, Pesticide, Flavor

W72 Comparative study of freeze-dried milk powder to spray-dried milk powder in water adsorption and stability. M. H. Seo*, S. H. Kim, J. Ahn, and H. S. Kwak, *Sejong University, Seoul, Korea*.

The present study was carried out to compare the stability such as water adsorption isotherms and solubility between freeze-dried milk powder and the spray-dried milk powder. Water adsorption isotherm of both freeze-dried and spray-dried milk powder samples were measured at 20, 30 and 40°C using COST-90 (Cooperation in the Field of Scientific Technical System-90) modified method. Results showed that isotherm were sigmoidal in shape in both milk powders. The adsorption isotherm of moisture content (g water/100 g dry solids) increased slowly in early stage and then increased sharply thereafter at all temperatures when

water activity changed from 0 to 1. The difference of moisture content between freeze-dried and spray-dried milk powders increased with the increase of the water activity. Especially, the moisture content difference was enhanced when the temperature increased. Equilibrium monolayer moisture content was in the range of 3.0 to 3.7 g H₂O/100 g dry solids in freeze-dried milk powder, while 0.4 to 1.7 g H₂O/100 g dry solids in the spray-dried milk powder at all temperatures. The composition of the freeze-dried milk powder was 3.4% in moisture, 41.7% in fat, and 26.8% in protein, which was comparable to that of the spray-dried milk powder. The solubility index and acidity were 0.02 mL and 0.11% in freeze-dried milk powder, and 0.17 mL and 0.19% in spray-dried milk powder, respectively. There was no difference in non-casein nitrogen (NCN) and non-protein nitrogen (NPN) contents. These results showed that the adsorption isotherm of moisture content was higher in freeze-dried milk powder than that in spray-dried milk powder, which may indicate the high stability of freeze-dried milk powder.

Key Words: Adsorption Isotherm, Freeze-Dried Milk Powder, Spray-Dried Milk Powder

W73 Comparative study of reconstituted milk made by freeze-dried milk powder to control reconstituted milk. S. I. Ahn*, S. H. Kim, J. Ahn, and H. S. Kwak, *Sejong University, Seoul, Korea.*

The present study was performed to compare the physico-chemical properties and nutrients of reconstituted milk made by freeze-dried milk powder to the control or spray-dried milk powder. There were three groups as follows: 1) control, raw milk, 2) freeze-dried, the reconstituted milk made by freeze-dried milk powder and 3) spray-dried, the reconstituted milk made by spray-dried milk powder. The freeze-dried powder was produced at 85°f using PVTFD-100 and contained 13% solid. In milk composition, freeze-dried group showed the little higher fat content and little lower moisture compared with those of the control. Spray-dried group showed much less moisture content than the control and freeze-dried group. Significant difference in L-value was found between the control and both reconstituted milks at 0 day period, however, the change was decreased throughout the period times. In addition, b-value of freeze-dried milk was significantly higher than others at 0 day. Total concentration of short chain fatty acids of freeze-dried reconstituted milk was significantly higher than others at every storage period. The concentrations of most water-soluble vitamins were lower in reconstituted milk made by spray-dried milk powder than in reconstituted milk made by freeze-dried milk powder when compared with the control. The present study indicated that there was no profound difference in physico-chemical properties in reconstituted milks made by freeze-dried and spray-dried milk powders, therefore, there is possibility of the dairy product manufacture using freeze-dried milk powder.

Key Words: Reconstituted Milk, Freeze-Dried Milk Powder, Spray-Dried Milk Powder

W74 Hysteresis of buffer capacity curves of cow, goat and sheep milks. J. Li*, M. Corredig, and A. Hill, *University of Guelph, Guelph, ON, Canada.*

Acid titration and buffer capacity measurements are simple tools that may yield information about ionic equilibria in milk and associated

changes to the micelle structure with implications for dairy technology, cheese texture and melting properties. Acid and base titrations and counter titrations show buffer capacity maxima near pH 2, near pH 4, in the range of 5.0 to 6.3, and near pH 12 for all species of milk. The colloidal calcium phosphate (CCP) maximum occurred at pH 5.1 to 5.2 during acid titration from native pH. Base titration following acid titration revealed a hysteresis effect for CCP. For minimum pH values during acid titration ranging from 5.4 to 4.8, the pH values for the CCP during subsequent base titration ranged from pH 6.5- 6.2 for cow and goat milk and 6.3-5.8 for sheep milk. Because the targeted minimum pH for most rennet coagulated varieties of cheese is near pH 5.0, the CCP peak is important for process control. Similarly, the hysteresis effect during base titration subsequent to acid titration may be important to pH control during the early stages of cheese ripening.

Key Words: Buffering Capacity, Milk, Hysteresis Effect

W75 Effects of yogurt fermentation bacteria on milk-based bioactive peptides. M. Paul and G. Somkuti*, *USDA-ARS-ERRC, Wyndmoor, PA.*

The incorporation of bioactive materials to increase the nutraceutical value of yogurt requires that these compounds survive all of the production processes, including proteolysis by endogenous enzymes. Since strains of the yogurt starter cultures *Streptococcus thermophilus* (ST) and *Lactobacillus delbrueckii* subsp. *bulgaricus* (LB) are known to have cell-associated peptidases involved in breaking down proteins to peptides transportable across cell membranes, this research focused on the sensitivity of selected bioactive peptides to ST and LB cells. The 11mer antimicrobial and 12mer hypotensive milk-protein based peptides were incubated with mid-log ST and LB cells at pH 4.5 and 7.0 to monitor the extent of proteolysis by membrane-bound peptidases, the presence of which was demonstrated by PCR analysis. Samples were removed at various time points and analyzed by reverse phase-high performance liquid chromatography (RP-HPLC). Results showed that the peptides were rapidly and extensively degraded by LB strains at both pH 4.5 and 7.0, while they remained intact at pH 4.5 in the presence of ST strains. The results suggested that the optimum time for the addition of these bioactive peptides is near the end of the yogurt making process when pH levels have dropped to 4.5 or lower, thereby limiting the extent of peptide loss caused by peptidase digestion.

Key Words: Lactic Acid Bacteria, Bioactive Peptides, Bacterial Peptidases

W76 Simplified petrifilm assay for lactococcus phage. Y. C. Tseng* and C. L. Hicks, *University of Kentucky, Lexington.*

Simplified procedures were developed to determine lactococcal phage plaques on specially prepared Petrifilm. To test this system *Lactococcus lactis* ssp. *lactis* C2 and c2 phages were used as a test culture/phage system and all films were compared to top/bottom gels in Petri plates. Phage plaques were viewed after 6 to 8 h of incubation at 30°C. M17 medium containing 1.0% fast hydrating cold set gelling agent, 0.01% FD&C Blue #1 dye and 15 mM CaCO₃ was prepared and weighed into vials (2.8 ml in each vial). In another vial 0.1 ml of *Lactococcus lactis* culture was combined with the appropriate dilution of phage (0.1 ml).

The two vials were mixed together and glucono- δ -lactone was added (final conc. 30 mM). The mixture then was poured into the well of the Petrifilm. Two types of Petrifilm prepared by 3M Corporation were tested. The first film was prepared by securing a clear film flap onto a second film. A 45mm ID o-ring (3 mm thick) was laid on the first film, and the gelling mixture was poured into the center of the o-ring. The well of second Petrifilm was prepared by stacking two expanded styrene films (2 mm thick) onto a clear film. The expanded styrene contained a 50 mm hole that formed the well, thus the well was 4 mm deep. After the gelling mixture was poured into the well, the top plastic sheet was lowered to seal the well. The development of large defined plaques required the use of a gelling agent that would form a soft non-weeping gel adhered well to the plastic film similar to the qualities of top agar. Soft gels allowed phage movement within the gel and the development of large plaques. A head space of 0.5 mm above the gel surface was required to prevent the top film from resting on the gel. If the film rested on the gel and the phage diffused across the surface of the gel, the whole lawn on the gel would plaque out. The use of a dye enhanced the contrast between the bacterial lawn and the clear plaque. Plaque size and counts were comparable to those determined using a standard top/bottom M17 medium agars in a Petri dish system.

Key Words: Simplified Assay, *Lactococcus*, Phage

W77 Construction of an integrative vector for recombinant gene expression in *Streptococcus thermophilus*. J. A. Renye* and G. A. Somkuti, *USDA-ARS-ERRC*.

Streptococcus thermophilus (ST) is an essential starter culture in yogurt and cheese production. Its “generally recognized as safe” (GRAS) status makes this organism an attractive candidate for the expression of gene products to improve the safety and nutritional value of dairy foods. The antibiotic resistance marker genes traditionally used in plasmid vectors may be eliminated by inserting heterologous genes into the bacterial chromosome. This pINTRS integrative vector was constructed with a temperature sensitive origin of replication and an erythromycin resistance marker gene (Erm) for initial selection in *S. thermophilus*. The green fluorescent protein (GFP) gene was transcriptionally controlled by a plasmid borne hsp promoter and cloned into pINTRS. The GFP gene was flanked by sequences homologous to an inactive ST pseudogene to facilitate integration within the locus. The pINTRS-GFP vector in *E. coli* DH5 α showed strong GFP expression at 32°C. In *S. thermophilus* the plasmid was maintained at 32°C but a temperature shift to either 37°C or 42°C resulted in plasmid loss. Weak GFP fluorescence was observed microscopically in individual cells of cultures grown at both low and high temperatures. Plasmid from cells grown at 32°C was back-transformed into *E. coli* yielding strong fluorescing colonies, suggesting that limited GFP expression in *S. thermophilus* is caused by low gene copy number. PCR analysis showed the *hsp-gfp* construct in colonies grown at 32°C and 37°C, but cells grown at the high temperatures were negative for the Erm gene suggesting that proper integration had occurred. The vector is also useful in testing the biological activity of recombinant products when expressed from single copy of a gene on the chromosome.

Key Words: *Streptococcus thermophilus*, Integrative Vector, GFP

W78 Fresh style panela cheese as a vehicle for probiotics and resistant starch. M. C. Escobar-Ramirez*¹, S. L. Amaya-Llano¹, M. Singh², and M. J. Miller³, ¹*PROPAC, Universidad Autónoma de Querétaro, Querétaro, Qro, Mexico*, ²*National Center for Agricultural Utilization Research, Peoria, IL*, ³*University of Illinois, Urbana*.

The importance of probiotic-containing products for maintaining health and well-being is becoming a key factor affecting consumer choice. In particular, there is interest in developing new probiotic containing products. Panela cheese, a Mexican fresh cheese, is a staple food in Mexico yet it lacks any probiotic microorganisms. As a potential vehicle for probiotics, panela has several advantages over yogurt including: 1) higher pH; 2) higher fat content; and 3) solid matrix. In addition, Panela cheese may also be a vehicle for resistant starch (RS) addition due to the potential for RS to complement the texture of traditional Panela cheese. The aim of this investigation was to manufacture and evaluate a Mexican fresh cheese (Panela) made with probiotic bacteria and resistant starch (RS). *Lactobacillus* spp. and *Bifidobacteria* spp. from our culture collection were screened to identify strains that could ferment RS from faba beans (*Vicia Faba* L.). None of the twenty *Lactobacillus* spp. examined were able to ferment RS. Of the 8 *Bifidobacterium* spp. examined, only *B. breve* ATCC 15700 were able to ferment RS. *B. breve* ATCC 15700 and *L. rhamnosus* GG ATCC 53103 were selected for use as probiotics. Two types of fresh cheese (with and without 3% RS) were made. Four combinations of probiotics was added to each of these cheeses: 1) no added cultures; 2) *L. rhamnosus* GG only; 3) *B. breve* only; and 4) both *L. rhamnosus* and *B. breve*. Viability analysis during 4 weeks of storage at 4°C demonstrated that the addition of RS had minimal effect on the viability of either probiotic culture. Scanning electron microscopy revealed that Panela cheese with RS has a more closed structure than traditional panela cheese. The addition of RS produced a greater softness in penetration test for cheeses samples. Panela cheese is an effective vehicle for delivery of probiotic microorganisms.

Key Words: Panela, Resistant Starch, Probiotic

W79 α -Ketoglutarate biosynthesis in *Lactococcus lactis* strains isolated from specific natural niches. N. Gutiérrez-Méndez, E. Valenzuela-Soto, A. F. González-Córdova, and B. Vallejo-Cordoba*, *Centro de Investigación en Alimentación y Desarrollo, A.C. (CIAD, A.C.), Hermosillo, Sonora, México*.

There has been an increased interest in the exploration of new strains of *L. lactis*, particularly those isolated from artisanal raw milk dairy products or vegetables since wild strains may produce large amounts of flavor compounds in dairy products. These compounds produced by *L. lactis* mainly derive from the amino acid catabolism, where the limiting factor is the α -ketoglutarate (α -KG) required in the transamination step. There are two main pathways in α -KG biosynthesis. One is the citrate-isocitrate pathway which needs the action of two key enzymes, the aconitase (AS) and the isocitrate dehydrogenase (IDH). The second pathway requires the enzyme glutamate dehydrogenase (GDH). Thus, the objective of this work was to explore both pathways involved in the biosynthesis of α -KG in strains of *L. lactis* isolated from different natural niches previously characterized for their capacity to produce aroma. The enzymatic activities (IDH, AS and GDH) of eighteen strains of *Lactococcus lactis* isolated from raw-milk cheeses, vegetables and commercial dairy starter cultures (DSC) were studied. Strains did not

present isocitrate dehydrogenase (IDH) and aconitase (AS) activities. Thus, it was concluded that *L. lactis* strains were not able to biosynthesize α -KG by the citrate-isocitrate pathway. On the other hand, half of the strains confirmed glutamate dehydrogenase (GDH) activity. Thus, the ability of *L. lactis* to synthesize α -KG via GDH was confirmed. Additionally, NADP-GDH activity was mainly found in strains isolated from vegetables, whereas NAD-GDH activity was mainly found in strains isolated from dairy products. These enzymatic activities may be related to the flavor production capacity of the different strains.

Key Words: *L. lactis*, Flavor Production, α -Ketoglutarate Biosynthesis

W80 Characterization of *Streptococcus thermophilus* isolates from traditional Turkish yogurts. N. Altay^{*1,2}, G. C. Gurakan¹, and J. L. Steele³, ¹Middle East Technical University, Ankara, Turkey, ²Selcuk University, Konya, Turkey, ³University of Wisconsin, Madison.

The objective of this study was to phenotypically and genotypically characterize *S. thermophilus* isolates from traditionally produced Turkish yogurts. By plating on LM17 agar, sixty putative *S. thermophilus* isolates were obtained from ten yogurts. The species designations of the Turkish isolates and four commercial isolates were confirmed by 16S sequencing. Fifty-six out of sixty Turkish isolates and all 4 commercial isolates were identified as *S. thermophilus*. Technological properties of the isolates were screened in sterile reconstituted skim milk. To determine the rate and extent of acid production, acidification profiles were examined. The twenty-six isolates having acidification rates comparable to commercial isolates (Δ pH at 4h \geq 1.3) were also tested for their final pH after 24 h incubation, acetaldehyde production and proteolytic activity. The final pH after 24 h incubation at 42°C was within the range of 3.76-4.09, which was comparable to the commercial isolates. The acetaldehyde production by the Turkish isolates was also comparable to commercial isolates and measured between 3.96-7.02 μ g acetaldehyde/ml using an acetaldehyde determination kit. Proteolytic activities of the isolates were examined by an OPA-based colorimetric assay and Δ Abs at 340nm were between 0.042-0.065. For genotypic characterization, CRISPR 1 locus was amplified and both leader and trailer ends were sequenced. Sixteen distinct amplicons were identified based upon amplicon size within the Turkish isolates. Based upon the sequence of the leader and trailer ends of the CRISPR 1 locus, the Turkish isolates were divided into 10 and 9 groups according to the first three spacers, respectively. The results demonstrate that significant phenotypic and genotypic diversity is present within *S. thermophilus* isolates from traditional Turkish yogurts and that these isolates may have commercial potential.

Key Words: *S. thermophilus*, Technological Properties, CRISPR

W81 Influence of encapsulated probiotic bacteria on the characteristics of plain yogurt. E. Noland and K. Aryana^{*}, Louisiana State University, Baton Rouge.

Encapsulation is a method of providing probiotic living cells with a physical barrier against adverse environmental conditions. *Lactobacillus acidophilus* is one of the very effective forms of probiotic bacteria and

is commercially available as pure culture (non encapsulated) and in an encapsulated form. In an attempt to use yogurt as a vehicle to successfully deliver large number of viable cells of *L. acidophilus*, it is not clear whether the use of encapsulated *L. acidophilus* will result in yogurt of a better quality compared to *L. acidophilus* in pure (non-encapsulated) form. The objective was to determine whether encapsulated *Lactobacillus acidophilus* R0052 altered the physico-chemical, microbiological and sensory characteristics of plain yogurt. Yogurt mixes were pasteurized, cooled to 37°C and inoculated with *Streptococcus thermophilus*, *Lactobacillus delbrueckii* subsp. *bulgaricus* and encapsulated *L. acidophilus* R0052 or non encapsulated *L. acidophilus* R0052. Yogurt manufacture was replicated three times. Yogurts with encapsulated *L. acidophilus* R0052 had significantly ($p < 0.05$) higher flavor scores, significantly ($p < 0.05$) lower body and texture scores and significantly ($p < 0.05$) lower appearance scores compared to yogurts with non-encapsulated *L. acidophilus* R0052. Apparent viscosity, pH, syneresis, lactobacilli counts and L*, a* and b* values of the yogurts with encapsulated *L. acidophilus* R0052 were not significantly ($p < 0.05$) different from those of yogurts with non-encapsulated *L. acidophilus* R0052. Use of encapsulated *L. acidophilus* R0052 resulted in better tasting yogurts.

Key Words: Yogurt, Probiotic, Encapsulated

W82 Evaluation of buffering capacity of amino acid and milk protein ingredients in acidic conditions. V. Harrison^{*}, D Song, F. O. Uruakpa, C. W. Seo, and S. A. Ibrahim, North Carolina A&T State University, Greensboro.

The buffering capacity of amino acids and protein is an important physico-chemical characteristic that corresponds to the ability of the food products to be acidified or alkalinized. There is a considerable amount of data available concerning the buffering capacity (BC) of several substances, but very little pertaining to the BC of amino acids and milk protein ingredients. The objective of this study was to determine the BC of amino acids and various milk proteins ingredients in acidic conditions. Nineteen amino acids (asparagine, methionine, proline, cysteine, alanine, arginine, serine, glycine, valine, threonine, glutamic acid, isoleucine, tyrosine, leucine, phenylalanine, aspartic acid, tryptophan, and histidine) and seven different milk protein ingredients were tested for their ability to resist pH change when titrated with 0.1 M HCl. Testing solution was prepared by mixing 1.0 g of amino acid or milk protein ingredient powder in 100 ml deionized water. The pH of the solution was then adjusted to 7 using NaOH in solution. A standard solution of 0.1 M HCl was used to titrate the amino acid solution at 1.0 ml intervals using a bottle top burette until pH 2.0 was reached. The buffering capacity was calculated as the amount of acid required to reach pH 2.0 divided by the overall change in pH. Our results showed that protein ingredients such as hydrolyzed milk had high BC (>50). Glycine and aspartic acid had the highest BC values (33.3 and 34.5) while tyrosine had the lowest BC value of 5.0. It is evident that proteins and amino acids could be used in several food systems to maintain pH value. In addition, including such ingredients in food products with controlled buffering capacity would be desirable to maintain stable food characteristics.

Key Words: Buffering Capacity, Milk Proteins

W83 Use of beta-cyclodextrin to lower level of cholesterol in milk and its influence on activity of probiotic bacteria. L. Alonso^{1,2}, P. Cuesta^{*1}, J. Fontecha³, M. Juarez³, and S. E. Gilliland¹, ¹Oklahoma State University, Stillwater, ²Instituto de Productos Lacteos. CSIS, Asturias, Spain, ³Instituto del Frio. CSIC, Madrid, Spain.

While dairy products in general have the image of healthy foods, this image is often not perceived for products with a high fat content like butter, cream and certain type of cheeses. The World Health Organization, the American Heart Association and others have recommended that consumers reduce their consumption of saturated fatty acids and cholesterol as a deterrent to coronary heart disease. Thus there is a growing interest in the manufacture of cholesterol reduced dairy products. Currently, the most effective method for reducing cholesterol content in milk is by using beta-cyclodextrin (BCD). One objective of this study was to find the optimum conditions for cholesterol removal from raw milk at 4°C on an industrial scale by adding BCD in a specially designed bulk mixer tank for use in continuous recycling of the milk from a storage tank. Optimum conditions found for removing cholesterol was treating the milk with 0.6% BCD for 20 min followed by holding it 6 h. Profiles of triglycerides and fatty acids in control and treated milk did not show significant differences. Related experiments revealed the BCD does not adversely affect the growth of probiotic cultures of lactobacilli in a broth medium but did enhance their deconjugation of bile acid. Thus in addition to being able to remove cholesterol from milk the BCD may enhance control of serum cholesterol by consumption of a selected probiotic culture since bile salt deconjugation is one of the proposed mechanisms whereby the culture provides this benefit.

Key Words: Beta Cyclodextrin, Cholesterol, Lactobacilli

W84 Effect of prebiotics on probiotic growth curves and resulting pH changes in skim milk and a model system. D. Olson* and K. Aryana, Louisiana State University, Baton Rouge.

The effect of Raftiline[®] GR, Raftiline[®] HP-Gel, and Raftilose[®] P95 prebiotics on growth curves of the probiotics *Lactobacillus casei*-01 and *Lactobacillus acidophilus* LA-K and resulting pH changes in skim milk and a model system consisting of 0.1% peptone was investigated. Skim milk and 0.1% peptone each containing 1% Raftiline[®] GR, Raftiline[®] HP-Gel, or Raftilose[®] P95 prebiotics were autoclaved and then inoculated with 13.21 µL of either *Lactobacillus casei*-01 or *Lactobacillus acidophilus* LA-K per 100 mL of skim milk and 0.1% peptone. Controls containing the probiotics without the prebiotics and controls containing neither prebiotics nor probiotics were also prepared. Both the growth of each probiotic and the changes in pH were followed for 16 h at 37°C. The growth was determined by measuring the absorbance at 650 nm. The 0.1% peptone proved to be a more suitable medium than skim milk for preparing growth curves because of the high absorbance of the skim milk blanks. Absorbance readings for the 0.1% peptone controls containing neither prebiotics nor probiotics were very stable as they varied by less than 0.002 absorbance units in 16 h. The 0.1% peptone containing prebiotics had less change in absorbance over 16 h than their probiotic containing controls for *L. casei* but greater change than the corresponding controls for *L. acidophilus* suggesting that prebiotics stimulated growth of *L. acidophilus* but not *L. casei*. Skim milk was a better medium than 0.1% peptone for following pH changes due to greater buffering capacity of skim milk. The increase in the change in pH over 16 h for skim milk containing prebiotics compared with the

probiotic containing skim milk control was greater when using *L. acidophilus* instead of *L. casei* implying that prebiotics had a greater effect on *L. acidophilus* than on *L. casei*. Absorbance data obtained for 0.1% peptone and pH data obtained for skim milk implied that the prebiotics stimulated the growth of *L. acidophilus* more than *L. casei*.

Key Words: Prebiotics, Probiotic, Growth

W85 Evaluation of the effect of bovine colostrum on gene expression in *E. coli*. M. Worku*, Z. Liu, and S. Oh, North Carolina A&T State University, Greensboro.

Bovine colostrum-based immune milk products have proven efficacy in prophylaxis and treatment against various infectious diseases caused by pathogens such as *E. coli*. A proline-rich polypeptide (PRP) in colostrum has a regulatory effect on the immune response. The objective of this study was to determine the effect of commercial nutraceutical grade colostrum (high in PRP), on expression of *E. coli* K-12 heat shock protein genes using microarray analysis. Two *E. coli* K12 Starter V2 array chips, consisting of 2 identical grids, with a total of 192 spots (MWG Biotech, High Point) were used for expression profiling of *E. coli* and to conduct dye swap experiments. Data were acquired using Jaguar analysis software and preliminary analysis was conducted using the MicroArray Genome Imaging and Clustering Tool Version 1.0. Data were log transformed and the value for the negative control was subtracted. Expression ratios were used to evaluate the effect of colostrum treatment compared to a negative control on gene expression. The highest expressed genes on two slides have been selected for further characterization and validation. These genes are listed in the Kyoto Encyclopedia of Genes and Genomes, and include 1: Fused mannose-specific PTS enzymes: IIA component/IIB component[EC:2.7.1.69]; 2:50S ribosomal subunit protein L30 Signal Recognition Particle (SRP) component with 4.5S RNA (ffs); 3:F1 sector of membrane-bound ATP synthase, delta subunit[EC:3.6.3.14]; 4: conserved protein with nucleoside triphosphate hydrolase domain; 5: D-tagatose 1,6-bisphosphate aldolase 2, catalytic subunit [EC:4.1.2.40]; 6: NADH:ubiquinone oxidoreductase, membrane subunit L [EC:1.6.5.3]; 7:UDP-N-acetylmuramate:L-alanyl-gamma-D-glutamyl-meso-diaminopimelate ligase [EC:6.3.2.-]. Further validation and characterization of the effect of colostrum components on these genes may provide keys to understanding *E. coli* pathogenesis and control.

Key Words: Colostrum, *E. coli*, Gene Expression

W86 Binding characterization between lactic acid bacteria and milk fat globule membrane in different dairy products. G. Brisson* and R. Jimenez-Flores, California Polytechnic State University, San Luis Obispo.

We have developed a combination of methods to characterize the binding between four different strains of lactic acid bacteria (LAB) and four products with high content of milk fat globule membrane (MFGM). This binding is important because probiotic bacteria are mostly consumed in dairy products and because there is genomic evidence that the interactions between these bacteria and milk fat globules are essential for turning on some genes involved with preservation and delivery of benefit to humans. However, more objective methods are necessary for evaluation of processes and strains that can better describe the relation-

ship between genomics and function in our dairy products. The method we have developed allowed assessing different LAB phenotypes and their interaction with MFGM-containing dairy products by means of a sugar gradient ultracentrifugation (SGU) fractionation step, fluorescent microscopy observations, and protein profiles. The dairy products we tested include: raw and pasteurized creams, buttermilk, and buttermilk powder. The DPTC culture strains (NCFM *L. acidophilus*; 33199 *L. gallinarum*; 1063-S *L. reuteri* and 53103 *L. rhamnosus*) were grown in normal MRS media. Harvested cells were washed 3 times with PBS, then left to contact the dairy product for 5 minutes prior to loading them on top of the ultracentrifuge tube with the sugar gradient. The sugar gradient was optimized between 25 and 50% sugar (w/v), and the ultracentrifugation conditions were 54,000g for 4 hrs at 4 °C. Different fractions were taken for microscopic observations. Also, characterization of the LAB surface proteins was achieved after using a 5M LiCl treatment and the extracts were analyzed by SDS-PAGE. The results of these analysis and the combination of microscopic observations and SDS-PAGE analysis indicate that genes regulating S-layer protein components in the surface of the LAB are the major determinant in binding frequency with the MFGM related dairy product.

Key Words: Lactic Acid Bacteria, MFGM, Binding

W87 Biophysical analysis of the milk fat globule membrane.

C. Cabral, T. Nelson, D. Rios, D. Gragson, and R. Jimenez-Flores*, *California Polytechnic State University, San Luis Obispo.*

We have used several modern surface characterization techniques to elucidate physicochemical properties of monolayer films derived from the components of the milk fat globule membrane (MFGM). Our work to date has focused on comparing the physicochemical behavior of the whole lipid fraction (polar and non-polar) with the non-polar lipid fraction of the MFGM extracted from commercial bovine buttermilk powder. We have gained information about film stability and elasticity using a Langmuir-Blodgett film balance, about film morphology on widely varying length scales using fluorescence microscopy and atomic force microscopy (AFM), and most recently about the formation and stability of bilayers with a quartz crystal microbalance (QCM). Additionally we have obtained mass spectral data of the polar lipid fraction detailing composition at the level of fatty acid chain length and saturation. Our results indicate that lipid domains form under appropriate temperatures and film pressures in monolayer films composed of MFGM lipid components analogous to lipid rafts in cell membranes. Further, we find that sphingomyelin and phosphatidylcholine both play a crucial role in forming these lipid domains. Our analysis give us great insight into the spatial distribution of lipids in MFGM monolayers and thus provide insight into the role each component plays in the native MFGM.

Key Words: MFGM, Phospholipids, Sphingomyelin

W88 Methods for screening ropy milk producers in raw milk samples. A. Cano, A. Laubscher*, and R. Jimenez-Flores, *California Polytechnic State University, San Luis Obispo.*

A recent concern about the presence of bacteria that can cause “ropy” milk has caused the examination of old testing methods to detect milk that can develop “ropyness”. Ropy milk is characterized by its viscosity

and its tendency to adhere to surfaces and form a slimy thread when the surfaces to which it is attached are pulled apart. The viscous character of the milk is produced by a complex oligosaccharide normally present in the form of a capsule around the bacteria. The objectives of this study were to survey the commercial supply of milk presenting the ropy milk defect with various traditional and molecular microbiological methods, and to give information on which microorganism or population of microorganisms are responsible for this defect. Over 200 raw milk samples were received from plants throughout the southern states. Samples are plated on TPC agar and incubated at 25°C for 36 hours to identify 5 types and obtain isolates. Isolated strains are tested for RM production by inoculation in sterile and UHT milk, which was then incubated at 25°C for 36 hours. The API method was used for bacterial identification of isolated strains which is based on a series of tests for sugar utilization that discern the genus and species. The “ropy test” proved to be successful with ropy isolates producing 100% reproducibility ropy milk and non-ropy isolates producing 100% non-ropy milk. We have established a database that classifies the isolated bacteria from milk on the basis of their gram stain, morphology, and exopolysaccharide capsule. Identification based on detailed biochemical analysis has indicated that the strains isolated belong to the coliform group of bacteria, with genus *Klebsiella* (*Klebsiella pneumoniae* and *Klebsiella oxitoca*).

Key Words: Milk Quality

W89 Effect of pH and reconstitution methods on heat stability of milk protein concentrate. V. Sikand*, B. L. Golden, and P. S. Tong, *Dairy Products Technology Center, San Luis Obispo, CA.*

The objective of the research was to determine the effect of pH and reconstitution methods on heat stability (HS) of 80% milk protein concentrate (MPC80). In the first series of experiments, we determined the effects of solvent type (water or permeate) used to reconstitute MPC80 on HS. MPC80 was reconstituted (RC) to 3.5% protein content with either water or permeate powder (PP) from skim milk ultrafiltration. To study the impact of homogenization, a second series of experiments were conducted in a pilot plant as previously described and subjected to homogenization treatments at 2000 and 500 psi in the first and second stages, respectively. The pH of the RC MPC80 in either series of experiments was adjusted to a pH varying from 6.6 to 7.0 and samples were tested for HS. Each experimental unit was replicated three times. The HS, defined as the heat-coagulation time (HCT), was measured as the time required for visible coagulation of the sample immersed in a 140°C oil bath. In the first experiments, HCT for MPC80 RC with water showed a steady increase from pH 6.6 to 7.0. HCT for MPC80 RC with permeate did not change significantly from pH 6.6 to 7.0. The least squares mean of HCT for MPC80 RC containing 3.5% protein with water was 7.96(± 0.64) minutes and with permeate was 5.06(± 0.78) minutes. In the second experiment, HCT for MPC80 RC with water showed a steady increase from pH 6.6 to 7.0. MPC80 RC with permeate first increased with increase in pH from 6.6 to 6.8 and then decreased with increase in pH of 6.9 - 7.0. MPC80 homogenized with permeate showed a significant increase in HS ($p < .001$). The least squares mean of HCT for homogenized MPC80 containing 3.5% protein RC with water was 7.48 (± 0.55) minutes and with permeate was 13.82(± 0.64) minutes. It was observed that permeate RC homogenized MPC samples are very similar to HCT- pH curves of skim milk sample. We suggest that the milk permeate can be exploited to improve HS (compared to water) of beverages containing MPC80 between natural pH of 6.7–6.8 when milk

components can be dispersed effectively (i.e. use of homogenization).

Key Words: MPC, Permeate, pH

W90 The concentration of lactoferrin in the bovine colostrum and immune milk. J. B. Cheng¹, J. Q. Wang*¹, D. P. Bu¹, G. L. Liu¹, C. G. Zhang^{1,2}, X. L. Dong^{1,2}, H. Y. Wei¹, L. Y. Zhou¹, and K. L. Liu¹, ¹*State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China*, ²*College of Animal Science and Technology of Yangzhou University, Yangzhou, China*.

Lactoferrin (LF) is a key element in the host innate defense system, and the level of protection mainly depends on the concentration of LF in milk. In this study, changes of LF level in the immune milk were monitored and compared with that of colostrums. The colostrum from thirty-six Holstein cows was collected in this study. The concentration of LF in the milk was detected by Sandwich enzyme-linked immuno-

sorbent assay (ELISA). The relative concentration of them in colostrum was analyzed by Dodecyl sodium sulfate-gel electrophoresis of proteins (SDS-PAGE). The immune milk used in this study was made by implanted Antigen Release Devise. The data was analyzed with FIXED MODEL by SAS 9.0. It was indicated that the concentration of LF in colostrum had a dramatic change, especially in the first 24 hours after parturition, from 1.315 ± 1.086 mg/mL to 0.655 ± 0.377 mg/mL ($P < 0.05$), then another sharply decrease occurred on day 4, with the level of 0.264 ± 0.098 mg/mL, which had no difference to the LF concentration in the normal milk (0.209 ± 0.071 mg/mL, $P > 0.05$). SDS-PAGE results resembled the aforementioned trends. In addition, implanted Antigen Release Devise could increase the concentration of LF in the milk. On day 7 after implantation, the concentration of LF in the milk (0.313 ± 0.133 mg/mL) could be equal to the level of colostrum on day 3. This result might indicate that the concentration of LF in the colostrum and milk is influenced by parturition and immune stress, indicating LT might be an important part of bovine protection system.

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Key Words: Lactoferrin, Colostrum, Sandwich ELISA

Forages and Pastures II

W91 The influence of wilting on the quality of *Acacia mangium* silage. T. Clavero* and R. Razz, *Centro de Transferencia de Tecnología en Pastos y Forrajes. Universidad del Zulia, Maracaibo, Zulia, Venezuela.*

An experiment was conducted in the dryland farming area of northwest Venezuela to evaluate the ensiling properties of *Acacia mangium* using microsilage techniques. Factors studied were wilting for 0 and 3 h and ensiling time of 0, 5, 8 and 16 days. A 1:2 (w:v) ratio of legume:molasses was mixed and stored at 25°C. Data were analyzed as a randomized design with a 2X4 factorial of wilting time and ensiling time, respectively. Means were compared by Tukey test. Response variables were: dry matter (DM), cellulose (C), pH, total nitrogen (TN), ammonia (NH₃) and NH₃/TN. Increasing ensiling time of high moisture *Acacia* resulted in losses of DM and C in the silage. Ensiling *Acacia mangium* from 0 to 16 d resulted in decreased ($P \leq 0.05$) DM and C content of 12 and 10%, respectively for high moisture silage in contrast to 8.5 and 6% for wilted. This could have been due to the cumulative activity of plant cell respiration, enzymes cellulose and some facultative bacteria in the fresh ensiled forage. The pH increased ($P \leq 0.05$) while CP, NH₃ and NH₃/TN decreased ($P \leq 0.05$) with reduced moisture content of ensiled *Acacia*. The concentrations of fermentation end-product decreased with wilting, showing that low moisture restricted fermentation. Therefore, pH increased in wilted silage. The reduction in CP content in wilted silage was expected due to breakdown of true protein during sun-drying and ensiling process. Wilting resulted in a decrease ($P \leq 0.05$) in NH₃ and NH₃/TN when compared to high moisture silage. The concentrations of NH₃ and NH₃/TN in high moisture silage were 38 and 25.9% greater, respectively, than wilted silage. However, the levels of NH₃ were still within acceptable limits, with values less than 80-100 g/kg TN which is commonly used to represent well fermented silage. Although fermentation patterns were different ($P \leq 0.05$), all silages in the current experiment achieved satisfactory preservation.

Key Words: *Acacia mangium*, Silage, Wilting

W92 Mulberry (*Morus alba*) fodder response to increasing levels of organic nitrogen. J. A. Elizondo-Salazar* and C. Boschini-Figueroa, *Estación Experimental Alfredo Volio Mata. Facultad de Ciencias Agroalimentarias, Universidad de Costa Rica, Costa Rica.*

In some areas of Costa Rica and many other countries, the available grazing is sometimes not sufficient to meet the nutrient requirements of animals, at least for part of the year. Thus, the use of fodder from trees and shrubs is widely utilized as dietary supplements for ruminants. However, high fodder yields and adequate CP levels require application of large doses of chemical N, increasing production costs and pollution risk. In order to reduce cost, producers utilized organic fertilizers without knowledge of the right amounts to use in order to obtain high yields. For this reason, a study was conducted to evaluate the application of increasing levels of N from organic fertilizer consisting of green waste composted material. A 12-yr-old mulberry plantation planted at spacings 0.9 × 0.40 m (27,777 plants/ha) was utilized in a randomized block design with 4 treatments: 150, 300, and 450 kg of N/ha/yr, and a control (no fertilizer). All plots were uniformly pruned at 0.6 m from the ground at the beginning of the trial. Organic fertilizer was applied in 2

doses during the rainy season. For a 365-d period, plants were pruned consecutively every 90 d. Leaves and stems were separated and analyzed for DM and CP content. On average, 475 kg of N/ha/yr were removed. There was no significant difference in dry matter yield; suggesting that the amount of N mineralized from the organic fertilizer was low during the duration of the study. However, CP content was greater for the higher N applications, indicating that greater N quantities were available for uptake. In order to replenish the N being removed, at least 450 kg of N/ha/yr should be applied.

Table 1.

Variable	Treatment kg N/ha/yr				SEM	P
	0	150	300	450		
Dry matter, %						
Leaves	22.28	22.16	21.12	21.51	0.44	NS
Stalk	23.47	23.80	22.70	23.03	0.43	NS
Total	22.67 ^a	22.63 ^a	21.63 ^b	21.60 ^b	0.33	0.09
Dry matter, kg/ha/yr						
Leaves	14,492.0	14,091.4	15,740.3	15,740.3	892.5	NS
Stalk	9,353.2	9,176.1	10,704.9	10,951.3	712.8	NS
Total	23,845.2	23,267.5	26,098.9	26,691.6	1,538.9	NS
Crude protein, %						
Leaves	15.23 ^b	15.79 ^{ab}	16.35 ^a	16.43 ^a	0.31	0.03
Stalk	5.36	5.48	5.52	5.82	0.16	NS
Total	11.50 ^b	11.78 ^{ab}	12.05 ^{ab}	12.21 ^a	0.20	0.07

Key Words: *Morus alba*, Nitrogen, Organic Fertilizer

W93 Effects of one-seed juniper on intake, rumen fermentation, and plasma amino acids in sheep and goats fed supplemental protein.

S. A. Utsumi¹, A. F. Cibils¹, R. E. Estell², S. Soto-Navarro¹, and D. M. Hallford¹, ¹New Mexico State University, Las Cruces, ²USDA/ARS Jornada Experimental Range, Las Cruces, NM.

We tested the effect of feeding one-seed juniper (*Juniperus monosperma*) on total intake, VFA profile, and plasma AA of 12 does and 12 ewes fed sudangrass (*Sorghum vulgare*) and a basal diet with no protein supplement (Control; 5% CP) or rumen degradable (SBM; RDP 15% CP) or undegradable (FM; RUP 15% CP) protein supplements. After 15 d of adaptation to sudangrass and basal diets (period 1), animals were individually fed one-seed juniper leaves in addition to the sudangrass and basal diets during a second 15-d period (period 2). Each food was fed separately during 3-h periods at 110% of previous day intake. Blood and ruminal fluid samples were collected on the last 2 d of each period to determine plasma AA, VFA, and rumen pH. Analyses followed a split-plot design with periods with or without juniper as a sub-plot factor. Juniper intake did not vary between species ($P = 0.54$) or supplement treatments ($P = 0.93$; 4.7 g/kg^{0.75}). Total intake (TI), basal diet intake (BDI), and sudangrass intake (SGI) were not affected by supplements ($P > 0.05$), were higher for sheep than goats ($P < 0.01$), and decreased with juniper feeding in period 2 ($P < 0.01$). Total intake, BDI, and SGI for periods 1 and 2 were 54.9 vs. 47.6, 36.7 vs. 31.5, and 18.2 vs. 11.5 g/kg^{0.75}, respectively. Total VFA, acetate (Ac), and propionate (Pr) increased with juniper in period 2 ($P < 0.01$; period 1 vs. 2, VFA:

63.9 vs. 79.4; Ac: 47.5 vs. 60.5; Pr: 9.3 vs. 11.7 mM). Rumen pH averaged 6.4 and did not differ between supplements, species, or periods. Total AA and some individual AA differed between supplements (RUP \ge RDP>Control), species (goats>sheep), and decreased with the feeding of juniper in period 2 ($P < 0.05$). Juniper intake in period 2 was associated with decreases in plasma ALA, GLY, THR, SER, ASP, MET, GLU, PHE, CYST, TYR, and TRP. These data suggest one-seed juniper in sheep and goat diets depresses intake, but may increase VFA and requirements for certain amino acids.

Key Words: Essential Oils, *Juniperus monosperma*, Protein Supplementation

W94 Effects of one-seed juniper and polyethylene glycol on intake, rumen fermentation, and plasma amino acids in sheep and goats fed supplemental protein and tannins. S. A. Utsumi¹, A. F. Cibils¹, R. E. Estell², S. Soto-Navarro¹, and D. M. Hallford¹, ¹New Mexico State University, Las Cruces, ²USDA/ARS Jornada Experimental Range, Las Cruces, NM.

We tested the effect of polyethylene glycol (PEG) on juniper (*Juniperus monosperma*) and total intake, rumen fermentation, and plasma AA of 12 does and 12 ewes fed sudangrass (*Sorghum vulgare*) and basal diets containing 10% quebracho (*Aspidosperma quebracho*) tannins with no protein supplement (Control; 5% CP) or high rumen degradable (RDP 15% CP) or undegradable (RUP 15% CP) protein supplement. After 15 days of exposure to non-restrictive amounts of juniper leaves, sudangrass, and basal diets (period 1), animals received an additional 50 g of PEG for a second 15-d period (period 2). Blood and ruminal fluid samples were collected on the last 2 d of each period to determine AA and VFA. Analyses followed a split-plot design with periods with or without PEG treated as sub-plot factor. Juniper intake did not differ between species ($P > 0.05$) or supplements ($P > 0.05$), but increased with addition of PEG in period 2 (Period 1 vs. 2: 4.3 vs. 10.8 g/kg^{0.75}; $P < 0.01$). Total intake and intake of sudangrass and basal diets were higher for sheep than goats ($P < 0.01$) and differed between supplements and periods (supplement x period, $P < 0.05$). Polyethylene glycol stimulated higher intakes of basal diet for Control and RDP, and of sudangrass for RUP. Total VFA was higher for sheep than goats ($P < 0.05$) and decreased from period 1 to period 2 with supplemental PEG in sheep (70.6 vs. 62.1 mM; species x period, $P < 0.05$) and with RDP (67.3 vs. 58.6 mM; supplement x period, $P < 0.05$). Acetate and propionate differed between periods with or without PEG in the same manner as total VFA. Total AA and some individual AA differed between species (sheep > goats), supplements (RUP \ge RDP > Control), and periods ($P < 0.05$). Increased juniper intake with PEG in period 2 was associated with lower plasma GLY, THR, SER, ASP, MET, GLU, PHE, CYST, GLN, ORN, LYS, HIS, and TRP. Polyethylene glycol increased juniper intake and decreased several plasma AA when tannin-rich foods with varying CP were fed.

Key Words: Essential Oils, *Juniperus monosperma*, Condensed Tannins

W95 Effect of essential oils on in vitro NDF digestion. M. D. Tassoul*, J. P. Goeser, R. D. Shaver, and D. K. Combs, *University of Wisconsin, Madison*.

Our objective was to determine the effect of essential oils on in vitro NDF digestibility (ivNDFD). Corn (35.6% NDF) and alfalfa (41.8% NDF) silage samples were dried, ground (1 mm), and treated in one of two ways; left unsupplemented (Control, C) or mixed with an essential oil blend (CRINA[®], EO) at a rate similar to supplementing EO at 1.2 g/cow/d and weighed (0.5 g) into Ankom F57 forage fiber bags. Samples were digested with Goering and Van Soest in vitro media in duplicate using a modified ivNDFD assay for 0, 7, 10, 14, 21, 24, 30, 36, 46, 54, 72, or 96 h. Rumen fluid was collected and pooled from two cannulated donor cows. Strained rumen fluid was mixed with buffer, reducing solution and primed with a mixture of carbohydrates and nitrogen, and allowed to produce 0.3 ml gas/ml of rumen fluid inoculum prior to inoculating feed samples. In vitro NDF digestibility was calculated as: ivNDFD (% of NDF) = 100 X [(NDF_{0h} - NDF_{residue})/(NDF_{0h})]. Results were analyzed with SAS Proc Mixed. The model included fixed effects of: feed, EO, time, and two way interactions between each. Means were compared with the lsmeans statement. Corn silage NDF was more digestible than alfalfa silage NDF (32.1 vs. 31.1% ivNDFD, $P = 0.04$). There was a tendency for a feed by EO interaction ($P = 0.08$), Corn silage mean ivNDFD was greater with EO compared to C (32.9 vs. 31.3%, $P < 0.05$), while alfalfa silage did not differ. A significant time effect and a time by feed interaction were both observed ($P < 0.05$). There was a trend for an EO by time interaction ($P = 0.13$). Mean 24 h ivNDFD was greater for EO than C (24.51 vs. 20.57%, $P < 0.05$). The increased ivNDFD for both feeds at 24 h with EO, and improved corn silage ivNDFD with EO observed in this research agrees with previous in vitro experiments, but the feed by EO interaction merits further study.

Key Words: Essential Oils, In Vitro, NDF

W96 Nutritive evaluation of three browse tree foliages during rain and dry seasons: Total tannins and in situ digestibility in cattle and goats. R. Rojo*¹, D. López¹, F. Vázquez¹, O. Vázquez¹, B. Albarrán¹, S. Rebollar¹, J. Hernández¹, D. Cardoso¹, F. González¹, E. Dorantes¹, F. Avilés¹, A. García¹, and C. Narciso², ¹Universidad Autónoma del Estado de México, Temascaltepec, Estado de México, México, ²Colegio de Postgraduados, Córdoba, Veracruz, México.

Foliages from three browse spp. (*Lysiloma acapulcensis*, *Quercus laeta* and *Pithecellobium dulce*), native to the southern subtropical region of the state of México, México, was harvested during the rain (2006) and dry (2007) seasons to evaluate chemical composition (CP, NDF, ADF), total tannin (TT) and *in situ* digestibility of DM (DMD), fiber fractions (NDFD, ADFD), and crude protein (CPD), using three different ruminal inoculums (bovine, BOV; goat unadapted, GUA; goat adapted, GA). Animals were equipped with ruminal cannula and received forage:concentrate (80:20) diets; where forage for BOV and GUA was a mixture of: alfalfa hay (30%), corn silage (30%) and corn straw (20%), for GA the forage was alfalfa hay (24%) and browse species (56%). Browse foliages, season, and ruminal inoculums were arranged in a 3 X 2 X 3 factorial design. The incubations period was

48 h. Crude protein and fiber fractions were affected ($P < 0.01$) by species and season. Total tannin content varied among species ($P < 0.01$) (*L. acapulcensis* rain: 187.77^a vs dry: 160.24^a; *Q. laeta* rain: 89.9^{bc} vs dry: 108.99^b; *P. dulce* rain: 62.55^c vs dry: 94.11^{bc} g kg⁻¹ DM). Inoculum and season affected ($P < 0.01$) DMD, NDFD, and CPD. During the dry season, DMD was highest for *P. dulce* ($P < 0.01$) and lowest for *L. acapulcensis* ($P < 0.01$). In the dry season, DMD was higher for goats than cattle (rainy: BOV: 54.43^c, GUA: 54.78^c, GA: 51.46^d vs dry: BOV: 59.69^b, GUA: 66.89^a, GA: 65.28^a). NDFD was higher for goats in the dry season ($P > 0.01$) and was higher for *P. dulce* (rain: BOV: 30.86^{bc}, GUA: 33.24^{ab}, GA: 27.38^c vs dry: BOV: 21.47^d, GUA: 36.62^a, GA: 33.62^a). A similar effect was observed for CPD ($P < 0.01$). Goats had more capacity to use browse species with tannins. *P. dulce* could be a forage species with potential of use as protein source in small ruminants.

Key Words: Browse Species, Tannin, Digestibility

W97 Effect of fodder tree species, season, and inoculum source on in vitro gas production from foliage. L. M. Camacho^{*1}, R. Rojo¹, G. D. Mendoza², F. Avilés¹, D. López¹, D. Cardoso¹, S. Rebollar¹, and N. Pescador¹, ¹Universidad Autónoma del Estado de México, Temascaltepec, Estado de México, México, ²Universidad Autónoma Metropolitana, Distrito Federal, México.

The *in vitro* gas production of *Lisyloma acapulcensis*, *Quercus laeta* and *Pithecellobium dulce* harvested during the rainy and dry seasons was measured, using three different ruminal inoculums bovine (BOV), unadapted goat (UAG), and adapted goat (AG). Animals were fitted with ruminal cannulae and received forage:concentrate (80:20) ratio diets, where forage for BOV and UAG was a mixture of alfalfa hay (40%), corn silage (40%) and corn stover (20%), and for AG the forage was alfalfa hay (24%) and browse species (56%). Browse foliage, season, and ruminal inoculums were arranged in a 3 X 2 X 3 factorial design. Chemical composition (CP, NDF) and total condensed tannin (TCT) were determined. The gas volume was recorded at 0, 2, 4, 6, 8, 12, 16, 20, 24, 48, 72 and 96 h and the data fitted to the model $P = a + b(1 - e^{-ct})$. *P. dulce* had the highest ($P < 0.05$) CP content (186 and 167 g kg⁻¹ DM) in rainy and dry season, respectively. *L. acapulcensis* had the highest NDF (554 and 559 g kg⁻¹ DM) in the rainy and dry season, respectively. The highest levels ($P < 0.05$) of TCT were detected in *L. acapulcensis*, (188 and 160 g kg⁻¹ DM), while the lowest were observed in *P. dulce* (63 and 94 g kg⁻¹ DM) in rainy and dry season, respectively. Cumulative gas release at 96 h was 181–183 mL g⁻¹ DM for *P. dulce* in dry season with inoculum from goats while *L. acapulcensis* produced 30–39 mL g⁻¹ DM with inoculum from BOV in both seasons. The highest gas volume from the b pool was found with *P. dulce* ($P < 0.05$; 182 and 179 mL g⁻¹ DM) in rainy season with inoculum of AG and UAG, respectively. The least quantity from this fraction was produced in both seasons (46 and 43 mL g⁻¹ DM) from *L. acapulcensis* with inoculum from BOV. The highest constant rate of gas production (c) was observed with *P. dulce* (5% h⁻¹) from the dry season using UAG and AG inoculum. The lowest constant rate (1% h⁻¹) was observed with *Q. laeta* from the rainy season with BOV inoculum. *P. dulce* showed highest nutritional value and could be used for grazing goats in semi-arid regions.

Key Words: *In Vitro* Gas Production, Browse Species, Inoculums

W98 Ozone and nitrogen deposition effects on nutritive quality of a species-rich subalpine grassland. M. K. Cline^{*1}, J. C. Lin¹, K. Nadarajah¹, M. Volk², R. B. Muntifering¹, S. Bassin², and J. Fuhrer², ¹Auburn University, Auburn, AL, ²Swiss Federal Research Station for Agroecology and Agriculture, Zurich, Switzerland.

Rising global levels of tropospheric ozone (O₃) and excessive rates of atmospheric N deposition represent major threats to productivity and sustainability of grasslands across the Northern Hemisphere. Effects of exposure to each of these on productivity and nutritive quality of intensively managed forages have been reported, but little is known about their combined effects or impacts on extensively managed grasslands. For these reasons, we conducted an experiment to determine effects of co-exposure to a range of current and projected levels of these air pollutants on productivity and nutritive quality of an extensively managed, species-rich (primarily *Festuca*, *Nardus* and *Carex*, numerous forb and few legume spp.) pasture located at Alp Flix, Switzerland. One hundred eighty plots (40 × 30 cm) representative of vegetation at the site were exposed during the April–October growing seasons in 2004–2006 to one of three levels of O₃ (1.0, 1.2 or 1.6 × ambient) in a free-air fumigation system that comprised 9 exposure rings (3 rings/O₃ level). Within each ring, 20 plots received biweekly applications of NH₄NO₃ solution that simulated five areal concentrations of atmospheric N deposition equivalent to 0, 5, 10, 25 or 50 kg/ha (4 plots/N concentration). Plots were harvested once each year in August by cutting forage at 2 cm above ground surface. Differences ($P < 0.0001$) were observed among years in forage concentrations of N, NDF, ADF and ADL, and in relative nutritive quality calculated from forage concentrations of NDF and ADF. Across all three growing seasons and levels of N input, there was no systematic effect of O₃ exposure level on grassland nutritive quality. However, there was an O₃ × N interaction ($P = 0.09$) such that positive responses in forage quality to N inputs of 25 and 50 kg/ha were abated by increased deposition and lignification of cell-wall constituents associated with accelerated foliar senescence in the elevated-O₃ treatments. Results indicate that excessive rates of N deposition may increase plant sensitivity to elevated O₃, presumably from increased stomatal uptake, and further compound the phytotoxic effects of O₃ on forage quality.

Key Words: Ozone, Nitrogen, Forage Quality

W99 Forage quality of native pasture in an alpine area for the production of Bitto cheese. S. Colombini^{*1}, A. Tamburini, A. Sandrucci, and L. Rapetti, University of Milan, Milan, Italy.

Bitto is an Italian traditional cheese produced in Valtellina by grazing cows on alpine pasture with a maximum inclusion of 3 kg concentrate/day. The objective of this research was to characterize the nutrient composition and the feed value of native alpine pasture during rotational grazing. Grass samples were collected in two experimental study areas located in Valtellina (1500 m o.s.l.) in 2006. Triplicate samples were collected every 15 days during the grazing season (June–September) and chemically analyzed. NRC 2001 equations were used to predict the nutritive value of grass. NDF digestibility at 48 h was determined by Ankom Daisy Incubator II. Results were used to predict energy and protein metabolism of the cows with CPM-Dairy model and NRC Dairy

Cattle Program. Data were analyzed by GLM procedures of SAS, with 2 pasture levels and 8 sampling data.

DM content increased in both experimental sites during the grazing season (from 43.6 to 58.0% in site 1 - $P < 0.05$, and from 34.9 to 43.9% in site 2 - $P < 0.05$). Average NDF contents (67.6 and 62.9% on DM in site 1 and 2, respectively) were higher than those reported for north Italy alpine pastures. The energy value (Mcal NE_l/kg DM) was generally low and decreased from 1.11 to 0.78 in site 1 ($P < 0.01$) and from 1.41 to 0.94 in site 2 ($P < 0.10$). CP content decreased during the grazing season from 12.9 to 9.2% ($P < 0.05$) and it was negatively correlated with the date of sampling ($y = -0.0484 + 1895.3; r^2 = 0.86$). At the beginning of the season, in the diet there was low energy/nitrogen ratio due to herbage characteristics. Simulation of energy and protein requirements showed a negative balance for ME during the entire grazing season even with the daily integration of 1 kg soybean meal and 2 kg corn meal. Metabolizable protein balance was positive. The results showed an average low energy value of pasture, with significant differences between the two sites due to different botanical composition. The energy value decreased from June to September suggesting the importance of providing, during the grazing season, a proper supplementation in order to meet the energy and protein requirements of the cows.

Key Words: Alpine Pasture, Energy Value

W100 Mineral profiles of selected grass and legume species as affected by liquid hog manure and inorganic fertilizer. G. N. Gozho¹, M. Undi², J. Sletmoen², F. Stewart³, J. C. Plaizier², and K. M. Wittenberg², ¹University of Saskatchewan, Saskatoon, Saskatchewan, Canada, ²University of Manitoba, Winnipeg, Manitoba, Canada, ³Manitoba Agriculture, Food and Rural Initiatives, Beausejour, Manitoba, Canada.

Mineral profiles of selected grass and legume forages grown on land receiving either liquid hog manure or inorganic urea fertilizer were determined. Two sources of N, liquid hog manure or urea, were used, with application rates of 112, 224 and 336 kg available N ha⁻¹. Urea-treated plots received 5.5 kg P₂O₅ ha⁻¹ and 5.5 kg K₂O ha⁻¹ each year. Manure ammonia-N was measured using a Nova meter (Agros Nova Nitrogen Meter, Kalby, Sweden) before application. Liquid hog manure in western Canada generally contains, DM basis, 74 to 146 g kg⁻¹ N, 19 to 49 g kg⁻¹ P and 99 to 117 g kg⁻¹ K. A control that received no liquid hog manure or inorganic fertilizer was included. Three legume forages namely, alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.), and birdsfoot trefoil (*Lotus corniculatus* L.) and three grass forages, tall fescue (*Festuca arundinacea* Schreb.), reed canarygrass (*Phalaris arundinacea* L.), and quackgrass (*Elytrigia repens* [L.] Nevski) were evaluated. The two replicates were harvested on June 12 and 18 (cut 1) and on September 4 and 6, 2001 (cut 2). Urea application reduced ($P < 0.05$) the ash content of grass forages at first cut but not second cut relative to unfertilized and liquid hog manure treatments. Grasses harvested from the highest urea treatment had the highest Ca content, whereas those receiving the highest liquid hog manure application had the lowest Ca content, with other treatments being intermediate. A similar profile emerged for plant Mg response to fertility. Fertility reduced ($P < 0.05$) Ca content of legume forages but had no effect ($P > 0.05$) on P, Mg or S concentrations. Liquid hog manure application resulted in elevated ($P < 0.05$) K levels compared to urea treatment in all forages. The tetany ratio, K:(Ca + Mg), used to predict incidence of tetany in cattle, was highest in grass and legume forages for the highest liquid hog manure.

Results of this study demonstrate that forage mineral profiles can be impacted differently when liquid hog manure is applied as opposed to conventional inorganic fertilizer sources.

Key Words: Liquid Hog Manure, Grass, Minerals

W101 Split application of nitrogen on perennial grasses compared to manure applications. D. J. R. Cherney*, J. H. Cherney, Q. Ketterings, and M. Davis, Cornell University, Ithaca, NY.

Timing of N applications and the form of the nutrients applied can impact forage yield and quality. Split application of nitrogen fertilizer on four field replications (3 × 6.1 m) of orchardgrass, tall fescue and reed canarygrass was compared with dairy manure applications. Nitrogen fertilizer was applied at 90.8 kg N/acre at spring greenup, or 45.4 kg N fertilizer/acre at spring greenup followed by 45.4 kg N fertilizer after first cut, or 45.4 kg N fertilizer/acre at spring greenup followed by 22.7 kg N/acre after first cut and 22.7 kg N/acre after second cut. Commercial N treatments were compared to two applications of 44.8 metric tons/ha of semi-solid dairy manure applied at spring greenup and after first harvest. A combination treatment of 89.6 metric tons/ha of manure split applied and 68 kg N fertilizer/ha split applied at spring greenup and after first and second cuts was also used. Plots were harvested with a forage harvester (Carter Mfg. Co., Brookston, IN). There was about a 5% yield increase due to a split N application and about an 8% yield increase using a three-way split application. Nitrogen fertilizer recovery decreased ($P < 0.05$) with split application of N from 60% to 53%. The proportion of the total yield in the first two cuts decreased ($P < 0.05$) from 80% to 71% with split N application. Manure application resulted in 20% lower yield ($P < 0.05$) than commercial N application, while a combination of manure and N fertilizer increased yields 10% ($P < 0.05$) over commercial N application alone. Grasses reacted similarly to treatments for yield and N recovery; yield of tall fescue was distributed more uniformly over the three cuts compared to the other species. Reed canarygrass was consistently 30-40 g/kg higher in CP and averaged 50 g/kg lower NDF than the other species over all three harvests. NDF averaged 530, 560, and 530 g/kg for the 3 cuts and NDF digestibility averaged 760, 690, and 640 g/kg for the three cuts. Treatments did not significantly impact NDFD. There was a small yield advantage for split application of N fertilizer on perennial grasses, and it will take more than four years of manure application at a 89.6 metric tons/ha rate to produce yields comparable with commercial N fertilization.

Key Words: Perennial Forage, Manure

W102 In vitro dry matter digestibilities of perennial peanut, annual peanut, alfalfa, and bermudagrass forages in horses. J. V. Eckert*, R. O. Myer, L. K. Warren, J. L. Foster, and J. H. Brendemuhl, University of Florida, Gainesville.

In vitro dry matter digestibilities (IVDMD) of perennial peanut (PP, *Arachis glabrata*, 'Florigraze'), annual peanut (AP; *Arachis hypogea*) hays (grown in Marianna, FL, 2005, 2006) as well as dried fresh forage samples taken from the same fields (2006), alfalfa hay (A; Iowa, 2006), Tifton 85 (T85) and Coastal (CB) bermudagrass hays (*Cynodon dactylon*, both from Suwannee county, FL, fertilized fields), and six vari-

ies of PP were compared (Marianna, FL, 2006). All hays had no rain damage. Seven yearling horses fed their normal diet (grass pasture and concentrate) were used as the source of feces. Samples were incubated in a closed fermentation apparatus (Daisy^{II} incubator). Freshly voided feces were collected from all horses, mixed with buffers, and placed in four incubation vessels. Twenty-one filter bags (each containing 0.5 g of sample) were placed in each vessel. Jars were heated and rotated for 48 h. Data were analyzed using PROC MIXED of SAS. Least square means of IVDMD (%±SE) from samples of dried fresh AP were 80 and 78% (±2). The IVDMD of AP hay (65% ±2) was lower than fresh AP (P < 0.0001). Dried fresh AP samples were greater than dried fresh PP (P < 0.01). Alfalfa hay (71% ±2) and PP hay (68% ±2) had similar IVDMD (P > 0.2). The IVDMD of A was greater than AP hay (P < 0.01) while PP and AP hays did not differ (P > 0.2). Perennial peanut, T85, and CB hays from a previous digestion trial (abstract 38 in 2007 meeting of the Southern Section of ASAS) showed a greater IVDMD for PP than T85 or CB (P < 0.0001; comparable to the in vivo DMD) and no differences (P > 0.2) between T85 and CB from the first two periods of that trial. During period 3 of that same trial, CB IVDMD tended to be greater than T85 (P < 0.06). Numerically, the IVDMD of the grasses was lower than their in vivo DMD. Of the six varieties of PP, the two with the highest IVDMD were Elite Line (75.7% ±2) and Ecoturf (73.8% ±2), even though all varieties were highly digestible. Results indicate that PP and AP are highly digestible, but PP may be better suited for horses.

Key Words: Perennial Peanut, In Vitro Digestibility, Horse

W103 Forage management affects bermudagrass Forage yield and nutritive value. A. E. Lee*¹, A. V. Riojas¹, B. D. Lambert^{1,2}, and J. P. Muir², ¹Tarleton State University, Stephenville, TX, ²Texas AgriLife Research, Stephenville, TX.

Bermudagrass (*Cynodon dactylon*) cultivars are common forages in the southern USA. Coastal (CB) and Tifton 85 (T85) bermudagrass are widely cultivated in Texas. As fuel and labor costs rise, producers have opted to “stockpile” standing forages for winter grazing instead of using hay. Experiments compared the effects of stockpiling (Exp. 1) and hay cutting (Exp. 2) on CB and T85 forage yield and nutritive value. Sixteen 3 × 9 m plots were utilized, consisting of four plots of each species (CB or T85) per treatment. All plots received a single spring application of nitrogen (94 kg/ha). In Exp. 1, previously unharvested forage was sampled by hand clipping (1 m²) to ground level every 14 days to determine the effect of maturity on forage stockpiling. In Exp. 2, forage was sampled by hand clipping to ground level (1 m²) every 21 days and only regrowth was subsequently sampled, emulating well-managed hay production. Samples were analyzed for dry matter (DM), nitrogen (N), neutral detergent fiber (NDF), and acid detergent fiber (ADF) concentrations. Forage DM yield (kg ha⁻¹ year⁻¹) was calculated. In Exp. 1, CB had greater yield (P=0.02) as well as greater N (P<0.0001), NDF (P<0.0001) and ADF (P=0.006) concentration. In Exp. 2, T85 had higher N (P=0.007) and lower NDF (P=0.01) concentrations than CB. Preliminary results indicate that CB is better suited for stockpiling than T85 while the reverse is the case for hay.

Key Words: Stockpiling, Coastal Bermudagrass, Tifton 85 Bermuda-grass

W104 Forage nutritive value of crown rust resistant and susceptible oat cultivars in Northern Mexico. H. Bernal-Barragán*¹, R. Quintero-Martínez¹, J. A. Hernández-Aguilar¹, M. A. Cerrillo-Soto², A. S. Juárez-Reyes², E. Gutiérrez-Ornelas¹, J. E. Treviño-Ramírez¹, and F. Zavala-García¹, ¹Facultad de Agronomía UANL, Escobedo, N.L., México, ²Facultad de Medicina Veterinaria y Zootecnia UJED, Durango, Dgo., México.

Oat (*Avena sativa* L.) cultivated in Mexico is mainly utilized as green forage or hay for feeding ruminants in winter and early spring. Crown rust caused by *Puccinia coronata* is an important oat disease, especially when relative humidity is high during the growing season, and it can affect forage productivity and quality. This study was conducted with the aim to assess the nutritive value of four crown rust resistant oat cultivars (L-112, L-124, L-135 and L-164), which were released at the Facultad de Agronomía UANL in 2007, and two crown rust susceptible oat cultivars (Cocker and Cuauhtemoc). Crown rust was present during the experiment in 100% of the plots of susceptible cultivars, whereas resistant cultivars were not affected at all. Three random whole plant samples were collected from small plots at 92 and 103 days of growth, oven dried at 55° C, and ground to pass through 1 mm screen. Dry matter, ash, CP, NDF, ADF, and ADL, were determined and contents of cellulose, and hemicellulose were calculated. Further analyses were conducted using a Daisy^{II} Incubator and an adiabatic calorimeter to determine in vitro true digestibility of DM (IVTDMD) and digestible energy (DE) content, respectively. A 6 x 2 factorial arrangement (six oat cultivars x two cutting stages) was used in a complete randomized design, with three replicates per treatment. Ash contents were least (P < 0.05) for L-135 and greatest for Cuauhtemoc. Differences in CP, cellulose, hemicellulose, IVTDMD, and digestible energy content were found (P < 0.05) among oat cultivars (Table 1). There were no differences in ADL content. Ash and CP content of cultivars at 103 days were 16% less (P < 0.05) than at 92 days, whereas IVTDMD and digestible energy content were 5% less (P < 0.05) at 103 than at 92 days. In conclusion, the forage nutritive value of crown rust resistant cultivar L-112 was similar to those crown rust susceptible oat cultivars Cocker and Cuauhtemoc.

Table 1.- CP, fiber fractions, IVTDMD, and DE of oat cultivars (% or Mcal/kg DM)

Cultivar	CP	Cellulose	Hemicellulose	IVTDMD	DE
L-112	16.4 ^a	38.2 ^a	17.6 ^c	70.0 ^b	3.09 ^{abc}
L-124	14.4 ^{ab}	37.9 ^a	18.9 ^{bc}	65.1 ^c	2.81 ^c
L-135	12.0 ^b	35.6 ^{ab}	21.3 ^{ab}	62.2 ^c	2.86 ^{bc}
L-164	13.4 ^{ab}	38.0 ^a	19.4 ^{bc}	64.5 ^c	2.79 ^c
Cocker	15.9 ^{ab}	33.7 ^b	22.1 ^a	75.3 ^a	3.33 ^{ab}
Cuauhtemoc	16.6 ^a	38.0 ^a	21.5 ^{ab}	71.3 ^b	3.43 ^a
Mean	14.8	36.9	20.1	68.1	3.05
SEM	0.38	0.39	0.26	0.36	0.046

^{a,b,c} Means in a column with unlike superscripts are different (P<0.05)

Key Words: *Avena sativa*, Crown rust resistance, Nutritive value

W105 In vitro gas production characteristics and metabolizable energy content in crown rust (*Puccinia coronata*) resistant and susceptible oat (*Avena sativa* L.) cultivars. M. A. Cerrillo-Soto*¹, A. S. Juárez-Reyes¹, H. Bernal-Barragán², R. Quintero-Martínez², J. A.

Hernández-Aguilar², E. Gutiérrez-Ornelas², J. E. Treviño-Ramírez², and F. Zavala-García², ¹Facultad de Medicina Veterinaria y Zootecnia UJED, Durango, Dgo, México, ²Facultad de Agronomía UANL, Escobedo, N.L. México.

This study was conducted to determine the kinetics of in vitro gas production and the metabolizable energy (ME) content of four crown rust resistant oat cultivars released in 2007 at the Facultad de Agronomía UANL, México (L-112, L-124, L-135, and L-164) and of two crown rust susceptible oat cultivars (Cocker and Cuauhtemoc). During the experiment crown rust affected 100 % of the plots of susceptible oat cultivars, but plots of resistant cultivars were not affected at all. Three random whole plant samples were collected from small plots at 92 days of growth. Samples were oven dried and ground through 1 mm screen. In vitro gas production in oat samples was performed by incubating in triplicate 200 mg DM in 100 ml calibrated glass syringes. A buffered solution was mixed with rumen fluid from three ruminal fistulated sheep fed alfalfa hay and commercial concentrate (75:25) in a ratio of 1:2 (v/v). Thirty ml of the mixture was added to the syringes and the gas production was recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96 h of incubation. The data were fitted to the exponential equation $p = a + b(1 - e^{-ct})$. The content of ME was calculated by: $ME (Mcal\ kg^{-1}\ DM) = (2.20 + 0.136\ Gas\ Prod_{24h} + 0.057\ Crude\ Protein + 0.0029\ Crude\ Fat^2)/4.184$. Data were analyzed using ANOVA for a completely randomized design. Data shown in Table 1 indicate that in vitro gas production allowed identification of a greater nutritional value for resistant crown rust oat cultivar L-112 compared to the crown rust susceptible cultivars.

Table 1. In vitro gas production (mL/200 mg DM) and ME (Mcal/kg DM)

Cultivar	b	c	a+b	ME
L-112	64.5 ^a	0.049 ^{ab}	55.7 ^a	2.02 ^a
L-124	60.1 ^b	0.045 ^b	51.9 ^c	1.84 ^b
L-135	59.7 ^b	0.047 ^b	54.6 ^{ab}	1.90 ^b
L-164	57.5 ^b	0.053 ^a	50.9 ^c	1.93 ^{ab}
Cocker	59.2 ^b	0.047 ^b	52.3 ^{bc}	1.84 ^b
Cuauhtemoc	58.0 ^b	0.046 ^b	50.9 ^c	1.92 ^b
Mean	59.9	0.048	52.7	1.91
SEM	2.45	0.003	2.39	0.06

b= gas from slowly degraded fraction; c = constant rate of gas prod. (% h⁻¹); a+b = potential gas prod. ^{a,b,c} Means within columns with different superscript differ (P<0.05)

Key Words: *Avena sativa*, Crown Rust Resistance, Forage Nutritive Value

W106 Chemical composition, metabolizable energy content and in vitro gas production of grasses from North Mexico. E. Herrera-Torres, M. Murillo-Ortiz, M. A. Cerrillo-Soto*, O. Reyes-Estrada, and A. S. Juárez-Reyes, *Universidad Juárez del Estado de Durango, Durango, Dgo., Mexico.*

The objective of this study was to determine the chemical composition, in vitro gas production characteristics and metabolizable energy content of grasses commonly selected by grazing cattle in the semiarid region of North México. Samples of Plateado (1) (*Bothriochloa barbinodis*), Navajita (2) (*Bouteloua gracilis*), Banderita (3) (*Bouteloua curtipendula*), Pata de gallo (4) (*Chloris submutica*), Rhodes (5) (*Chloris gayana*), Rosado (6) (*Rhynchelytrum roseum*) and Buffel (7) (*Cenchrus ciliaris*) were collected during the wet season in an open grassland in Durango, Mexico. The samples were dried and ground (1 mm). Chemical analyses for CP, NDF and ADF were performed. In addition, triplicate samples (200 mg DM) were incubated in calibrated 100 ml glass syringes, with 30 ml of a mixture of buffer:rumen fluid. The inoculum was collected from three sheep fed alfalfa hay and a commercial concentrate (75:25). Gas production was recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96h. Data were fitted to the equation: $p = a + b(1 - e^{-ct})$. The ME content (Mcal Kg⁻¹DM) of sample was calculated by: $ME: (2.20 + 0.136GP_{24h} + 0.057CP + 0.0029CF^2)/4.184$. Statistical analysis was performed using a completely randomized design. Differences (P<0.05) were observed for CP and NDF among grasses. The content of ME calculated from in vitro gas production as well as the gas produced from the insoluble but slowly degradable fraction of the feed **b** and the constant rate of gas production **c** were also different among grasses. Based on our results, *C. ciliaris* has potential to improve grazing for cattle in the semiarid region of North Mexico.

Table 1. Chemical composition, metabolizable energy and in vitro gas production of grasses from North Mexico

Grasses	CP	NDF	ME	b	c
1	3.3 ^e	81 ^c	1.0 ^d	60 ^a	2.2 ^b
2	5.4 ^d	83 ^b	1.4 ^c	61 ^a	2.9 ^{ab}
3	4.3 ^f	82 ^b	1.5 ^b	57 ^a	2.6 ^b
4	4.8 ^e	84 ^a	1.4 ^c	61 ^a	2.7 ^{ab}
5	7.3 ^c	65 ^f	1.4 ^c	46 ^b	3.1 ^{ab}
6	7.8 ^b	77 ^d	1.4 ^c	55 ^a	2.6 ^b
7	10.5 ^a	70 ^e	1.8 ^a	54 ^a	4.2 ^a
Mean	6.2	77.4	1.4	56	2.9
SD	0.09	0.28	0.01	2.8	0.005

^{abcdefg}Means within columns with different superscript differ (P<0.05). CP, NDF (%); ME(Mcal/kgDM); **b**(ml/.2gDM); **c**(% h⁻¹)

Key Words: Grasses, In vitro Gas, Metabolizable Energy

W107 Evaluation of African star grass– pastures grazed under the leaf stage concept on commercial dairy farms in the humid tropics of Costa Rica. J.M. I. Sánchez*^{1,2}, S. Salazar^{1,3}, and A. Martínez^{1,2}, ¹Universidad de Costa Rica, San José, Costa Rica, ²Centro de Investigación en Nutrición Animal, San José, Costa Rica, ³Escuela de Zootecnia, San José, Costa Rica.

African star grass (*Cynodon nlemfuensis*) is used widely on dairy and beef farms in tropical countries. In Costa Rica it grows from sea level to 1200 m in altitude and it is the most important grass in the humid tropics, where annual average precipitation is 4500 mm and annual average temperature is 23°C (minimum of 10°C; maximum of 27 °C). This grass is characterized by a high DM yield and good nutritional value; however grazing intervals are critical because nutritional value declines rapidly with advancing maturity. Thus dairy farmers have had to apply plant phenological concepts such as the leaf stage concept, to determine when to graze this pasture. The aim of this study was to analyze the DM yield, utilization of the pasture on offer, botanical composition of African star grass-based pastures and nutritional value according with NRC (2001) proposed methodologies, on three dairy farms located in the humid tropics of Costa Rica. Farms were selected at random from a

group of farms where the pasture is intensively managed with fertilization, weed control and well-established grazing systems. Measurements and samples were taken every two mo for 1 yr period. Cows grazed the African star grass when it had an average number of 7.9 leaves. Botanical composition analysis showed that 86.7 % of the biomass was African star grass, 2.4% other grasses, 2.9% weeds and 7.8% senescent material. Average DM yield was 26.25 t/ha/year, which is similar to values reported in the literature when this grass is intensively managed. Pastures on the three farms were established more than 20 years ago, indicating farmers use management practices that sustain the grass. On average, pasture contained 20.3% CP, 72.8% NDF, 37.9% ADF, 8.7% ash, 7.7% NFC, 5.6% lignin and 1.2 Mcal/kg NEL (3X). Agronomic and nutritional data strongly suggest African star grass should be grazed when it has 8 leaves. A grazing system based on the leaf stage concept is a good tool for managing African star grass in the humid tropics.

Table 1.

Farm N°	N° of leaves at grazing	Regrowth period, d	DM yield, kg/ha/cut	% of grass on offer utilized	C P DM%	NE ₁ (3X) Mcal/kg DM
1 ¹	8.50 ^a	29	2570 ^a	44	19.8	1.20
2	7.45 ^b	30	1624 ^b	38	20.8	1.21
3	7.77 ^b	27	1864 ^b	47	20.2	1.20

^{a,b} Means in a column with different superscripts are different (p≤0.05)

¹ Average of 12 samples or measurements

Key Words: African Star Grass, Plant Phenology, Nutritional Value

W108 Production of *Brachiaria brizantha* and *Panicum maximum* forages according to period of intercropping with corn and nitrogen fertilization. R. S. Barducci¹, C. Costa¹, T. C. Putarov¹, L. M. N. Sarti¹, E. S. Ogawa¹, D. D. Millen¹, R. D. L. Pacheco¹, J. P. S. T. Bastos¹, T. M. Mariani¹, T. C. B. da Silva², and S. R. Baldin¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Faculdade de Zootecnia/UNESP, Dracena, São Paulo, Brazil.

The objective was to evaluate forage dry matter production (FDMP) according to period of intercropping with corn and responses to nitrogen fertilization (NF) applied after harvesting of corn. This study, conducted at São Paulo State University (UNESP-Botucatu) farm, Brazil, was designed in a split plot 4x4 factorial arrangement: corn with *Brachiaria brizantha* intercropped in the sowing (BS), corn with *Brachiaria brizantha* intercropped in the coverage fertilization (BC), corn with *Panicum maximum* intercropped in the sowing (PS) and corn with *Panicum maximum* intercropped in the coverage fertilization (PC) and four rates of N (0, 30, 60, 120 kg/ha) and three periods of growth (1=07/20/2006, 2=09/29/2006, 3=11/09/2006). Corn hybrid 30F90 from Pioneer was utilized to establish 55,000 plants/ha while 20kg of seed/ha of each forage was sown. Corn and BS and PS forages were sown on 12/20/2005, but BC and PC forages were sown on 01/14/2006 with coverage fertilization. Forage coverage fertilization was made on 05/24/2006. In period 1 FDMP increased (P<0.01) for BS as rates of N increased, but no effects were found (P>0.05) for BC, PS and PC. BC had greater (P<0.01) FDMP as rate of N increased in period 2. In period 3 as N rate increased, FDMP for BS, BC and PC increased (P<0.01). Summing the three periods, PS did not show a response (P>0.05) to rates of N. Thus, the system of cultivation, forage species, daylength and temperature are important factors to determine FDMP in tropical forages.

J. Anim. Sci. Vol. 86, E-Suppl. 2/J. Dairy Sci. Vol. 91, E-Suppl. 1

Table 1. F values of tropical forage dry matter productivity in response to doses of nitrogen fertilization

Item	Response	Period 1	Period 2	Period 3	Sum
PS	L	4.71	4.97	2.76	0.04
PS	Q	2.79	0.95	1.47	9.79
BC	L	10.08	0.37	23.97**	11.80**
BC	Q	0.004	21.77**	33.90**	39.25**
BS	L	111.30**	2.31	0.07	6.17**
BS	Q	63.81**	2.98	27.68**	46.14**
PC	L	2.19	2.87	81.83**	50.16**
PC	Q	17.70	0.69	83.34**	84.55**

** (P<0.01). L=linear, Q=quadratic.

Key Words: Fertilization, Forage, Intercropping

W109 Production of corn grain with *Brachiaria brizantha* and *Panicum maximum* forages according to period of intercropping. R. S. Barducci¹, C. Costa¹, T. C. Putarov¹, L. M. N. Sarti¹, E. S. Ogawa¹, D. D. Millen¹, R. D. L. Pacheco¹, J. P. S. T. Bastos¹, T. M. Mariani¹, S. R. Baldin¹, and T. C. B. da Silva², ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Faculdade de Zootecnia/UNESP, Dracena, São Paulo, Brazil.

The study evaluated the production of corn grain intercropped with *Brachiaria brizantha* and *Panicum maximum* forages in no tillage systems. This study, conducted at São Paulo State University (UNESP-Botucatu) farm, Brazil, examined 5 treatment systems of corn cultivation with tropical grasses replicated four times and randomly blocked: single corn crop (MS), corn with *Brachiaria brizantha* intercropped in the sowing (BS), corn with *Brachiaria brizantha* intercropped in the coverage fertilization (BC), corn with *Panicum maximum* intercropped in the sowing (PS) and corn with *Panicum maximum* intercropped in the coverage fertilization (PC). Corn hybrid 30F90 from Pioneer was utilized to establish 55,000 plants/ha and 20kg of seed/ha of each forage was used. T-tests were used to compare means at P<0.05. Corn and BS and PS forages were sowed on 12/20/2005, but BC and PC forages were sowed on 01/14/2006 with coverage fertilization. Corn grain was harvested on 05/18/2006 when more than 50% the grain grain was at black layer. Results are showed on a 100% DM basis. BS and PC produced more (P<0.05) corn grain compared to MS (MS= 0%, BS= 1.3%, BC= -7%, PS= -9.3%, PC= 11%). Corn production was greater (P<0.05) for PC than MS, BS, BC and PS (MS=10729, BS=10873, BC=10089, PS=9731, PC=11904 kg/ha). Less competition for nutrients may contributed increased production for PC. Thus, the system of cultivation may impair or enhance corn grain productivity, as observed for PS and PC, respectively. Other factors that affect corn grain productivity are related to forage species, as observed for BC and PC.

Key Words: Corn, Forage, Intercropping

W110 Use of a nutraceutical feed produced by solid state fermentation of apple pomace in lactating dairy cows diets. C. Rodríguez-Muela*, F. J. Gutiérrez-Piñ, M. A. Gallegos-Acevedo, H. Garcí-Nevarez, H. E. Rodríguez-Ramírez, O. Ruiz-Barrera, and J. Jiménez-Castro, Universidad Autónoma de Chihuahua, Chihuahua, Mexico.

Manzarina (MZ), a feed rich in phenol compounds and yeasts produced by Solid State Fermentation of apple pomace, was evaluated in lactating cow diets. Two groups of 11 mature lactating cows (93 days of lactation) were used in a 2X2 Latin Square with a switch back arrangement. Treatments were: a concentrate with 15% MZ (MT) and a concentrate without MZ (CT). Concentrates were offered in the parlor and hay (alfalfa and oat) was offered free choice in the bunk. A 12 d adaptation period was followed by a 12 d sample collection during the two periods of the Latin Square (P1 and P2). Milk production was measured and milk samples were collected from each cow daily at milking. Milk constituents were analyzed with a Milk Scan FT 120[®]. Two blood samples per cow were obtained at the beginning and the end of each period. The concentrate intakes were 11.77 kg cow⁻¹ d⁻¹ for CT and 13.25 kg cow⁻¹ d⁻¹ for MT; the forage intakes were 12.60 kg cow⁻¹ d⁻¹ for CT and 11.19 kg cow⁻¹ d⁻¹ for MT. Milk production was different (P<0.05) between treatments (CT= 22.06±0.23 kg cow⁻¹ d⁻¹, MT= 22.84±0.23 kg cow⁻¹ d⁻¹). Milk constituents were not different between treatments (P>0.05). A diet*period effect (P<0.05) occurred for somatic cell count (P1: MT= 6.44±0.20*10³ cells ml⁻¹, CT= 7.13±0.21*10³ cells ml⁻¹; P2: MT= 6.64±0.20*10³ cells ml⁻¹, CT= 5.60±0.20*10³ cells ml⁻¹). White blood cell count was higher for MT (P<0.05; MT= 7.12±0.75%, CT= 4.86±0.75%). Plasma antioxidant activity differed across periods (P<0.05; 18.65±0.53 mM Fe₂ in P1, 22.52±0.53 mM Fe₂ in P2). We conclude that MZ can be incorporated into lactating dairy cow diets during early lactation.

Key Words: Nutraceutical Feed, Oxidative Stress, Phenol Compounds

W111 Use of feed produced by solid state fermentation of apple pomace (manzarina) in lambs feedlot diets. C. Hernández-Gómez*, C. Rodríguez-Muela, J. A. Ortega-Gutiérrez, H. E. Rodríguez-Ramírez, F. Salvador-Torres, A. Flores-Mariñelarena, and G. Corral-Flores, *Universidad Autónoma de Chihuahua, Chihuahua, México*.

The productive behavior and carcass characteristics of lambs fed with manzarina (MZ) were evaluated in 24 males and females (Charolais×Dorper and Katahdin) with an initial body weight (BW) of 25.5±3.3 kg. Lambs were assigned to two treatments: MT (with 5% MZ) or CT (without MZ); diets were isonitrogenous and isocaloric; diet ingredients were alfalfa, corn, soybean meal, animal fat, sugar cane molasses, mineral premix and MZ. Lambs were confined in individual stalls and received water and feed *ad libitum*. Feed intake (FI) was measured daily. The BW increase was evaluated by period (PWG) and by day (DWG). Periods were of 14 d each. Carcasses were evaluated 24 h after the slaughter in order to determine carcass yield (CY), rib eye area (RA) and back fat (BF). Productive variables were analyzed with a mixed statistical model with diet, sex and their interactions as fixed effects, replicate as random effect and initial BW as covariate. Carcass data were analyzed in SAS GLM procedure. There was a linear increase (P<0.01) on BW during the experiment. Males with MT diet had greater PWG (4.76±0.19 kg) and DWG (0.349±0.019 kg) than those with CT diet (3.96±0.19 and 0.309±0.018 kg), with a final body weight (FBW) of 44.58±0.77 and 41.97±0.71 kg respectively. Females with MT diet had less PWG (3.65±0.27 kg) and DWG (0.246±0.019 kg) than those with CT diet (4.05±0.27 and 0.290±0.019 kg), with a FBW of 38.94±0.76 and 41.46±0.72 kg respectively. There was a linear increase (P<0.01) on the FI throughout the trial; the increase was 2.68 g d⁻¹ lamb⁻¹. There was a sex effect (P<0.05) for Feed:gain ratio (FG). Males had greater (P<0.05) FG than the females (5.4±0.21 and 4.5±0.21 respectively). There was a diet*sex effect (P<0.06) for CY. Males of MT had a CY value of 48.00±1.25% and the males of CT of 50.23±1.14%.

Females of MT had a CY value of 51.52±1.23% and the females of CT of 48.96±1.15%. There was not effect (P>0.05) for RA. The BF was greater (P<0.06) on females (4.5±0.81 mm) compared with males (2.5±0.81 mm). We conclude that the use of manzarina is feasible in lambs feedlot diets.

Key Words: Apple Pomace, Manzarina, Lambs

W112 Fermentation of apple waste products added with bakery residues. Y. Castillo-Castillo¹, O. Ruiz-Barrera*¹, D. Cruz-Guillen¹, A. Elias-Iglesias², C. Rodríguez-Muela¹, J. Ortega-Gutiérrez¹, O. La O-Leon², and C. Arzola-Alvarez¹, ¹Facultad de Zootecnia, Universidad Autónoma de Chihuahua, Chihuahua, Chih, Mexico, ²Instituto de Ciencia Animal, La Habana, Cuba.

Solid state fermentation (SSF) is a tool to improve nutritive value of agroindustrial by-products. By promoting growth of epiphytic microorganisms, SSF is one of the most efficient methods to breakdown lignocellulosic compounds, increase the quantity and quality of protein and reduce environmental impact. The study assessed the influence of adding bakery waste (0, 15, 30 and 45%) on an as-is basis to apple waste on changes of pH and yeast count across fermentation time. Bakery waste was a mix of salted and sweetened bread, cookies, dough, etc. We hypothesized that adding bakery waste would increase DM, reduce pH, and increase counts of useful microorganisms. A completely random design with 6 replications of treatments in a 4 x 3 factorial was used. The variables were four levels of bread inclusion and three incubation periods (0, 24 and 48 h). During fermentation, pH decreased linearly (P<0.001) across time for all four treatments. Only the pH at 48 h of the 45% inclusion level was higher than the control (4.6 vs 4.01; P<0.001). Yeast count (log 10) increased across time (quadratic effect; P<0.001) for all levels of bakery waste. Yeast count was higher (P<0.001) for the 30 and 45% treatments compared to the control and 15% treatments. As levels of bakery waste increased, texture of the mix was improved. Based on these results we conclude that 30% inclusion of bakery waste improves the SSF fermentative process of apple residues and enhances beneficial bacterial populations.

Key Words: Solid State Fermentation, Apple Waste, Bread

W113 Fiber degradation during solid state fermentation of apple pomace. H. E. Rodríguez-Ramírez*, C. Rodríguez-Muela, H. A. Castillo-Gonzalez, J. A. Ortega-Gutiérrez, O. Ruiz-Barrera, D. Villagran-Torres, C. Hernández-Gómez, S. Romero-Villalobos, and C. A. Arzola-Alvarez, *Universidad Autónoma de Chihuahua, Chihuahua, Mexico*.

This experiment was conducted to measure yeast growth (YG) and changes in the structural carbohydrates during solid state fermentation of apple pomace (AP). Treatments (T) were: T1 (n=36) 100%AP as substrate and T2 (n=36) mixture of 66.67%AP+33.33% non commercial apple as substrate to get different carbohydrates concentration. Both were amended with urea, ammonium sulfate and a mineral mixture (1.5, 0.4, 0.5%, wet basis); around 350 g of substrate were placed on plastic containers (n=72), stirred four times daily every 5 h at 30±1°C. Six samples of each T were taken on 0, 1, 2, 4, 8 and 16 days (D) during the experiment to determine YG (using malt extract agar cultures) and %DM

consumed during fermentation (DMc). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin (L) were determined on d0 and d8 following ANKOM™ procedures. Colony forming units (CFU) were converted to their natural logarithm prior to statistical analysis. Data were analyzed with the MIXED procedure of SAS, using T, D and their interaction (T*D) as fixed effects, and sample as random effect. There was T*D effect ($P<0.05$). YG on d8 was different ($P<0.05$) between T1 and T2; YG of T1 increased from 2.14×10^9 on d0 to 3.09×10^{10} CFU*g DM⁻¹ on d8. YG of T2 increased from 1.99×10^9 on d0 to 4.69×10^9 CFU*g DM⁻¹ on d8. DMc was lower ($P<0.05$) in T1 than T2 on d2 (+2.08 vs. -7.79%); DMc reached 40.73 and 49.92% on d8 and d16 respectively without T effect ($P>0.05$). NDF of T1 decreased ($P<0.05$) from 55.81

on d0 to 28.59% on d8 and NDF of T2 increased ($P<0.05$) from 45.07 on d0 to 61.45% on d8. ADF of T1 decreased ($P<0.05$) from 40.52 on d0 to 31.98% on d8. ADF of T2 increased from 31.98 on d0 to 48.82% on d8. L of T1 decreased ($P<0.05$) from 17.29 on d0 to 9.83 on d8. L of T2 increased ($P<0.05$) from 9.62 on d0 to 25.87% on d8. These results suggest that a higher yeasts concentration and species diversity on T1 can degrade structural carbohydrates more efficiently than in T2, probably due to higher rapidly fermentable carbohydrates content on T2. Therefore we recommend further work on microbial isolation and community characterization on apple pomace solid state fermentation.

Key Words: Apple Pomace, Solid State Fermentation, Yeast

Nonruminant Nutrition: Carbohydrate and Lipids

W114 Effect of xylanase supplementation to wheat-rye based diet on the energy availability and the performance of ducks. L. Babinszky^{*1}, J. Tossenberger¹, and I. Kühn², ¹Kaposvár University, Kaposvár, Hungary, ²AB Enzymes GmbH, Darmstadt, Germany.

The objective was to determine the effect of dietary xylanase (xyl) supplementation on energy availability (intake-excretion/intake*100) and duck performance. The availability trial used 6 birds/Treatment (Trt) (Cherry Valley, Super M-3 Heavy drakes, individual keeping). Availability of energy was determined on the 2nd & 5th weeks of age. The performance trial was conducted with a total number of 756 birds (same hybrid) (252 birds/Trt, 50% male & 50% female, 49 days of age). Diets were formulated on a wheat-rye-soybean basis for a 2-phase feeding program. Birds were fed starter diets (days 1-14: AME: 11.0 MJ/kg, CP:208 g/kg, LYS: 10.0 g/kg) in crumbled form and grower diets (days 15-49: AME: 11.0 MJ/kg, CP:162 g/kg, LYS: 7.6 g/kg) in pelleted form. The trials consisted of 3 Trts. Birds in Trt1 were fed diets without added xyl. Diets in Trts 2 and 3 were supplemented with 6000 BXU/kg and 16000 BXU/kg ECONASE[®] XT (thermostable xylanase produced by *Trichoderma reesei*), respectively. Data were analyzed by ANOVA (SAS, 2004). According to our data xyl added at 6000 BXU/kg significantly increased the availability of energy ($P \leq 0.05$) (Wk2: 75.5 vs 77.2%; Wk5: 72.6 vs 76.7%). Xyl added at 16000 BXU/kg resulted further improvement of energy availability on Wk5 only.

The live weight of the ducks (49 days) was increased significantly ($P \leq 0.05$) by xyl supplementation added at the rate of 6000 BXU/kg (2974 g vs 3101 g). The higher enzyme dosage (16000 BXU/kg) was not associated with any further increase of the final weight of the ducks ($P \geq 0.05$). The xyl supplementation of the diets at the rate of 6000 BXU/kg, however, improved the feed conversion ratio of the birds by 3.1 % (2.92 kg/kg vs 2.83 kg/kg) while xyl added at the rate of 16000 BXU/kg improved it by 4.8 % (2.93 vs. 2.78 kg/kg). Based on these results xylanase supplementation to wheat-rye based duck diets starting from an inclusion rate of 6000 BXU/kg can be recommended.

Key Words: Duck, Xylanase, Availability

W115 Effect of phytase supplementation of the diets on the digestibility and urinary excretion of phosphorous and calcium in weaned piglets. J. Tossenberger¹, I. Kühn², and L. Babinszky^{*1}, ¹Kaposvár University, Kaposvár, Hungary, ²AB Enzymes GmbH, Darmstadt, Germany.

Aim was to determine the effect of dietary phytase supplementation on P and Ca digestibility and urinary excretion in weaned piglets. The trials used 4 hybrid barrows per treatment (Trt) in 2 replicates (8 pigs/Trt, individual keeping, initial live weight: 13.1±1.1 kg). The corn-soy based diets contained P_i supplementation at 1 g/kg of diet. The trial consisted of 5 Trts. The control diet contained no phytase supplementation (Trt1). Diets of Trts 2, 3, 4, 5, were supplemented with phytase (6-phytase produced by *Trichoderma reesei*) at the rate of 125, 250, 500 and 750 PPU/kg, respectively. Measured phytase activity of the diets was 90, 337, 424, 672 and 968 PPU/kg. Data were analyzed by ANOVA and regression analysis (SAS, 2004). According to our data phosphorous (P) digestibility (%) already showed a 17.0% increase (from .433 to .603) due to 125 PPU/kg phytase supplementation of the diet ($P < 0.05$).

According to the regression analysis the end value of P digestibility was 67.5% – 95% of which (i.e. 64.1%) was reached at 183 PPU/kg added phytase activity of the diets. Due to the restrictive P supply urinary P excretion was at a minimum. Retention of P (%) improved by 16.8% (from .425 to .593) when supplementing phytase at 125 PPU/kg of diet ($P < 0.05$). The 95% of the end value of P retention is estimated to occur at 185 PPU/kg added phytase activity of the diets. The limited P supply (1 g inorganic P/kg) and phytase activity (90 PPU/kg) has a negative impact on the digestibility of calcium (Ca). Calcium digestibility (%) already showed a 12.1% increase (from .656 to .777) due to 125 PPU/kg phytase supplementation of the diet ($P \leq 0.05$). Urinary Ca excretion – irrespective of the Trt – was on average about nine times higher than the (physiological) value characteristic of weaned piglets, suggesting a P deficiency. The 95% of the end value of P digestibility (i.e. 64.1%) is estimated to occur at 183 PPU/kg added phytase activity of the diets.

Key Words: Piglet, Phosphorous, Digestibility

W116 Ileal and post-ileal digestibility of heat treated cereals in weaners. J. Tossenberger¹, L. Babinszky^{*1}, and S. Reischl², ¹Kaposvár University, Kaposvár, Hungary, ²Agrokomplex C.S. Zrt., Zichyújfalu, Hungary.

Our study was aimed at evaluating the ileal and post-ileal digestibility of energy (E) and crude protein (CP) in heat-treated corn (C), wheat (W) and barley (B), using hybrid weaned piglets (barrows) (4 pigs/treatment, 2 replicates, initial weight: 9.4±0.8 kg, individual keeping), fitted with a simple T-cannula prior to the start of the trials. Both ileal and post-ileal (ileal undigestible-faecal undigestible/ileal undigestible*100) digestibilities were determined on the same animal using a marker (Cr₂O₃). Animals were provided with trial diets in an amount corresponding to 2.6 times their maintenance energy requirement (458 KJ MEs/kg^{0.75}/d). Cereals (C, W and B) were flaked after steam conditioning (125 °C) for ten minutes. GE levels were 16.2(C), 16.2(W) and 16.4(B) MJ/kg, CP contents were 87.0(C), 131.0(W) and 119(B) g/kg, respectively. Data were analyzed by ANOVA (SAS, 2004).

According to our data ileal digestibility of GE in the cereals studied was 85.1%(C), 70.6%(W) and 63.2%(B) ($P \leq 0.05$). A further 35.7%(C), 61.6%(W) and 52.4%(B) of GE reaching the post-ileal gut section was digested there ($P \leq 0.05$). Of total GE absorbed, 94%(C), 79.4%(W) and 76.3%(B) was digested in the ileal section, and 6.0, 20.5 and 23.6% in the post-ileal section. Accordingly, total tract GE digestibilities were 90.4%(C), 88.7%(W), and 82.7%(B) ($P \leq 0.05$), while DEs values were 14.6(C), 14.3(W) and 13.5(B) MJ/kg. Ileal digestibility of CP was found to be 73.4%(C) 61.4%(W) and 74%(B) ($P \leq 0.05$), CP post-ileal digestibility was 42.4%(C), 55.4%(W) and 34.50%(B) ($P \leq 0.05$), while total tract digestibility was 84.7%(C), 82.8%(W) and 83.0%(B). Our data highlight the possibility of substantial differences in the location of E absorption of the cereals studied, which should be considered for a more balanced energy supply of young pigs. In the interest of optimal protein supply the differences in the ileal digestibility of CP in heat treated cereals should also be considered.

Key Words: Ileal, Postileal, Digestibility

W117 Digestible and metabolizable energy content of high-oil corn for growing pigs. Y. L. Ma^{*1}, G. L. Cromwell¹, M. D. Lindemann¹, and K. E. Nestor, Jr.², ¹University of Kentucky, Lexington, ²Mycogen Seed, Indianapolis, IN.

An experiment was conducted to determine the DE and ME content of a high-oil corn (Supercede HE hybrid; Mycogen Seeds, Indianapolis, IN) based on energy balance with growing pigs. The corn analyzed 86.9% DM, 3,959 kcal GE/kg, 7.81% CP, 5.26% fat, and 0.26% lysine on an "as is" basis. Twelve crossbred barrows averaging 58 kg were assigned to one of two diets, placed in metabolism crates designed for separation of feces and urine, and fed a standard diet for a 7-d adjustment period. Pigs were then fed their assigned experimental diet twice daily for an additional 4 d of diet adjustment followed by a 5-d total collection of feces and urine. The experimental diets consisted of a basal diet (high-oil corn + minerals and vitamins) or the basal + supplemental AA to meet the estimated AA requirements. Indigo carmine was included at 0.25% in the morning feed of day 1 and day 6 to mark the beginning and end of the fecal collection period. Urine collection began and ended 4 hr after feeding the marked diet. The energy content of the diets, feces, and urine was determined by bomb calorimetry. Feed intake averaged 1.81 and 1.90 kg/d and GE intake averaged 6,973 and 7,313 (7,212 adjusted for the GE in AA) kcal/d for the two treatments, respectively. Pigs fed the AA supplemented diet retained more N ($P < 0.05$) than those fed the basal diet (17.84 vs. 13.30 g/d; 68.2 vs. 56.4% of N intake; 79.4 vs. 66.8% of N absorbed). The DE and ME of the high-oil corn (DM basis) following adjustment for the energy provided by the AA were 4,062 and 4,138 kcal DE/kg and 3,995 and 4,075 kcal ME/kg for the two treatments, respectively, with estimates tending to be slightly higher for the AA supplemented diets ($P < 0.09$). When adjusted to 89% DM and averaged across treatments, the DE of the high-oil corn was $3,646 \pm 17$ and the ME was $3,588 \pm 18$ kcal/kg. These energy values are 3.4 and 4.9% higher, respectively, than the DE and ME of normal corn at 89% DM (3,525 and 3,420 kcal/kg) listed in the current NRC *Nutrient Requirements of Swine*.

Key Words: Pigs, High-Oil Corn, Metabolizable Energy

W118 Effects of heat processing of corn and rice on faecal digestibility of nutrients and adipose tissue fatty acid composition in young pigs. D. Menoyo, M. P. Serrano, D. G. Valencia, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid, Spain*.

Heat processing (HP) of cereals gelatinizes the starch portion of the grain, which may result in improved nutrient utilization. A 24-d trial was conducted to evaluate the effect of the main cereal of the diet (corn or rice) and heat processing of the cereal (HP) on coefficients of apparent total tract digestibility (CATTD) of nutrients in young pigs. Also, diet effect on fatty acid (FA) composition of the adipose tissue was assessed. The experimental design was completely randomized with four treatments and nine replicates (one pig) per treatment. Piglets were fed their respective experimental complex diets with 52% of corn or rice either raw or cooked from 23 to 48 d of age. Pigs were slaughtered at 49 d of age and samples (5g) of subcutaneous fat were analyzed for FA composition. The CATTD of GE, OM, EE, and CP was higher for piglets fed rice than for piglets fed corn ($P \leq 0.01$). Heat processing of the cereal improved GE, OM, EE, and CP digestibility ($P \leq 0.001$). Also, the improvement of CATTD of nutrients with HP was higher in the corn- than in the rice-diets (7.4 vs. 0.8% for GE, 5.9 vs. 0.5% for OM, 9.4 vs. 2.7% for EE, and 5.9 vs. 0.6% for CP; $P \leq 0.01$). The

proportion of saturated FA (SFA) in the adipose tissue of the pigs was higher with rice than with corn (35.4 vs. 33.6%; $P \leq 0.05$), but HP did not affect SFA content. Both cereal type and HP of the cereal affected 18:2n-6 concentration ($P \leq 0.01$). Also, 18:2n-6 concentration was decreased with HP of corn but was increased with HP of rice ($P \leq 0.01$ for the interaction). In conclusion, feeding rice instead of corn and HP of the cereal portion of the diet increases nutrient digestibility in piglets. A more saturated fat with lower 18:2n-6 concentration was obtained in pigs fed rice than in pigs fed corn, especially when rice was HP. This effect might have important implications on meat quality of pigs when HP cereals are fed at the end of the growth period.

Key Words: Piglets, Cereal, Heat Processing

W119 Evaluation of a dynamic in vitro model to simulate the porcine ileal digestion of diets differing in the carbohydrate composition. J. P. Meunier^{*1}, E. Manzanilla², M. Anguita², S. Denis³, J. F. Pérez², J. Gasa², J. P. Cardot³, F. Garcia², and M. Alric³, ¹Pancosma Research, Geneva, Switzerland, ²Universitat Autònoma de Barcelona, Spain, ³University of Auvergne, France.

The aim of the study was to assess the ability of a dynamic in vitro model to determine the digestibility of OM, CP, and starch as compared to in vivo ileal digestibility obtained from growing pigs fitted with a T-cannula. Five experimental diets with different carbohydrate types and level were assessed: a standard corn-based diet (ST) or the same diet with coarse ground corn (CC), 8% sugar-beet pulp (BP), 10% wheat bran (WB), or 8% sugar beet pulp and 10% wheat bran (HF). In the in vivo experiment, diets CC and HF reduced ileum digestibility of OM when compared to ST diet (65.0 and 65.1 vs. 70.8%, $P = 0.015$, respectively). The inclusion of sugar-beet pulp reduced (65.9 vs. 76.6%, $P = 0.049$) ileal CP digestibility in the BP diet. This reduction was not statistically significant when sugar beet pulp was combined with the wheat bran in the HF diet. No differences were found in the in vivo starch digestibility among diets. The dynamic in vitro model yielded OM and CP digestibility coefficients comparable to those obtained in vivo for the ST and CC diets. However, values were considerably affected by the incorporation of the fibrous ingredients. Diets BP, WB, and HF had lower OM digestibility (33.3 vs. 74.9, $P = 0.009$, 48.5 vs. 74.9%, $P = 0.058$, and 24.0 vs. 74.9%, $P = 0.004$, respectively) compared with ST diet. Protein digestibility was also lower (43.0 vs. 81.8%, $P < 0.001$, 64.9 vs. 81.9%, $P = 0.019$ and 56.0 vs. 81.8%, $P = 0.003$, respectively) with the BP, WB, and HF diets than with the ST diet. However, digestibility was reduced to a greater extent in the BP diet than in the WB and HF diets, both containing wheat bran. The R-square between the dynamic model and in vivo results for CP digestibility was 0.99 when CC diet was not considered. No differences were found in starch digestibility among the diets with the dynamic in vitro model.

Key Words: In Vitro Model, Pig, Digestibility

W120 Performance of weanling piglets offered low, medium or high lactose diets supplemented with a seaweed extract from *Laminaria* spp. D. A. Gahan¹, M. B. Lynch¹, J. J. Callan¹, J. T. O'Sullivan², and J. V. O'Doherty^{*1}, ¹University College Dublin, Ireland, ²Bioatlantis Ltd, Ireland.

A 3 × 4 factorial experiment was conducted to investigate the interaction between different levels of lactose (60 (low) vs. 150 (medium) vs. 250 (high) g/kg) and seaweed extract (0 vs. 1 vs. 2 vs. 4 g/kg) on growth performance and nutrient digestibility of weanling pigs. The seaweed extract contained only laminarin and fucoidan. Three hundred and eighty-four piglets (24 days of age, 7.5 kgs live weight) (96 pens containing 4 piglets) were blocked on the basis of live weight and were assigned to one of 12 dietary treatments (n=8). The pigs were offered the diets *ad libitum* for 21 days post weaning. There was a significant lactose × seaweed extract interaction (P<0.05) in average daily gain (ADG) and food conversion ratio (FCR) from day 0 to 21. At the low and medium level of lactose there was an increase in ADG as the level of seaweed extract increased to 2 g/kg (P<0.05). However, at the high level of lactose there was no further response in ADG as the level of seaweed extract increased above 1 g/kg (P<0.05). At the low level of lactose there was a significant improvement in FCR as the levels of seaweed extract increased to 4 g/kg (P<0.01). At the medium level of lactose there was a significant improvement in FCR as seaweed extract increased to 2 g/kg. However, there was no significant effect of seaweed extract on FCR at the high levels of lactose. There was a linear increase in average daily feed intake from day 0-21 (488 \hat{I} / \hat{s} . 514 \hat{I} / \hat{s} . 541 \hat{I} / \hat{s} . 518 g/day s.e 14.8; P<0.05) as levels of seaweed extract increased. There was a quadratic decrease (P<0.01) in nitrogen (84.41 \hat{I} / \hat{s} . 80.48 \hat{I} / \hat{s} . 79.78. s.e 0.469) and neutral-detergent fibre (36.01 \hat{I} / \hat{s} . 23.34 \hat{I} / \hat{s} . 25.89. s.e 1.883) digestibility as the levels of lactose increased. In conclusion, pigs responded differently to the inclusion levels of seaweed extract at each level of lactose supplementation. The inclusion of a laminarin-fucoidan extract in piglet diets may alleviate the use for high lactose diets and would also alleviate some of the common problems that occur post weaning.

Key Words: Lactose, Seaweed Extract, Pigs

W121 Development of feeding program for gestating gilts and its effects on reproductive performance and progeny. L. G. Piao*, H. F. Long, W. S. Ju, J. H. Lee, H. K. Oh, and Y. Y. Kim, *Seoul National University, Seoul, South Korea.*

Numerous feeding programs for gestating sows was introduced because high producing sows are reared in swine farm. This study was conducted to compare the effect of four different feeding programs for gestating gilts on reproductive performance and progeny. A total of 41 F1 gilts (Yorkshire×Landrace) were assigned to four treatments in a complete randomized design. For treatments, gestating period of gilts was divided for three trimesters (0~35, 36~90 and 91~farrowing) and treatments were Flat, Down-Up-Down, Up-Down-Up and Down-Up-Up feeding program. Gestating gilts body weight gain from d 0 to 110 was affected by feeding program (50.8 kg, 73.3 kg, 72.6 kg and 75.7 kg for Flat, DUD, UDU and DUU, respectively; P<0.05). However gilts consumed constant feed ration (flat feeding), less body weight loss tended to be observed in lactating sows (-0.9 kg, -6.7 kg, -9.2 kg and -7.8 kg for Flat, DUD, UDU and DUU, respectively, P=0.17) and desirable backfat thickness (average 19.5mm) can be acquired at 110 days of gestation. Feed intake of lactating sows tended to be higher (4.22 kg/d, 3.60 kg/d, 3.97 kg/d and 4.13 kg/d, P>0.05) when gilts had low backfat thickness during gestation. Low feed intake of lactating sows resulted in increasing weaning to estrus interval after weaning which may affect on reproductive performance of sows in next parity. When gilts were fed higher feed during midtrimester, higher stillborn (1.4 piglet/litter, P<0.05) and mummies (0.8 piglet/litter P=0.25) were observed compared to other treatments.

Various and complex feeding programs for gestating gilts had no effect on litter weight gain and individual pig weight during nursing period. These results suggested that changing of feed intake for gestating gilts resulted in detrimental effects on body condition and reproductive performance of sows. And flat feeding program for gestating gilts showed better reproductive performance and less body fat loss in lactating period because sows consumed more feed at this time.

Key Words: Feeding Program, Reproductive Performance, Gilts

W122 Dietary energy levels of gestating gilts on gestation parameters and reproductive performance. H. F. Long*, L. G. Piao, W. S. Ju, C. S. Chang, H. K. Oh, and Y. Y. Kim, *Seoul National University, Seoul, South Korea.*

This study was conducted to determine the effects of different energy intake for gestating gilts on gestation parameters and reproductive performance of sows. A total of 40 F1 gilts (Large White × Landrace) were allotted to 4 treatments in a completely randomized design (CRD). Dietary energy levels for gestating gilts were 3165, 3265, 3365 and 3465 kcal ME/kg and 2 kg of experimental diet was provided daily during gestating period. After farrowing, lactating sows were fed lactation diet *ad libitum* approximately 5 days post-farrowing. During the whole gestation period, body weight gain and backfat thickness gain of gilts were increased in proportion to dietary energy level (P<0.01). Fat mass gain was also increased when gilts were fed 3465Kcal ME/kg diet (P<0.01). But estimated protein mass gain of sows was not significantly affected by dietary energy level (P>0.27). At farrowing, litter size did not show any significant differences among all treatments (P>0.11). Litter weight at birth was improved as higher energy diet was provided (P=0.06), but litter weight gain during 21 day lactating period was not affected by dietary energy treatments (P>0.23). 3465Kcal ME/kg for gestating gilts didn't show positive responses on reproductive performance of sows. Lower feed consumption during lactating period was observed when higher dietary energy was provided during gestating period of gilts. These results demonstrated that higher dietary energy level were not required for high producing gilts and NRC requirement of energy (3265 kcal ME/kg) were adequate for gestating gilts when 2 kg of diet was provided daily.

Key Words: Energy Level, Body Weight, Gilt

W123 The effect of dietary starch sources on the performance, nutrients digestibility and blood biochemical parameters in growing pigs. Q. Z. Dai², Y. Yin^{*1}, R. Huang¹, and T. Li¹, ¹*Laboratory of Animal Nutrition and Health and Key Laboratory of Subtropical Agro-ecology, Institute of Subtropical Agriculture, Changsha, Hunan, P. R. China,* ²*Hunan Institute of Animal Science, Changsha, Hunan, P. R. China.*

A feeding trial covered 30 days and a 5 × 5 Latin square design metabolism experiment using 45 20 ± 0.642kg Duroc × Landrace × Yorkshire cross breed pigs were conducted to study the effect of dietary starch sources on the performance and nitrogen metabolism. 4 iso-nitrogen, iso-energy and iso-starch diet were formulated using Maize, Brown rice, Stick rice and Resistant starch (Hi-maize-1043) as starch sources, as well as a nitrogen free diet was also formulated to determine the endogenous nitrogen losses. The results showed that the body weight

gain of Maize group was 719.52g per day which was 14.69%, 11.92% and 3.03% higher than Resistant starch, Stick rice and Brown rice group respectively. While the feed conversion (feed consumption/ body weight gain) was 1.64%, 12.46 ($p < 0.05$) and 0.5% lower than Resistant starch, Stick rice and Brown rice group correspondingly. The lowest fecal crude protein apparent and true digestibility were found in Resistant starch group, which were 10.23%, 12.76%, 12.42% and 9.64%, 12.11%, 11.73% ($p < 0.05$) lower than Maize, Stick rice and Brown rice group, and also the digestibility of energy and dry matter of Resistant group were lower than other groups. When compared with other groups, Resistant starch group excreted the most fecal nitrogen ($p < 0.05$), while Stick rice had the highest urinary nitrogen excretion ($p < 0.05$), but the largest whole body nitrogen retention was found in Maize group. The results of blood biochemical parameters analysis indicated that, the change of post-prandial blood glucose, insulin concentration and insulin/ glucose in Resistant starch was stable, while other groups had larger fluctuation, 1h after the meal which reached the pinnacle, among them Stick rice group had the highest blood glucose, insulin concentration and insulin/ glucose in post-prandial 1h, they were 1.21mg/ml, 52.35(μ U/ml) and 43.27(μ U/ml) respectively, and were significantly higher than other groups ($p < 0.05$).

Key Words: Pig, Metabolism, Starch

W124 The effect of dietary starch sources on amino acids portal flux and balance in growing pigs. W. Wang, Y. Yin*, R. Huang, and T. Li, *Institute of Subtropical Agriculture, Changsha, Hunan, P. R. China.*

Four Duroc \times Landrace \times Yorkshire cross breed male pigs fitted with permanent catheters in the portal vein, mesenteric vein and in the carotid artery were used in a 4 \times 4 Latin square to measure the different effect of dietary starch sources on net portal absorption of blood glucose, volatile fatty acids (VFA), amino acids and lactate in growing pigs. When calculated as per 100g feed intake, 8h post-prandial maize group portal vein net absorbed 27.52g glucose, which was 54.26%, 7.88% and 1.55% higher than resistant starch, stick rice and brown rice respectively. Stick rice group absorbed 2.52g lactate and it was significantly higher than other groups ($P < 0.05$). In resistant starch group the portal vein absorbed blood ammonia was (5.36g) lower than other groups ($P < 0.05$), while the absorbed VFA (403.87mmol) was significantly higher than maize, brown rice and stick rice group. Portal vein net absorbed total amino acids of resistant starch, maize, brown rice and stick rice group were 5.93g, 8.89g, 8.77g and 7.83g, the lowest net portal vein absorption was found in resistant group. The proportion of net absorbed total amino acids in ileum apparent and true digested amino acids were 52.70% and 48.39%, which were lower than 67.66%, 65.83%, 63.62% and 63.76%, 61.80%, 59.18% of maize, brown rice and stick rice group ($P < 0.05$). The proportion of essential amino acids in absorbed total amino acids of resistant starch group was 50.0% it was also lower than 57.43%, 56.64%, 57.74% of maize, brown rice and stick rice respectively. Portal vein net absorbed Glu, Ser, His, Arg, Ala, Tyr, Meth, Val, Phe, Ile, Leu and Lys of resistant starch group and His, Arg, Tyr, Val, Meth, Lys and Leu of stick rice were lower than maize and brown rice group ($P < 0.05$). There are no significant difference between maize and brown rice group for most net absorbed amino acids, but His, Lys and Leu in maize group were higher ($P < 0.05$), while Arg was lower than brown rice group ($P < 0.05$). The balance pattern of portal vein net absorbed amino acids of maize group was better than other groups.

Key Words: Portal Flux, Amino Acid, Pig

W125 Intravenous glucose tolerance test in Ningxiang pigs. X. F. Kong¹, M. J. Bo¹, X. Y. Song¹, Y. L. Yin*¹, B. E. Tan¹, Z. Q. Liu¹, H. J. Xu¹, W. J. Tang¹, F. G. Yin¹, and G. Y. Wu^{1,2}, ¹*The Chinese Academy of Sciences, Changsha, Hunan, P. R. China,* ²*Texas A&M University, College Station.*

Intravenous glucose tolerance test was conducted with the Ningxiang pig (a Chinese swine breed), which has a relatively slow rate of growth and small body size. Four Ningxiang barrows (approximately 60 kg) with indwelling catheters in the hepatic vein and carotid artery were fasted for 12 h before use for the experiment. On d 1, at 10 min before saline infusion, as well as at 0, 5, 10, 20, 30, 60, 120, 180, and 240 min after saline infusion, blood samples (5 ml per barrow) were taken from the carotid artery into tubes containing sodium heparin. Meanwhile, urine samples from each of the animals were collected for glucose analysis. On d 2 and 3, saline and a 50% glucose solution were infused into the hepatic vein, respectively. Blood and urine samples were obtained as described above. Plasma was analyzed for glucose, insulin and glucagon. The insulin/glucose ratio was calculated for each sampling time. Results indicate that plasma concentrations of glucose at 5-10 min and those of insulin at 5-30 min post glucose infusion were greater ($P < 0.05$) than the values obtained after saline infusion. Intravenous glucose infusion increased ($P < 0.05$) the insulin/glucose ratio at 10-60 min but reduced ($P < 0.05$) plasma concentrations of glucagon at 30-60 min, when compared with saline infusion. Glucose was detected in urine beginning at 30 min after glucose infusion. These findings suggest that Ningxiang barrows may exhibit insulin resistance, which explains in part their relatively slow growth rate.

Key Words: Intravenous Glucose Tolerance Test, Indwelling Catheters, Ningxiang Barrows

W126 Evaluation of nutrient equivalency values of natuzyme for broiler chickens. M. Majdeddin*, M. Zaghari, and H. Moravej, *Tehran University, Karaj, Tehran, Iran.*

The experiment was conducted to determine the nutrient equivalency values of commercial multi enzyme (natuzyme) for broiler chickens. 480 day-old male commercial broiler chickens (Ross 308) were used from 1 to 28 days of age. The experimental design was completely randomized and the experimental units (pens) were allotted randomly to 8 treatments, each in 4 replicates. The dietary treatments 1 to 4 formulated without enzyme and contained graded levels of ME, CP and non-phytate phosphorus. The dietary treatments 5 to 8 have graded levels of multi enzyme 0.1 to 0.4 gr/kg diets respectively. Performance of chicks fed dietary treatments 1 to 4 and 5 to 8 compared with each other and calculated the total nutrient equivalency values of enzyme. Body weight, group feed consumption and viability was recorded weekly. Toe ash Ca, P and Ca, P and protein content of excreta were measured at day 28. Data was analyzed using the general Liner and non-liner model procedure of SAS software. Final body weight for treatments 1 to 4 was increased ($p < 0.05$). Addition of enzyme increased final body weight ($p < 0.05$). Liner relationship between ME, CP, non- phytate phosphorus, enzyme and body weight in 28 day-old was observed ($p < 0.05$). The result showed that added enzyme (0.4 gr/Kg diets), increased availability of energy, crude protein and phosphorus, 2.8, 3.1 and 19.8 % respectively. The effect of age on nutrient equivalency was not significant.

Key Words: Equivalency, Broiler, Natuzyme

W127 In vitro fermentation of diets incorporating different levels of carob pulp by rabbit cecal fluid. G.-B. Aziza^{*1}, B. Ridha¹, K. Abdelhamid², M.-L. Maria-Rosa³, and K. Abdeljabbar¹, ¹*INAT, Tunis, Tunisia*, ²*INGREF, Institut National des Recherches en Génie Rural, Eaux et Forêts, Tunis, Tunisia*, ³*Escuela Polytechnica Superior, Universidade de Santiago de Compostela, Lugo, Spain*.

Fermentation characteristics of diets incorporating 0% (D1), 10% (D2), 20% (D3) and 100% (D4) dry matter (DM) of carob pulp were determined in an in vitro experiment using cecal contents collected from 4 rabbits. Samples of diets were incubated in glass syringe for 72 h and various fermentation variables were determined. Diets varied in their crude protein and fermentable carbohydrates. Potential gas production ranged from 123 (D3) to 179 (carob pulp) ml/g DM and was similar ($P > 0.05$) for D1, D2 and D3. Low value of pH after 72 h fermentation was observed in D4 (carob pulp: 6.47), and the highest was in diet incorporating 10% of carob pulp (6.66). Of all diets, carob pulp was fermented the most rapidly and had higher ($P < 0.05$) organic matter digestibility (64.3%) than D1 (62%), D2 (60.3%) and D3 (58.6%). In vivo studies will be conducted to validate the in vitro results.

Key Words: Carob Pulp, Rabbit, Gas Production

W128 Dietary fiber decreases fecal nutrient digestibility and ammonia emission in growing swine, but increases odor emission and odor intensity in air. W. Zhang¹, E. van Heugten^{*1}, T. van Kempen², V. Fellner¹, and P. Kai³, ¹*North Carolina State University, Raleigh*, ²*Provimi RIC, St. Stevens Woluwe, Belgium*, ³*University of Aarhus, Horsens, Denmark*.

This study was designed to determine the effects of dietary fiber on nutrient digestibility and emission of ammonia and odor compounds in air. Diets consisted of a low fiber diet (degermed, dehulled corn and soy protein isolate), a semi-low fiber diet (corn and soy protein isolate), a typical commercial diet (corn and SBM), and a high fiber diet (corn and SBM with 10% soy hulls), containing 2.8, 8.9, 7.6, and 13.6% NDF, respectively. The study consisted of 4 replicates. For each replicate, 40 pigs (BW=20.3±0.98 kg) were allotted by weight into 4 groups of 10 pigs and were adjusted to the diets for 14 days. Pigs were then transferred into one of 4 identical air-flow controlled (316 m³ per h) odor chambers (3.0 × 2.4 × 2.0 m) with fully slatted floors and pit recharge. Pigs remained in the chambers for 6 days prior to measurements. Total reduced sulfur (TRS) in exhaust air was measured using a Jerome meter and ammonia was measured by trapping in sulfuric acid. Air samples were collected in 10 L Tedlar bags for odor detection threshold evaluation by 8 panelists. Odor compounds were adsorbed using SPME fibers and analyzed by GC/MS. Fecal digestibility of CP, ADF, NDF, and GE was reduced ($P < 0.05$) with increasing fiber. Ammonia emission decreased with increasing dietary fiber (1.35a, 0.63bc, 0.78b, 0.49c ppm; means without a common letter denote differences at $P < 0.05$). Peak area for acetic acid (6.42a, 6.61a, 6.78ab, 7.26b), propionic acid (6.49a, 6.85a, 7.23b, 7.39b), butyric acid (6.74a, 6.89a, 7.54b, 7.69b), phenol (5.78a, 5.96a, 6.14ab, 6.65b), concentration of TRS (4.21a, 4.88ab, 7.92c, 8.50cd ppb), and odor intensity (144a, 174ab, 208ab, 251b) increased ($P < 0.05$) with increasing dietary fiber, but p-cresol, indole, and skatole were not affected. In conclusion, increasing dietary fiber reduced nutrient digestibility, increased odorous compounds and odor intensity of air, but it reduced ammonia emission.

Key Words: Ammonia, Fiber, Odor

W129 Effects of different fiber level diets on normal microbiological floras in goose intestines. M. A. Zhang, B. W. Wang^{*}, B. Yue, F. Y. Long, X. P. Wu, and X. H. Jia, *Qingdao Nongye University, Qingdao, Shandong Province, China*.

Different levels (5% and 9%) of *Leymus Chinesis* were appended in the diets to study normal microflora in the intestine of adult geese. The quantitative method of diluted inoculability was used to study the effect of different proportion of *Leymus Chinesis* on normal microbiological flora in four parts (duodenum, jejunum, ileum and caecum) of goose intestines. The results showed that the number of dominant bacterial flora was relatively large, when the content of CF was 9% in the diet, pH of intestine chyme in CF 9% group was lower than CF 5% group ($P < 0.01$). It indicated that increasing the content of *Leymus Chinesis* power in the diets could decrease intestine pH, thus the acid environment was good for the fermentation of intestine microorganisms. It made sure that the dominant bacterial floras were *Bifidobacterium* (8.21±0.8cfu/g), *Clostridium* (7.98±0.4cfu/g) and *Lactobacillus* (7.33±0.4cfu/g). The isolation efficiency of *Staphylococcus* and *Bacteroides* was the lowest. The number of cecum bacteria was significantly larger than the other intestine bacteria ($P < 0.01$). The total number of intestine bacteria in crude fiber (CF) 9% group was larger than in CF 5% group ($P < 0.01$), and that of ganders was larger than that of geese ($P < 0.05$). In this trial, the number of bacteria in intestine secretion of geese was 10⁶ cfu/g~10⁸cfu/g. The results also showed that in the intestine of geese, fungi had the best ability to decompose crude fiber, the following was actinomycetes and the worst was bacterium ($P < 0.01$).

Key Words: Goose, Intestines, Cellulose

W130 Stabilized rice bran improves weaning pig growth performance when feed in an antibiotic-free diet. T. Herfel, S. Jacobi, X. Lin, and J. Odle^{*}, *North Carolina State University, Raleigh*.

Stabilized rice bran (SRB) is classified as a functional food because of its prebiotic characteristics. With increasing corn prices and the possible removal of antibiotics from swine diets due to concern over antibiotic resistance, SRB was investigated as a replacement for corn with and without the addition of antibiotics (ANT). Two hundred pigs were weaned at ~21 days of age, blocked by weight, and allotted to diets containing 0 or 10% SRB and (-) or (+) ANT according to a 2 × 2 factorial design. Five animals were housed per pen throughout a 28 day growth period. At the end of the trial, one pig from each pen was euthanized for measurement of intestinal parameters. Antibiotic supplementation improved average daily gain by 6.3% from day 14 to 28 ($P < 0.05$). Gain:feed improved by 22% in pigs fed the ANT-free + 10% SRB diet compared to pigs fed the ANT-free + 0% SRB diet ($P < 0.05$), but was similar to pigs fed diets containing antibiotics. Cumulatively, pigs fed the ANT-free + 10% SRB diet improved gain:feed by an average of 14% compared to all other treatments ($P < 0.05$). Ileal histology revealed a 28% decrease in crypt depth for pigs fed the ANT-free + 10% SRB and ANT + 0% SRB diets compared to the ANT + 10% SRB diet ($P < 0.05$). Villi length: crypt depth (V:C) decreased due to SRB (23%) and ANT (22%) supplementation ($P < 0.05$). Differences in ileal and cecal digesta short chain fatty acid concentrations were not detected. In conclusion, SRB appears to improve the efficiency of nutrient utilization with only modest alterations in ileal mucosal morphology. Further research is warranted to elucidate the underlying mechanism by which SRB effects are mediated.

Key Words: Stabilized Rice Bran, Antibiotics, Gastrointestinal

W131 Linseed oil addition alters swine adipose fatty acid composition. A. A. AbuGhazaleh*, G. Apgar, and W. Brown, *Southern Illinois University, Carbondale.*

Previous studies have shown that including linseed oil (LSO) in swine diets increase the omega-3 fatty acids (FA) content in adipose tissues. The objective of this study was to determine the effect of the duration of LSO supplementation on omega-3 FA content in adipose tissues. Ninety six pigs (48 barrows and 48 gilts) with an average weight of 30 kg ± 3.7 were used in this study. Pigs were allotted to four dietary treatments (4 barrows and 4 gilts per pen with 3 pens per treatment) on the basis of body weight using a randomized complete block design. The four dietary treatments were: 1) conventional corn-soybean meal diet + 3% saturated fatty acid source (DM basis; CONT), 2) conventional corn-soybean meal diet + LSO at 3% (LS), 3) CONT diet fed until pigs reached a target weight of 60 kg ± 2.5 then switched to the LSO diet (LSO1) and 4) CONT diet fed until pigs reached a target weight of 80 kg ± 2.5 then switched to the LSO diet (LSO2). Pigs feed intake and growth performance were measured every 2 weeks. Pigs were slaughtered once they reached a target weight of 100 ± 5 kg. Samples of adipose tissues were dissected at the 10th rib and analyzed for the concentration of FA. Treatment diets had no effects (P > 0.10) on weight gain, back fat, marbling or color. Pigs on the LS diet tended (P < 0.13) to have lower feed intake (2.26 kg/d) when compared with other treatment diets (2.61, 2.49, and 2.72 kg/d for the CONT, LSO1 and LSO2 diets, respectively). The concentrations of C16:0 and C18:0 were higher (P < 0.10) while the concentration of C18:2n6 was lower (P < 0.10) with the CONT and LSO2 diets when compared with the LS and LSO1 diets. The concentrations of C18:3n3 were higher (P < 0.10) with the LS (8.73% of total FA) and LSO1 (8.49%) diets when compared with the CONT (3.13%) and LSO2 (4.57%) diets. The n6/n3 FA ratios were lowered (P < 0.10) with the LSO supplementations averaging 3.68, 2.78, 1.76 and 1.63 with the CONT, LSO2, LSO1 and LS diets, respectively. In conclusion, LSO supplementation altered the FA profiles of adipose tissues without compromising pigs performance and such alteration is affected by the duration of LSO consumption.

Key Words: Linseed Oil, Fatty Acids

W132 Influence of glycerol and added fat on finishing pig performance. A. W. Duttlinger*, M. D. Tokach, S. S. Dritz, J. M. DeRouchey, J. L. Nelssen, and R. D. Goodband, *Kansas State University, Manhattan.*

A study was conducted to determine the effects of dietary glycerol and fat on finishing pig performance. The experiment was conducted at a commercial swine research facility in southwest MN in August, 2007. Glycerol was procured and stored in the feed mill for approximately 60 d before diets were mixed. A total of 1,093 pigs (PIC, initially 77.7 kg) were used in a 28-d study. Pigs were blocked by initial weight and randomly allotted to 1 of 6 dietary treatments with 7 replications per treatment. Pigs were fed corn-soybean meal-based diets arranged in a 2 × 3 factorial with main effects of glycerol (0, 2.5, or 5%) and added fat (0 or 6%). Overall (d 0 to 28), there was a fat × glycerol interaction (P < 0.04) for ADFI. As added glycerol increased, ADFI was not influenced in diets containing added fat; however, ADFI was reduced when increasing levels of glycerol were added to diets without fat. Pigs fed diets with added fat had improved (P < 0.01) ADG and G:F compared

with pigs fed diets with no added fat. Increasing glycerol decreased ADG (linear, P < 0.02) and ADFI (linear, P < 0.04) and tended (linear, P < 0.11) to decrease G:F which was due to the negative impact when added to diets without fat. In conclusion, 6% added fat improved ADG and G:F, but the glycerol used in this study decreased ADG and ADFI when added to diets without added fat. The storage of glycerol before use may have contributed to the negative impact on performance in this experiment.

Table 1.

Item	Added Fat, %:			Glycerol, %:			SE
	0	0	0	0	2.5	5	
ADG, kg	0.84	0.81	0.76	0.92	0.90	0.91	0.02
ADFI, kg	2.90	2.92	2.74	2.87	2.82	2.85	0.04
G:F	0.29	0.28	0.28	0.32	0.32	0.32	0.01

Key Words: Fat, Glycerol, Pigs

W133 Conjugated linoleic acid and tryptophan supplementation improve immune response of weaned piglets. J. Morales¹, R. Gatnau², and C. Pineiro*¹, ¹*PigCHAMP Pro Europa, SA, Segovia, Spain,* ²*Molimen, Barcelona, Spain.*

Conjugated linoleic acid (CLA) is a natural product that enhances immune function while decreasing the negative effects of inflammatory responses. This effect is especially interesting at weaning, when piglets are highly susceptible to enteric diseases. On the other hand, aminoacidic profile of proteins affecting the immune system is different than muscle proteins, especially higher Trp: Lys ratio. The aim of this study was to assess the effect of CLA in combination with two different Trp:Lys ratios in weaned piglets in a low-health status nursery unit. Therefore, there were four treatments arranged factorially with 2 CLA dietary contents (0 vs 1%) and 2 Trp:Lys dietary ratios (0.15 vs 0.22). For the experiment, 336 piglets were used (7.6 ± 1.78 kg BW) and allotted in 48 pens. Average daily gain (ADG), feed intake and feed efficiency were controlled. Fecal consistency was assessed at 56 d of age (scale 0-normal, 1-soft, 3-diarrhea). During the trial period an acute outbreak of diarrhea occurred but, under these special circumstances, CLA supplementation improved ADG 80% (P=0.0001) and FGR 44% (P<0.001). Consequently, CLA supplemented piglets reached significantly higher final BW (13.5 vs 10.9 kg; P<0.001) than control piglets. Higher dietary Trp: Lys ratio allowed expressing CLA improvements in performance (P interaction < 0.10 in ADG). On the other hand, Trp also improved ADG (170 vs 155 g/d; P=0.02). Mortality rate was not significantly affected, but in the total nursery period the highest risk group (0% CLA & low Trp content) showed the highest % of mortality (10.7%; P=0.02). Fecal consistency was only affected by CLA supplementation, which reduced the signs of diarrhea (0.9 vs 1.8; P=0.001). We conclude that 1 % of CLA supplementation improved ADG, clinical symptoms and decreased the number of animals that needed to be treated during an acute outbreak of diarrhea in the nursery period. Furthermore, higher dietary Trp content facilitates the expression of the CLA effect, demonstrating compatibility and certain synergy between both (CLA and Trp).

Key Words: Conjugated Linoleic Acid, Tryptophan, Piglet

W134 Effect of conjugated linoleic acid on immune function and nutrition composition of duck. B. W. Wang*, Y. C. Wang, M. A. Zhang, B. Yue, L. Z. Jing, X. X. Wei, and G. L. Liu, *Qingdao Nongye University, Qingdao, Shandong Province, China.*

The experiment was conducted to study the effects of different grades of dietary Conjugated linoleic acid (CLA) on immune function and nutrition composition of duck. Two hundred and forty healthy Cherry Valley Ducks of one day old with the similar body weight were selected ($P > 0.05$), and divided into four treatment groups according to one-factor completely random design, with six replications each group and ten ducks each replication. The proportion of CLA in the basal diets was 0%, 1%, 2% and 3% respectively. The whole trial period was 56 days. Sterile blood collecting from each 12 ducks in every group, centrifuging, separate loading, to determine the Cellular Immunity Index, the antibody titer of Avian influenza and the content of Cytokines IL-2. Then slaughter the animal to determine indexes of immune organs on the day of 14, 28, 42 and 56. On the day of 42 and 56 the nutrition related index was carried on. The results showed that 1% and 2% CLA diets increased the indexes of the thymus and Fabricius's gland in different period ($P < 0.05$); 2% CLA diets increased the antibody titer of Avian influenza significantly at the 6th weekend ($P < 0.05$), 1% and 2% CLA diets increased the rate of lymphocyte transformation and the number of E-rosette ring; increased the content of IL-2 significantly after 4 weeks ($P < 0.05$). CLA reduced the percentage of abdominal fat and Subcutaneous fat percentage ($P < 0.05$ or $P < 0.01$), and 2% CLA diets increased the breast muscle percentage significantly at the 6th weekend ($P < 0.05$); 1% and 2% CLA diets increased the content of fat and saturated fatty acids in fatty acids of CLA diets was increased significantly in breast muscle ($P < 0.05$), and reduced significantly that of unsaturated fatty acids ($P < 0.05$). The results indicate that, CLA did promotion on the development of immune organs, increased the function of Humoral immunity and Cellular Immunity, regulate the immunity of meat duck effectively; and CLA did definite function of nutrition redistribution. The proper percent of CLA in diets was 2%.

Key Words: CLA, Meat Duck, Immune Function

W135 Efficiency of retention and conversion of α -linolenic acid (ALA) to other n-3 fatty acids (FA) in the whole body of growing gilts is reduced over time. H. R. Martínez-Ramírez* and C. F. M. de Lange, *University of Guelph, Guelph, ON, Canada.*

Fifteen gilts were used in a serial slaughter study to determine the rate of ALA retention; ALA conversion to other n-3 FA, including eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic (DHA); and ALA disappearance. A corn-barley-soybean meal based diet with 10% flaxseed, containing 2.0% ALA, was fed for 30 d to pigs between 27.7 ± 1.9 and 45.7 ± 2.2 kg BW. Feed intake was fixed at 70% of ad libitum intake according to NRC (1998). Body composition was determined at initial, intermediate (d 15; 39.2 ± 1.4 kg) and final BW in 4, 6 and 5 pigs, respectively. At slaughter on d 15 and 30 digesta was sampled for measurement of apparent ileal fat digestibility, which was used as an estimate of ALA availability. Disappearance of ALA was calculated as the difference between available ALA intake and the sum of ALA retention and ALA conversion to other n-3 FA. At the initial BW (2516 g of body fat), the content of ALA, C18:4n-3, C20:3n-3, C20:4n-3, EPA, DPA and DHA was 0.79, 0.09, 0.10, 0.02,

0.04, 0.09 and 0.14% of body fat, respectively. Whole body content of individual n-3 FA increased linearly from d 0 to 30 ($P < 0.01$), except for DHA. Expressed as a portion of ALA intake, ALA retention declined numerically from 64% (day 0 to 15) to 49.8% (day 15 to 30; $P = 0.11$). Similarly, conversion of ALA to C20:3n-3 (7.06 vs. 4.29%), C20:4n-3 (0.60 vs. 0.34%), and DHA (1.07 vs. 0.33%) was reduced over time ($P < 0.05$), while disappearance of ALA tended to increase over time (3.07 vs. 22.02%; $P = 0.074$). Conversion of ALA to EPA (1.14 vs. 1.51%) and DPA (2.36 vs. 2.04%) did not change over time ($P > 0.10$). The rate of conversion of ALA to C20:3n-3 was much higher in this experiment than reported in other animals and humans and should be explored further. The rate of whole body n-3 FA catabolism appears to increase over time. Based on this study, feeding ALA to pigs only leads to modest increases in contents of EPA, DPA and DHA in the pig's body.

Key Words: Omega 3 Fatty Acid, Elongation, Growing Pigs

W136 Effects of betaine, conjugated linoleic acid or both on nutrient digestibility of growing Iberian gilts. I. Fernandez-Figares*, L. Gonzalez Valero, J. M. Rodriguez-Lopez, R. Nieto, L. Manuel, and J. F. Aguilera, *CSIC (Spanish National Research Council), Granada, Spain.*

We have demonstrated that betaine and CLA show a synergistic effect on growth rate and protein deposition in growing Iberian gilts (Fernandez-Figares et al., 2008). No difference on protein digestibility was encountered between treatments but no information on amino acid digestibility was available. The aim of the present study was to assess if betaine or CLA had an effect on apparent faecal amino acid digestibility of Iberian gilts. Twenty gilts (20 kg BW) were individually penned and fed barley-soybean meal based diets (12% CP, 0.81% lysine and 14.8 MJ ME / kg DM) containing either no added betaine or CLA (control), 0.5% betaine, 1% CLA, or 0.5% betaine + 1% CLA, at 95% *ad libitum* energy intake. At 30 kg BW, a balance experiment was conducted where animals were individually housed in metabolic cages placed in a controlled environment room to allow for separate collection of faeces and urine. Pigs were moved to the cages 3 d before starting excreta collection and fit with a self-retaining urethral catheter for urine collection. Total collection of faeces and urine was performed daily for 4 d. Aliquot samples of faeces and urine representative of total daily faecal output and of total urine were stored at -20°C and was then freeze-dried and finely ground for further analysis. Total nitrogen was determined by the Kjeldahl procedure. Dry matter content and total ash were carried out by standard procedures. Gross energy determination was measured in an adiabatic bomb calorimeter. Amino acids were determined after protein hydrolysis in 6 M HCl plus 1% phenol in sealed tubes at 110°C for 24 h, by HPLC according to the Waters Pico Tag method. The treatment effect was assessed by ANOVA and treatment means were compared by Duncan's procedure. Significance was set at $P < 0.05$. Digestibilities of DM, OM, GE, total nitrogen, total amino acids and ME (0.819, 0.836, 0.808, 0.771, 0.809 and 0.793, average values, respectively) were not affected by dietary treatments ($P = 0.27$ to 0.51). The synergistic effect of betaine and CLA on protein deposition must be exerted at tissue level and not at digestive level.

Key Words: Betaine and CLA, Pig, Amino Acid Digestibility

W137 Effects of dietary coconut fat powder supplementation on performance, nutrient digestibility and blood and milk characteristics in lactating sow. W. T. Kim*¹, H. J. Kim¹, J. H. Cho¹, Y. J. Chen¹, J. S. Yoo¹, S. O. Shin¹, Y. Haung¹, J. D. Hancock², C. Y. Lee³, and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Kansas State University, Manhattan, ³Jinju National University, Gyeongnam, Korea.

A total of thirty sows (Landrace×Yorkshire) were used to determine the effects of dietary coconut fat powder supplementation on performance, nutrients digestibility and blood and milk characteristics. A feeding trial was conducted for 21 days from parturition to weaning. Experimental diets were supplied for 1 week before the parturition day and throughout the experimental period. Dietary treatments included: 1) CON (basal diet), 2) CFP (basal diet added 0.5% coconut fat powder) and 3) CFH (basal diet added 0.5% coconut fat powder containing husk). Average daily feed intake was significantly improved ($P < 0.05$) in CFP and CFH treatments compared with CON treatment. Backfat loss was significantly lower ($P < 0.05$) in CFP and CFH treatments than CON treatment. Compared with CON treatment, final body weight, weight gain and average daily gain in piglet were significantly increased ($P < 0.05$) in CFP and CFH treatments. Red blood cell was significantly increased ($P < 0.05$) in CFH treatment compared with others. White blood cell at the final period and lymphocyte at the final period were significantly increased ($P < 0.05$) in sows fed coconut fat powder diet. At the final period, milk fat concentration was significantly improved ($P < 0.05$) in CFP and CFH treatments compared with CON treatment. Milk protein concentration was significantly higher ($P < 0.05$) in CFP treatment than CFH treatment at the initial period and was significantly lower ($P < 0.05$) in CFP and CFH treatments than CON treatment at the final period. Milk lactose concentration at the initial period was significantly increased ($P < 0.05$) in CFH treatment compared with CON and CFP treatments. On diarrhea rate in piglet, three piglets presented diarrhea in CON treatment from 0 to 5 days. Explanation should be the intestines of newborn piglets were not developed yet. However, none diarrhea occurred in all treatment from 5 to 20 days. In conclusion, dietary fat source from coconut supplementation improved feed intake, backfat loss, RBC, WBC and lymphocyte in sow and weight gain in piglet.

Key Words: Coconut, Nutrient Digestibility, Sow

W138 Use of glycerol for glucose, glycogen and non-essential amino acid synthesis by embryos from small and large chicken eggs. N. E. Sunny, J. Moorefield, S. L. Owens, and B. J. Bequette*, *University of Maryland, College Park.*

The objective was to determine the contribution of glycerol to glucose, glycogen and non-essential amino acid (NEAA) synthesis by d 14 and d 19 chicken embryos derived from small (56.6 ± 0.88 g) and large eggs (71.7 ± 1.09 g). After setting the eggs, small and large eggs were each divided into 2 groups (d 14 and d 19, $n = 7$ per group), after which [¹³C₃]glycerol (14 mg in 75 μ L H₂O) was administered into the chorio-allantoic fluid for 4 consecutive days prior to tissue and blood collection on d 14 and 19 embryonic. Blood and tissues were analyzed by GC-MS for ¹³C-mass isotopomer enrichments in blood glycerol, glucose, and NEAA, and liver and muscle glycogen. At both embryonic ages, [¹³C₃]glycerol administration led to the synthesis of [M+1], [M+2] and [M+3] isotopomers in blood glucose and liver and muscle glycogen. In d 14 embryos, ¹³C-isotopomer enrichments (moles ¹³C-isotopomer/100 moles ¹²C-isotopomer) were higher ($P < 0.05$) in small vs. large egg embryos

for blood glucose ([M+1]; 3.6 vs. 2.1, [M+2]; 3.7 vs. 2.2, [M+3]; 2.6 vs. 1.4) with a similar trend for liver and muscle glycogen. Compared to d 14 embryos, blood glucose ¹³C-isotopomer enrichments from d 19 embryos were 2-fold higher ($P < 0.05$), suggesting a greater reliance on glycerol for gluconeogenesis. There was also synthesis of [M+1], [M+2] and [M+3] isotopomers of alanine, aspartate and glutamate, the latter two of which were more highly enriched ($P < 0.05$) in liver. This study provides unequivocal evidence that glycerol is a major precursor for glucose synthesis by chicken embryos and that the indirect pathway of glycogen synthesis is a major metabolic route in the liver and the muscle for glycogen synthesis.

Key Words: Embryo, Chicken, Metabolism

W139 The effect of feeding omega-3 fatty acids during the grower and early finisher phases on intramuscular fatty acid composition at market weight in pigs. S. A. Meers*, C. R. Dove, T. D. Pringle, and M. J. Azain, *University of Georgia, Athens.*

The objective of this study was to determine the effects of feeding a diet containing omega-3 fatty acids during the grower and/or early finish phases on intramuscular fat content and fatty acid composition of loin muscle. The study was designed as a 2 × 2 factorial arrangement, with main effects of fat (Control, C or Omega-3, O) and diet phase (Grower, G d0-35, or Early Finisher, EF d35-70). All pigs were fed a common Late Finisher (LF, d70-98) diet. Diets were corn-SBM based: G (17.9% CP, 1.0% lys), EF (17.0% CP, 0.9% lys), & LF (15.9% CP, 0.8% lys). Omega-3 fatty acids were supplemented by adding 2% fish oil (Virginia Prime Gold, Omega Protein, Houston, TX) to the G and EF diets. Soybean oil (2%) was used as the control in G, EF, and common LF diets. Pigs ($n=92$, initial BW 29.3 kg) were allotted by gender and weight to pens where C or O diet treatments were assigned at random. There were no effects of diet on overall growth performance. There was a trend for 19% greater lipid content in loin from pigs fed the O diet relative to the C diet (5.03 vs 4.23%, $P < 0.10$). Pigs fed the O diet had lower loin concentrations of linolenic acid (0.32%, $P < 0.01$) and greater concentrations of EPA (1.03%, $P < 0.0001$), DPA (0.62%, $P < 0.006$), and DHA (0.91%, $P < 0.0001$) when compared to C fed pigs (0.44%, 0.16%, 0.38%, and 0.05% respectively). The addition of fish oil to the diet decreased the n-6/n-3 ratio in loin muscle (C 17.7 vs O 3.4, $P < 0.0001$). A 100-g loin sample from pigs fed the O diet in G and EF contained greater amounts of total n-3 fatty acids (112 vs 31 mg, $P < 0.0001$) and greater EPA & DHA (64 vs 5.6 mg, $P < 0.0001$) relative to that found in loin from C fed pigs. It should also be noted that despite dietary differences, there were no diet effects on the percent of saturated fatty acids ($37.7\% \pm 1.11\%$) or the iodine value (77.86 ± 3.35) in the loin muscle. These results demonstrate that feeding diets with 2% fish oil during the G & EF phases, followed by a withdrawal period, results in an increase in the omega-3 content and a trend for greater intramuscular fat in loin muscle.

Key Words: Fish Oil, Omega-3 Fatty Acids, EPA

W140 Effect of different dietary protein levels on lipid metabolism of subcutaneous adipose tissue in lean-type and fat-type fattening pigs. W. T. Gu¹, T. L. Liu², P. W. Xu¹, M. J. Bo¹, H. J. Xu¹, Y. L. Yin^{*1}, X. F. Kong¹, T. J. Li¹, Z. Q. Liu¹, W. J. Tang¹, and R. L. Huang¹,

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Thirty six Duroc × Landrace × Yorkshire hybrid (lean-type) and twenty seven Ninxiang breed (fat-type) fattening pig were individually housed in metabolic cages and randomly allocated into three groups, fed each of three diets for 46-day periods. The corn and soybean meal-based diets included 10%,13% and16% protein levels for Ninxiang breed, and 13%,16% and 19% protein levels for hybrid, respectively, and each diet were identical in calories as fat. The effects of those diets on serum lipoprotein, cholesterol, triglyceride and leptin levels, and subcutaneous adipose tissue lipogenesis and lipolytic gene mRNA expression in two breed pigs were detected. With the increasing protein levels, serum triglyceride and leptin levels in hybrid breed were increased (quadratic; $p < 0.05$), while in Ninxiang breed, 16% group (493.00 ± 37 pg/mL) had higher serum leptin levels than 10% group (117.00 ± 46 pg/mL) ($p < 0.05$), but serum triglyceride levels was not significantly effected. The abundance of Acetyl-CoA carboxylase (ACC) mRNA in subcutaneous adipose tissue of hybrid breed was increased (linear; $p < 0.05$) but was not significantly changed in Ninxiang breed with the increasing of protein levels. The subcutaneous adipose tissue leptin mRNA abundance of Ninxiang breed was reduced (quadratic; $p < 0.05$), and the expression of leptin mRNA was positive correlated with the abundance of liver × receptor LXR in both breed ($p < 0.05$). The abundance of sterol regulatory element-binding protein (SREBP-1) mRNA of two breed tend to increase. Our findings suggest that different dietary protein levels alters the energy homeostasis of fattening pig, thereby effect the expression of key enzymes and related genes of lipid metabolism (mainly ACC and leptin) in order to regulate the lipid synthesis and secretion in subcutaneous adipose tissue. Furthermore, different dietary protein may act on nuclear transcription factors LXR/SREBP-1 directly or indirectly via leptin signaling.

Key Words: Lipid Secretary Function, Fattening Pig, Dietary Protein

W141 Cloning and characterization of porcine adipose triglyceride lipase (pATGL) gene. T. Shan, Y. Wang*, T. Wu, J. Guo, G. Yao, J. Feng, and Z. Xu, Zhejiang University, Hangzhou, P. R.China.

Adipose triglyceride lipase was recently identified as a major novel triglyceride lipase in animals. In this study, we aimed to study the tissue- and development- specific expression of porcine adipose triglyceride lipase (pATGL) in pigs, and the effect of resveratrol on expression of pATGL in vitro. The full-length cDNA sequences of pATGL was 1958 bp (accession no: EF583921), with an Open Reading Frame (ORF) of 1458 bp encoding 486 amino acids protein (the predicated molecular mass of 53.2 kDa, accession no. ABS58651). Comparison of the deduced amino acid sequence with the bovine, mouse, rat, dog and human adipose triglyceride lipase showed 87%, 84%, 83%, 81% and 80% similarity, respectively. Furthermore, The pATGL was highly expressed in porcine adipose tissue, to a lesser degree in kidney, heart, and muscle, and lowest but detectable in brain. In subcutaneous adipose tissue, the pATGL mRNA was very low at birth (1 kg body weight), and kept increasing postnatal, reaching a maximal value ($P < 0.01$) at 20 kg body weight (about 7 weeks old). Similarly, in peritoneal and omental adipose tissue, the highest expression of pATGL was observed at 40 kg body weight (about 14 weeks postnatal). Finally, administration of 40 μ M resveratrol and 80 μ M resveratrol for 24 h increased ($P < 0.05$) the mRNA levels of pATGL in cultured adipocytes by 95.3% (mean value = 1.95) and 146.8% (mean value = 2.47), respectively. Accordingly, lipid accumulation was decreased ($P < 0.05$) by 25.7% (mean value = 0.051) and 60.8% (mean value = 0.027), respectively. When treated with resveratrol for 48 h, the mRNA levels of pATGL were increased ($P < 0.05$) by 104.1% (mean value = 2.04) and 163.1% (mean value = 2.63), respectively. And 80 μ M resveratrol treatment decreased ($P < 0.05$) the lipid accumulation by 29.0% (mean value = 0.055). These data would be helpful for manipulating fat deposition via controlling adipose triglyceride lipase expression, thus improving meat quality.

Key Words: Gene Expression, Porcine Adipose Triglyceride Lipase (pATGL), Resveratrol

Physiology and Endocrinology: Gestation and Lactation Physiology

W142 Mathematical simulation to assess the validity of Bonnier's equation for estimating the frequency of monozygous twinning in a population of Holstein cattle. N. Silva del Río*¹, G. A. Broderick², and P. M. Fricke¹, ¹University of Wisconsin, Madison, ²US Dairy Forage Research Center, Madison, WI.

Twin calving records (n = 96,069) were extracted from MN DHIA (1996 to 2004) to estimate the incidence of monozygous twinning (MZ) and to evaluate the impact of varying the twin sex ratio and frequency of same-sex twins (SST) on estimates of MZ calculated using Bonnier's equation. Bonnier's equation: $m = 2npq - n^2 / 2pq(n - n^2)$, estimates the proportion of MZ among SST (m) based on total opposite-sexed twin (OST) pairs (n₂) and the observed proportions of male (p) and female (q = 1 - p) calves among all twin births. Bonnier's equation assumes the sex of one twin is independent of the other, therefore, similar proportions of SST and OST would be expected in the absence of MZ. We hypothesized a dramatic decrease in Bonnier's estimate of MZ if SST comprised a smaller proportion of a population than reported. Based on our study, 56.4% of twin calves were SST, and 51.9% were male. The estimates of MZ were calculated by simulating a reduction of SST of 5% (54.2% SST) or 10% (52.0% SST), whereas the proportion of male calves born as twins was 51.9% (observed) or simulated to be 50% (Table 1). Estimates of MZ were greater than expected based on observed outcomes of MZ (Silva del Río et al., *Therio.* 66:1292; 2006). We conclude that slight changes in the percentage of SST dramatically affect MZ estimates using Bonnier's equation, whereas the percentage of male calves born as twins has a minimal impact. Thus, if factors other than MZ affect the proportion of SST, such as oocyte maturity, vaginal and uterine pH, or hormonal estrous synchronization, then Bonnier's equation will inaccurately estimate the frequency of MZ.

Table 1. Estimation of monozygous twinning as a percentage of all twins using Bonnier's equation for observed and simulated percentages of same-sex twins (SST) and proportion of male calves born as twins.

SST (%)	Male calves born as twins (%)	
	51.9 (observed)	50.0
56.4 (observed)	11.6	11.3
54.2	7.9	7.8
52.0	3.9	3.9

Key Words: Bonnier's Equation, Monozygous Twins, Holstein Cattle

W143 Activated caspase-3 activity in the bovine fetal ovary. N. M. Barkley*, M. F. Smith, and H. A. Garverick, *University of Missouri, Columbia.*

During early bovine fetal development there is a 170 fold increase in germ cells from d 50 to d 110 followed by a rapid decline of germ cells by d 170 and even fewer remaining germ cells by birth. The objective of this study was to determine if the decline in germ cell numbers in fetal bovine ovaries from d 110 to d 170 can be attributed to apoptosis by characterizing active caspase-3 (effector of apoptosis) positive cells in fetal bovine ovaries from d 60–260 of gestation. Ovaries were dis-

sected from fetuses upon slaughter and fetal age was estimated based on crown-rump length. Following dissection, ovaries from each animal were fixed in 4% paraformaldehyde (pH 7.6) and embedded in paraffin. Ovaries were sectioned at a thickness of 5 µm. Activated caspase-3 protein localization was characterized by immunohistochemistry. Two serial sections from each animal were stained and all positive cells on each section were counted, classified as either germ cells or non-germ cells, and averaged. The mean positive cells for each time period (d 60-80, 100-120, 130-150, 170-180, 190-210, and 240-260; n ≥ 4 animals per time period) were determined. Germ cells were distinguished based upon morphology, location within the tissue, and association with follicular cells. The mean values were transformed in SAS, due to heterogeneity in variance, to determine differences across the time periods of gestation. However, the reported values are the means prior to transformation. The mean numbers of active caspase-3 positive cells per section were 63^{ab}, 156^a, 38^{ab}, 16^b, 25^b, and 11^b for d 60-80, 100-120, 130-150, 170-180, 190-210, and 240-260, respectively (^{ab} $P < 0.05$). Analysis of only germ cells showed 18.3^{abc}, 50.4^a, 13.9^{ab}, 3.3^{cd}, 6.1^{bcd}, and 0.1^d positively stained cells per section for d 60-80, 100-120, 130-150, 170-180, 190-210, and 240-260, respectively (^{abcd} $P < 0.05$). The greatest amount of caspase-3 activity occurred prior to d 150 of gestation. Thus, the sharp decline in germ cell numbers from d 110 to d 170 can, in part, be attributed to apoptosis.

Key Words: Bovine, Fetal Ovary, Caspase

W144 Multiple fibroblast growth factors stimulate interferon-tau production in bovine trophectoderm. K. A. Pennington* and A. D. Ealy, *University of Florida, Gainesville.*

Maintenance of early pregnancy in bovids depends on interferon-tau (IFNT) secretion from trophectoderm. Fibroblast growth factor 2 (FGF2) stimulates IFNT production in bovine blastocysts and a trophectoderm cell line (CT1). Several FGF receptors (FGFR) exist in the bovine conceptus, including FGFR2IIIb, a receptor subtype implicated in regulating placental development in several species. Multiple ligands for this receptor, notably FGF1, 7 and 10, are produced in bovine and ovine endometrium during early pregnancy. The objective was to determine if these uterine FGFs increase IFNT production in bovine trophectoderm. In study 1, CT1 cultures were incubated in medium containing 0, 0.05, 0.5, 5, 50 and 500 ng/mL of recombinant (r) bovine (b) FGF1, r human (h) FGF7, or rhFGF10. All cultures contained carrier protein (500 µg/mL BSA). RNA was extracted 24 h later and quantitative RT-PCR was used to determine IFNT mRNA abundance relative to an internal control (18s RNA). Four replicate experiments were completed. IFNT mRNA concentrations increased ($P < .05$) at 50 ng/mL rbFGF1 (5.9 ± 0.9 fold induction over non-treated controls), 50 ng/mL rhFGF7 (5.4 ± 0.2 fold induction) and 500 ng/mL rhFGF10 (8.4 ± 0.5 fold induction). In study 2, CT1 cultures were supplemented with various amounts of rbFGF1 or rhFGF10. rhFGF7 was not included in this study. Media were collected 48 h later and antiviral assays were completed to quantify IFNT protein concentrations. Five replicate experiments were completed. IFNT concentrations in conditioned medium increased ($P < .05$) in cells exposed to 50 ng/mL FGF1 (766.8 ± 266.1 pg/mL) and 500 ng/mL FGF10 (389.0 ± 185.5 pg/mL) compared with controls (56.3 ± 5.3 pg/mL). In conclusion, various FGFs can act on bovine trophectoderm to regulate IFNT mRNA and protein production. Further work is required to address the functional implications of these findings. Project supported

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Key Words: Placenta, Embryo, Conceptus

W145 Identification and characterization of three MX1 isoforms in sheep. D. S. Clark^{*1}, K Williams², and T. L. Ott¹, ¹*Pennsylvania State University, University Park*, ²*University of Idaho, Moscow*.

Ruminant conceptuses produce interferon tau (IFN tau) during early pregnancy which increases expression of the myxovirus resistance gene, MX1, in the uterus. The role of MX1 in pregnancy is not known, but its role in the immune response is well-characterized. Kojima, et al. (2003) showed MX1 isoforms existed in cattle. In this study we characterized MX1 isoform expression in the sheep uterus. Sequence analysis of amplicons generated using a common set of MX1 primers in ovine endometrial cell lines revealed three isoforms that differed in their 5' regions. Full-length sequences for each isoform were generated. Compared to the published sequence (Accession # X66093:MX1a) one isoform contained an 18 base deletion (MX1b) and the other an insertion of 186 bases (MX1c). Computer-assisted translation of MX1b resulted in a protein lacking 6 amino acids near the amino terminus. An early stop codon in MX1c caused a 27 amino acid exchange on the amino terminus. Sequence differences occurred at the boundary between putative exon 3 and exon 4, suggesting the isoforms may be splice variants. We developed a quantitative, real-time PCR assay to distinguish each isoform. All three isoforms were identified in ovine uterine luminal epithelial (oLE) and stromal (oSC) cell lines. Interestingly, only two of the isoforms, MX1a and MX1c, were detectable in glandular epithelial (oGE) cells and sheep endometrium. Levels of MX1c mRNA were roughly 1000-fold greater and did not change with the application of IFN tau in any cell line. However, levels of MX1a and MX1b strongly increased in response to IFN tau in oLE (> 300-fold at 6 hours). In endometrial RNA from pregnant ewes, MX1a mRNA levels increased approximately 17-fold, while MX1c levels did not change. We have yet to confirm the presence of proteins representing each putative splice variant *in vivo*, but those experiments are ongoing. Results suggest that three splice-variants of MX1 mRNA are present in sheep, and that, unlike MX1a and MX1b, MX1c is highly abundant and is not regulated by IFN tau.

Key Words: Sheep, Uterus, Interferon

W146 Effects of nutrient restriction during early gestation on postnatal calf growth. C. L. Bailey^{*}, N. M. Long, M. J. Prado-Cooper, E. C. Wright, and R. P. Wettemann, *Oklahoma Agricultural Experiment Station, Stillwater, OK*.

Effects of prenatal nutritional restriction on postnatal growth of calves were evaluated in Angus \pm Hereford heifers (15 mo). Heifers were AI with semen from a single Angus sire in each of 3 yr. At 32 \pm 0.5 d after insemination, pregnancy was verified and heifers were stratified by BW and BCS and allotted to low or moderate nutrition (L, n = 25, fed 55 %; M, n = 25, fed 100% NRC 1996 requirements). After 83 \pm 3 d of treatment (115 d of gestation) heifers were commingled and received a common diet (100% NRC). Bulls were castrated at birth and calves

were weaned at 229 \pm 8 d of age. Data were analyzed using PROC MIXED procedures of SAS. There were no year \times treatment effects. At treatment BW ($P = 0.16$) and BCS ($P = 0.21$) were similar for L and M heifers. After treatment, M heifers had greater BW ($P < 0.001$; 487 kg) and BCS ($P = 0.006$; 5.49) compared with L heifers (373 kg, SE = 10; 4.38, SE = 0.14). At calving, BCS did not differ ($P = 0.20$) for M and L heifers (5.05 vs. 4.64, SE = 0.24). Length of gestation was not influenced by treatment ($P = 0.50$; 274 and 275 d for L and M, respectively). Birth weights were similar ($P = 0.75$) for L and M calves (32 and 33 kg, respectively). Weight of calves at weaning (222 kg, SE = 5) was not influenced by treatment ($P = 0.81$). Glucose in plasma of calves at birth (80 and 79 mg/dL for L and M, respectively, SE = 7) was similar between treatments ($P = 0.93$). Cortisol in plasma of calves at birth (57 and 73 ng/mL for L and M, respectively, SE = 9) was not influenced by treatment ($P = 0.20$). Prenatal nutritional restriction of heifers that resulted in 1.1 BCS units difference at 115 d of gestation did not influence gestation length, birth weight, weaning weight, or plasma concentrations of glucose and cortisol in calves at birth.

Key Words: Prenatal Nutrition, Calves, Growth

W147 Effects of nutrient restriction during early gestation on carcass and organ weights of beef steers. N. M. Long^{*}, M. J. Prado-Cooper, C. R. Krehbiel, U. Desilva, and R. P. Wettemann, *Oklahoma State University, Stillwater*.

Angus \times Hereford heifers (15 mo of age) were used to evaluate the effect of prenatal nutritional restriction on tissues and organs of 22 mo old steers. At 32.0 \pm 0.5 d after AI with semen from one sire, pregnancy was verified and heifers were stratified by BW and BCS and allotted to low (L, fed 56 % of NRC requirements) or moderate (M, fed 100% NRC requirements) nutrition. After 83 d of treatment, heifers were commingled and received a common diet (100% of NRC requirements). Bull calves were castrated at birth and maintained as a group before and after weaning. At 16 mo of age, L (n = 5) and M (n = 5) steers were fed a high concentrate diet and gained 2.2 \pm 0.1 kg/d to an average BW of 550 kg. Steers were harvested and weights of the empty body, heart, lungs and trachea, spleen, kidney, liver, pancreas, and the gastrointestinal tract were recorded. Samples of organs, muscle (complexus), subcutaneous fat (SubQ), and KPH were stored at -80 $^{\circ}$ C and DNA in tissue was quantified using Hoechst H33258 dye. RT-PCR was utilized to evaluate abundance of mRNA for genes involved in fatty acid metabolism in SubQ and KPH. Low steers had greater (2.41 \pm 0.51 g; $P = 0.05$) total DNA in the pancreas compared with M steers (1.64 \pm 0.51 g) and KPH from L steers tended ($P = 0.09$) to have increased concentrations of DNA compared with M steers. Concentrations of DNA in the other organs and SubQ fat were not influenced by treatment. Muscle fiber area was increased ($P = 0.04$) in L steers compared with M steers (1824 \pm 76 vs 1336 \pm 44 μm^2 , respectively) and concentrations of DNA were greater ($P = 0.04$) in muscle from L steers than M steers. Abundance of RNA for fatty acid binding protein 4, fatty acid translocase and GLUT 4 was decreased in KPH from L steers compared with M steers. Nutritional restriction during early gestation increased muscle fiber area and decreased abundance of RNA for genes involved in fatty acid and glucose transport in KPH of steers at 22 mo of age.

Key Words: Steers, Organs, Gene Expression

W148 Effect of age at first calving on milk production and days open in first-parity Iranian Holstein dairy cows. A. Heravi Mous-savi*, M. Danesh Mesgaran, and R. Noorbakhsh, *Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran.*

Age at first calving (AFC) is one of the important factors contributing to economic return and is determined partially by farmer policy. The aim of this study was to evaluate the effect of age at first calving on milk production and days open in first-parity Iranian Holstein dairy cows. Calving data were collected during 1996 until 2006 in seven large commercial Holstein farms. During the period the median number of cows in the study herds was 500. Farms were located in northeastern Iran and were enrolled in the official milk-recording scheme. Each cow was characterized by demographic data (birth date, sire, first calving date), production data (cumulative first 60 and 200 days milk productions), and reproduction data (days open). The dependent variables analyzed were the cumulative first 60 and 200 days milk production, and days open. The AFC was included in the model with 23 levels (from 17 to 40 mo, one per month). Data were analyzed using General Linear Models using the statistical software package JMP. Age at calving averaged 27.23 ± 3.37 month. The median was 26 mo and 25% and 75% quartiles were 25 and 28 mo, respectively. Its distribution showed almost a bell shape. Age at first calving decreased from 1996 to 2006 ($P < 0.01$). The cumulative first 60 and 200 days milk production was impacted by AFC ($P < 0.001$) and the milk yields were increased in greater AFC. Days open was similar among different levels of AFC. The results of this study demonstrate that milk yields increased with increasing AFC, but the AFC had no apparent impact on the interval from calving to conception. The

results also demonstrated that mean AFC is higher than the optimum age at first calving and can be decreased by 4 months.

Key Words: Dairy Cows, Age at First Calving, Days Open

W149 Changes in muscle proteome of dairy cattle with onset of lactation. P. J. Tyler*, K. A. Cummins, D. M. Carpenter, and R. Sabharwal, *Auburn University, Auburn, AL.*

An experiment was conducted to evaluate changes in the muscle proteome of dairy cows before and after the onset of lactation. Samples ($n = 3$ cows) of semi-tendinosus muscle were taken under local anesthesia either 7 d before expected calving date (mean 7.2 d) or 10 d after calving. Samples were subjected to two-dimensional gel electrophoresis in triplicate and stained with Sypro Ruby (Bio-Rad). Gel images were captured on a Typhoon 9410 (Amersham, Piscataway, NJ) and were processed with PD Quest software (Bio-Rad, version 8.0.1) for spot detection and expression quantification. The data were imported into the SAS statistical software (Version 9.1) for statistical differential protein expression analysis. There were a total of 613 spots detected in the union from all gels. Of these, 206 spots were matched in all 9 pre-calving gels, 251 matched in all 9 post-calving gels and 183 were matched across all 18 gels. Of the 183 commonly expressed spots, twenty-eight showed statistically significant ($P < 0.05$) differential expression, with 9 down-regulated and 19 up-regulated between pre- and post-calving. Significant changes occur in the muscle proteome of lactating dairy cattle with the onset of lactation.

Key Words: Parturition, Muscle, Proteome

Physiology and Endocrinology: Hormonal Control of the Estrous Cycle

W150 Immunosterilization of bitches with an anti-LHRH vaccine using CpG ODN as an adjuvant. R. Zanella¹, M. Ragagnin de Lima^{*4}, J. J. Reeves¹, V. Conforti², D. DeAvila¹, A Ferreira Marques⁴, S. A. Messina¹, R Bogden³, and E. L. Zanella⁴, ¹Washington State University, Pullman, ²Cincinnati Zoo & Botanical Garden, Cincinnati, OH, ³Amplicon Express, Pullman, WA, ⁴Universidade de Passo Fundo, Passo Fundo, RS, Brazil.

There are around 400 million street dogs in the world (WSPA), generating serious sanitary and welfare problems. Currently, contraceptive methods used in dogs are surgical spaying or neutering procedures or hormone treatments. However, the surgical methods are irreversible, and hormone treatments can cause undesirable side effects. Immunosterilization using an anti-LHRH vaccine has been tested in cattle, goats, and sheep, resulting in reproductive sterilization. Luteinizing hormone-releasing hormone (LHRH) immunization causes reproductive sterilization by disrupting the hypothalamic-pituitary-gonadal axis through immunoneutralization of LHRH. The objective of this study was to evaluate the effect of LHRH immunization with cytosine guanine oligodeoxynucleotide (CpG ODN 2006) as an immunostimulant in female dogs. Fourteen (n = 14) healthy, adult female dogs were used. Animals were randomly assigned in two treatment groups (n = 7 dogs/group): A) two injections of ova-LHRH with CPG ODN, 50 d apart (1 mg total dose); B) two injections of CpG ODN, 50 d apart (negative control). The effect of the vaccine was evaluated by comparing the proportions of females that showed estrous behavior and became pregnant. Four months after immunization, all dogs in group A and B that presented estrous behavior were bred. In Group B, 4 dogs displayed estrous behavior and became pregnant delivering 20 puppies. In Group A, one dog (out of 2 that displayed estrous) became pregnant with 3 puppies. The t-test result showed a difference between puppies born/treatment ($P < 0.02$). Although this vaccine was not 100% efficient in preventing pregnancy, our results suggest that LHRH immunization with CpG ODN reduced estrous activity and fertility rates in female dogs.

Key Words: LHRH Vaccine, Immunosterilization in Dogs, CpG ODN

W151 Ovarian follicular dynamics during the interovulatory interval in Najdi goats. H. Kohram^{*1,2}, S. Gooraninejad², A. Motaghedi², G. Mohammadi², and E. Dirandeh¹, ¹Tehran University, Karaj, Tehran, Iran, ²Shahid Chamran University, Ahvaz, Khoozestan, Iran.

The purpose of the present study was to characterize follicular dynamics during the estrous cycle in najdi goats. Najdi goats (n = 5) were synchronized with 2 im injections of prostaglandin F2a given 11 d apart (estrus = d 0). Ovarian follicular development was monitored daily by real-time ultrasonography using a B-mode instrument with a 7 MHz linear-array transducer. The mean (\pm SEM) interovulatory interval for the five najdi goats was 20.6 ± 0.9 d. The follicular patterns included either four (n = 2) or five (n = 3) follicular waves per cycle and the mean number of follicular waves in najdi goats was 4.6 ± 0.5 . The mean (\pm SEM) diameters of the largest follicles were 5.6 ± 0.8 , 5.6 ± 0.5 , 6.0 ± 1.7 , 7.0 ± 1.8 , and 5.2 ± 0.4 for first through fifth follicular waves, respectively. The mean (\pm SEM) appearance day of follicular wave was -0.8 ± 1.1 (n = 5); 3.2 ± 0.4 (n = 5); 7.0 ± 0.6 (n = 5); 12.3 ± 1.7 (n = 5); and 13.0 ± 1.6 (n = 3) for first to fifth follicular waves, respectively (n = number

of goats). Dominant follicles reached their maximum diameter on d 2.9 ± 1.5 , 7.6 ± 0.6 , 12.2 ± 1.4 , 16.7 ± 2.1 , and 18.6 ± 0.5 of the estrous cycle and the intervals from follicular wave emergence to dominant follicle maximum diameter were 4.3 ± 1.6 , 4.2 ± 1.3 , 4.3 ± 1.4 , 4.3 ± 1.4 , and 4.4 ± 1.4 d for first through fifth follicular waves, respectively. During the fourth and fifth follicular waves the maximum diameters of the dominant follicles were 7.7 ± 0.8 and 5.2 ± 0.4 , respectively. Najdi goats ovulated in average 1.8 ± 0.4 follicles per estrous cycle. Our results suggest that follicular growth in najdi goats is a dynamic process, and the development of ≥ 2 mm follicles occurs in waves. However, during each wave a single follicle becomes dominant whereas other follicles in the same wave regress.

Key Words: Goats, Follicles, Real-Time Ultrasonography

W152 Alteration of ovarian follicular dynamics by GnRH in water buffaloes. H. Kohram^{*1,2}, G. Mohammadi², and E. Dirandeh¹, ¹Tehran University, Karaj, Tehran, Iran, ²Shahid Chamran University, Ahvaz, Khoozestan, Iran.

The objective of the present study was to evaluate the ovarian response of buffaloes to GnRH injections given at different moments of the estrous cycle. The estrous cycles of 15 buffaloes were synchronized with 2 im injections of prostaglandin F2a \pm given 11 d apart. The buffaloes were randomly assigned to 1 of 3 treatments. Buffaloes in the control treatment received no treatment, whereas G6 buffaloes received a GnRH injection between d 5 and 7 and G16 buffaloes received a GnRH injection between d 15 and 17 of the estrous cycle (estrus = d 0). Daily, from estrous cycle d 0 to the next estrous cycle d 23, cows had their ovaries scanned by ultrasound. All follicles were classified in to 4 to 6 mm, and ≥ 7 mm follicles. Data were analyzed using the GLM procedure of SAS. In the three treatments, the number of 4 to 6 mm follicles had a declining trend from d 1 and reached their smallest amount on d 4 and 5 ($P < 0.05$). Thereafter, the number of this class of follicles in the control, G6 and G16 treatments increased until d 8, 10 and 6, respectively ($P < 0.05$). In response to an injection of GnRH, the number of small follicles in treatment G6 and G16 increased on d 9 and 18, respectively. Again, the number of small follicles increased in the control and G6 treatments from d 15 and 19, respectively, to d 21 of the estrous cycle. The number of ≥ 7 mm follicles had an increase ($P < 0.05$) until d 3 in the control and d 5 in the G6 and G16 treatments. In the G6 treatment of buffaloes, GnRH injection on d 6 increased ($P < 0.05$) the number of large follicles on d 10. The number of ≥ 7 mm follicles in the two treatments (control and G6) increased between d 17 and 19 of the estrous cycle. An increase the number of small and medium sized follicles 2 d after GnRH injection showed that an injection of GnRH at the beginning or later days of the estrous cycle could promote the emergence of a new follicular wave in buffaloes.

Key Words: Buffaloes, Follicles, Real-Time Ultrasonography

W153 Effects of oral doses of colostrum on luteal regression and synchronization of estrus in dairy heifers. S. L. McKee^{*}, S. P. Washburn, and C. S. Whisnant, North Carolina State University, Raleigh.

A 1984 study indicated an effect of 900 ml of oral colostrum on lowering milk progesterone (P4) in cattle, presumably due to estrogens and prostaglandin metabolites in colostrum. The objective of this experiment was to examine responses of cyclic dairy heifers to oral colostrum in comparison to untreated heifers or those receiving prostaglandin F2 α (PGF). The pooled, frozen-thawed colostrum used was either high (\approx 6 L) or medium (\approx 18 L) quality based on a colostrometer (Biogenics-Mapleton, OR). Heifers (n = 29) were Holsteins, Jerseys, or crossbreds of both breeds with mean BW = 287 \pm 11 kg. A corpus luteum (CL) was identified for each heifer with use of ultrasound; average CL diameter = 2.9 \pm 0.1 cm. Heifers were assigned at random to 1 of 4 treatment groups: T1 -untreated control (n = 7); T2-positive control, 25 mg PGF i.m. (n = 7); T3-1 L oral colostrum (n = 7); or T4 -2 L oral colostrum (n = 8). Colostrum was administered using an esophageal tube and pump. Ultrasound measurements and blood samples were collected before treatment, and 1 and 4 d after treatment to determine changes in CL size and serum P4 concentrations. Heifers received tailhead paint and were observed for estrus twice daily. All 7 heifers receiving PGF (T2) came into estrus within 4 d after treatment (2.8 \pm 0.2 d) whereas only 3 heifers from T1, 2 heifers from T3, and 3 heifers from T4 were detected in estrus within 6 d after treatment. All heifers detected in estrus had P4 \geq 2.0 ng/ml at treatment which declined after treatment. In contrast, the 14 heifers not observed in estrus by 6 d had concentrations of P4 \geq 2.0 ng/ml at treatment and 1 and 4 d after treatment. All PGF-treated heifers responded with a decline in P4 and subsequent estrus whereas responses among the 15 heifers that received colostrum were similar to the 7 untreated heifers. This trial does not support the hypothesis that oral doses of 1 to 2 L of colostrum enhance luteal regression. It is not known whether use of colostrum of higher quality or at higher doses would be more effective.

Key Words: Colostrum, Synchronization, Heifers

W154 Plasma progesterone concentrations determined by commercial radioimmunoassay kit as puberty criteria for Brahman-crossbred heifers. R. F. Cooke^{*1,2}, B. R. Austin², and J. D. Arthington¹, ¹University of Florida - IFAS, Range Cattle Research and Education Center, Ona, ²University of Florida - IFAS, Animal Sciences, Gainesville.

Concentrations of plasma progesterone (P4) greater than 1.0 ng/mL are often used as puberty criteria for beef heifers. Prepubertal Brahman-crossbred heifers may have P4 concentrations above this level, decreasing the accuracy of puberty determination in heifer development studies. The objective of this experiment was to evaluate three different plasma P4 concentrations (1.0, 1.5 or 2.0 ng/mL) as puberty criteria for Brahman-crossbred heifers. A total of 960 blood samples were collected, concurrently with assessment of ovarian luteal tissue via trans-rectal ultrasonography, from 37 Braford and 43 Brahman \times Angus heifers. Plasma samples were analyzed for P4 concentrations using a Coat-A-Count Kit (DPC Diagnostic Products Inc., Los Angeles, CA) solid phase ¹²⁵I RIA. Puberty was determined by detection of ovarian luteal tissue and elevated plasma P4 concentrations. Only data from prepubertal heifers were evaluated (630 of 960). Data were analyzed using the GLM procedure of SAS. A puberty criteria \times breed interaction was detected ($P < 0.05$). Increasing puberty criteria from 1.0 to 1.5 ng/mL decreased ($P < 0.01$) the incidence of false positives in Brahman \times Angus heifers; approximately 15 % (41 of 265) of false positives were

detected for 1.0 ng/mL, 6% (17 of 265) of false positives were detected for 1.5 ng/mL, and 4% (10 of 265) of false positives were detected for 2.0 ng/mL. Increasing puberty criteria from 1.0 to 1.5 or 2.0 ng/mL decreased ($P < 0.01$) the incidence of false positives in Braford heifers; approximately 33% (121 of 365) of false positives were detected for 1.0 ng/mL, 18% (65 of 365) of false positives were detected for 1.5 ng/mL, and 10% (37 of 365) of false positives were detected for 2.0 ng/mL. In conclusion, the adoption of 1.5 and 2.0 ng/mL of plasma P4 concentrations as puberty criteria for Brahman \times Angus and Braford heifers, respectively, decreased the incidence of false positives and appear to be appropriate for assessment of puberty in heifer development studies using these types of cattle.

Key Words: Brahman-Crossbred Heifers, Progesterone, Puberty Criteria

W155 Progesterone concentration during follicular development affects follicular fluid composition and uterine release of PGF2 α in dairy cows. R. L. A. Cerri^{*1,2}, F. Rivera², C. D. Narciso², R. A. Oliveira², R. C. Chebel², M. A. Amstalden³, W. W. Thatcher¹, and J. E. P. Santos¹, ¹University of Florida, Gainesville, ²University of California, Tulare, ³Texas A&M University, College Station.

Two experiments evaluated the influence of progesterone (P4) concentrations on follicular fluid content and circulating prostaglandin (PG) F metabolite (PGFM). Cows were pre-synchronized and then assigned to 1 of 2 synchronization protocols on d 7 of the estrous cycle: high progesterone (HP): modified Ovsynch (GnRH+CIDR, 7 d PG+CIDR removal, 2 d GnRH); and low progesterone (LP), similar to HP, but with additional PG injections on d 2, 2.5 and 3 of estrous cycle preceding the Ovsynch, and on d 0, 2, 2.5 and 3 relative to the first GnRH of the Ovsynch. Ovaries were evaluated by ultrasonography, and blood analyzed for concentrations of P4 and estradiol (E2). In experiment 1 (Exp 1; n = 20), blood was analyzed for LH concentrations every 15 min for 3 h on d 5 of the Ovsynch. The dominant follicle (DF) was aspirated 48 h after PG and the follicular fluid (FF) analyzed for P4, E2, and free and total IGF-1. In experiment 2 (Exp 2; n = 26), follicular development, and P4 and E2 concentrations were measured until d 16 after the Ovsynch, when cows were challenged with estradiol/oxytocin and PGFM measured. In Exp 1 and Exp 2, HP cows had less plasma E2 and greater P4 ($P < 0.001$) and smaller ($P = 0.005$) DF diameter during the Ovsynch than LP. In Exp 1, concentration of LH tended ($P = 0.10$) to be less for HP than LP (0.79 vs. 0.93 ng/mL). Concentrations of P4 in the FF were similar, but HP had less ($P = 0.005$) E2 than LP (330.9 vs. 387.5 ng/mL). Free IGF-1 was similar ($P = 0.15$) for HP and LP (5.23 vs. 3.53 ng/mL), but total IGF-1 was greater ($P = 0.02$) for HP than LP (51.7 vs. 40.8 ng/mL). In Exp 2, plasma concentrations of E2 and P4 did not differ ($P = 0.34$) between treatments after the Ovsynch. Proportion of cows with a short luteal phase was less for HP (0%) than LP (25%). Concentrations of PGFM were less ($P < 0.05$) for HP than LP at 90 and 120 min after the oxytocin challenge. Reduced P4 concentrations during Ovsynch altered follicular dynamics, FF composition and E2 concentrations, and exacerbated PG release in the subsequent estrous cycle when plasma P4 and E2 were comparable between treatments.

Key Words: Dairy Cow, Progesterone, Prostaglandin

W156 Evidence that the diminished production of progesterone during estrous cycles of cattle with a low antral follicle count during follicular waves is repeatable and not caused by alterations in size of the corpus luteum. F. Jimenez-Krassel*¹, J. K. Folger¹, G. W. Smith¹, P. Lonergan², A. C. O. Evans², and J. J. Ireland¹, ¹Michigan State University, East Lansing, ²University College Dublin, Dublin, Ireland.

The mechanisms that regulate the variation in progesterone (P) production in animals, which may contribute to infertility, are poorly understood. Previous results demonstrate that cattle can be phenotyped reliably based on antral follicle count (AFC) during ovarian follicular waves, and that cattle of similar ages with low versus high AFC not only have a diminished ovarian reserve (number of healthy eggs) and higher FSH concentrations, but lower serum P concentrations during estrous cycles. Based on these observations, animals with a low AFC are hypothesized to have smaller corpora lutea (CL) which have a correspondingly reduced capacity to produce progesterone during consecutive estrous cycles. To test this hypothesis, beef heifers (10-12 mo; 392 ± 14 kg) with low (≤15 follicles > 3 mm in diameter) or high (>25 follicles) AFC during follicular waves were identified and synchronized with two injections of prostaglandin F2α (PG) spaced 11-d apart. After the second PG injection, blood samples were collected daily until 14 d after ovulation. This estrus synchronization and blood sampling regimen was repeated three times during three different estrous cycles. CL size was measured by daily ultrasonography during the second estrous cycle. Although P concentrations were similar within groups during each estrous cycle, P was much higher ($P < 0.05$) from Day 3 to 14 and increased at a greater rate ($P < 0.05$) after ovulation during each of three consecutive estrous cycles for animals with a high versus low AFC. However, CL size did not differ ($P > 0.1$) between groups. Taken together, these results indicate that despite similarity in CL size, the capacity of the CL to produce P is diminished during several different estrous cycles for animals with relatively low versus high AFC. Whether the low circulating progesterone concentrations cause or contribute to infertility in cattle with low AFC during follicular waves and correspondingly low ovarian reserve is unknown. Project supported by NRI Competitive Grant no. 2007-35203-18178 from the USDA-CSREES to JJI.

Key Words: Progesterone, Corpus Luteum, Follicles

W157 Protocols using progesterone intravaginal device for lactating Holstein cows. R. M. Santos*¹, D. G. B. Demétrio², J. L. M. Vasconcelos², B. L. Cardoso², F. M. Abreu², L. H. Cruppe², and S. Soriano³, ¹EAFUDI, Uberlândia, ²FMVZ-UNESP, Botucatu, ³Fazenda Colorado, Araras, Brazil.

Studies in Brazil with dairy cows maintained on pasture, show that the protocol using an estradiol benzoate (EB) plus progesterone intravaginal device for 9 d results in a higher synchronization rate than the Heatsynch protocol. The objective of this study was to evaluate ovulation and conception of high producing cows maintained in a free stall barn treated with 2 different protocols. Lactating Holstein cows ($n = 637$) producing 37.9±9.64 kg milk/d and with 178.1±150 DIM, were randomly assigned to receive one of 3 treatments: Group 1 ($n = 270$): cows received AI 12 h after estrous detection; Group 2 (Heatsynch; $n = 248$): CIDR insertion (CIDR® 1.9 mg Pfizer) + GnRH (1 mL Fertagyl® Intervet) - 7 days - CIDR removed + PGF2α (5 mL Lutalyse® Pfizer) - 24h - Estradiol Cypionate (0.5 mL ECP® Pfizer), and Group 3 ($n = 119$):

CIDR insertion + EB (2 mL Estrogin® Farmavet) - 7 days - PGF2α (5 mL Lutalyse®) + 2 days - CIDR removed + Estradiol Cypionate (0.5 mL ECP®). Cows that showed heat received AI 12 h later and the remaining were TAI 48 h after the ECP injection. Presence of CL at d 7 (ovulation rate) and pregnancy 28 d after AI were evaluated by ultrasound. The variables ovulation, conception of all cows and ovulated cows were analyzed by the logistic model to evaluate the influence of the covariates (DIM, milk yield, parity, and treatment) on the probability of success. The ovulation rate was not affected by treatment ($G1=92.2$; $G2=92.7$; $G3=87.4\%$), but was negatively affected by parity ($P < 0.05$) and DIM ($P < 0.01$). The conception rate of all cows ($G1=22.6$; $G2=30.2$; $G3=19.3\%$) and ovulated cows ($G1=24.5$; $G2=32.6$; $G3=22.1\%$) was affected by treatment ($P < 0.05$) and DIM ($P < 0.05$). These results show that the protocol Heatsynch can increase conception in lactating dairy cows. This result is probably because the development of the ovulatory follicle occurs in higher progesterone concentration, due to formation of corpus luteum after GnRH injection, since no difference in ovulation rate was observed.

Key Words: Synchronization, Conception, Dairy Cows

W158 Effects of high vs. low progesterone concentrations during Ovsynch on double ovulation rate and pregnancies per AI in high producing dairy cows. A. P. Cunha*, J. N. Guenther, M. J. Maroney, J. O. Giordano, A. B. Nascimento, S. Bas, H. Ayres, and M. C. Wiltbank, University of Wisconsin, Madison.

The aim of this study was to evaluate if starting Ovsynch in a low progesterone (P4) environment (Short group) vs. a high P4 environment (Long group) would alter double/multiple ovulation rates (DOV) and pregnancies/AI (P/AI) in high producing dairy cows. Holstein cows ($n = 514$) from 2 different dairy farms were assigned to two groups in a CRD design. Cows were presynchronized before the breeding Ovsynch with an Ovsynch72 protocol (GnRH-7d-PGF-3d-GnRH) but no TAI was performed. This presynchronization Ovsynch allowed initiation of the breeding Ovsynch on a known day of the cycle. Cows then began Ovsynch immediately (the 2nd GnRH of the Ovsynch72 was the 1st GnRH of the breeding Ovsynch) (Short; $n = 259$) or cows received the 1st GnRH of the breeding Ovsynch 1 wk later (Long; $n = 255$). Ovarian ultrasound and blood samples were performed in order to assess ovulation, pregnancy diagnosis, and circulating P4 concentrations. As expected, cows in the Long had much higher P4 than cows in the Short at the 1st GnRH of the breeding Ovsynch (1.84ng/mL vs 0.28ng/mL) and higher P4 at the PGF treatment (4.40ng/mL vs 2.23ng/mL). Long and Short groups showed similar ovulation rate to the last GnRH of the breeding Ovsynch (94.5% vs 95.1%). The DOV was much greater in Short than Long (21.0% vs 7.1%; $P < 0.05$). Overall P/AI (at Day 29 pregnancy diagnosis) was much greater in Long than Short (48.2%, $n = 255$ vs 33.2%, $n = 259$; $P < 0.01$). Surprisingly, pregnancy loss (between d 29 to 57) was also less in Long than Short (4.3% vs 15.6%; $P < 0.05$). Thus, high P4 (Long protocol) during follicle development dramatically reduces selection of co-dominant follicles reducing double ovulation rate. In spite of ovulating fewer follicles, cows treated with the long protocol had better fertility than the Short providing strong evidence for the importance of high P4 during Ovsynch. Thus, the Long protocol may both reduce twinning rate and increase fertility during timed AI.

Key Words: Conception Rate, Fertility

W159 Effect of the third use of CIDRs on the pregnancy rate of beef cattle. W. A. Greene* and M. L. Borger, *The Ohio State University, Wooster, OH.*

The objective of this study was to determine the effect of the third use of intra-vaginal progesterone inserts (CIDRs), as a part of a synchronization program, on pregnancy rates (PR) in beef cattle. One hundred and twenty-two animals were allotted to two similar groups, new CIDR (N) and used CIDR (U), based upon breed, age, postpartum interval, and postpartum cyclicity (as determined by ultrasonography). All cattle received 100 µg GnRH im on d 0. Also on d 0, cattle in the N group received a new CIDR, containing 1.38 g progesterone, while U group cattle received a CIDR previously used for two 7 d periods. On d 7, jugular blood samples were collected for plasma progesterone (P₄) analyses, CIDRs were removed, and all animals received 25 mg PGF_{2α} im. Each removed CIDR was evaluated for signs of vaginal infection and scored from 1 to 5 (1 = clear, 5 = heavy pus). Animals were observed for estrus 0700 and 1900 and were bred by AI 11 - 13 h after estrus was observed. If estrus was not observed, animals were timed AI and received 100 µg GnRH im 70 - 72 h after PGF_{2α}. Following the synchronization period, repeat breedings were done until d 60. Cows were pregnancy diagnosed by ultrasonography on d 88. N and U groups had similar ($P > 0.05$) estrus detection rates [EDR] (59.0 and 62.3%). The N group had higher ($P < 0.05$) PR to synchronization (54.1 vs. 31.2%) and overall PR (91.8 vs. 73.8%) than the U group. Cycling ($n = 86$) and anestrus animals had similar ($P > 0.05$) EDR (66.3 and 47.2%), PR to synchronization (44.2 and 38.9%), and overall PR (87.2 and 72.2%). Cattle with high vaginal scores (4 & 5, $n = 90$) and low vaginal scores (1, 2, and 3) had similar ($P > 0.05$) PR to synchronization (43.3 and 38.7%) and overall PR (82.2 and 83.9%). The rates of high vaginal scores were similar ($P > 0.05$) for the N and U groups (78.3 and 70.5%). Mean P₄ levels (ng/ml) at CIDR removal were similar ($P > 0.05$) for N (1.1 ± 0.8) and U (1.1 ± 1.1) cattle. The third use of CIDRs in a beef cattle synchronization program resulted in lower pregnancy rates than the use of new CIDRs.

Key Words: Synchronization, CIDR Reuse, Progesterone

W160 Effect of the timing of CIDR insertion on the GnRH-induced LH surge and ovulatory response. G. A. Perry* and B. L. Perry, *South Dakota State University, Brookings.*

Elevated concentrations of progesterone have been reported to reduce the magnitude of a GnRH-induced LH surge, and GnRH is frequently used to induce ovulation and synchronize a follicular wave at the start of estrous synchronization protocols. Therefore, the objective of this study was to determine the effect of elevated concentrations of progesterone, from a CIDR, on the GnRH-induced LH surge and ovulatory response. Angus cross beef heifers ($n = 112$) were assigned to one of three treatments. Heifers received an injection of GnRH: 1) at CIDR insertion (CIDR-0), 2) 6 h before CIDR insertion (CIDR-6), or 3) 48 h after CIDR insertion (CIDR+48). Follicle size was determined prior to GnRH, and ovulatory response (follicle disappearance) was determined 2 d later. Blood samples were collected from a subset of heifers ($n = 60$) at 0, 30, 60, 90, 120, 150, 180, 210, 240, 300, and 360 min after GnRH. At time of GnRH, heifers that had initiated estrous cycles had greater ($P < 0.02$) concentrations of progesterone compared to periparturient heifers, and CIDR+48 (3.3 ± 0.6 ng/mL) had greater ($P < 0.01$) concentrations of progesterone compared to CIDR-0 (1.2 ± 0.6 ng/mL) and tended ($P = 0.1$) to be greater than CIDR-6 (1.9 ± 0.7 ng/mL) heifers.

There was no effect ($P = 0.2$) of cycling status on induction of ovulation (29/41 and 42/72 for periparturient and cycling). Ovulation was induced in more ($P < 0.05$) CIDR-0 (26/38) and CIDR-6 (28/37) heifers compared to CIDR+48 (17/38) heifers. There was no influence ($P = 0.19$) of treatment on concentrations of LH during the GnRH-induced LH surge, but there was an effect ($P < 0.01$) of progesterone. Heifers having elevated concentrations of progesterone at time of GnRH had a reduced LH surge compared to heifers with decreased concentrations of progesterone. However, there was no difference ($P = 0.11$) in the magnitude of the LH surge between heifers that did and did not ovulate. In summary, elevated concentrations of progesterone at time of GnRH decreased the GnRH-induced LH surge, but there was no difference in the magnitude of the LH surge between heifers that did or did not ovulate.

Key Words: Heifer, Ovulation, LH

W161 Ovarian activity and response to estrus synchronization with CIDR, β-estradiol and PGF_{2α} in Creole Rodeo compared to Hereford cows. J. A. Ramírez-Godínez*, J. P. Zárate-Martínez, F. A. Rodríguez-Almeida, and A. Flores Mariñelarena, *Universidad Autónoma de Chihuahua, Chihuahua, Chihuahua, Mexico.*

The objective was to compare ovarian activity, serum progesterone (P₄) concentrations and conception rates of Creole rodeo (Cr) and Hereford (HE) cows, synchronized and AI'ed 12 h after estrus initiation. The Cr ($n = 8$) and HE ($n = 10$) cows received a CIDR (1.9 g of P₄) and 1 mg of β-estradiol (d 0). On d 7, the CIDR was removed and 30 mg of PGF_{2α} was administered. On d 8, 1 mg of β-estradiol was injected. The anovulatory estrous rate (AOR), follicular waves number (FWN) and conception rate (CR) were analyzed with PROC FREQ of SAS. The time from CIDR removal to estrus (TE) was analyzed using PROC GLM, with breed (B) as a fixed effect. Diameter of the dominant follicle (DF) and corpus luteum (DCL), and P₄ were analyzed using PROC MIXED of SAS, with B, day (D) and their interaction as fixed effects and cow within B as a random effect. The Cr had a greater ($P < 0.05$) AOR (62.5%) compared to HE (30%) cows. The TE was greater ($P < 0.05$) in Cr (40.17 ± 1.06 h) than in HE (31.68 ± 0.95 h) cows. In both breeds a relationship between AOR and FWN was observed. At a greater FWN a greater AOR (44.4 %) was found ($P < 0.05$). A B by D interaction was observed ($P < 0.01$) for P₄. The Cr cows had increased P₄ (4.36 ± 0.30 ng/mL) during the synchronization period than HE (2.30 ± 0.31 ng/mL); however, during the luteal phase after the synchronized estrus, Cr had decreased ($P < 0.01$) P₄ (0.96 ± 0.13 ng/mL) than HE (1.8 ± 0.16 ng/mL) cows. The DF and DCL were smaller ($P < 0.01$) in Cr vs HE (1.32 ± 0.08 vs 1.67 ± 0.07 cm and 3.07 ± 0.17 cm vs 3.6 ± 0.15 cm, respectively). The conception rate was decreased ($P < 0.05$) in Cr (25%) vs HE (60%) cows. We concluded that Creole rodeo cows showed a greater incidence of anovulatory estrous than Hereford cows, which could be the cause of reduced fertility.

Key Words: Creole Cows, Synchronization, Ovarian Activity

W162 Effect of progestin treatment on formation of persistent follicles in postpartum beef cows. M. E. Risley*, J. A. Atkins, and M. F. Smith, *University of Missouri, Columbia.*

Progestins (melengestrol acetate [MGA] and Controlled Internal Drug Release [CIDR] inserts) are frequently used to effectively control estrus

and ovulation in beef cattle. Treatment of cycling cows with MGA for 14 d, in the absence of a corpus luteum, induces formation of persistent follicles and a corresponding reduction in fertility. The objective was to determine if the presence of a new or used CIDR in postpartum cows, without a corpus luteum, would induce the formation of persistent follicles and to compare serum concentrations of progesterone (P4) in cows treated with a new or used CIDR to luteal phase concentrations of P4 in non-treated cows. Normally cycling cows were blocked by days postpartum, age and body condition score and allocated into the following treatment groups: Control (n = 10), MGA (n = 11; 0.23 kg⁻¹hd⁻¹day), new CIDR (n = 9; 1.38 g P4), and used CIDR (n = 9; new CIDR previously inserted into cows for 7 d and subsequently stored for approximately six months). Groups were presynchronized with a CIDR for 7 d, prostaglandin F_{2α} (PGF) on d 6 and GnRH 48 hr after CIDR removal. Progestin treatment began on d 4 post-estrus and PGF_{2α} was injected on d 6 to induce luteolysis (d 0 = estrus). MGA or CIDR treatment continued for 14 d and length of a follicular wave was defined as the interval from follicular recruitment to ovulation or initiation of a new wave. Length of the first follicular wave (d) was 10.7^a, 15.6^b, 15.4^b, and 13.2^b (^{ab}P = 0.07) and maximum diameter (mm) of the dominant follicle was 14.1^a, 17.3^b, 16.7^b, and 16.1^b (^{ab}P < 0.08) in the Control, MGA, new CIDR, and used CIDR groups, respectively. Maximum diameter of the dominant follicle was similar (P > 0.1) in the used CIDR, new CIDR, and MGA groups. Serum concentrations of P4 in the new and used CIDR groups were similar (P > 0.1) throughout the 14 d treatment period but lower than in the control group. In summary, treatment with a new or used CIDR induced formation of persistent follicles in postpartum beef cows and serum concentrations of P4 were similar between the two CIDR groups.

Key Words: Progesterone, Persistent Follicle, Beef Cows

W163 Effect of duration of CIDR exposure on reproductive performance of beef heifers using a CIDR-based timed-AI protocol. A. Ahmadzadeh^{*1}, D. Gunn², and B. Glaze³, ¹University of Idaho, Moscow, ²University of Idaho Extension, Fort Hall, ³University of Idaho Extension, Twin Falls.

The objective of this experiment was to determine the effect of reducing the length of CIDR exposure in a CIDR-based timed-AI protocol (CIDR-PGF_{2α}-GnRH and AI) on conception and pregnancy rates in beef heifers. The experiment was conducted in two years using 152 heifers. In Year 1, British cross-bred heifers (n = 82) were stratified by body weight (BW), body condition score (BCS) and age; and were randomly subjected to one of the two Treatments: 1) heifers (n = 41) received CIDR (d -7) for 7 d, PGF_{2α}(25 mg) at CIDR removal (d 0), GnRH (75 ug) 56 h after CIDR removal and immediate AI (d 3; 7-d CPG); or 2) heifers (n = 41) received CIDR (d -5) for 5 d, PGF_{2α} (25 mg) at CIDR removal (d 0), GnRH (75 ug) 56 h after CIDR removal and immediate AI (d 3; 5-d CPG). In Year 2, 70 heifers were used. The experimental protocol was the same as in Year 1. Heifers were assigned to 7-d CPG (n = 35) or 5-d CPG (n = 35). Estrual behavior was monitored for three d following CIDR removal. Blood samples were collected on the day of CIDR insertion and at breeding (d 3). Heifers were exposed to bulls 14 d after AI. Pregnancy status was determined by ultrasonography at d 32 and 82 after AI. Data were analyzed by logistic regression. Percentage of heifers detected in estrus was different between Years (44% vs. 69 % for Year 1 and 2, respectively) but not different between treatments. Based on progesterone results, the synchronization rates were similar between treatments. However, at experiment initiation fewer animals

were cyclic in Year 1 compared with Year 2. There was a Treatment by Year interaction effect on conception to AI (P < 0.05). For 7-d CPG and 5-d CPG, in Year 1 conception to AI was 39% and 65.8 %; whereas in Year 2 conception to AI was 64.7% and 41%. Age tended to effect conception to AI (P = 0.07), whereas BW and BCS did not affect conception to AI. Overall pregnancy rate was not different between groups (93.4%). The yearly results from this study are inconsistent regarding the effect of reducing the length of CIDR treatment (5-d vs. 7-d) on conception to AI and thus, further research is warranted.

Key Words: Beef Heifers, CIDR, Timed-AI

W164 A field trial comparison of first service conception rates of Ovsynch-56 and CO-Synch-72 protocol in lactating dairy cattle. R. L. Nebel^{*1}, J. M. DeJarnette¹, M. R. Hershey², D. A. Whitlock², and C. E. Marshall¹, ¹Select Sires Inc., Plain City, OH, ²Select Sire Power, Rocky Mount, VA.

This study compared first service conception rates in 3 herds of lactating dairy cows (n = 739) after fixed time AI to one of 2 protocols. All cows received PGF (25 mg, i.m.) on treatment days -35, -21, and 0, GnRH (100 µg, i.m.) on d -7, and fixed time AI at +72 h after the last PGF injection. Within each herd, cows were randomly assigned to receive GnRH at +56 (Ovsynch-56) or +72 h (CO-Synch-72) after the last PGF injection. Data were analyzed in a least square means model including the effects of herd, treatment, parity and all two-way interactions. The mean days postpartum at AI (73 ± 0.1), parity (2.2 ± 0.05), and peak milk yield (kg) per cow (47 ± 0.34) did not differ by treatment. Conception rates were influenced (P < 0.05) by the parity by treatment interaction. Among multiparous cows, conception rates were greater (P < 0.05) among Ovsynch-56 (47%, n = 204) than CO-Synch-72 treated cows (25%, n = 253). Among primiparous cows, the numeric difference in conception rates favored the Ovsynch-56 treatment (37%, n = 134) but could not be confirmed as statistically different (P = 0.33) than those of the CO-Synch-72 (31%, n = 148) treated cows. No other main effects or interactions were determined to be significant. In conclusion, although difficult to implement in many large herds due to the necessity to handle or lock-up cows at an interval that is not divisible by 24 h, these data indicate that where facilities, labor and management allow for effective implementation the Ovsynch-56 protocol results in greater timed AI conception rates than does the CO-Synch-72 protocol.

Key Words: Timed AI, Ovsynch, Dairy Cows

W165 Effect of supplemental FSH during Ovsynch in high producing Holstein cows. H. Ayres^{1,2}, R. M. Ferreira^{1,2}, A. P. Cunha^{*1}, R. R. Araújo¹, and M. C. Wiltbank¹, ¹University of Sao Paulo, Sao Paulo, Sao Paulo, Brazil, ²University of Wisconsin, Madison.

Programs that allow timed artificial insemination (TAI) have been used to improve reproductive efficiency in dairy herds; however, in many cases pregnancies per AI (P/AI) during these programs remain sub-optimal. Previous research indicated an increase in fertility when beef cattle were supplemented with low doses of FSH (10 or 20 mg) during the latter stages of a timed AI protocol. We hypothesized that treatment with FSH at the time of the prostaglandin F_{2α} (PGF_{2α}) treatment of Ovsynch would increase fertility to the timed AI in dairy cattle. This experiment

was done during the months of June through November 2007 on two commercial dairy farms in south-central Wisconsin. Weekly, a cohort of 35 to 65 cows at 120±73 DIM were stratified by parity and insemination number, and randomly assigned to 1 of 2 treatments: Ovsynch (n = 561) or Ovsynch+FSH (n = 571). All cows received the Ovsynch protocol (GnRH-7d-PGF_{2α}-56h-GnRH-18h-TAI) with prior presynchronization of first service cows and initiation of Resynch at 32d after previous TAI in cows at second or later services. Ovsynch+FSH cows received 20 mg of FSH at the same time as PGF_{2α}. Pregnancy diagnosis was performed 39 d after TAI. Statistical analyses were performed with logistic regression by PROC GLIMMIX of SAS. There were no interactions of treatment with days in milk, parity, insemination number, locomotion score, sire, batch, inseminator, or farm. Therefore, these variables were removed from the statistical model. The overall P/AI were not different between Ovsynch and Ovsynch+FSH [36.2% (203/561) vs. 39.1% (223/571); *P*>0.05]. Analysis of treatment effects by parity also indicated no difference between Ovsynch vs. Ovsynch+FSH on P/AI in primiparous [41.6% (96/231) vs. 42.0% (103/245); *P*>0.05] or multiparous [32.4% (107/330) vs. 36.8% (120/326); *P*>0.05] cows. Surprisingly, FSH tended to increase P/AI in cows with BCS that was greater than 2.5 [36.5% (148/406) vs. 42.7% (179/419); *P*=0.07] but not in cows with less than 2.5 BCS. Thus, these data do not indicate a major fertility-enhancing effect of a single FSH treatment during Ovsynch in high-producing dairy cows.

(Acknowledgements: Bioniche)

Key Words: FSH, Ovsynch, High Producing Holstein Cows

W166 Administering human chorionic gonadotropin (hCG) 7 d prior to initiating a CO-Synch protocol. C. R. Dahlen^{*1}, G. Marquezini², A. DiCostanzo², S. L. Bird³, and G. C. Lamb⁴, ¹University of Minnesota, Crookston, ²University of Minnesota, St. Paul, ³University of Minnesota, Grand Rapids, ⁴University of Florida, Marianna.

We determined the effects of administering human chorionic gonadotropin (hCG) 7 d prior to the CO-Synch estrous synchronization protocol on pregnancy rates and concentrations of progesterone in beef cows. Sixty-three suckled (n = 36) and non-suckled (n = 27) cows from 2 locations were stratified by body condition score or days post-partum and randomly assigned to receive one of two treatments: 1) CO-Synch protocol (100 µg injection of GnRH, followed in 7 d by a 25 mg injection of PGF_{2α}, followed in 48 hours by insemination and a 100 µg injection of GnRH); CONT, n = 32), or 2) pre-treatment with 1000 IU hCG 7 d prior to the initiation of the CO-Synch protocol (hCG: n = 31). Blood was collected on d -16, -9, -2, 0, 7, and 14 relative to insemination. On d 28 after insemination, transrectal ultrasonography was used to determine presence of a viable fetus. Days post-partum at the time of insemination was greater (*P* < 0.05) for suckled cows at Location 1 (65.8 ± 3.8) compared to Location 2 (23.9 ± 6.2). Pregnancy rates at Location 1 (65.1%; 23/35) were greater (*P* < 0.05) than Location 2 (28.6%; 8/28). However, no differences (*P* > 0.05) in pregnancy rates were detected between CONT (56.3%; 18/32) and hCG (41.9%; 13/31). On d -9, concentrations of progesterone were greater (*P* < 0.05) for cows in the hCG treatment compared to those in the CONT treatment (2.7 ± 0.46 vs 1.4 ± 0.43 ng/ml for hCG and CONT, respectively) No differences (*P* > 0.05) in concentrations of progesterone were present on d -2, 0, 7, or 14 among treatments. We concluded that while pre-treatment with hCG 7 days prior to a CO-Synch protocol appeared not

to alter pregnancy rates, it increased concentrations of progesterone at the time of the GnRH injection of the CO-Synch protocol.

Key Words: Human Chorionic Gonadotropin, Beef Cows, Progesterone

W167 Effect of human chorionic gonadotropin (hCG) on ovarian structure dynamics and concentrations of progesterone in cycling Holstein heifers. C. R. Dahlen^{*1} and G. C. Lamb², ¹University of Minnesota, Crookston, ²University of Florida, Marianna.

We determined the effects of administering hCG on subsequent ovarian structures and concentrations of progesterone in cycling Holstein heifers. In Exp 1, 20 heifers were assigned to receive one of two treatments: 1) 100 µg GnRH im (GnRH; n = 10); and 2) 1000 IU hCG im (hCG; n = 10). All heifers were given 25 mg PGF_{2α} im on d 6 after treatment. Blood collection and ovary examination via transrectal ultrasonography were conducted on d -9, 0, 2, 4, 6, 8, and 10 relative to treatment. In Exp 2, 21 heifers were given 100 µg GnRH im and a CIDR followed in 7 d by 25 mg PGF_{2α} im and CIDR removal. Heifers were scanned via transrectal ultrasonography 40 h after PGF_{2α}, stratified by size of dominant follicle, and randomly assigned to receive one of two treatments: 1) 100 µg GnRH im (GnRH; n = 10); and 2) 1000 IU hCG im (hCG; n = 11). Ovarian structures were evaluated and blood was collected on d -9, -2, 0, 7, and 14 relative to treatment. In Exp 1, a greater (*P* < 0.05) proportion of hCG heifers (9 of 10) ovulated in response to treatment compared to GnRH heifers (3 of 10). Subsequently, size of the largest follicle present on either ovary was smaller (*P* < 0.05) for hCG compared to GnRH heifers on d 2 (7.8 ± 1.2 vs 11.5 ± 1.2 mm, respectively), and tended to be smaller (*P* = 0.07) on d 4 (9.6 ± 0.7 vs 11.6 ± 0.7 mm, respectively) after treatment. In Exp 2, volume of luteal tissue on d 7 was greater (*P* < 0.05) in hCG heifers (5.4 ± 0.6 cm³) compared to GnRH heifers (3.4 ± 0.6 cm³). However, no differences were present on d 14 after treatment. No differences in concentrations of progesterone were present after treatment in either experiment. We conclude that hCG was superior to GnRH in its ability to ovulate follicles and increased volume of luteal tissue present 7 d after treatment in heifers previously synchronized, but had no effect on concentrations of progesterone.

Key Words: Human Chorionic Gonadotropin, Holstein Heifers, Ovulation

W168 Factors affecting ovulatory follicle size following follicular wave synchrony in beef heifers. J. A. Atkins, C. L. Johnson*, and M. F. Smith, University of Missouri, Columbia.

GnRH-induced ovulation of small dominant follicles (<11 mm) resulted in decreased pregnancy rates compared to larger follicles following the CO-Synch fixed-time insemination protocol (GnRH-1 on d -9, PGF_{2α} on d -2, and GnRH-2 plus insemination on d 0) in beef heifers. Factors contributing to the presence of small dominant follicles at insemination following the CO-Synch protocol have not been determined. Failure to synchronize a follicular wave following GnRH-1 seemed a likely hypothesis; however, ovulatory response to GnRH-1 had no effect on ovulatory follicle size at GnRH-2 in beef heifers (Atkins et al., 2008).

The objective was to examine the effect of day of the estrous cycle at GnRH-1 and growth rate of the dominant follicle (from d -5 or d -2 [PGF_{2α}] to GnRH-2 [d 0]) on ovulatory follicle size at GnRH-2. Pubertal beef heifers (n = 63) were allotted by age, weight, and breed to receive GnRH-1 on d 2 (no dominant follicle), 5 (first wave small dominant follicle), 10 (first wave large dominant follicle), 15 (second wave dominant follicle), or 18 (second or third wave large dominant follicle) after estrus (d 0 = estrus; n = 10 to 14 per group). Ovulatory response to GnRH-2 was greatest when GnRH-1 was administered on d 2, 5 or 10 compared to d 15 or 18, since many of the heifers in the d 15 and 18 groups were detected in estrus and ovulated on or before PGF_{2α} injection. There was no difference ($P > 0.1$) in follicle growth from d -5 to GnRH-2 among heifers given GnRH-1 injection on d 2, 5, or 10 of the cycle or based on ovulatory response to GnRH-1. Growth rate of the ovulatory follicle was less ($P < 0.01$) for ovulatory follicles that were < 11 mm compared to ovulatory follicles ≥ 11 mm (0.57 mm/d vs. 0.90 mm/d, respectively). Ovulatory follicle size and serum concentrations of estradiol at GnRH-2 were correlated ($r = 0.67$; $P < 0.01$). In summary, ovulatory follicle size was affected by growth rate from d -5 to GnRH-2 but not d of GnRH-1 injection or ovulatory response to GnRH-1.

Key Words: Estrus Synchronization, Ovulatory Follicle Size, Beef Heifers

W169 Early postpartum treatment of dairy cows with GnRH does not improve fertility. A. Ata and M. S. Gulay*, Mehmet Akif Ersoy University, Burdur, Turkey.

The objective of the current experiment was to determine the effect of early postpartum treatment with GnRH on reproductive performance of dairy cows. Two hundred thirty seven multiparous Holstein cows (3 to 10 yr old) averaging 13.1 d in milk at the start of the study were housed in a semi-open, freestall barn and were randomly assigned to GnRH (TRT; n = 126) and control (C; n = 111) groups. Cows in TRT group were given an iv injection of Receptal (5 mL; 0.0042 mg busserelin acetate) at assignment, whereas cows in C were not given Receptal. After assignment, estrus was confirmed based on secondary signs of estrus. Uterus and ovaries were checked by rectal palpation once a week. Grafian Follicles were confirmed and cyclic cows were inseminated. AI was performed according to the am-pm rule and pregnancies were confirmed by rectal palpation 45 - 60 d after AI. Open cows were re-inseminated until confirmed pregnant. Cows that did not cycle were injected with PGF_{2α}, whereas cows with metritis were treated with antibiotics. Mean number of AI for pregnancy was 2.5 and 2.4 for TRT and C, respectively. Percentages of cows injected with PGF_{2α} were 43.6 (TRT) and 51.3 (C). Days to first estrus were less for cows in TRT (TRT = 42.6 vs. C = 68.0 d; $P < 0.05$). The days open in cows that became pregnant did not differ between groups (TRT = 127.7 vs. C = 127.2 d). First (20.5 vs. 20.4%), second (41.1 vs. 39.7%), third (16.6 vs. 22.8%), fourth (10.7 vs. 10.8%), fifth (5.8 vs. 3.6%) and sixth (2.9 vs. 1.2%)-service conception rates also were similar for TRT and C. Overall, no significant effects of early postpartum injections of GnRH were detected on pregnancy rates (TRT = 80.9 vs. C = 74.7%). Number of cows with metritis was greater in TRT (13.4%) than C (5.4%) ($P < 0.05$). Results indicated that although early postpartum injections of GnRH decreased the days for first estrus, it did not improve fertility.

Key Words: GnRH, Dairy Cows, Conception Rates

W170 Factors associated with ovulatory follicle growth rate and diameter in postpartum beef cows. J. A. Atkins^{*1}, T. W. Geary², and M. F. Smith¹, ¹University of Missouri, Columbia, ²USDA ARS, Ft. Keogh, Miles City, MT.

Beef cows induced to ovulate small (≤ 11 mm) follicles had reduced establishment and maintenance of pregnancy compared to cows ovulating large (> 11 mm) follicles when bred after the CO-Synch protocol (GnRH1 on d -9, PGF_{2α} on d -2, and GnRH2 with timed AI on d 0). The reason for the presence of small ovulatory follicles is unknown but could be explained by failure to ovulate and synchronize a new follicular wave at GnRH1 or slower growth rate leading to GnRH2. Experiments were conducted in cycling (n = 60) or suckled, postpartum anestrus (n = 55) beef cows. Cycling cows were assigned to 1 of 5 treatments (n = 12 per treatment) based on day of the cycle at GnRH1 of the CO-Synch protocol (d 2, 5, 9, 13, and 18 [estrus = d 0]). The anestrus cow experiment was a 2x2 factorial design (n = 9 to 18 per treatment) based on ovulation (GnRH1+) or failure to ovulate (GnRH1-) to GnRH1 and presence (CIDR+) or absence (CIDR-) of a CIDR from GnRH1 to PGF_{2α}. Only cows ovulating to GnRH2 were used to analyze follicle growth. For the cycling cow experiment, follicle growth from d -5 to 0 was greatest in d 18 cows, followed by d 13, 5, 9, and 2 cows (1.1^a, 0.72^{ab}, 0.67^{ab}, 0.66^b, and 0.47^b mm/d, respectively; $^{ab}P < 0.05$). Cows that ovulated following GnRH1 had faster follicle growth from d -5 to d 0 than did the cows that did not ovulate (0.79 vs. 0.49 mm/d; $P < 0.05$). Follicle growth was slower in d 2 cows than d 9 cows from d -2 to 0 (0.339 vs. 1.29 mm/d, respectively; $P < 0.05$) but was similar among all other treatment groups (1.06, 1.13, and 1.28 mm/d in the d 5, 13, and 18 cows, respectively). In the anestrus cow experiment, GnRH1+ cows had greater follicle growth from d -5 to 0 ($P < 0.01$) compared to GnRH1- but similar growth rate from d -2 to 0 ($P > 0.10$), while CIDR+ cows had faster growth rate from d -2 to 0 ($P < 0.05$) compared to CIDR- cows but the growth rate was similar from d -5 to 0. In both experiments, follicle growth was faster ($P < 0.05$) from d -5 to d 0 in cows ovulating large (> 11 mm) compared to small follicles. Research supported by USDA 2006-35203-17284

Key Words: Beef Cows, Ovulatory Follicle Size

W171 Effect of reducing the period of follicle dominance in a timed AI protocol on reproduction of dairy cows. R. C. Chebel^{*1}, F. Rivera¹, C. Narciso¹, W. W. Thatcher², and J. E. P. Santos², ¹University of California, Davis, ²University of Florida, Gainesville.

Objectives were to determine the effect of reducing the period of follicle dominance in a timed AI protocol on pregnancy risk (PR) in dairy cows. In experiment 1 (Exp 1), 164 Holstein cows received 2 injections of prostaglandin F_{2α} (PGF, cloprostenol sodium) at 37 and 51 d in milk (DIM). At 61 DIM, cows were randomly assigned to: Cosynch 72 h (CoS72: d 61 GnRH, d 68 PGF, d 71 GnRH + timed AI) or 5 d-Cosynch 72 h with one (5dCoS1: d 61 GnRH, d 66 PGF, d 69 GnRH + timed AI) or two injections of PGF (5dCoS2: d 61 GnRH, d 66 and 67 PGF, d 69 GnRH + timed AI). Blood was sampled at the first GnRH, first PGF, and at timed AI and assayed for progesterone (P4). Ultrasound of the ovaries was performed to determine ovulatory responses to treatments. In experiment 2 (Exp 2), 933 cows were randomly assigned to CoS72 or 5dCoS2. Blood was sampled as described for Exp 1 and also 7 d after timed AI and assayed for P4. Ultrasound of the ovaries was performed as described for Exp 1. Pregnancy was diagnosed on d 38 and 66 after

timed AI. In Exp 1, CL regression differed ($P < 0.01$) and were 78.0, 58.7 and 95.8% for CoS72, 5dCoS1, and 5dCoS2, respectively. Cows that ovulated to the first GnRH of the Cosynch had less ($P < 0.01$) CL regression than cows that did not ovulate (68.6 vs. 90.8%). In Exp 2, CL regression (92.0 vs. 96.0%) was less ($P = 0.02$), but detection of estrus at timed AI (30.9 vs. 23.6%) was greater ($P < 0.01$) for CoS72 than 5dCoS2, respectively, and cows in estrus had increased ($P < 0.01$) PR (46.0 vs. 31.9%). Nevertheless, PR was greater ($P = 0.03$) for 5dCoS2 than CoS72 (37.7 vs. 31.1%). For cows with $P4 < 1$ ng/mL at timed AI, PR also were greater ($P < 0.01$) for 5dCoS2 than CoS72 (40.1 vs. 34.2%). Concentrations of P4 were similar between treatments and averaged 2.9 ng/mL 7 d after AI. Treatment with PGF on d 5 and 6 after GnRH resulted in high luteolysis and allowed for reducing the interval from GnRH to timed AI, which increased PR. Improvements in PR for 5dCoS2 were observed despite changes in luteolysis. This study reinforces the concept that reducing follicle dominance in timed AI protocols improves PR in dairy cows.

Key Words: Dairy Cow, Follicle Dominance, Reproduction

W172 Effects of an additional PGF_{2α} and estradiol-17β during Ovsynch in lactating dairy cows. D. J. Brusveen*, A. H. Souza, and M. C. Wiltbank, *University of Wisconsin, Madison*.

This study was designed to evaluate whether decreasing circulating progesterone (P4) and increasing circulating estradiol-17β (E2) near the

time of AI in an optimized Ovsynch protocol would increase pregnancies per AI (P/AI) in lactating dairy cows. Six hundred and nineteen lactating Holstein cows ($n = 782$ inseminations) received Ovsynch (GnRH-7d-PGF_{2α}-56h-GnRH-16h-timed AI). Cows were randomized in a 2 x 2 factorial design to receive or not receive: 25 mg PGF_{2α} 24h after the normal PGF_{2α} of Ovsynch and/or 0.5 mg of E2 at the time of the final GnRH. Blood samples were collected at 24h after the normal PGF_{2α} (BS1) and again at the time of the final GnRH (BS2) to evaluate circulating P4. Ovarian ultrasound was done at the time of the final GnRH to determine preovulatory follicle size and ovulation was confirmed by ultrasound 5 d after AI. Treatment with an additional PGF_{2α} increased the percentage of cows that regressed their CL (95.6%) compared to control cows (84.6%; $P < 0.001$). However, additional PGF_{2α} had no effect ($P > 0.1$) on overall P/AI (44.7; $n = 379$ vs. 41.5%; $n = 393$, treatment vs. control, respectively). Supplementation with E2 increased ($P < 0.001$) expression of estrus (84.4% vs. 37.2%), but had no effect ($P = 0.731$) on fertility (42.2%; $n = 393$ vs. 43.9%; $n = 379$). Thus, it appears that an additional PGF_{2α} treatment increases synchronization during Ovsynch; however, supplementation with 0.5 mg E2 at the time of the final GnRH did not improve fertility to Ovsynch.

Key Words: Ovsynch, Estradiol-17β, Prostaglandin-F_{2α}

Production, Management and the Environment: Nutrient and Animal Management

W173 A mass balance computer model of nutrient flow for a California dairy. H. A. Johnson*, E. J. DePeters, J. G. Fadel, P. L. Price, P. H. Robinson, and D. Meyer, *University of California, Davis.*

Estimating nitrogen (N) and phosphorus (P) output from a dairy production facility is essential to determining the land area necessary for environmentally sustainable nutrient recycling. To understand nutrient partitioning of N and P between liquid and solid waste streams from dairy farms, a dynamic computer model was created using acslXtreme v. 2.4 simulation software. The model consists of four parts: 1. Estimations of manure production and N, P content using regression equations based on milk production (Nennich et al., 2005), 2. Manure collection via scraping, flushing or vacuuming, 3. Manure storage and treatment including sand traps, solids separator, anaerobic digester, and holding ponds, and 4. Output composition of solid waste used for bedding or land application and liquid waste used as recycled flush water or land application i.e., irrigation. Simulations were run for 30 days for 1,500 milking cows at which time the amount and yield of N and P in recycled flush water reached steady state. Model predictions of yield of N and P in manure recycled flush water (N = 8,385 kg, P = 967 kg) were within ranges of data collected over 6 months at the test dairy (N = 8,458 kg, standard deviation (SD) = 1,032 kg; P = 972 kg, SD = 564 kg). Estimated yield of solid waste at 30 days was N = 2684 kg, P = 309 kg and liquid waste was N = 1509 kg and P = 174 kg. These comparisons indicate that this mass balance computer model is useful in predicting the yield of N and P in dairy waste output. However, more data are needed along the waste stream over a longer period of time to fully test the model. Data describing effects of storage and treatment on manure nutrient composition would increase the usefulness of the model by allowing addition of more manure handling technologies to simulate potential strategies to manipulate nutrient waste output.

Key Words: Manure, Waste Stream

W174 Bacteroidales PCR for universal, human, hog, and ruminant fecal pollution markers. B. R. Min*^{1,2}, G. Giovanni³, N. Garcia³, E. Casarez³, H. Y. Kim¹, M. K. Ho¹, J. Chang¹, L. Chang¹, C. Bae¹, and P. Dyer², ¹*Ichthus Education Center, La Trinitaria, Chiapas, Mexico*, ²*Texas AgriLife Research, Vernon, TX*, ³*Texas AgriLife Research, El Paso, TX.*

The overall objective is to quantify the effect of fecal contaminated drinking water on bacterial population in four Mayan villages. Raw water samples (7 to 25 ml) were collected from four villages (Comitan, Chiapas) in Mexico and analyzed for the presence of the fecal pollution indicator *Bacteroidales*. Samples were concentrated by membrane filtration and DNA was extracted from the concentrates by way of a commercial DNA kit (Qiagen DNA mini kit). DNA extracts were tested by PCR for the presence of *Bacteroidales* fecal bacteria in general using the universal marker, and *Bacteroidales* host-specific markers (nested PCR) for humans, ruminants, and hogs. Using a universal *Bacteroidales* marker, positive PCR products were detected for fecal contamination obtained from various samples in Mayan villages, indicating a presence of fecal pollution problems. However, *Bacteroidales* host-specific mark-

ers for humans, ruminants, and hogs shown that sample tested positive for the human marker, but negative for ruminants and hogs. This may have been due to the difference in PCR cycling conditions that have been optimized for the individual markers. It should be noted that nested PCR, with its increased sensitivity and detection levels, was able to confirm the presence of the human marker. In conclusion, the sources of the fecal contamination indicated by the universal markers in general shown that the most of Mayan villages have water pollution problem from animals or human. However, results in samples analyzed by host-specific markers shown that fecal contamination from humans, hogs and ruminants were identified with the limited markers available, and they may have originated from other animal (e.g. wildlife) or human sources. Further work to increase the sensitivity of the assays is underway. Additional samples are needed to confirm results and to determine if there is a trend in the sources of fecal pollution for the study sites.

Key Words: Water, Fecal Pollution, Bacterial Contamination

W175 Compost: A potential value-added product for dairy operations? E. M. Shane*¹, M. I. Endres¹, D. G. Johnson², and C. J. Rosen¹, ¹*University of Minnesota, St. Paul*, ²*University of Minnesota, Morris.*

The objective of this descriptive study was to evaluate the composting potential of various bedding materials that were previously used in experimental bedded packs. Each material was placed in windrows (1.83m height × 9.14m length × 2.29m width) from April 2007 to September 2007 and managed as needed to promote composting. Materials included: sawdust (SD), corn cobs (CC), woodchip/sawdust mix (WC/SD), soybean straw (SS), woodchip/soybean straw mix (WC/SS), and soybean straw/sawdust mix (SS/SD). Replicated samples were taken weekly and analyzed for DM, pH and C:N ratio. Temperature was measured twice weekly. Results for initial and final samples of the composting material (mean (SD)) are reported on Table 1. Number of days temperature stayed above 54.4°C (temperature needed to kill pathogens and weed seeds) were: SD, 35; CC, 109; WC/SD, 106; SS, 95; WC/SS, 92, and SS/SD, 95. Initial temperature across materials was 51#deg;C and final temperature was 39.2°C. Some of the observed C:N ratios were slightly below 20:1, but all materials still composted efficiently.

Table 1.

Item	Material					
	SD	CC	WC/SD	SS	WC/SS	SS/SD
DM (%)						
Initial	38.6 (2.4)	45.7 (4.0)	33.7 (1.6)	37.7 (2.4)	41.6 (0.5)	37.8 (0.8)
Final	51.5 (8.6)	73.9 (3.1)	42.9 (5.6)	63.0 (10.2)	68.1 (1.9)	54.4 (4.0)
pH						
Initial	8.25 (0.26)	8.36 (0.13)	8.69 (0.16)	8.75 (0.06)	8.55 (0.06)	8.78 (0.16)
Final	6.96 (0.22)	7.97 (0.31)	7.38 (0.22)	8.19 (0.31)	6.98 (0.16)	7.05 (0.12)
C:N Ratio						
Initial	34.7 (3.4)	18.2 (0.3)	39.8 (2.2)	17.5 (1.0)	32.0 (2.4)	18.7 (0.8)
Final	27.3 (4.8)	14.3 (1.1)	30.5 (1.2)	13.0 (0.6)	20.9 (0.8)	14.4 (0.6)

Key Words: Housing System, Compost, Value-Added

W176 Associations between non-dietary factors and dairy herd performance. A. Bach*^{1,2}, N. Valls³, A. Solans³, and T. Torrent⁴, ¹ICREA, Barcelona, Spain, ²IRTA-Unitat de Remugants, Barcelona, Spain, ³CADI, Lleida, Spain, ⁴Pirenaica, Lleida, Spain.

Forty seven dairy herds (approximately 3,129 lactating cows) from northeast of Spain that were feeding exactly the same lactating ration were surveyed to determine the effect of non-dietary factors on herd performance. The survey collected information on the profile of the owners (their future intentions, the number of workers, and time devoted to the enterprise), information regarding the animals (reproductive performance, incidence of pathology, culling rate, etc...), information on the facilities (number of feeders, waters, stalls, cleanliness, etc...) and information on management practices (numbers of daily milkings, feed deliveries, feed push-ups, cleaning frequency, etc...). In addition, the chemical quality of drinking water from each dairy enterprise was determined. Also, amount of feed delivered to each herd, daily total milk production, and milk quality were obtained for each herd for a period of 8 months prior the fulfillment of the survey. Mortality rate of calves, tended to be lower in herds that weaned progressively than in those that weaned abruptly. Age at first calving (AFC) was negatively correlated with level of milk production (mainly due to the type of heifer rearing system used). Culling rate tended to be lower in herds that used a close-up ration than in those that did not. Using gloves and paper towels (instead of cloth towels) tended to reduce the somatic cell count in milk. Concentration of calcium in the drinking water tended to be negatively correlated with the number of days open and with the proportion of cows culled due to infertility problems. Despite that the 47 herds fed the same ration and shared a similar genetic base, average milk production per cow ranged from 20.6 to 33.8 kg/d. A positive relationship ($r = 0.57$; $P < 0.05$) between the number of stalls per cow and milk production was found. The most important non-dietary factors that affect milk production in these dairy herds were AFC, presence or absence of feed refusals, ratio of number of free stalls per lactating cow, and whether feed was pushed up in the feed bunk. These factors accounted for more than 50% of the observed variation, not attributable to the diet, in milk yield.

Key Words: Water, Housing, Management

W177 Boric acid and borax treatment of stored swine manure to reduce ammonia and hydrogen sulfide emissions from swine facilities. M. Yokoyama*, S. Hengemuehle, and R. von Bernuth, *Michigan State University, East Lansing.*

The objective of this research was to evaluate the efficacy of boric acid and borax in reducing ammonia and hydrogen sulfide emissions from stored swine manure under in vitro and in vivo conditions. Boric acid was reagent grade (J.T.Baker Co.) and borax was commercial grade (20 Mule Team Borax). Swine manure was obtained from the MSU swine facility and incubated (200 ml) with 0.00, 0.0625, 0.125, 0.25, 0.25, 0.50 and 1.0% (w/v) of the borates in 2-L Erlenmeyer flasks for 7 days. Ammonia was measured daily in the headspace gases with Dräger ammonia tubes and hydrogen sulfide was measured using a Jerome analyzer. Increasing amounts of borates to swine manure in the incubations delayed hydrolysis of urea to ammonia by 48-144 hours (e.g. 2-6 days). Adding 1% borates almost completely inhibited (95%)

ammonia emissions. Borates at 1% almost completely inhibited (99%) hydrogen sulfide emissions. Shallow manure pits under nursery rooms at the MSU swine facility were treated with borax for 4 weeks. Air quality was continuously monitored with a Continuous Emission Photoacoustic Multi-Gas Monitor (CEM) with computer software program. Paired t-test comparisons of treatment means indicated that the control room had significantly higher hydrogen sulfide/carbon dioxide concentrations than the boron treated room. Hydrogen sulfide concentrations in the nursery room when pull plugs were opened, indicated that hydrogen sulfide levels were reduced by at least 80%. Paired t-test comparisons of treatment means indicated that the control room had significantly higher ammonia concentrations than the boron treated room. When normalizing the data for carbon dioxide concentrations, the boron treated room had higher ammonia concentrations than the control room. These results demonstrate that boric acid and borax are effective in controlling hydrogen sulfide emissions from stored swine manure. This project was supported by the National Pork Checkoff.

Key Words: Boric Acid, Ammonia, Stored Swine Manure

W178 Effect of different feed push-up schedule on milk production, feed intake and behavior in Holstein dairy cows. D. V. Armstrong*¹, T. R. Bilby¹, V. Wuthirornarith², W. Sathonghon², and S. Rungruang², ¹The University of Arizona, Tucson, ²Charoen Pokphand Foods Public Co. LTD, Bangkok, Thailand.

Primiparous and multiparous Holstein cows in early to mid lactation were divided into 2 groups of 43 based on milk production, days in milk and parity. Both groups were milked 2x daily and fed 3x daily (600, 1300 and 2200 hrs). Milk production and group feed weights and refusals were recorded daily. The feed area was empty for 2 hrs daily for both groups. Feed push-up schedule for the control group was once per hr, every 24 hrs, for a total of 22 push-ups daily. The treatment group was pushed-up every 30 min for the first 2 hrs after each feeding for an additional 9 push-ups totaling 31 push-ups daily. A crossover design was used with treatments being applied for one week then switching treatments between groups for another week with a 2 day interval between weeks. Cows were housed in a tunnel ventilated free stall barn with a feed line soaker. Milk production was increased in the treatment group versus the control (29.7 vs. 28.5 kg, respectively; $P < 0.01$). In addition, there was a significant interaction ($P < 0.05$) between treatment and parity with treatment moderately increasing milk production for primiparous cows (29.1 and 29.8 kg) but significantly increasing milk production in multiparous cows (27.8 and 29.6 kg). Daily dry matter intakes were not significantly different. Cow behavior was observed every 15 min for 24 hrs on the sixth day. Observations recorded were as follows: number of cows either (1) eating at the feed line, (2) standing at feed line, (3) lying at feed line, (4) standing in free stall, (5) lying in free stall, (6) at the water trough or (7) at the milking barn. Percent of cows at the water trough tended to be increased in treatment versus control groups (5.2 % vs. 4.2 %; $P < 0.10$). No significant differences between groups for all other behaviors. In conclusion, increasing feed push-ups at feeding increased milk production with little effects on dairy cow behavior.

Key Words: Feeding, Behavior, Dairy

W179 Hydrated lime bedding treatment for mastitis control. T. A. McCaskey*, R. S. Chettri, C. R. McCarthy, M. B. Brady, and L. I. Chiba, *Auburn University, Auburn, AL.*

Dairy cow mastitis is the inflammation of the mammary gland, usually caused by microbes, which is estimated to cost the dairy industry over \$1 billion annually. The principal remedy is antibiotic therapy, and the major preventive measure is good sanitary practices prior to, during, and after milking, and dry cow antibiotic treatment at time of dry-off. Most mastitis cases are associated with staph, strep and coliform bacteria which are acquired during the milking procedure due to improper milking practices, or acquired from the environment such as the bedding where the cows lie down. Earlier studies have evaluated alkalizing and acidifying agents to reduce microbial loads in cow bedding. Hydrated lime treatment of bedding has been reported to reduce bacterial counts by 100-fold, but the effect diminished in two days. A study was conducted to evaluate the daily application of hydrated lime to free-stall bedding, and to determine its effect on the incidence of mastitis for cows assigned to the stalls. Dairy cows with similar udder health status were allotted to two groups of 16 cows each. Both groups were bedded in free-stalls with peanut hull bedding. The control cow group received no lime, and the treatment group received daily applications of lime (~50grams) to the back 1/3 of the stalls. The assessment of the incidence of mastitis for both groups of cows was determined by the Wisconsin Mastitis Test (WMT) performed monthly for 12 months on quarter, foremilk collected from the cows in the milking parlor prior to milking. A somatic cell count (SCC) of 200,000/ml or more was used as the guideline to indicate an intramammary infection of the mammary quarter. Based on WMT data there was a 38% decrease in the incidence of mastitis for the cow group assigned to stalls with hydrated lime-treated bedding. SCC data taken from DHIA records indicated a 33% decrease in the incidence of mastitis for the lime treatment group. However, when the data for the cow groups were normalized for number of lactations and lactation period these differences were not significant ($P > 0.05$).

Key Words: Dairy Cow, Bedding Treatment, Mastitis

W180 Bedding options for an alternative housing system for dairy cows. E. M. Shane*¹, M. I. Endres¹, D. G. Johnson², and J. K. Reneau¹, ¹*University of Minnesota, St. Paul*, ²*University of Minnesota, Morris.*

Availability of bedding material for compost bedded pack barns is a concern for dairy producers who use this type of alternative housing system. The material most commonly used in these barns is sawdust. The objective of this descriptive study was to evaluate different types of material that could potentially work for these housing systems. The study was conducted at the West Central Research & Outreach Center in Morris, Minnesota from November 2006 to March 2007. Materials included: sawdust (control) (SD), corn cobs (CC), woodchips, and soybean straw (SS). Some of these materials were evaluated as mixtures on a 2:1 by volume ratio. These mixtures included: wood chips/sawdust (WC/SD), wood chips/soybean straw (WC/SS), and soybean straw/sawdust (SS/SD). Six bedded packs were used, each with one of six different materials, and 16 cows were placed on each pack for the specified time period. Replicated samples of the bedded pack material were collected biweekly and analyzed for dry matter. C:N ratios and pH were analyzed monthly. Temperatures of each pack were measured weekly at various depths (15.24, 30.48, 45.72, and 60.96 cm). Cows

were scored for hygiene (1=clean, 5=dirty) biweekly. Dry matter (mean \pm SD) of SD was 48.35 ± 21.16 ; CC, 53.78 ± 9.94 ; WC/SD, 47.60 ± 21.13 ; SS/SD, 41.77 ± 10.31 ; WC/SS, 60.45 ± 28.77 ; and SS, 63.31 ± 8.94 . SD pH was 8.69 ± 0.28 ; CC, 7.69 ± 0.73 ; WC/SD, 8.62 ± 0.28 ; SS/SD, 8.59 ± 0.20 ; WC/SS, 8.41 ± 0.37 ; and SS, 8.64 ± 0.15 . C:N ratio of SD was 36.61 ± 9.91 ; CC, 29.39 ± 6.05 ; WC/SD, 47.48 ± 11.81 ; SS/SD, 25.47 ± 4.92 ; WC/SS, 30.49 ± 4.95 ; and SS, 21.88 ± 3.11 . Temperatures (&DEG;C) were averaged across depths: SD, 31.00 ± 11.35 ; CC, 40.00 ± 12.22 ; WC/SD, 22.55 ± 13.93 ; SS/SD, 26.00 ± 8.83 ; WC/SS, 20.00 ± 10.54 ; and SS, 13.00 ± 11.14 . Hygiene score of cows on SD was 2.39 ± 0.74 ; CC, 2.71 ± 0.81 ; WC/SD, 2.46 ± 0.76 ; SS/SD, 2.90 ± 0.83 ; WC/SS, 2.63 ± 0.85 ; and SS, 2.84 ± 0.80 . Based on these results and our observations, it appears that any of the materials evaluated in this study would potentially work in this type of housing system if proper bedding management is applied on a consistent basis.

Key Words: Dairy Cow, Housing System, Bedding Material

W181 Effects of corn particle size and feeding management on dry matter intake, ruminal fermentation, chewing activity and nutrient digestibility in midlactation cows. Z. Cao*, S. Li, and M. Ma, *College of Animal Science & Technology, China Agricultural University, Beijing, China.*

The objective of the experiment was to estimate the effects of corn particle size and feeding management on dry matter intake, ruminal fermentation, chewing activity and nutrient digestibility in midlactation cows. Four multiparous Holstein cows with ruminal cannulas, averaged 625 kg (SD = 63) of BW and 195 DIM (SD = 21) were assigned randomly to a 4×4 Latin square design. Treatments were the effects of 1) corn silage particle size [100% short corn silage (SS, 6.3 mm), 50% short corn silage + 50% long corn silage (SL, 10.7 mm) and 100% long corn silage (LL, 16.4 mm)] in the TMR and 2) feeding TMR compared with SI. Dry matter intake and milk yield were similar for all diets. Cows fed SI spent more time ruminating (445 min/d vs 484 min/d, $P = 0.05$) and consumed less ADF (3.34 kg/d vs 2.89 kg/d, $P = 0.04$) than cows fed SS in the TMR. With the increasing of corn silage particle size, ruminating time ($P = 0.05$) and chewing time ($P = 0.03$) quadratic increased, and digestibility of dry matter ($P = 0.03$), organic matter ($P = 0.03$) and nitrogen ($P = 0.02$) linear increased.

Key Words: Corn Particle Size, Feeding Management

W182 Impact of simulated selection for feed efficiency and length of breeding season on beef life cycle performance. C. Williams* and T. Jenkins, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

The Decision Evaluator for the Cattle Industry (DECI) was used to simulate production for a base herd (BA), a herd in which genetically superior sires for feed efficiency were used (SA), and a herd in which genetically superior sires for feed efficiency and lower fertility were used (SB). Within each selection scenario, four breeding season lengths (BSL) were simulated, 90 d, 75 d, 60 d, and 45 d. Eight 15-yr-simulation runs were done for each selection by length of breeding season scenario. Animals were a composite of 50% Angus and 50% Simmental. Exposed females were palpated at weaning and open cows were culled at that

time and replaced with pregnant heifers to maintain herd size at 150 calving females. At weaning all open and excess pregnant heifers were sold, and all steers and non-replacement heifer calves were put on a stocker program for 150 d to gain 0.91 kg/day, then finished on a high-concentrate diet (3.258 Mcal ME/kg DM). In each 15-year simulation, yearly production and financial data were collected and averaged over yr 14 and 15 to measure selection response relative to the BA. Compared to BA, ADG increased by 0.04 kg ($P < 0.05$) and feed efficiency increased by 0.02 ($P < 0.05$) in both SA and SB. Decreasing BSL from 90 to 45 d, required an increase of 15 female replacements to maintain herd size, and resulted in a greater proportion of steers to heifers going into the finishing phase and heavier average slaughter weights. Except for the 90-d breeding season, the impact of lower fertility sires was to increase the number of replacement females needed to maintain herd size by 2 in SB herds. Income over feed costs (IOFC) for the combined cow/calf and post-weaning phases was significantly higher in SA and SB and decreased as BSL decreased. These results show that selection for feed efficiency would increase post-weaning feed efficiency and IOFC by about 10 and 12% respectively, and have a small positive impact on ADG. Shorter BSL increased replacement rate and decreased IOFC.

Key Words: Beef Model, Feed Efficiency, Selection

W183 Agricultural sustainability: The environmental impact of using recombinant bovine somatotropin (rbST) to improve the productive efficiency of one million lactating dairy cows. J. L. Capper*¹, R. A. Cady², and D. E. Bauman¹, ¹Cornell University, Ithaca, NY, ²Monsanto Company Animal Agriculture Group, St Louis, MO.

This study modeled the effects of supplementing one million lactating cows with rbST on the environmental impact of dairy production when compared to an equivalent milk production from unsupplemented cows. The model employed 2006 average milk yields (28.9 kg/d) and a 4.54 kg/d response to rbST, a 14 mo calving interval and a 60 d dry period. Use of rbST was assumed to begin at 57 DIM. Each population contained lactating cows, dry cows and replacement heifers, for which rations were formulated according to NRC. Resource inputs included feedstuffs, fertilizers and fossil fuels; waste outputs included manure, N and P excretion and greenhouse gas emissions. Supplementation of one million cows with rbST reduced the total population size required to produce 12.1 billion kg milk by 334,859 animals. In consequence, the quantity of nutrients required to maintain the population was decreased by 6.24×10^9 MJ metabolizable energy and 6.05×10^4 kg crude protein, and land required for feedstuff production was reduced by 2.19×10^5 ha. Total N and P excretion was considerably lower from the rbST-supplemented population, with annual reductions in greenhouse gas emissions of 8.2 million kg CO₂, 41 million kg CH₄ and 9,600 kg N₂O. Non-renewable resource (fossil fuel) requirements for feedstuff production were 7.28 million MJ/y lower in the rbST-supplemented population. Furthermore, both electricity (1.56 million kWh/y) and water (5.43 billion l/y) use were lower for the population supplemented with rbST. The carbon footprint, calculated as total CO₂-equivalents, was reduced by 1.77 billion kg/y. Reductions in resource inputs and waste outputs conferred by rbST use would considerably lessen the environmental impact of dairy production. Clearly rbST is a valuable dairy management tool that increases the efficiency of milk production, reduces the carbon footprint and improves agricultural sustainability.

Key Words: Recombinant Bovine Somatotropin, Biotechnology, Dairy

W184 Change in natural abundance of ¹⁵N and estimation of nitrogen losses from dairy manure during storage by mass balance and nitrogen to phosphorus ratio. M. J. Aguerre*¹, G. A. Broderick^{1,2}, and M. A. Wattiaux¹, ¹University of Wisconsin, Madison, ²US Dairy Forage Research Center, Madison, WI.

The main objective was to evaluate methodologies to estimate nitrogen (N) losses from stored dairy manure. Manure with high N (HN) and low N (LN) content was obtained from two groups of cows assigned diets of 17 and 15% CP (DM), respectively. Manure collected from the barn floor was diluted with water to 10% DM, loaded in 200 L barrels (186 kg) with or without addition of chopped straw (22 g/kg of undiluted manure) and stored in a partially temperature-controlled environment. Manure samples were collected on days 0 and 136 of storage and analyzed for N, phosphorus (P) and ¹⁵N natural abundance ($\delta^{15}N$). Nitrogen loss was estimated by mass balance and changes in N:P ratio. The study was conducted once in May and twice in October. There were no interactions for the reported measurements. Addition of straw had no effect on N loss measured by mass balance or N:P ratio. Nitrogen losses estimated by mass balance were reduced by 36 % on LN relative to HN (see table). Using the N:P ratio there was a trend for a reduction in N loss for LN relative to HN manure, however N loss measured using this technique was on average 44 % lower than estimated by mass balance. Average ¹⁵N abundance in manure increased during storage from 4.965 to 5.995‰, probably due to volatilization of ammonia depleted in ¹⁵N, but there was no difference in the magnitude of the increase between the LN and HN manures. Abundance in ¹⁵N at day 136 was lower when straw was added (5.603 vs. 6.398 ‰, $P < 0.01$), indicating that straw-containing manure may have lost less ammonia N. Results from this study suggested also that N loss was influenced by initial manure N content. Estimates of N losses were substantially lower using the change in N:P ratio compared with the values observed by mass balance.

Table 1.

Item	LN	HN	SEM	P-value
Total N Day 0, g	546	642	17.3	<0.01
Total N Day 136, g	447	490	13.8	0.06
N loss, g	98	153	16.3	0.04
N:P Day 0	6.03	6.98	0.5	0.23
N:P Day 136	5.20	5.94	0.4	0.18
N loss, g	54	85	10.0	0.07
$\delta^{15}N$ Day 0, ‰	4.95	4.98	0.4	0.96
$\delta^{15}N$ Day 136, ‰	6.01	5.98	0.2	0.93

Key Words: Nitrogen Loss, Manure

W185 Performance and selenium incorporation in beef heifers grazing pastures growing in saline soils containing high levels of trace minerals. S. O. Juchem*^{1,2}, S. E. Benes², P. H. Robinson¹, P. Vasquez², M. Brito², G. Getachew³, and P. Chilibruste⁴, ¹University of California, Davis, ²California State University, Fresno, CA, ³University of California, Davis, CA, ⁴Instituto Nacional de Investigaci3n Agropecuaria, Montevideo, Uruguay.

Salinification of soils in parts of the San Joaquin valley of California has led to the need to grow salt tolerant forages as a means of evapotranspiring water in order to concentrate salts in drainage water. Our objective

was to determine tissue selenium (Se) concentrations and performance of beef heifers grazing forages with high (>3 mg/kg DM) of Se, being 'Jose' tall wheatgrass (TWG) (*Thinopyrum ponticum* var. 'Jose') and creeping wildrye (CWR) (*Leymus triticoides* var. 'Rio'). Twenty 6 m old Angus heifers were allocated to two grazing areas, where each ~9 ha TWG or CWR area was divided into two subplots, with each subdivided into 4 paddocks that were rotationally grazed at 14 d intervals. Heifers grazed the TWG and CWR pastures for 190 d from May to November (2007). Blood and liver were sampled before grazing and at 190 d of grazing. At ~45 d intervals during grazing, additional samples of blood were collected and BW was recorded before grazing and at 135, 150 and 190 d of grazing. Concentrations of minerals in whole blood or serum, and in liver tissue, were determined. Data sampled over time were analyzed as repeated measures with the experimental unit (heifers) nested within subplots. Preliminary data (n=16) on chemical composition indicates that TWG had higher ME (7.7 vs. 6.6 MJ/kg DM) and CP (12.2 vs. 11.0% DM), whereas Se did not differ (4.7 vs. 3.9 mg/kg DM). Heifers grazing TWG gained more BW (0.59 vs. 0.27 kg/d; P<0.01), and these BW gains were higher than expected. Accumulation of Se in blood occurred quickly, with Se increasing by more than 300% by 45 d of grazing, with TWG heifers having higher concentrations of Se (0.67 vs. 0.48 ppm; P<0.05) at 45 d of grazing than did CWR heifers. However by 190 d, Se concentrations in blood were similar (0.87 vs. 0.94 ppm). Concentrations of Se in liver increased with time, but heifers grazing CWR had higher concentrations of Se (3.9 vs. 2.1 mg/kg) at 190 d of grazing than did TWG heifers. Use of TWG and CWR are viable options to increase the value to soils with low agronomic potential due to salinity, in spite of the high concentrations of Se in the plant tissue.

W186 Factors affecting milk component levels in Northern New York dairy herds. L. E. Chase*, W. C. Stone, C. M. Ryan, J. P. Tauzel, and T. R. Overton, *Cornell University, Ithaca, NY.*

Milk components are key determinants of the price received for milk on dairy farms. The objective of this field study was to investigate nutritional and management factors that may be related to differences in milk fat and true protein (TP) in cooperating dairy herds. Dairy herds (n=52) in 6 Northern NY counties were used in this study. All herds had to be on DHI test, feed total mixed rations and average > 29.5 kg/d of milk per cow. Milk fat percent was the main factor used to select herds. Visits were made to each herd and feed, forage, TMR, water and bulk tank milk samples were collected. Ration and grain mix composition was obtained from the feed representative. Regression analysis was used to identify factors that were related to variations in milk component levels across herds. Average milk production was 34.4 kg (SD ± 9.7). Average milk fat % was 3.47 (SD ± 0.29, range = 2.7 to 4.2%). Milk TP mean was 3.0 (SD ± 0.1, range = 2.8 to 3.3%). Seventeen herds were housed in tie-stall barns and 35 herds were housed in free-stall barns. Twenty-four herds milked twice a day and 28 herds milked 3 times per day. There were no significant relationships between number of cows per herd or herd average milk production and milk fat or TP percent in this study. There were only a few factors that had a significant (P<0.05) relationship with either milk fat or TP content. These were corn silage particle size, as determined using the Z-box, and milk fat %. Corn silage starch, NDF and nonfiber carbohydrate (NFC) levels also had significant relationships with milk fat %. The only significant relationships detected with milk TP % were ration starch and NFC levels. None of these factors accounted for > 10% of the variation observed in milk component levels. Herds with lower milk fat levels had significantly (P<0.05) higher levels of trans-10 C18:1 in bulk tank milk samples. The results of this study

identified some nutritional parameters that appear to be associated with milk component levels in these herds.

Key Words: Milk Fat, Milk Protein

W187 Survival curves and reproductive risk factors for culling in dairy herds. A. De Vries*¹ and J. Olson², ¹*University of Florida, Gainesville,* ²*Pfizer Animal Health, Fort Collins, Co.*

Objective of this study was to quantify dairy cow survival by stage of lactation and parity and reproductive risk factors for culling in Holstein herds. Data were DHI lactation records from 38 states primarily from the eastern US. After editing, the final data set contained 2.2 million records in 707 herds with at least 200 cows in each of the years from 2001 to 2006. For each herd-year, the breeding program was characterized as unlikely, possibly, probably or most likely synchronized. Synchronized breeding occurred mostly on Thursday (48%) or Friday (30%). Daily risk of culling was expressed per 100,000 days at risk. Daily risks of culling at 5, 30, 60, 120, 200, 300, 400, and 500 d after calving were 73, 124, 150, 145, 146, 275, 381, and 446 for open cows, respectively. For pregnant cows, daily risk of culling was -, -, 4, 35, 43, 46, 66, and 79. At day 5, the risk of culling was 132 for first parity cows, but increased from 32 to 64 for cows in parity 2 to 6 respectively. At day 30, cows in the second parity had the lowest risk. At day 60 and later, greater parity cows had higher daily risks of culling. At day 30, the primary reason for leaving the herd was death (35%) followed by injury/other (23%). By 400 DIM, primary reasons were repro problems (36%), followed by death (24%) and low production (15%). Hazard ratios of culling for parities 2 and 3+ were 2.2 and 4.2, respectively compared to parity 1. Breeding program did not affect the hazard of culling. The hazard ratio for cows with milk yields < 5 kg at 70 DIM compared to average herd mates was 3. For average cows it was 1.3 compared to cows with relative milk yields > 5 kg. Longer herd average days to first service only marginally increased the hazard ratio of culling. Herds with pregnancy rates < 12% had hazard ratios of 1.3 compared to herds with > 16% pregnancy rates. Of the first parity cows not pregnant at 150 DIM, 9% were culled by 365 DIM. For second and greater parity cows, results were 19 and 30%, respectively. Quantification of survival curves and reproductive risk factors for culling is useful for identification of opportunities to reduce forced culling losses.

Key Words: Culling, Reproduction, Hazard

W188 Effect of concentrations of progesterone during a timed AI protocol on fertility of lactating dairy cows. J. R. Lima¹, J. E. Santos², F. Rivera*¹, C. D. Narciso¹, R. A. Oliveira¹, and R. C. Chebel¹, ¹*University of California Davis, Tulare, CA,* ²*University of Florida, Gainesville, FL.*

Objective was to evaluate the effect of progesterone (P4) concentrations during a timed AI protocol on pregnancy risk (PR). Lactating dairy cows, from 2 dairy herds, were presynchronized with 2 injections of prostaglandin F2 α (PGF), 14 d apart (Presynch), and cows observed in estrus were inseminated (EST = 1,301). Cows not inseminated by 11 d after the end of the Presynch were submitted to the Heatsynch (d 0 GnRH, d 7 PGF2 α , d 8 estradiol cypionate, and d 10 TAI). At the beginning of the Heatsynch, cows were randomly assigned to receive

no exogenous P4 (CON = 432), one CIDR insert (CIDR1 = 440), or two CIDR inserts (CIDR2 = 440) from d 0 to 7. Blood was sampled at the end of the Presynch and at the beginning of the Heatsynch for determination of P4 concentrations. Cows with P4 concentration < 1.0 ng/mL in both samples were considered anovular and those with at least one sample > 1.0 ng/mL were considered cyclic. From a subgroup of cows, blood was sampled on d 3 and 7 of the Heatsynch. Pregnancy was diagnosed at 38 and 66 d after AI. Data were analyzed including all cows or only cows randomly assigned to treatments. During the Heatsynch, CIDR2 cows had the greatest ($P < 0.01$) P4 concentration (CON = 3.7 ± 0.3 , CIDR1 = 4.6 ± 0.3 , CIDR2 = 5.5 ± 0.3 g/mL). Proportion of cows classified as anovular was similar ($P = 0.67$) among treatments (CON = 20.2, CIDR1 = 17.8, CIDR2 = 19.3%), but it was different ($P < 0.01$) between sites (11.1 and 20.6%). When all cows were evaluated, treatment did not affect PR at 38 d (CON = 35.9, CIDR1 = 39.1, CIDR2 = 37.1, EST = 40.9%; $P = 0.43$) or 66 d (CON = 32.4, CIDR1 = 35.8, CIDR2 = 34.4, EST = 37.8; $P = 0.62$). When only cows randomly assigned to treatments were evaluated, treatment and the interaction between treatment and cyclicity did not affect PR at 38 ($P = 0.61$ and $P = 0.28$, respectively) and 62 ($P = 0.59$ and $P = 0.42$, respectively) d after AI. Anovular cows, however, tended to have smaller PR at 38 (31.2 and 38.9%; $P = 0.07$) and 62 (28.0 and 35.8%; $P = 0.06$) d. Treatment with 2 CIDR inserts increased P4 during a timed AI protocol but did not improve PR.

Key Words: Dairy Cow, Progesterone, Synchronization

W189 Effect of change in body condition score during the dry period on incidence of diseases and lactational and reproductive performance of Holstein cows. L. Lima¹, J. E. Santos², and R. C. Chebel^{*1}, ¹University of California Davis, Tulare, ²University of Florida, Gainesville.

Objectives were to evaluate the association between body condition score (BCS) change during the dry period and health, lactation, and reproductive performances of Holstein cows. Data from 2,089 multiparous cows and 3,451 lactations were collected. Cows received a BCS at dry off and at parturition and were classified according to change in BCS during the dry period as no change (NC), lost BCS (LB), and gained BCS (GB). Postparturient diseases were diagnosed by farm personnel. Milk yield and fat and true protein concentrations were recorded monthly. Productive and reproductive data were collected up to 305 d postpartum (DIM). The length of the dry period was longest ($P < 0.01$) for GB cows (NC = 63.9 ± 1.0 , LB = 64.6 ± 1.0 , GB = 67.5 ± 1.1 d). Change in BCS in the dry period tended ($P = 0.07$) to affect incidence of ketosis (NC = 2.3, LB = 4.3, GB = 2.5%). Milk yield (NC = 37.7 ± 0.4 , LB = 36.1 ± 0.4 , GB = 38.7 ± 0.4 Kg/d) and yield of 3.5%-fat corrected milk (NC = 40.2 ± 0.5 , LB = 38.6 ± 0.5 , GB = 41.4 ± 0.5 Kg/d) were ($P < 0.01$) greatest for GB cows. Milk fat concentration tended ($P = 0.06$) to be affected by BCS change (NC = 3.56 ± 0.03 , LB = 3.55 ± 0.03 , GB = $3.60 \pm 0.03\%$) and GB cows had ($P < 0.01$) the greatest yield of fat (NC = 1.41 ± 0.02 , LB = 1.35 ± 0.02 , GB = 1.45 ± 0.02 Kg/d). Change in BCS was not ($P = 0.71$) associated with true protein concentration, but it was associated ($P < 0.01$) with yield of true protein (NC = 1.18 ± 0.01 , LB = 1.14 ± 0.01 , GB = 1.20 ± 0.01 Kg/d). Interval from parturition to pregnancy (NC = 186.7 ± 2.8 , LB = 182.1 ± 2.7 , and GB = 175.6 ± 3.8 d) and from parturition to the time cows left the herd (NC = 256.5 ± 2.5 , LB = 255.6 ± 2.6 , and GB = 272.4 ± 3.0 d) were ($P < 0.01$) associated with BCS change. Greater ($P < 0.01$) proportion of GB cows remained in the herd after 305 DIM (NC = 73.9, LB = 72.9, and GB = 79.1%). Increase in BCS during the dry period was associ-

ated with improved health, reproductive, and productive performance of multiparous lactating dairy cows.

Key Words: Dairy Cow, Dry Period, Body Condition Score

W190 Comparison of pregnancy diagnosis strategies by stochastic simulation. A. H. Sanders* and A. De Vries, University of Florida, Gainesville.

Recent emphasis has been on earlier pregnancy diagnosis (PD) in dairy cattle. Combining earlier PD with an estrous control plan (SYNC, e.g. Ovsynch[®]) to minimize time to re-breeding, could decrease days open, but the success of a re-breeding plan is also influenced by pregnancy losses which occur after PD, accuracy of PD, and success in re-breeding. The economic efficiency of these strategies is less clear, being influenced by costs and returns from cows. Stochastic simulation is a useful way to compare different strategies while controlling influential factors over a long time span. In this study, PD by ultrasound (US) at 27 days post breeding was compared to PD by rectal palpation (RP) at 35 days post breeding. A 100 cow herd with production based culling for bred heifer replacements was modeled. Stochastic elements included gestation length, cyclicity, estrus detection (ED), fertilization, pregnancy loss, and milk production. Daily risk of resuming cyclicity was LogN~(19,11). Probability of ED were 0.30, 0.50, or 0.70. Probability of fertilization when breeding at estrus was 0.90, with daily risk of embryo loss before 42d Exp~(60) and fixed after 42d so overall probability of a late abortion was 0.03. Cows observed in estrus >60 days in milk (DIM) were bred by artificial insemination (AI). Open cows were bred by timed AI (TAI) at 75 DIM following SYNC. Cows open at PD were enrolled in SYNC for re-breeding. Cows open after 250 DIM were not rebred. Sample size was selected for >80% power using GLMPOWER (SAS[®]). Data were yearly milk yield (MY), live calves (LC), SYNC enrollments, AIs, PDs, and culls, in steady state, from 700 replicates of each PD x ED combination. Improving ED from 0.3 to 0.7 increased yearly MY (103.3kg) and LC (0.04), and decreased culls (0.04) and inputs (0.35, 0.28, and 0.14 for TAI, PD, and AI) per cow-slot. Yearly SYNC enrollments and PDs were 0.037 ± 0.003 and 0.177 ± 0.003 greater per slot with US than RP, and MY was 10.33 ± 3.09 kg less. Culls, LC and AI differed only slightly. This suggests that US may not be an efficient PD strategy because costs are generally greater than RP without improved returns from milk or cow turnover.

Key Words: Pregnancy Diagnosis, Simulation

W191 Supplementation of progesterone via CIDR inserts during ovulation synchronization protocols in lactating dairy cows. R. C. Chebel^{*1}, M. J. Al-Hassan², P. M. Fricke², J. E. Santos³, C. A. Martel⁴, J. S. Stevenson⁴, R. Garcia⁵, R. L. Ax⁵, and F. Moreira⁶, ¹University of California Davis, Tulare, ²University of Wisconsin, Madison, ³University of Florida, Gainesville, ⁴Kansas State University, Manhattan, ⁵University of Arizona, Tucson, ⁶Pfizer Animal Health, New York, NY.

Our objective was to determine the effect of exogenous progesterone (P4) during timed AI protocols on pregnancy risk (PR) in dairy cows not previously observed in estrus. Lactating cows, from 6 dairy herds, were submitted to a Presynch protocol (2 injections of PGF2 α [PGF] 14 d apart), and cows in estrus after the second PGF received AI (EDAI, n

= 1366). Cows not inseminated by 12-14 d after the end of the Presynch received a timed AI (TAI) protocol (GnRH [d 0], PGF [d 7], GnRH [48-72 h after PGF], TAI [0-24 h after GnRH]). At onset of the TAI protocol cows were blocked by parity and DIM and randomly assigned to receive no exogenous P₄ (CON, n = 721) or a CIDR insert (CIDR, n = 770). Blood was sampled at the second PGF injection of Presynch and at onset of the TAI protocol for P₄ determination. Cows with 2 samples in which P₄ < 1.0 ng/mL were classified as anovular and those with 1 or 2 samples in which P₄ > 1.0 ng/mL were classified as cyclic. Pregnancy was diagnosed at 38 and 62 d after AI. Data were analyzed including all cows or only cows randomly allocated into treatments. Proportion of cows inseminated following the Presynch was different among sites (P < 0.01). Proportion of anovular cows at the onset of the TAI protocol was affected (P < 0.01) by site (range 13.7 to 33.5%), but it was similar (P = 0.88) between treatments (CON = 25.7, CIDR = 26.0%). When all cows were considered, treatment did not (P = 0.12) affect PR at 38 d (CON = 33.7, CIDR = 37.9, EDAI = 38.5%), but it tended (P = 0.08) to affect PR at 62 d (CON = 30.0, CIDR = 34.9, EDAI = 34.9%). When only cows randomly assigned to treatments were considered (model 2), PR at 38 and 62 d tended to be (CON = 33.7, CIDR = 37.9%; P = 0.10) and was (CON = 30.0, CIDR = 34.9%; P = 0.05) improved by exogenous P₄, respectively. Cyclic cows had greater (P < 0.01) PR at 38 (38.4 vs. 29.1%) and 62 (34.9 vs. 25.7%) d than anovular cows, but PR did not differ (P > 0.15) among sites at 38 (range 31.9 to 42.4%) and 62 (range 28.6 to 37.5%) d. Use of exogenous P₄ during TAI protocols improved fertility of lactating dairy cows not previously observed in estrus.

Key Words: CIDR Insert, Dairy Cow, Synchronization

W192 Characterization of postpartum estrous behavior in lactating cows using radiotelemetry in a large dairy. C. R. Johnson^{*1}, M. W. Ayers², A. Ahmadzadeh³, S. Etter⁴, R. C. Chebel⁵, and J. C. Dalton¹, ¹Caldwell Research and Extension Center, Caldwell, ID, ²Caine Veterinary Teaching Center, Caldwell, ID, ³University of Idaho, Moscow, ⁴Canyon County Extension, Caldwell, ID, ⁵University of California, Tulare.

The objective of this study was to describe postpartum estrous behavior in lactating cows using radiotelemetry in a large dairy (n = 1,315 cows). Average annual milk production was 12,310 kg. Cows (n = 30) were continuously monitored for behavioral estrus by HeatWatch II (CowChips LLC, Denver, CO) from 14 to 49 d postpartum. Blood collection (for analysis of progesterone, P₄) and ovarian ultrasonography were performed once weekly. Based on increased concentration of P₄, 25 cows exhibited first ovulation without behavioral estrus. First ovulation was estimated to have occurred within four days before evidence of increased P₄ concentration (Appl. Anim. Behav. Sci. 66; 2000; 153-159). Estimated first ovulation occurred at 23.3±10.2 d (range 10-45 d) for 25 animals without evidence of behavioral estrus. A corpus luteum was visualized by ultrasonography in 22 of 25 cows. First ovulation was associated with behavioral estrus in 3 cows and occurred at 28±10.1 d (range 17-37 d). The average duration of estrus was 7.5±3.6 h (range 3-10.5 h), and average number of mounts were 19±1.7 (range 17-20). The interval postpartum to estimated first ovulation and first ovulation associated with behavioral estrus was not different. Cows that showed evidence of first ovulation with or without behavioral estrus (n = 28) were placed into two milk production groups, >47.3 kg (n = 12) and <47.3 kg (n = 16), based on first milk test weights. Level of milk production did not affect the interval to estimated first ovulation without estrus or first ovulation associated with estrus. The remaining two animals

did not show evidence of ovulation based on P₄ concentration. The majority of first ovulations (25/28; 89.3%) were not associated with behavioral estrus.

Key Words: Radiotelemetry, Estrous Behavior, Dairy Cattle

W193 Effect of overnight pasture on metritis and milk production of transition cows. C. Goldhawk^{*1}, N. Chapinal^{1,2}, D. M. Veira², J. Rushen², A. M. de Passillé², D. M. Weary¹, and M. A. G. von Keyserlingk¹, ¹University of British Columbia, Vancouver, BC, Canada, ²Pacific Agri-Food Research Centre, Agassiz, BC, Canada.

Transition dairy cows are highly susceptible to disease, and thus require management practices which reduce the occurrence of disease. Continuous access to pasture has shown improvements in udder health, however, it is unclear if this benefit can be extended to other health issues, such as metritis. This study tested the effect of housing transition cows on pasture overnight on dry matter intake, milk production and incidence of metritis. Forty-four multiparous and 26 primiparous Holstein dairy animals were monitored for 3wk prior to calving and 3wk post calving. All animals were housed in freestall pens (n=6) with 12 stalls at densities of 8-12 animals. Control cows (n=35) remained indoors 24 hr/d. Pasture cows (n=35) were housed in the same pens as controls but remained indoors from 0700-2000 and on pasture from 2000-0700. Detailed feeding behaviour of 20 pasture and 20 control cows was monitored from 2 wk pre to 3 wk post-calving in one pre-partum and two post-partum pens. After calving, body temperature and milk production were collected daily, and vaginal discharge was examined for detection of metritis at +3, +5, +7, +14 and +21 d. Following data collection, cows were classified as healthy (metritis score 0 or 1, no fever) or metritic (one metritis score ≥2). Cows with confounding health issues were removed, leaving 26 cows in the pasture group and 25 cows in the control group. We found no difference in the number of cases of metritis between treatment groups (11 pasture vs. 9 control, P>0.1). DMI of TMR, which was provided indoors, was similar between control and pasture cows for the duration of the transition period (12.8kg/d±0.95 vs. 11.62kg/d±0.67, P>0.1), except during week -2 when DMI was higher for control cows (13.7kg/d±0.73 vs. 11.8kg/d±0.60, P<0.05). Milk yields were also similar between groups (pasture=32.0kg/d±1.20, control=32.2kg/d±1.17) during the first 21 DIM. The results of this study indicate that overnight pasture access does not reduce TMR intake nor milk yield and has no effect on the prevalence of metritis.

Key Words: Transition, Pasture, Metritis

W194 Influence of hen's age on some productive indices of broilers in the hot humid southwestern Nigeria. O. T. F. Abanikannda¹, A. O. Leigh¹, O. Akinsola¹, I. S. Okoya^{*1}, O. N. Coker², I. O. Ola-Gbadamosi¹, and A. L. Dare³, ¹Lagos State University, Ojo, Lagos State, Nigeria, ²S & D Farms Nigeria Limited, Odeda, Ogun State, Nigeria, ³Obasanjo Farms Nigeria Limited, Igboora, Ogun State, Nigeria.

The relatively high meat yield and fast growth rate in broilers provides for an economical source of animal protein, which has been widely accepted by consumers. This study examined the effect of hen's age on some productivity indices (egg weight, fertility, hatchability, egg weight at candling and chick weight) within four flocks of the same breed that

originated from the same line, albeit at different ages. The hens were kept under similar management and environmental conditions and were all derived from the same line. The 607 hatchable eggs used in this study were sampled from the a single line of Anak broiler breeders at 39, 43, 66 and 106 weeks of age, comprising 34.60, 11.53, 34.10 and 19.77 percent respectively. Egg weight at 18 days consistently increased with age, aside from a slight drop observed at 43 weeks, which may have been attributed to a small sample size. However, the chick weight progressively increased as the hen's age increases. Fertility of the eggs was least at 66 weeks, while hatchability was least at 106 weeks. Hatchability after the initial rise at 43 weeks consistently decreased afterwards. A test of independence of fertility and hatchability of eggs on hen's age was highly significant ($P < 0.001$), with X^2 values of 24.79 and 29.53 respectively. It was observed that for a profitable and successful hatchery operations, breeder hens are better kept for optimal productivity up to about one year old and should be disposed thereafter.

Table 1. Some productive indices of Anak broiler breed at different ages

Age (Weeks)	N	Egg Weight (g)	Fertility (%)	Hatchability (%)	‡Weight at Candling (g)	Chick Weight (g)
39	210	56.94±0.33 ^b	88.10	79.46	49.28±0.33 ^b	37.72±0.33 ^c
43	70	56.17±0.59 ^b	90.00	82.54	48.36±0.58 ^b	37.79±0.59 ^{bc}
66	207	60.84±0.43 ^a	71.50	70.27	51.83±0.47 ^a	39.50±0.39 ^b
106	120	61.23±0.63 ^a	74.17	65.17	52.94±0.69 ^a	43.60±0.61 ^a
Combined	607	59.03±0.25	79.90	74.43	50.61±0.25	39.19±0.24

[†]Means differ significantly ($P < 0.05$) [‡]Candling done at 18th day

Key Words: Egg Weight, Fertility, Chick Weight

Ruminant Nutrition: Management and Misc Additives - Dairy

W195 Effect of two levels of diet density and milking frequency on performance of Holstein fresh lactating cow. N. Aghaziaraty*, H. Amanlou, D. Zahmatkesh, E. Mahjoubi, and S. Siari, *Zanjan University, Zanjan, Iran.*

The aim of this study was to investigate the effect of diet density and milking frequency on performance of fresh lactating cows. 20 fresh lactating cows (8 primiparous and 12 multiparous) arranged in a 2×2 factorial block design. The cows were fed two levels of diet density (high density (H) or low density (L) diet) and milked 3 time (3x) or 6 time (6x) daily. The four treatment combinations were L3, L6, H3 and H6, and experimental period comprised from day of 3 to 25 postpartum. The effect of milking frequency on DMI ($P<0/05$), milk production ($P<0/002$), and yield of milk fat ($P<0/003$) and milk protein ($P<0/002$) was significant and for 6x cows was higher, but on percentage of milk fat, milk protein, SNF, and blood metabolites was not significant. The NEFA concentration was affected by milking frequency ($P<0/01$). The effect of diet density on DMI, percentage of milk fat, milk protein, blood metabolites, and SNF was not significant, but on milk production ($P<0/035$), yield of milk fat ($P<0/02$) and milk protein ($P<0/01$) was significant and was higher for high density diet. The interaction of milking frequency and diet density was not significant for any measured parameters in this study. Final conclusion is that increasing milking frequency and diet density in early lactation can increase milk production.

Key Words: Fresh Cow, Milking Frequency, Diet Density

W196 Effect of applying bacterial inoculants to corn silage on the performance of dairy cattle. K. G. Arriola*, A. T. Adesogan, S. C. Kim, T. W. Kang, A. F. Pedroso, O. C. Queiroz, J. L. Foster, and C. R. Staples, *University of Florida, Gainesville.*

This study examined the effect of applying different bacterial inoculants to corn silage at the point of ensiling on the performance of lactating dairy cows. Corn plants were harvested at 35% DM, chopped and ensiled in Ag bags after application of 1) nothing (CON), 2) a homolactic inoculant (B2+) containing 3.63×10^{10} cfu/g of *Pediococcus pentasaceus* and *Propionibacteria freudenreichii* 3) a heterolactic inoculant (BUC) containing 4.95×10^{10} cfu/g *Lactobacillus buchneri*; and 4) a combo inoculant (500) containing 4.99×10^{10} cfu/g of *P. pentosaceus* and *L. buchneri*. Each of the 4 silages was mixed into separate total mixed rations consisting of 44% corn silage, 50% concentrate and 6% alfalfa hay (DM basis). Fifty two lactating Holstein cows were classified according to milk production and parity and randomly assigned at 22 DIM to the four dietary treatments. Cows were fed ad libitum and milked twice daily for 49 d. Dietary treatment did not affect intakes (kg/d) of DM (20.1), CP (3.65), NDF (5.72), or ADF (3.54), or digestibility (%) of DM (73.8) or CP (72.4). However, cows fed B2+ had lower NDF digestibility than those fed other diets (45.3 vs. 53.0%). Consequently, cows fed B2+ had lower digestible NDF intake (kg/d) than those fed other diets (2.5 vs. 3.1 kg/d). Nevertheless, dietary treatment did not affect milk yield (32.3 kg/d), efficiency of milk production (1.64), concentrations of milk fat (3.18%) and protein (2.78%), or yields of milk fat (1.02 kg/d) and protein (1.26 kg/d). Inoculant application to corn silage did not affect the milk yield or feed intake of the cows.

Key Words: Inoculants, Corn Silage, Cow

W197 Timing of herbage allocation on milk production and composition in mid-lactation dairy cows in winter. M. Vaccaro², F. Luparia^{1,2}, C. A. Cangiano¹, D. A. Garcarena¹, and G. A. Gagliostro*¹, ¹*Instituto Nacional de Tecnología Agropecuaria, INTA, Balcarce, Buenos Aires, Argentina,* ²*Facultad de Ciencias Agrarias, UNMDP, Balcarce, Buenos Aires, Argentina.*

The objectives were to evaluate milk yield and composition and dry matter intake (DMI) when the daily pasture strip was allocated each morning (M) or afternoon (A) in winter. Sixteen Holstein cows in mid-lactation (132 ± 11 DIM) were used in a cross over design. Cows were paired based on average milk production during early lactation and randomly assigned to one of two treatments: M: pasture was offered from 0530 to 1100 h and A: pasture was offered from 1100 to 1630 h. In both treatments cows grazed an oat (*Avena sativa*) sward at a daily herbage allowance of 13 kg DM/cow. During the rest of the day cows received 7.3 kg DM/d of maize silage, 2.7 kg DM/d sunflower meal and 6.2 kg DM/d of concentrate (TMR). Each experimental period lasted 20 d with the first 15 d for diet adaptation and the last 5 days for data collection. Data were analyzed as a cross-over design that included effects of treatment, period and sequence. Pasture DM (250 vs 275 g/kg) and soluble carbohydrate (229 vs 199 g/kg DM) contents were higher ($P<0.01$) during the afternoon. Milk production (22.1 kg/cow/d), 4%FCM (20.7 kg/cow/d) and milk fat content (35.9 g/kg) did not differ. Milk protein content was increased ($P<0.01$) in A (38.5 vs. 37.6 g/kg) and milk protein yield did not differ (0.80 kg/d). The efficiency of milk to yield cheese (kg cheese/100 kg of milk) resulted higher ($P<0.01$) in A (10.56) compared to M (10.31). Lactose content was increased ($P<0.01$) in A (51.4 vs 50.5 g/kg). Milk urea content (35 mg/dl) did not differ. Intakes (kg DM/cow/d) of pasture (3.94) and stall TMR diet (15.47) did not differ. The afternoon grazing management in winter improved milk protein content and the value of milk yield for cheese making. These results could probably be linked to a higher concentration of soluble carbohydrates in the afternoon grazed pasture.

Key Words: Morning or Afternoon Grazing, Pasture Water Soluble-Carbohydrates, Grazing Dairy Cows

W198 Effects of feed bunk competition on the feeding behavior of growing dairy heifers. T. J. DeVries*¹ and M. A. G. von Keyserlingk², ¹*University of Guelph, Kemptville, ON, Canada,* ²*The University of British Columbia, Vancouver, BC, Canada.*

Decreased feed bunk access for adult dairy cows increases competition and promotes feeding behavior patterns that increase the between-cow variation in the composition of ration consumed. To date, there is limited data on the effects of feed bunk competition on the behavior of growing dairy heifers. The objective of this study was to determine how feed bunk competition influences the feed sorting, feeding behavior, and feed intake of dairy heifers. Thirty-six prepubertal Holstein heifers, consuming a TMR diet, were assigned to one of 2 treatments: 1) noncompetitive (1 heifer/feed bin) or 2) competitive (2 heifers/feed bin). Dry matter intake and feeding behavior were monitored for 7 d for each animal. Fresh feed and orts were sampled on the last 3 d of the treatment period from each bin and were subjected to particle size analysis. The particle size separator consisted of three screens (18, 9, and 1.18 mm) and a bottom pan resulting in 4 fractions (long, medium, short and fine).

Sorting activity for each fraction was calculated as the actual intake expressed as a percentage of the predicted intake. To determine if sorting occurred, each fraction was tested for a difference from 100%. Overall, the heifers sorted against long particles (93.8%; $P \leq 0.01$), and sorted for medium (102.2%; $P \leq 0.005$) and short (102.7%; $P \leq 0.02$) particles. There was no difference in sorting behavior between the treatments. The competitively-fed heifers did not have lower daily DMI (6.3 vs 6.2 kg/d; SE=0.3, $P=0.8$), but did consume a higher proportion of their daily DMI in the later hours of the day. The competitively-fed heifers tended to have shorter feeding times (191.8 vs 212.5 min/d; SE=7.8, $P=0.08$), particularly during peak feeding times. These changes translated into a tendency for a higher intake rate (0.047 vs. 0.038 kg/min; SE=0.004, $P=0.15$) throughout the day for the competitively-fed heifers. These results suggest that increased competition at the feed bunk promotes feeding behavior patterns that will likely increase the between-heifer variation in composition of ration consumed.

Key Words: Heifers, Sorting, Competition

W199 Relationship between indices of energy status and plasma lipids, lipid-soluble vitamins and hepatic-derived export proteins in periparturient Holstein and Jersey cows. P. Rezamand*, T. A. Hoagland, R. M. Clark, and S. M. Andrew, *University of Connecticut, Storrs.*

In an observational study, the effect of breed on indices of energy status and plasma concentrations of lipid-energy metabolites, lipid-soluble vitamins, and hepatic-derived export proteins were investigated. Fifteen Holstein and 15 Jersey cows were monitored from cessation of lactation at wk -9 before expected calving date (ECD) through 8 wk of the subsequent lactation. Body condition scores (BCS) were measured at wk -9, -4, -2 and -1 (before ECD), and at wk 1, 3, 5, 7 and 8 postpartum (PP). Body weights (BW) were measured at wk -4 and -2 before ECD, and daily milk yield, weekly milk energy yield, and BW were measured for 8 weeks PP. Plasma metabolites were determined at wk -2 (before ECD) and at wk 1, 2, 4, and 8 PP. Data were analyzed using the mixed model of SAS with wk as a repeated measure. Although milk yield was greater for Holstein cows, there were no breed differences in milk energy yield adjusted to metabolic body size. Holstein cows lost more BW as compared with Jersey cows (128.1 vs. 89.1 \pm 11.6 kg). Although Holstein cows had greater BCS at wk -4 and wk -2 (before ECD), Jersey cows had a greater BCS at wk 8 PP ($P = 0.001$). Plasma non-esterified fatty acid and β -hydroxy butyrate (BHB) concentrations at wk 1 PP tended to be greater (+133 μ Eq/L and +170 μ mol/L) for Holstein than for Jersey cows. Holstein cows had reduced plasma concentrations of phospholipid (20 vs. 35.1 \pm 4.1 mg/dL; $P = 0.03$) and β -carotene (3.51 vs. 5.69 \pm 0.55 μ g/mL; $P = 0.03$) and greater plasma cholesterol concentrations PP compared with Jersey cows ($P = 0.001$). Holstein cows with high peak plasma BHB concentrations (>1000 μ mol/L) and no clinical signs of ketosis had reduced plasma apolipoprotein B (24.1 vs. 30.6 \pm 1.23 mg/dL), transthyretin (0.79 vs. 1.00 \pm 0.04), and retinol-binding protein (0.84 vs. 1.02 \pm 0.04) compared with Holstein cows with low peak BHB ($P < 0.003$). These findings suggest that the association between increased lipid mobilization and reduced synthesis or release of export proteins was greater for Holstein than for Jersey cows.

Key Words: Energy Status, Transition Period, Holstein and Jersey

W200 Effects of monensin and propylene-glycol on milk production and milk composition of Holstein lactating cows. H. Bahrami-Yekdangi, K. Rezayazdi, M. Dehghan-Banadaky*, A. Nejati-Javaremi, and F. Fatehi, *University of Tehran, Tehran, Iran.*

We evaluated the effects of Monensin and propylene glycol on feed intake, milk production and milk composition on 16 primiparous and multiparous Holstein lactating cows (60 \pm 30 DIM, Milk production 33 \pm 3 Kg/day) between September and November of 2007. Cows were used in a completely randomized design with 4 treatments (additives) and 4 replication (cows) and were fed a balanced total mixed ration (60% concentrate and 40% forages) with or without additives. Cows in group 1 were fed TMR without additive (control), Cows in group 2 were fed TMR with 335 mg/day monensin, Cows in group 3 were fed TMR with 400 ml/day propylene glycol, and cows in group 4 were fed TMR with 335 mg/day Monensin and 400 ml/day propylene glycol. Data were analyzed using mixed models for repeated measurement.

Experimental treatments did not affect feed intake and milk composition but propylene glycol significantly increased milk yield of cows (32.23, 34.53, 35.91 and 33.79 kg/day for groups 1-4 respectively). Monensin and/or propylene glycol significantly increased concentrations of plasma glucose (51.92, 56.15, 56.92 and 58.56 mg/dl for groups 1-4 respectively) and insulin (0.43, 0.65, 0.54 and 0.91 mg/dl for groups 1-4 respectively). Concentration of Plasma triglycerides (13.67, 11.97, 11.63 and 8.96 mg/dl for groups 1-4 respectively) were lower in Monensin and/or propylene glycol treated cows ($P < 0.05$). Treatments had not significantly effect on concentration of plasma calcium and phosphorus ($P > 0.05$).

Key Words: Monensin, Propylene-Glycol, Milk

W201 Feed sorting in growing dairy heifers: Effects of dietary dilution. A. M. Greter*¹, T. J. DeVries², and M. A. G. von Keyserlingk¹, ¹*The University of British Columbia, Vancouver, BC, Canada,* ²*University of Guelph, Kemptville, ON, Canada.*

An alternative to limit feeding of dairy heifers is to limit the nutrient density of a formulated diet fed ad libitum, primarily through the addition of a low-quality, inexpensive feedstuff to the ration. The objective of this study was to determine how adding straw to the TMR of growing dairy heifers affects their intake, feeding behavior, and feed sorting behavior. Six prepubertal Holstein heifers were subjected to 3 treatment diets in a replicated 3x3 Latin square design. The treatment diets were: 1) control (17.0% corn silage, 52.1% grass silage, 30.9% concentrate), 2) control diet with 10% straw, and 3) control diet with 20% straw. DMI and feeding behavior were monitored for 7 d for each animal on each treatment. Fresh feed andorts were sampled on the last 3 d of each treatment period for each heifer and were then subjected to particle size analysis. The particle size separator contained 3 screens (19, 8, and 1.18 mm) and a bottom pan, resulting in 4 fractions (long, medium, short, and fine). Sorting activity for each fraction was calculated as the actual intake expressed as a percentage of the predicted intake. To determine if sorting occurred, each fraction was tested for a difference from 100%. Heifers sorted against long particles (90.2%; $P \leq 0.07$) and for short particles (106.3%; $P < 0.05$) on all 3 diets. On the 10% and 20% straw diets heifers sorted for medium particles (102.9 and 105.5%; $P \leq 0.01$). Heifers also sorted for fine particles on the 20% straw diet (107.8%; $P = 0.02$). Feeding time increased (180.2, 193.3, and 199.2 min/d; SE=13.4, $P = 0.05$), whereas DMI decreased (8.1, 7.1, and 6.2 kg/d; SE=0.3, $P < 0.001$) with the addition of straw in the diet. Energy and nutrient requirements were

sufficiently met when the animals consumed the control and 10% straw diet. The results suggest that a moderate level of straw may be included in the diet to target nutrient intake without negatively affecting feeding behavior or growth potential. Furthermore, the ad libitum feeding of a diluted diet provides increased opportunity for these animals to express their natural foraging behavior.

Key Words: Sorting, Heifers, Straw

W202 Fenugreek as forage for dairy cows 2. Effect on rumen fermentation and turnover. A. W. Alemu* and L. Doepel, *University of Alberta, Edmonton, AB, Canada.*

Six multiparous Holstein cows fitted with ruminal cannula were used in a 3x3 replicated Latin square design to examine the effect of two varieties of fenugreek haylage, AAFC F70 and CDC Quatro, on rumen fermentation and turnover rate. Cows were fed isonitrogenous diets consisting of 50% concentrate, 10% barley silage, and 40% AAFC F70 haylage (F70), CDC Quatro haylage (QUAT), or alfalfa haylage (ALF) once daily. Periods were 18 d, with the last 7 d for sample collection. Rumen VFAs, lactate, and ammonia were measured over the last 24h of each period and rumen pH was monitored continuously using indwelling pH probes from d 12-15. Rumen digesta mass and kinetics of rumen neutral detergent fiber (NDF) were determined by complete ruminal evacuation. Data were analyzed using orthogonal contrast of alfalfa vs. fenugreek (FEN) and F70 vs. QUAT. Differences were considered significant at $P < 0.05$. Rumen pH was unaffected by treatment. Rumen ammonia nitrogen (NH_3N) was higher with FEN than with ALF ($P = 0.02$). Ruminal VFAs were not different between treatments except for total VFA, which was higher for ALF than FEN. Mean pool sizes of rumen digesta (84.4 kg) and rumen NDF pool (6.7 kg) were not affected by treatment. Rumen NDF passage rate (Kp), NDF intake rate (Ki) and NDF digestion rate (Kd) were higher for ALF than FEN, and Kp and Ki were higher for QUAT than F70. Rumen turnover time was higher for cows fed F70 than for those fed QUAT, which were both higher than for cows fed ALF. Overall, longer turnover times and slower NDF digestion rates likely contributed to the lower DMI of the FEN fed cows.

Table 1.

	Treatment				Contrasts	
	F70	QUAT	ALF	SEM	ALF vs. FEN	F70 vs. QUAT
DMI,kg/d	16.8	18.7	22.9	0.7	<0.001	0.10
pH	5.9	6	5.9	0.1	0.88	0.52
NH_3N ,mg/dl	22.1	20.7	16.5	1.6	0.02	0.56
Total VFA, mmol/L	113	111.1	125.3	6.4	0.02	0.75
Acetate*	57.1	58.9	59	3.4	0.65	0.50
Propionate*	29.7	26.8	27.3	2.8	0.74	0.37
Butyrate*	8.4	9.2	8.8	1.6	0.99	0.63
K_i ,d ⁻¹	64.2	77.9	87.6	5.0	0.001	0.003
K_p ,d ⁻¹	28.4	36.7	40.8	3.6	0.02	0.03
K_d ,d ⁻¹	35.9	41.2	46.8	3.9	0.03	0.16
Turnover time ¹ ,h	20.4	16.6	13.5	1.3	0.01	0.03

* Individual VFA reported as mmol/100mmol; ¹(Ruminal DM(kg)/DMI (kg/d)x24

Key Words: Fenugreek, Rumen Fermentation, Rumen Kinetics

W203 Viability of commercial active dry yeast products decreases with high-temperature storage. J. Miranda* and B. J. Bradford, *Kansas State University, Manhattan.*

Active dry yeast (ADY) products are utilized as feed additives in the dairy industry, with the goal of modulating ruminal fermentation and improving productivity. Several proposed modes of action for ADY require that viable cells are fed; however, little information is available regarding viable cell count of commercial ADY products or the effects of summer storage conditions on viability. Samples of 6 ADY products were acquired through normal distribution channels to measure viable yeast cell count. Viable cells were quantified in 3 different samples of each product (from different lots) on receipt. In addition, 1 sample of each product was stored for 3 months at 40°C with ambient humidity, and viable cell count was assessed monthly. Viable yeast cells were quantified according to AOAC method 997.02, with the procedure modified to allow 5 minutes for sample homogenization in phosphate buffer. Colony forming units per gram (CFU/g) were log₁₀-transformed and analyzed by ANOVA to assess effects of storage on yeast viability. Across products, 44% of samples analyzed did not contain the minimum CFU/g guaranteed on the respective product labels, and mean viable cell counts were less than the label claim for 4 of the 6 products sampled, with only 1 product meeting the label claim on all 3 samples collected. Across products, high-temperature storage significantly decreased viable cell count ($P < 0.001$), with mean CFU/g decreasing by more than 85% with each month of storage at 40°C (9.88, 7.37, 6.28, and 5.43 log₁₀ CFU/g for 0, 1, 2, and 3 months of storage, respectively). Active dry yeast products provide highly variable numbers of viable yeast cells, and viability decreases substantially with high-temperature storage.

Key Words: Feed Additives, Dairy Nutrition, Active Dry Yeast

W204 Exogenous amylase enzymes for lactating dairy cows. C. M. Klingerman*, E. E. McDonell, W. Hu, M. C. Der Bedrosian, and L. Kung, Jr., *University of Delaware, Newark.*

An experimental (7B, Novozymes A/S, Bagsvaerd, Denmark and Dutch State Mines, Heerlen, Netherlands) and a commercial formulation (AMA, Alltech Biotechnology, Nicholasville, KY) of enzymes, with α -amylase activity, were evaluated for activity at various pH, stability in ruminal fluid, the potential to improve in vitro ruminal fermentations and the potential to improve production performance of lactating cows. When incubated (40°C) in buffer with a pH of 5.4, 7B had about 10-25 times more amylase activity than AMA. When the pH was increased to 6.0, enzyme activity increased by 100% for 7B but it decreased by about 26% for AMA. Both formulations maintained enzyme activity when they were incubated in in vitro ruminal fermentations over a 24 h period. After 6 h of ruminal in vitro fermentations, additions of 7B resulted in linear increases ($P < 0.05$) in apparent total VFA production for flint and dent corn but had no effect on floury corn. In a lactation trial, 28 Holstein cows (68 ± 31 days in milk, 46.9 ± 9.1 kg milk/d) were fed a TMR supplemented with nothing (CTRL), a low dose of 7B (7BL, 0.88 ml/kg TMR DM), a high dose of 7B (7BH, 4.4 ml/kg TMR DM), or AMA (0.4 g/kg TMR DM). The experiment was conducted as a 4 × 4 Latin square design with 21-d periods. Cows fed 7BL produced more (47.1 kg/d, $P < 0.05$) milk than cows fed CTRL (43.2 kg/d) and 7BH (44.2 kg/d) but produced similar amounts to cows fed AMA (45.4 kg/d). The production of 3.5% fat corrected milk was greater ($P < 0.05$) from cows fed 7BL and AMA when compared to CTRL. The percentage of milk fat and milk protein were unaffected by treatment. Cows fed

7BL, 7BH, and AMA ate similar amounts of DM (ave. of 28.5 kg/d) and cows fed the latter two diets consumed more ($P < 0.05$) DM than did cows fed CTRL (27 kg/d). Cows fed 7BL had a greater ($P < 0.05$) apparent total tract digestion of DM, OM, and NDF when compared to the CTRL and 7BH diets but digestion of these components were similar to cows fed AMA. The formulations of amylase enzymes evaluated in this study varied greatly in their activity, but were both stable in rumen fermentations and had the ability to increase animal performance.

Key Words: Amylase, Enzyme, Dairy

W205 Evaluation of nutritional management strategies for cows with a short (40-d) dry period. H. M. Dann*¹, M. P. Carter¹, H. M. Gauthier¹, K. W. Cotanch¹, P. D. Krawczel¹, C. S. Mooney¹, C. S. Ballard¹, R. J. Grant¹, T. Eguchi², and T. Nakao², ¹*William H. Miner Agricultural Research Institute, Chazy, NY*, ²*ZEN-NOH National Federation of Agricultural Co-operative Associations, Tokyo, Japan*.

Dairy producers are adopting the use of shorter dry periods for cows, but are unsure of the best nutritional strategy to use. The objective of this study was to evaluate the effect of two nutritional strategies for feeding dry cows with a 40-d dry period on periparturient metabolism and subsequent lactational performance. Holstein cows ($n = 101$) housed in pens with freestalls were used in a randomized design to test the effects of diet: 1) low-energy (1.4 Mcal NE_L/kg) for the entire dry period (LL; $n = 51$) and 2) low-energy for the far-off period and high-energy (1.6 Mcal NE_L/kg) for the close-up period (LH; $n = 50$). The far-off and close-up periods started at 40 ± 3 d and 21 ± 3 d from expected parturition, respectively. Body condition score (BCS) and body weight (BW) were recorded (dry-off and wk -3, -2, -1, 0, 2, 4, 8). Serum nonesterified fatty acids (NEFA) and β -hydroxybutyrate (BHBA) were analyzed (dry-off and every other day from d -7 to 13). Milk yield (daily from wk 1 to 8) and composition (weekly from wk 2 to 8) were measured. Health problems were recorded (entire study). Data were analyzed by ANOVA using the MIXED procedure (except health data) and Fisher's Exact Test using the FREQ procedure (health data) of SAS. Cows fed LL and LH had similar ($P > 0.10$) BCS (3.65) and BW (727 kg) during the far-off period. During the close-up period, cows fed LH had more BCS gain ($P \leq 0.05$; 0.16 vs. -0.07), more BW gain ($P \leq 0.05$; 28 vs. 9 kg), and lower serum NEFA ($P \leq 0.05$; 355 vs. 458 μ Eq/L) than cows fed LL. There was no carryover effect of treatment ($P > 0.10$) on postpartum serum NEFA (845 μ Eq/L) and BHBA (7.2 mg/dL), change in BCS (-0.32) and BW (39 kg), milk yield (44.1 kg), and health disorders. Cows fed LH tended ($P \leq 0.10$, treatment \times time) to have higher serum BHBA at d 5, 7, and 9 than cows fed LL. Milk fat content tended ($P \leq 0.10$) to be lower for cows fed LL than LH (3.54 vs. 3.76%). Both nutritional management strategies (LL and LH) are acceptable based on data collected during the first 8 wk postpartum. However, both strategies need to be evaluated based on performance during a complete lactation.

Key Words: Dry Period, Nutrition, Transition Cow

W206 Effect of dietary malic acid supplementation on rumen methanogenesis and performance of lactating dairy cows at pasture. P. A. Foley¹, D. A. Kenny¹, D.K. Lovett¹, T. M. Boland*¹, and F. P. O'Mara², ¹*University College, Dublin, Ireland*, ²*Teagasc, Oak Park, Ireland*.

It has been estimated that enteric fermentation from dairy cows which naturally results in methane production accounts for almost 14% of the total greenhouse gas emissions associated with agriculture in Ireland. There is evidence from in vitro studies that organic acids such as malic acid can inhibit ruminal methanogenesis. However, there is equivocation between published reports on the utility of this strategy in vivo. Furthermore, most of the limited in vivo work to-date has been conducted with small ruminants or beef cattle with little information on effects in lactating dairy cows, particularly under pasture based production systems. The objective of the current study, therefore, was to examine the effect of dietary malic acid supplementation on methane emissions from lactating dairy cows grazing pasture. Twenty-four mid lactation Holstein-Friesian cows with a pre trial mean (\pm s.e.) milk yield of 23.9 kg/d (\pm 4.3 kg) and a BW of 628.1 kg (\pm 36.5 kg) were blocked on days in milk, pre trial milk yield and live weight, and within block, randomly allocated to one of two diets over a six week period. Diets consisted of ad libitum grazed grass plus 6 kg concentrate containing either (1) 0 g (CON) or 480 g of malic acid (MA; 2.6% DMI). Cows were allowed a three-week acclimatisation period followed by a 5-day methane measurement period. Individual methane measurements were made using the SF6 tracer gas technique, while herbage intake was estimated for each animal using the n-alkane technique. Measurements for milk yield were taken daily for each animal using flow meters while samples for compositional analysis were collected on a weekly basis. The dietary inclusion of MA had no effect ($P > 0.05$) on DMI or on ruminal methane emissions ($P > 0.05$). Furthermore, supplementation had no effect ($P > 0.05$) on animal performance in terms of milk yield, milk composition and weight gain.

W207 The impact of a blend of synthetic antioxidants (AGRADO® Plus) on milk production and milk fat synthesis when fed a diet high in unsaturated fatty acids. C. L. Preseault*¹, M. Vázquez-Añón², G. R. Bowman², C. S. Ballard³, H. M. Dann³, and A. L. Lock¹, ¹*University of Vermont, Burlington*, ²*Novus International Inc., St. Louis, MO*, ³*William H. Miner Agricultural Research Institute, Chazy, NY*.

Dietary-induced milk fat depression (MFD) is a result of changes in rumen biohydrogenation (BH) of unsaturated fatty acids and the passage of specific BH intermediates out of the rumen that subsequently reduce milk fat synthesis in the mammary gland. The objective of this study was to examine the impact of a blend of synthetic antioxidants, AGRADO® Plus (Agrado), on milk fat synthesis and milk production when cows were fed a diet with a high unsaturated fatty acid load (UFAL). The experiment was designed as a crossover with two 21-d periods. Sixteen lactating Holstein cows (163 ± 47 days in milk) were fed 1 \times /d and milked 3 \times /d. Cows were assigned randomly to one of two treatments: 1) basal diet (Control) and 2) basal diet supplemented with 0.02% (DM basis) of Agrado. The basal diet was designed to induce MFD, primarily through feeding distillers' grains (15% DM) to induce a high rumen UFAL. Individual feed intake and milk yield were recorded daily and milk samples collected every 5 d for milk composition. Data were analyzed as a crossover design with model effects for diet, period, sequence, day, and treatment by day using the MIXED procedure of SAS. There was no effect of treatment ($P > 0.05$) on DMI (26.6 ± 0.5 kg/d) or milk yield (49.8 ± 1.7 kg/d). Compared with pre-treatment values, MFD was observed when cows were fed both the Control and Agrado treatments, but the extent of MFD was significantly less across both periods when cows were fed Agrado; milk fat content was 3.22 and 3.32% ($P < 0.01$) and milk fat yield was 1.58 and 1.64 kg/d ($P < 0.05$) for the Control and Agrado treatments, respectively. This resulted in a

trend for 3.5% fat-corrected milk to be higher for cows on the Agrado treatment ($P < 0.10$). No other milk components were different between the two treatments ($P > 0.05$). Overall, data demonstrate the potential for dietary antioxidants in improving milk fat content and yield. Further studies, however are required to verify and extend these results and to determine the mechanism by which antioxidants impact rumen lipid metabolism and milk fat synthesis.

Key Words: Antioxidants, Milk Fat, Biohydrogenation

W208 Response of lactating cows to the supplementation with live yeast. L. L. Bitencourt^{*1}, M. N. Pereira¹, B. M. L. de Oliveira¹, J. R. M. Silva², G. S. Dias Júnior¹, F. Lopes¹, R. C. M. de Melo¹, and S. Siécola Júnior¹, ¹Universidade Federal de Lavras, Lavras, MG, Brazil, ²Centro Federal de Educação Tecnológica, Januária, MG, Brazil.

Performance and nutrient utilization of dairy cows supplemented with *Saccharomyces cerevisiae* strain CNCM I-1077 (Lallemand SAS, France) was evaluated. Twenty Holsteins, averaging 143±49 days in lactation at the beginning of the trial, formed ten blocks based on milk yield and were randomly assigned to a sequence of two treatments, in a cross-over design, with 28-day periods. Measurements were performed on the fourth week of each period. Treatments were: 10 g of the product Natucell (Ouro Fino Saúde Animal, Brazil) capable of providing 1×10^{10} cfu of live yeast or the same amount of placebo. Treatments were fed daily by allocation to each cow over the individually fed TMR. Diet composition was (% of DM): Corn silage (43.9), tifton hay (2.0), steam-flaked corn (14.4), pelleted citrus pulp (16.9), and soybean meal (21.7). Diet crude protein content was 16.8%, NDF was 30.9%, and NFC was 41.0% of DM. Data was analyzed with a model containing the effects of block, cow within block, period and treatment. Yeast supplementation increased daily milk (29.4 vs. 28.5 kg, $P=0.11$), protein (0.919 vs. 0.884 kg, $P=0.05$) and lactose yields (1.265 vs. 1.212 kg, $P=0.06$), and had no effect on milk fat ($P=0.53$). Daily dry matter intake was 21.4 kg with yeast and 20.7 for the control ($P=0.11$). Total tract apparent digestibility of the NDF was 48.1% with yeast and 43.2% for the control ($P=0.08$). There was a tendency for increased intake of digestible organic matter with yeast supplementation ($P=0.07$). Rumen fermentation and microbial parameters did not change between treatments. The concentration of purine derivatives in urine was numerically increased by yeast supplementation ($P>0.20$). The positive performance response to live yeast supplementation may have been the result of better diet digestibility.

Key Words: Yeast, Digestibility, Fiber

W209 The effect of feed sorting on chewing behavior, production, and rumen fermentation in lactating dairy cows. D. D. Maulfair^{*}, M. Fustini, and A. J. Heinrichs, *The Pennsylvania State University, University Park.*

Ration sorting is thought to allow cows to effectively eat different rations throughout the day, causing fluctuations in rumen fermentation patterns that can be detrimental to production. The objective of this experiment was to study the effects of varying TMR particle size on the sorting behavior of lactating dairy cows and to evaluate effects on chewing behavior, milk yield, milk components and rumen fermentation. Eight multiparous (parity = 2.3 ± 0.5) Holstein cows (90 ± 32 DIM initially;

642 ± 82 kg BW) were randomly assigned to replicated 4×4 Latin Squares. During each of the 4 periods cows were fed diets that varied only in the chop length of dry grass hay. When sieved through the Penn State Particle Separator (PSPS), the percentage of hay on the top screen (19.0 mm) was 23.1, 65.7, 86.6, and 94.9% for the short (S), medium (M), long (L), and extra long (XL) hay respectively. This resulted in the TMR of each diet having 6.4 (S), 17.4 (M), 18.6 (L), and 23.1 (XL) % on the top screen of the PSPS. The diet consisted of 29.4% corn silage, 22.9% ground corn, 17.6% alfalfa haylage, and 11.8% grass hay on a DM basis (DM 53.8%, forage 58.8%, NDF 32.1%, starch 27.7%). Chewing behavior was monitored using the IGER Behavior Recording system. No differences ($P < 0.05$) in chewing behavior between diets were found. Ruminating time/d was 518.7 ± 15.8 (S), 524.5 ± 15.4 (M), 495.6 ± 15.4 (L), and 522.5 ± 15.4 (XL) min/d (mean \pm SE). Chewing time was 373.4 ± 19.4 (S), 383.9 ± 18.9 (M), 365.7 ± 18.9 (L), and 385.6 ± 18.9 (XL) min/d. Milk production and DMI were also similar between diets. Milk yield was 39.0 ± 1.7 (S), 38.5 ± 1.7 (M), 37.3 ± 1.7 (L), and 36.3 ± 1.7 (XL) kg/d. DMI was 25.6 ± 1.0 (S), 25.3 ± 1.0 (M), 23.6 ± 1.0 (L), and 23.9 ± 1.0 (XL) kg/d. In addition no differences were found in milk fat, milk protein, MUN, rumen pH, rumen VFA and boluses/d. Despite drastic differences in particle size between these diets, there were no changes in chewing behavior, production, and rumen fermentation found in this study.

Key Words: Sorting, Particle Size, Rumination

W210 Effect of feed sorting on fecal particle size. M. Fustini^{*2}, D. D. Maulfair¹, A. J. Heinrichs¹, and A. Formigoni², ¹The Pennsylvania State University, University Park, ²University of Bologna, Bologna, Italy.

Increasing forage particle size of a TMR increases sorting activity by cows. Under this condition cows eat different diets during the day, with a higher intake of more palatable particles during the first meals and poorer quality feed during the later meals. The amount and timing of peNDF consumption and the impact of NFC, largely determine the fluctuations in rumen environment. The purpose of this study was to evaluate the effect of feed sorting and different diets throughout the day on fecal particle size distribution during a 24-h period. Four multiparous Holstein cows (BW = 659 ± 88 kg; DIM = 104 ± 15 d) were used in a 4×4 Latin Square design (21 d). During each of the 4 periods, cows were fed a diet that differed in the chop length of the grass hay. The diet was formulated to contain 58.8% forage (DM basis) in which dry hay comprised 11.8% of DM (20% of the forage). When sieved through the Penn State Particle Separator (PSPS) the percentage of hay on the top screen (19.0 mm) was 23.1, 65.7, 86.6, and 94.9% for the short (S), medium (M), long (L), and extra long (EL) hay respectively. This resulted in the TMR of each diet having 6.4 (S), 17.4 (M), 18.6 (L), and 23.1% (EL) on the top screen of the PSPS. Fecal samples were collected by rectal sampling 1 d during the last wk of each period at 0, 1.5, 3.5, 5.5, 8.5, 11.5, 14.5, 18, 21.5, and 24.5 h after feeding. Each sample was wet sieved in duplicate with screen apertures of 6.7, 3.35, 1.18, 0.6, and 0.15 mm using a vibrational sieve shaker. All diets resulted in similar fecal particle size distributions: fecal mean particle lengths (mm) of the 4 diets were 1.14 ± 0.16 (S), 1.15 ± 0.14 (M), 1.12 ± 0.15 (L), 1.12 ± 0.15 (EL), suggesting a possible sorting behavior against long particles. Each diet showed a daily variation in fecal particle size distribution, possibly an indication of inconstant rumen activity or passage.

Key Words: Fecal Particle Size, TMR Particle Size

W211 Interaction between particle sizes of alfalfa hay and concentrate on lactation performance, chewing activity, and ruminal pH of dairy cows. M. A. Bal* and E. B. Buyukunal Bal, *Kahramanmaraş Sutcu Imam University, Turkey.*

The objectives of this study were to determine the interactions between alfalfa hay and concentrate particle sizes on intake, milk yield, milk composition, chewing activity, and ruminal pH of dairy cows. Alfalfa hay was chopped either at 4 cm (long; L) or 1 cm (short; S) TLC using a hay harvester mounted with 10 or 58 mm screens. Particle size of concentrate was obtained by grinding dry corn with a hammer mill either at 1 mm (coarse; C) or less than 1 mm (fine; F) mean particle size. Four lactating multiparous Holstein cows (averaging 70 DIM) were used in a 4x4 Latin Square design in a 2x2 factorial arrangement of treatments with 21-d periods. Treatment diets consisted of 33.5% alfalfa hay, 16.5% corn silage, 22.5% dry corn, 7% cottonseed meal, 6% soybean meal based concentrate (DM basis) which was formulated to contain 16% CP and 1.45 Mcal/kg NE_L, and were fed once daily as a TMR. Mean particle sizes of treatment alfalfa hays and concentrates were 4.9, 3.1, 0.9, and 0.5 mm for L, S, C, and F, respectively. Mean particle sizes of treatment TMRs were 4.0, 3.8, 3.0, and 2.6 mm for LC, LF, SC, and SF, respectively. Intake of DM was not different among treatments averaging 23.6 kg/d. Similarly, yields of milk and milk protein were not different among treatments averaging 22.8 and 0.75 kg/d, respectively. However milk fat yield tended to be higher (P= 0.07) for C (0.82 kg/d) than F (0.73 kg/d). There was an interaction trend (P= 0.1) for milk protein percentage of cows received SC (3.31%) compared to LC (3.24%). Although cows received LF (371 min/d) spent more time for eating than SF (332 min/d), cows received LC (325 min/d) spent less time for eating than SC (356 min/d; P< 0.05). Ruminal pH was higher at 9 h of post-feeding (P< 0.05; time-alfalfa hay particle size interaction) for both SF (6.50) and SC (6.36) compared to LF (6.06) and LC (6.17). The data indicate that cows received C had higher milk fat percentage and yield but particle size of alfalfa hay had no effect on lactation performance and ruminal pH possibly due to closest particle lengths.

Key Words: Particle Size, Lactation Performance, Ruminal pH

W212 Effects of live yeast supplementation on lactation performance and ruminal pH of dairy cows fed medium and high levels of dietary concentrate. M. A. Bal*¹, S. Goksu¹, and V. Akay², ¹*Kahramanmaraş Sutcu Imam University, Turkey*, ²*Global Nutritech Ltd., Kocaeli, Turkey.*

The objectives of this study were to determine the effect of live yeast supplementation (Global Nutritech Ltd., Kocaeli, Turkey) and dietary concentrate level interaction on DMI, milk yield, milk composition, and ruminal pH. Four multiparous Holstein cows (averaging 83 DIM) were assigned to one of four dietary treatments in a 4x4 Latin Square design in a 2x2 factorial arrangement with 21-d periods. The dietary treatments (DM basis) were: 1) 50% concentrate + 10 g/cow/d live yeast (50LY), 2) 50% concentrate + no live yeast (50NLY), 3) 70% concentrate + 10 g/cow/d live yeast (70LY), and 4) 70% concentrate + no live yeast (70NLY). Treatment 1 and 2 consisted of 43% corn silage, 7% alfalfa hay, 50% concentrate, and had 13.8% CP, whereas Treatment 3 and 4 consisted of 23% corn silage, 7% alfalfa hay, 70% concentrate, and had 15.7% CP. Diets were fed once daily as a TMR. Live yeast supplementation had only a numerical difference on DMI (18.0 vs. 17.5 kg/d), milk yield (20.2 vs. 19.1 kg/d), 3.5% FCM (19.4 vs. 18.8 kg/d) and ECM (20.0 vs. 19.2 kg/d) compared to no live yeast supplementation,

respectively. Live yeast supplementation tended to increase (P= 0.06) milk fat yield in 50LY (0.66 kg/d) compared to 50NLY (0.62 kg/d). Similarly live yeast supplementation tended to increase (P= 0.08) SNF percentage in 50LY (9.83%) compared to 50NLY (9.63%). Percentage of lactose tended to be higher (P= 0.07) for 50LY (4.52%) than 50NLY (4.41%). A more distinct effect of live yeast supplementation on ruminal pH was observed at 9 h of post-feeding (P= 0.05) and cows received 70NLY had the lowest ruminal pH (5.81) compared to cows received 70LY (6.40; P< 0.05). Although there were only numerical increases in DMI, milk yield, 3.5% FCM and ECM with the supplementation of live yeast, results indicated that live yeast supplementation at 50% dietary concentrate would increase milk protein, SNF, and lactose percentages. Ruminal pH reductions during the feeding of high dietary concentrate diets can be prevented with live yeast supplementation.

Key Words: Live Yeast, Lactation Performance, Ruminal pH

W213 Efficacy of SOLIS[®], NOVASIL[™]Plus, and MTB-100[®] to reduce aflatoxin M₁ levels in milk of dairy cows fed aflatoxin. R. Kutz*¹, J. Sampson¹, D. Ledoux¹, J. Spain¹, and M. Vázquez-Añón², ¹*University of Missouri, Columbia*, ²*Novus International, St. Charles, MO.*

An experiment was conducted to determine the efficacy of three adsorbents, SOLIS[®](SO; Novus International, Inc), NOVASIL[™]Plus(NOV), and MTB-100[®](MTB), in reducing aflatoxin M₁ (AFM₁) concentrations in milk of dairy cows fed an aflatoxin (AF)-contaminated diet. Twelve early to mid lactation dairy cows averaging 163 days in milk (DIM) were used in a 4 × 4 Latin Square Design (LSD) with 3 replications. Cows were blocked by parity, body weight, milk production, and were provided *ad libitum* access to feed and water. Within each replicate, cows were randomly assigned to the 4 dietary treatments for 4 consecutive 7 day periods. Diets included: AF (112 µg AFB₁/kg diet dry matter (DM)); AF plus 0.5% SO; AF plus 0.5% NOV; and AF plus 0.5% MTB. Milk samples were collected on days 6 and 7 of each of the 4 experimental periods. Feed intake, milk production, percent milk fat, percent milk protein, and somatic cell count scores were not affected (P > 0.05) by dietary treatments and averaged 22.29 kg/day DM, 33.87 kg/day, 3.78%, 2.95%, and 1.60, respectively across all treatments. Transfer rates of AF from feed to milk averaged 2.64, 1.48, 1.42, and 2.52% for cows fed AF, AF+SO, AF+NOV, and AF+MTB, respectively. Daily AFM₁ excretion in milk averaged 66, 37, 35, and 63 µg/day for cows fed AF, AF+SO, AF+NOV, and AF+MTB, respectively. The addition of SOLIS[®] and NOVASIL[™]Plus to the AF diet resulted in a significant (P < 0.05) reduction in milk AFM₁ concentrations (SO, 45%; NOV, 48%) and AFM₁ excretion (SO, 44%; NOV, 46%). In contrast, MTB-100[®] was not effective (P > 0.05) in reducing milk AFM₁ concentrations (4%), AFM₁ excretion (5%), or AF transfer from feed to milk (2.52%). Results indicate that SOLIS[®] and NOVASIL[™]Plus at 0.5% of the diet were effective in reducing milk AFM₁ concentrations in cows consuming a totally mixed ration containing 112 µg AFB₁/kg diet DM.

Key Words: Aflatoxin, Adsorbents, Lactating Dairy Cows

W214 Effect of an essential oil blend on performance of periparturient and early lactation dairy cows. M. D. Tassoul* and R. D. Shaver, *University of Wisconsin, Madison.*

Multiparous Holstein cows (n = 40) were used to examine effects of dietary supplementation with an essential oil blend (EO, CRINA®). Cows were randomly assigned to either control (C) or EO supplemented (1.2 g/cow/d) TMR. Treatments began three weeks prepartum and continued through 15 weeks in lactation. The dry cow TMR contained 70% forage comprised of 70% corn silage, 15% alfalfa silage and 15% wheat straw (DM basis). The lactation TMR contained 50% forage comprised of 60% corn silage, 33% alfalfa silage, 7% alfalfa hay (DM basis). Dry cow and lactation TMR were formulated to contain 12 and 17% CP (DM basis), respectively. There were no differences in plasma NEFA, BHBA, glucose, and urea-nitrogen concentrations measured on days -21, -7, -1, 1, 8, 15, 22, and 29 relative to calving. There was no difference in prepartum DMI, but lactation DMI was lower for EO than C (22.7 vs. 24.5 kg/d, P = 0.04). There were no differences in milk or FCM yields (P > 0.10). Milk true protein (TP) was 0.15%-units greater for C than EO (P = 0.03). Milk TP yield was greater for C than EO during weeks 1-5 (1.46 vs. 1.35 kg/d, P = 0.03). Energy balance tended to be lower for EO than C (-4.1 vs. -1.6 Mcal/day, P = 0.06), and was lower during weeks 6-10 and 11-15 (-1.8 vs. 0.8, P = 0.02; -1.0 vs. 3.3 Mcal/d, P = 0.006, respectively). Weekly body weights and condition scores were unaffected by treatment (P > 0.10). Feed efficiency (FE) tended to be greater for EO than C (2.15 vs. 1.99 kg milk/kg DMI, P = 0.06), and was greater during weeks 6-10 (2.18 vs. 1.97 kg milk/kg DMI, P = 0.04) and 11-15 (2.13 vs. 1.89 kg milk/kg DMI, P = 0.02). Fat-corrected milk FE tended to be greater for EO than C (1.98 vs. 1.83 kg FCM/kg DMI, P = 0.07). During weeks 6-10 FCM FE tended to be greater for EO than C (1.89 vs. 1.72 kg FCM/kg DMI, P = 0.08) and during weeks 11-15 was greater for EO (1.80 vs. 1.58 kg FCM/kg DMI, P = 0.03). Results suggest that dietary addition of EO improves feed efficiency in lactating dairy cows, but further research is needed to determine the mode of action.

Key Words: Essential Oils, Feed Efficiency

W215 Effects of essential oil combinations on in vitro rumen microbial fermentation of a high-concentrate diet for beef cattle. I. Fandiño¹, S. Calsamiglia¹, A. Ferret¹, D. Moya¹, J. Martin-Tereso², and H. ter Wijlen*², ¹Universitat Autònoma de Barcelona, Spain, ²Nutreco, The Netherlands.

Seven essential oils (*Tea Tree* TE, *Thyme* TH, *Oregano* OR, *Rosemary Moroc* RM, *Rosemary Tunes*, *Salvia* SA, *Clove* CL) and 13 different essential oil combinations were used in a 24 h batch fermentation study with a 10:90 forage:concentrate diet (16% CP, 32% NDF, 38 % starch) to study their effects on rumen microbial fermentation. Treatments were supplied at 10, 50, 200 and 400 mg/L of culture fluid and tested in triplicate in 2 consecutive periods (n = 6). Differences were declared at P < 0.05. Monensin reduced acetate (Ac) proportion, acetate to propionate (A:P) ratio, butyrate (Bu) proportion, branch-chained VFA (BCVFA) and NH₃-N concentration, and increased propionate (Pr) proportion, as expected. The TE and OR (50 and 200 mg/L) decreased Ac proportion and A:P ratio, and increased Pr and Bu proportions; TH (50 and 200 mg/L) decreased Ac proportion and A:P ratio, and increased Pr proportion; TH (200 mg/L) also decreased Bu proportion; SA (400 mg/L) increased Pr proportion, reduced A:P ratio and NH₃ N concentration, and tended to reduce total VFA concentration; TH and RM (400 mg/L) increased Ac and decreased Bu proportions, and total VFA concentration, and TH (400 mg/L) also decreased BCVFA and NH₃ N concentrations, suggesting that deamination was inhibited; CL (400 mg/L) decreased Pr proportion, and increased Bu proportion and A:P ratio. The combina-

tions 75%TE+25%TH (400 mg/L), 75%TE+25%CL (200 and 400 mg/L), 50%TE+50%CL (400 mg/L), 75%TE+25%OR (400 mg/L) and 50%TE+25%TH+25%OR (200 and 400 mg/L) decreased Ac proportion and A:P ratio and increased Pr proportion; 75%TE+25%CL (400 mg/L) tended to reduce pH, and 50%TE+25%TH+25%OR (400 mg/L) tended to reduce NH₃ N concentration. Careful selection and combination of these extracts may allow the manipulation of rumen microbial fermentation.

Key Words: Rumen Fermentation, Plant Extract

W216 Dose-response effects of Rumensin® supplementation on ruminal digestion kinetics of fiber and starch. M. S. Allen and Y. Ying*, Michigan State University, East Lansing.

Eight ruminally and duodenally cannulated multiparous Holstein cows were assigned randomly to replicated 4 x 4 Latin squares in a dose response arrangement of treatments. Treatments were Rumensin® supplementation at 0, 8, 16, and 24 ppm DM. Diets consisted of corn silage and alfalfa silage (2:1 ratio, DM basis), high moisture corn, distiller's grains (6.9% of diet DM), protein supplement, minerals and vitamins and contained 25% NDF, 18.5% forage NDF, 28.6 % starch and 16.5% crude protein. Treatment periods were 28 d with the final 11 d used for sample and data collection. Ruminal digestion kinetics were calculated using the pool and flux method. Rumensin® treatment increased dry matter intake (P = 0.02 cubic) but did not affect milk yield (mean = 39.8 kg/d, P = 0.77). Quadratic effects of treatment were detected for rates of digestion (P = 0.05) and passage (P = 0.02) of potentially digestible NDF; rate of digestion increased from 1.94 %/h for 0 ppm to 2.50 %/h for 8 ppm and then declined to 1.63 %/h for 24 ppm and rate of passage decreased from 2.56 %/h for 0 ppm to 2.06 %/h for 8 ppm and then increased to 3.09 %/h for 24 ppm. These resulted in quadratic effects of treatment on ruminal and total tract NDF digestibility (P < 0.08). Greater ruminal pool sizes of NDF, OM, and DM for 8 and 16 ppm compared to 0 and 24 ppm (all P < 0.06 for quadratic effect) were due primarily to greater dry matter intake because NDF turnover rate in the rumen was not affected by treatment (P > 0.80). Ruminal and total tract starch digestibility as well as starch digestion kinetics were not affected by treatment. Treatment tended (P = 0.09) to decrease ruminal pH linearly from 6.26 to 6.14. Treatment tended (P = 0.07 quadratic) to increase true ruminal OM digestibility for 8 and 16 ppm compared to 0 and 24 ppm but did not affect total tract OM digestibility. Lower concentrations of Rumensin® (8-16 ppm) might increase ruminal and total tract NDF digestibility without decreasing its filling effect in the rumen.

Key Words: Rate of Digestion, Rate of Passage, Rumen Fill

W217 Effect of feeding essential oils and monensin on fatty acid profiles of milk fat. M. L. He*¹, W. Z. Yang¹, C. Benchaar², A. V. Chaves¹, and T. A. McAllister¹, ¹Agriculture and Agri-Food Canada, Research Centre, Lethbridge, AB, Canada, ²Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre, Sherbrooke, QC, Canada.

Essential oils (EO) from plant extracts have been reported to have an antibacterial activity against gram-negative and gram-positive bacteria. Several of the gram-positive bacteria are involved in ruminal biohydrogenation of fatty acids (FA), thus suggesting that feeding EO could

lower biohydrogenation of FA because of a decrease in the number of bacteria involved in that process. In addition, it has been reported that cows fed monensin produced milk with greater concentration of trans-10 18:1 and trans-11 18:1. The objectives of this study were to evaluate the effects of two EO (garlic and juniper berry oils) and monensin on FA profiles of milk fat. Four ruminally fistulated Holstein cows were used in a 4 × 4 Latin square experiment. Cows were fed for ad libitum intake a TMR without supplementation (control), or supplemented with monensin (330 mg/day), garlic oil (5 g/day), or juniper berry oil (2 g/day). The FA composition of saturated, monounsaturated or polyunsaturated was not affected ($P > 0.10$) by supplementation of EO and monensin. However, proportion of conjugated linoleic acid trans 10, cis 12 (CLA t10, c12) was higher ($P < 0.04$) for cows fed EO (0.11%) or monensin (0.12%) than for control cows (0.09%). Supplementation of monensin also increased ($P < 0.10$) the proportion of total trans FA compared with the control. The higher trans FA was primarily due to higher C18:1 trans 6-8 FA with monensin. These results indicate that supplementation of the dairy cow diet with garlic or juniper berry EO or monensin had the potential to increase the proportion of CLA t10,c12 in milk fat with minimal overall effects on FA of milk fat. The results also confirm the increase of trans-10 18:1 in milk fat by feeding monensin to dairy cows.

Key Words: Plant Essential Oil, Milk Fatty Acids, Dairy Cows

W218 Effect of abomasal infusion of formate on milk protein of cows fed a methionine deficient diet. J. A. A. Pires*, N. J. Benevenga, G. A. Broderick, and R. R. Grummer, *University of Wisconsin, Madison.*

Carbon from formate is transferred to the methyl group of Met in milk protein via the folate cycle. We hypothesized that post-ruminal formate infusion to dairy cows would partially compensate for dietary Met deficiency and enhance milk protein production. Six midlactation cows were used in a balanced replicated 3×3 Latin square design, with 7 d periods and sample collection during last 4 d of each period. Treatments were continuous abomasal infusions of L-Met (20 g/d; positive control), sodium formate (3× molar amount of L-Met; requirements for methyl groups may be 2 to 4× that for methionine in support of protein synthesis) or sodium acetate (1/2 molar amount of formate, to provide equal amount of carbon; negative control). Cows consumed a diet deficient in metabolizable Met and Lys (18 g/d and 25 g/d, respectively, for a cow producing 40 kg milk/d; estimated from NRC, 2001) ad libitum for at least 4 wk prior to treatment administration. One wk prior to initiation of abomasal infusions, feed was offered at a rate to meet requirements for milk produced the previous 7 d. L-Lys was mixed with each treatment (25 g/d), leading to an estimated total supply of 2.4% Met and 7.1% Lys (MP basis). As expected, Met infusion increased milk protein percent (Table 1), but protein yield was not different, probably due to greater variability in milk production. Formate did not differ from acetate for any of the measurements. The formate infusion rate may have been insufficient to elicit a production response. Formate may also have been catabolized by gastrointestinal tract, or it may have been diverted to other products of the folate cycle in the liver.

Table 1. Treatment effects on milk production and composition.

	Acetate	Formate	Methionine	SEM	<i>P</i>
Milk yield, kg/d	31.5	32.2	31.7	2.29	0.68
Protein, %	3.04 ^b	3.02 ^b	3.18 ^a	0.07	0.01
Protein yield, g/d	956	970	1,005	66	0.32
Fat, %	3.73	3.65	3.56	0.20	0.39
Fat yield, g/d	1,183	1,170	1,130	110	0.61
Lactose, %	4.78	4.79	4.78	0.04	0.99
Lactose yield, g/d	1,512	1,544	1,518	116	0.73
MUN, mg/dL	9.84	9.68	9.85	0.53	0.90

a, b: $P \leq 0.01$

Key Words: Methyl-Donor, Formate, Methionine

W219 Feeding rumen-protected choline reduces the risk of hepatic lipidosis in transition dairy cows. F. S. Lima¹, B. A. Barton*², and J. E. P. Santos¹, ¹*University of Florida, Gainesville,* ²*Balchem Co., New Hampton, NY.*

Objectives were to determine the effects of feeding rumen-protected choline (RPC) on hepatic tissue composition and hepatic lipidosis in dairy cows. Holstein cows, 46, 20 multiparous and 26 primiparous, were fed either 0 (n = 25) or 60 g of RPC to deliver 15 g/d of choline (n = 21; Reashure, Balchem) top dressed onto the diet once daily from 25 d prepartum to 80 d in milk (DIM). Blood was sampled at 1 and 14 d postpartum and analyzed for concentrations of 3-OH-butyrate (BHBA). Hepatic tissue collected by percutaneous biopsy at 9 DIM was analyzed for concentrations glycogen, triglycerides and dry matter (DM). Cows were categorized as having hepatic lipidosis if hepatic triacylglycerol concentration was > 5% on a wet basis. Data were analyzed using the Mixed and Logistic procedures of SAS and odds ratios (OR) and 95% confidence intervals (CI) were calculated. Concentrations of BHBA were similar ($P = 0.53$) for cows fed control and RPC at d 1 (1012.7 ± 137.5 vs. 836.6 ± 143.4 mMol) and d 14 (927.0 ± 137.5 vs. 926.3 ± 143.3 mMol) postpartum. Concentration of glycogen in hepatic tissue was similar ($P = 0.35$) for cows fed control and RPC (0.94 ± 0.15 vs. 1.14 ± 0.16 %). Similarly, concentration of triglycerides in the hepatic tissue did not differ ($P = 0.31$) for cows in the control and RPC diets (5.9 ± 1.2 vs. 4.1 ± 1.3 %); however concentrations of triglycerides on a DM basis tended ($P = 0.10$) to be greater for control than RPC cows (10.4 ± 1.7 vs. 6.0 ± 1.9 %). Feeding RPC reduced the risk (OR = 0.23; 95% CI = 0.05, 1.06) of cows to have hepatic lipidosis (40.0 vs. 14.3%; $P = 0.05$). Concentrations of glycogen in hepatic tissue declined as concentrations of triglycerides increased (glycogen % = $1.251 - 0.04451 \times$ triglycerides%; $r^2 = 0.11$, $P = 0.01$). Feeding rumen protected choline reduced triglyceride concentration in liver DM tissue and the risk of hepatic lipidosis in early lactation dairy cows.

Key Words: choline, dairy cow, fatty liver

W220 Effects of alcohol-fermented feedstuff on the feed intake, feed efficiency, milk quality and profitability of Holstein cows. J. K. Choi¹, B. W. Kim², and J. S. Shin*², ¹*Dae Han Feed, Incheon, Kyonggee, South Korea,* ²*Kangwon National University, Chuncheon, Kangwon, South Korea.*

This study was performed to determine the effects of alcohol-fermented feedstuff (AFF) on the milk yield, feed efficiency, milk composition, somatic cell count of Holstein cows and the earning per cow. Fifty percent corn meal was combined with 50% brewery meal to make AFF in addition with 5% molasses and 2% yeast for fermentation. Feeding trials were divided into control, T1, T2, and T3 groups which were supplied by 0, 5, 10, and 15% of AFF out of whole dairy feedstuff (50% corn meal and 50% sudangrass silage), respectively. The experiment was conducted from July to November in 2006. Forty Holstein cows were assigned using a completely randomized design. The groups fed AFF diets had a higher feed intake; control (19.40kg), T1 (20.64kg), T2 (21.89kg) and T3 (22.19kg). Especially, the feed intake in T3 group increased by 14.9% compared to control. The milk yields were lower in T1 and T2 groups than control, however the most yield was observed in T3 group, which was increased by 20.6% compared to control. The feed efficiency in control, T1, T2 and T3 groups were 1.04, 0.78, 0.87 and 1.09, respectively. The feed efficiency of 4% FCM production was improved in T2 and T3 groups, especially in T3 group in which it was improved by 19.8% compared to control. There was no significant difference in milk fat, milk protein, lactose, total solid, solid not fat, milk urea nitrogen, and citric acid between the groups. Somatic cell counts in control, T1, T2, and T3 groups were 457,810, 285,200, 254,860, and 73,310 cells/ml, respectively. Most earnings were resulted in T3 group (10.43 dollar per cow/day), least in T1 and T2 groups (8.56 and 8.49 dollar per cow/day), and intermediate in control (9.21 dollar per cow/day). These results indicate that the use of about 15% alcohol-fermented feedstuff with a conventional dairy feedstuff can ensure more profitable earnings as well as improved milk quality in the Holstein farm.

Key Words: Alcohol, Milk Quality, Holstein

W221 Effect of feeding polyphenols on growth, health, nutrient digestion, and immunocompetence of calves. R. A. Oliveira¹, C. D. Narciso¹, R. Bisinotto¹, M. A. Ballou*², and J. E. P. Santos¹, ¹University of Florida, Gainesville, ²Texas Tech University, Lubbock.

Objectives were to determine effects of feeding polyphenols from pomegranate extract (POMx) on growth, health, nutrient digestion, and immunocompetence of calves. Holstein calves (n = 67), at 3 ± 1 d of age (d 0 = birth day) were assigned to 0 (control), 5 (POMx5), or 10 g/d (POMx10) of POMx containing 10% gallic acid equivalent. Calves received colostrum in the first 24 h, pasteurized milk thereafter until 61 d of age, and grain was fed in the first 70 d of age. Grain intake, attitude and fecal scores, incidence and duration of health disorders were evaluated daily. Rectal temperature was measured for the first 21 d of age. Body weight was measured at 2, 30 and 70 d of age. Neutrophil phagocytic and killing activities and antibody response to immunization with ovalbumin were measured. Peripheral blood mononuclear cells (PBMC) were cultured and cytokine production measured. Concentrations of glucose and 3-hydroxybutyrate (BHBA) were measured in plasma. Nutrient digestion was measured using total fecal collection during a 3-d period. Feeding POMx tended to reduce (P=0.07) grain intake and the response was linear (847 vs 787 vs 754 g/d), with effects observed after 30 d of age. BW gain in the first 30 d was similar (P=0.98) and averaged 377 g/d, but BW gain after 30 d of age declined linearly (P=0.02) with feeding POMx (830 vs 784 vs 721 g/d). Plasma concentrations of glucose decreased and of BHBA increased with age, but treatments had no effect (P>0.55). Neutrophil phagocytic (61.3 vs 62.0 vs 64.6%) and killing percentages (54.8 vs 53.4 vs 58.2%) were similar (P>0.65) for control, POMx5 and POMx10, respectively. In

vitro production of tumor-necrosis factor-alpha was similar among treatments, but a linear increase (P=0.05) in PBMC production of interferon gamma (102 vs 200 vs 297 pg/mL) and interleukin-4 (271 vs 432 vs 497 pg/mL) was observed. Serum anti-ovalbumin IgG increased with immunizations, and response was enhanced (treatment x day, P=0.04) by feeding POMx. Results indicate that humoral immune response was enhanced by feeding polyphenols despite reduction in grain intake and BW gain after 30 d of age.

Key Words: Calf, Polyphenols, Immunity

W222 Changes in milk aflatoxin concentrations in response to investigational sequestering agents added to aflatoxin-contaminated diets fed to lactating Holstein cows. L. Waltman*, S. Davidson, B. A. Hopkins, G. W. Smith, and L. W. Whitlow, North Carolina State University, Raleigh.

Three experiments (EXP) were conducted to determine the effect of investigational sequestering agents, including clays or non-digestible yeast oligosaccharides (NYO), on milk aflatoxin concentrations in lactating Holstein cows consuming aflatoxin. All EXP included two periods in a randomized block design. Cows were fed an aflatoxin-contaminated total mixed ration (TMR) for both periods of all trials. During the first period, cows received no sequestering agents, but agents were included in the TMR for the second period. In EXP 1 and 2 there were two 7 d periods and 12 cows per treatment. Milk samples from d 5-7 and d 11-13 were analyzed for milk aflatoxin (AFM1) concentrations by HPLC. Two treatments in EXP 1 were: 1) control (no agent) and 2) 100g/d of a mixture of NYO-A and diatomite-montmorillonite (DMM). Four treatments in EXP 2 were: 1) control (no agent), 2) 10g/d NYO-B, 3) 10g/d NYO-C, and 4) 10g/d NYO-D. In EXP 3 there were two 8 d periods and 14 cows total. Milk samples from d 4-8 and d 11-16 were analyzed for AFM1 concentrations by ELISA. Three treatments in EXP 3 were: 1) control (no agent) (n=4), 2) 50g/d NYO-C (n=5), and 3) 227g/d bentonite (n=5). For all EXP, the percent differences in AFM1 concentrations between periods 1 and 2 were calculated. All percent differences were normalized using a correction factor that converted values for controls to zero. The changes from zero (%) due to sequestering agents were considered significant at P < 0.05. In EXP 1, the addition of a mixture of NYO-A and DMM resulted in a 5.2% numerical increase in AFM1 concentration. In EXP 2, investigational agents NYO-B, NYO-C, and NYO-D resulted in 8.0%, 6.2%, and 9.5% numerical increases in AFM1 concentrations respectively. In EXP 3, NYO-C resulted in a 5.1% numerical decrease in AFM1 concentrations, and the bentonite resulted in a 60.4% significant decrease in AFM1 concentrations. In summary, the bentonite in EXP 3 reduced AFM1 concentrations (P=0.01). There were no significant changes (P>0.25) in AFM1 concentrations in response to investigational sequestering agents other than bentonite.

Key Words: Aflatoxin, Milk, Binder

W223 Effect of monensin concentration on dry matter intake during the transition period of lactating dairy cows. M. A. Shah*¹, G. Schroeder¹, B. D. Strang¹, and H. B. Green², ¹Cargill Animal Nutrition, Elk River, MN, ²Elanco Animal Health, Greenfield, IN.

Feeding monensin to dairy cows is known to increase milk production efficiency (milk/unit energy intake). We analyzed data collected from

966 cows from nine randomized complete block design trials conducted in the US and Canada in which 4 doses of monensin (0, 7, 15, 22 g/ton of dry matter intake (DMI)) were fed for a complete lactation. The PROC MIXED and PROC NLIN procedures in SAS were used to analyze data. DMI and milk yield data were analyzed with monensin dose as fixed effect and location as a random variable. Location and cows were used as random factors and week in milk (WIM) as repeated measure in the model. Increased production efficiency (Milk/DMI) (1.51, 1.52, 1.56 and 1.59 ± 0.03 ; $P < 0.0001$) was a result of a linear reduction in DMI (20.4, 20.4, 19.8 and 19.6 ± 0.17 kg/d; $P = 0.003$) and similar milk yield (31.6 ± 0.4). When weekly DMI data for the first 12 WIM was analyzed using an exponential model ($DMI(t) = a - b \times \exp(-c \times t)$; where $DMI(t)$ = weekly DMI for corresponding WIM, a = asymptotic maximum DMI, b = potential increase in DMI, c = fractional rate of increase of DMI with WIM, and t = WIM) the rate of change in DMI was linearly increased as monensin dose increased (0.036, 0.047, 0.045, and $0.051 + 0.004$ % per d; $P = 0.007$). This also resulted in a linear increase in production efficiency (1.89, 1.92, 1.96, and 2.01 ± 0.04 ; $P < 0.0001$). These results may indicate that monensin may have a different effect on DMI depending on rumen dynamics or energy status of the cow. A faster intake recovery was associated with a reduction in the incidence of ketosis (12.7 % for control versus 6.2, 7.0 and 4.2 % for monensin treated, $P = 0.03$, 0.06 and 0.04, respectively), but there was no effect on reproductive efficiency (services per conception, days open, days to first service, calving interval and days open) except lower first service conception rate (37.5%) at 22 g/ton compared to the control group (49.6%). Feeding monensin to transition cows may help improve energy balance through a higher rate of DMI increase during early lactation.

Key Words: Monensin Concentration, Exponential Model, DMI

W224 Effect of malic acid on rumen fermentation *in vitro* with DHA diet. L. Liu, J. Q. Wang*, D. P. Bu, S. J. Liu, K. L. Liu, H. Y. Wei, and L. Y. Zhou, *Chinese Academy of Agricultural Sciences, Beijing, China*.

The objective of this study was to evaluate changes in rumen fermentation when different levels of malic acid were added in a DHA-enriched diet. The rumen-simulation technique (RUSITEC) apparatus containing eight vessels was employed in this experiment. Treatments were as follows: (1) base diet rich in DHA (CON); (2) base diet with 10 mM malic acid (Trt1) and (3) base diet with 20mM malic acid. This study was repeated at two-week intervals. Experimental period was 7 d including 6 d for adaptation and 1 d for sampling. Culture fluid was collected every 3 h over a 12 h period on the last day of each experimental period. The concentration of VFA was analyzed by gas chromatography (model 6890, Series II; Hewlett Packard Co., Avondale, PA). Data were analyzed with PROC MIXED procedure of SAS for a completely randomized design with repeated measures. The results showed that with the addition of malic acid, culture fluid pH numerically decreased ($P > 0.05$) from 6.17 to 6.14 and 6.09 for CON, Trt1 and Trt2, respectively. However, addition of malic acid in a DHA diet had no effect on acetate concentration in culture fluid ($P > 0.05$). Contrarily, propionate and butyrate concentration in culture fluid increased when malic acid was added. Compared to CON, concentration of propionate in Trt1 and Trt2 increased by 30.37% and 62.37%, respectively. Butyrate concentration increased by 21.76% and 24.85% for Trt1 and Trt2. The proportion of acetate to propionate decreased significantly ($P < 0.01$). Results suggest that malic acid supplementation in a DHA diet changes the rumen fermentation process.

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Key Words: DHA Diet, Malic Acid, Rumen Fermentation

W225 Effect of physical particle size on ruminal and post-ruminal disappearance of nutrients of a mixed concentrate in Holstein steers. H. Jahani-Azizabadi¹, M. Danesh Mesgaran*¹, and A. Rahmatimanesh², ¹*Ferdowsi University of Mashhad, Mashhad, Mashhad, Iran*, ²*Heram Talae Shargh Feed Mill Company, Nishabour, Iran*.

In situ ruminal and post-ruminal disappearance [dry matter (DM), crude protein (CP) and ether extract (EE)] of a mixed concentrate prepared as fine mesh (fm), fine pellets (fp) and coarse pellets (cp) were studied. All pellets were provided in a condition of 70°C with pressure of 3 bars in 7 seconds. Concentrate was composited of cereal grain, soybean meal, canola meal, fish meal, urea, wheat bran, beet pulp, bagasse, salt, sodium bicarbonate, mineral and vitamin premix, anionic salt, molasses, sugar, protected fatty acid and Mg oxide (318, 60, 150, 15, 3.6, 250, 33, 40, 6.7, 8.6, 8, 15, 55, 30, 5 and 2.1 g/kg DM, respectively). Four Holstein steers (430 ± 50 kg, BW) fitted with ruminal fistulae and T-shaped intestinal cannulae were used. Steers fed (DM basis) 2.5 kg of alfalfa hay, 2.1 kg of corn silage, 1.5 kg of straw and 2.5 kg of concentrate (170 g CP/kg of DM). Approximately 5 g of sample (DM) was placed in polyester bag (12x19 cm, pore size of 48 μ m, n=8), then incubated in the rumen for 12 h. After removal from the rumen, bags were washed and dried. Then, 1 g DM of un-ruminal disappeared sample was weighed into a mobile bag (3x6 cm, pore size of 48 μ m, n=8) and inserted in small intestine, then removed from the voided feces and rinsed in cold tap water. DM, EE and CP of intact and incubated samples were determined. Data were analyzed using completely randomized design. Ruminal DM, CP and EE disappearance of fm was significantly ($P < 0.01$) lower than fp and cp. Ruminal DM, CP and EE disappearance of fp was significantly ($P < 0.01$) higher than cp (0.71, 0.61 and 0.65 vs. 0.67, 0.58 and 0.59, respectively). Post-ruminal DM, CP and EE disappearance of fm concentrate (0.45, 0.50 and 0.80, respectively) was significantly ($P < 0.01$) higher compared with fp (0.35, 0.38 and 0.68, respectively) and cp (0.39, 0.38 and 0.57, respectively). Results of the present study indicated that the physical particle size of a mixed concentrate might impact on ruminal and post-ruminal disappearance of DM, CP and EE.

Key Words: Physical Processing, Disappearance, Mobil Nylon Bag

W226 Influence of an α -amylase on *in vitro* ruminal fermentation and starch degradation. W. Hu*¹, M. E. Persia², and L. Kung, Jr.¹, ¹*University of Delaware, Newark*, ²*Syngenta Animal Nutrition, Research Triangle Park, NC*.

A thermostable α -amylase was isolated and then expressed in corn grain. Although this amylase was specifically developed for use in ethanol production, because it has completed the FDA consultation process for food and feed, the utility of this amylase as a feed enzyme on rumen fermentation and starch degradation *in vitro* was explored. In experiment 1, pure corn grains were fermented individually with inoculums of rumen fluid and artificial saliva for 6 h at 40°C. Four corns were evaluated: flint, opaque and two corns with near identical nutrient profiles: one containing amylase (CA) and the other the isogenic control (IC).

Flint corn produced less ($P < 0.05$) total VFA (18.3 mM) than the other three corns (an average of 25.3 mM), validating the ability of the assay to detect differences in fermentation among hybrids. No difference ($P > 0.05$) was noted in total VFA production from CA when compared to IC, but there was a small but significant increase in starch degradation (90.6 vs. 89.7%, $P < 0.01$). In experiment 2, mixtures of the CA and IC corns (0, 25, 50, 75 and 100% CA grain concentrations) were fermented using the same *in vitro* model. Total VFA production was not different ($P > 0.05$) among treatments for any concentration of CA (0 to 100%). These data suggested that the amylase was not sufficiently active at the physiological temperature of the rumen. To test this hypothesis, CA and IC were incubated in water at 40 and 65°C for 24 h to determine starch degradation. Apparent starch degradation at 40°C was 1.99 and 1.60% for CA and IC, respectively. When both grains were incubated at 65°C, the apparent starch degradation was 10.56 and 0.85% for CA and IC, respectively. This >10-fold increase in starch degradation of the CA grain incubated at 65°C resulted in an interaction between corn variety and temperature. These data clearly demonstrate that amylase activity is expressed sufficiently in CA at a high temperature (65°C) but the amylase activity does not have any positive or negative effects at physiological temperature of the rumen (40°C) when used as a feed enzyme for ruminant production.

Key Words: Corn, Amylase, Starch

W227 N and energy synchronization of barley: Effect of variety and growth year. P. Yu* and K. Hart, *University of Saskatchewan, Saskatoon, SK, Canada.*

The objective of this study was to investigate N and energy synchronization of six barley varieties during three consecutive growth years of 2003, 2004 and 2005 in order to determine the magnitude of the differences between the varieties and growth years which affect optimizing rumen fermentation. The synchronization of N and energy was indicated by hourly effective degradation ratio between effectively degraded N and CHO. The difference in cumulative amounts degraded at successive hours was regarded as the amount of degraded each h. The experimental design was a RCBD and the data was analyzed using SAS Mixed Model procedure. The results showed less difference at the beginning of the incubations. However, with increasing incubation times, the difference was highly increasing among the varieties. At the beginning of the incubation, hourly effective degradation ratio of N/CHO was 3 to 5 g/kg. At 10 h incubation, the ratio ranged from 24 to 30 g/kg ($P < 0.05$). With further increasing times, the ratios were also increased ($P < 0.05$). However, the different varieties resulted in different magnitude of increments in ratio. The lowest increase was from 3 to 41 g/kg for CDC Trey. The highest increase was from 5 to 225 g/kg for Cowboy. The variations between the growth years were smaller at the beginning of incubations, but variations increased ($P < 0.05$) with increasing incubation times.

Key Words: Synchronization, Hourly Effective Degradation Ratio of N to CHO, Barley Variety

W228 Effects of fibrolytic enzymes on *in vitro* digestibility of destoned olive cake. D. Elia¹, P. P. Danieli¹, P. Bani², and U. Bernabucci*¹, ¹*Dipartimento di Produzioni Animali, Viterbo, Italy*, ²*Istituto di Zootecnica, Piacenza, Italy.*

Olive cake has a poor digestive utilization and can negatively interfere with the ruminal microflora activity. The use of exogenous enzymes can improve ruminal digestion of fibrous feedstuffs. Aim of the present study was to evaluate the effect of two different exogenous enzymes treatment (Natuzym S.F.[®] cellulase = CELL and an experimental impure macerage preparation = MAC) on *in vitro* feed utilization of destoned olive cake (DOC). CELL and MAC were added at the dose of 0.8 g/kg of DOC. *In vitro* evaluations were carried out using, as a substrate, the treated (CELL and MAC) or untreated (C) olive cakes alone or added (5 or 10%) to a TMR for dairy cattle. NDF digestibility (48 hours = NDFD) was measured according to the Ankom DaisyII procedure whereas *in vitro* gas production (GP) test was carried out for 72 hours in glass bottles by a pressure transducer method and measuring final AGV concentration in the fermentation liquor. Enzymatic treatment did not reduce NDF content of DOC. NDFD was numerically but not statistically lower in the treated samples (26.16, 23.55 and 22.56% for C, CELL and MAC, respectively). Enzymes reduced GP (0.26, 0.20 and 0.19 ml/mg of incubated sample, for C, CELL and MAC, respectively), but higher VFA concentration was measured for CELL. When added to the TMR substrate, olive cake increased GP and VFA concentration in a dose dependent manner. Enzymatic treatments significantly improved GP (+17%) but not VFA production. The additional amount of gas production due to addition of olive cake to TMR was not simply explained by the higher substrate available, suggesting an interference with the microbial activity. Adding olive cake had only minor influence on main VFA molar ratio, but total isoacids were significantly reduced. Enzymatic treatments did not improve DOC digestibility but had some positive effects when treated DOC was added to TMR. In general, olive cake showed positive effects on *in vitro* digestibility of TMR for dairy cattle.

Key Words: Destoned Olive Cake, *In Vitro* Digestibility, Exogenous Fibrolytic Enzymes

W229 The effect of alcohol fermented feedstuff made of byproduct on *in vitro* fermentation characteristics and NDF disappearance. J. S. Shin¹, G. Z. Lin², and B. W. Kim*¹, ¹*Kangwon National University, Chuncheon, Kangwon, South Korea*, ²*Linyi Normal University, Linyi, Shandong, China.*

An *in vitro* study was conducted to examine the influence of alcohol-fermented feedstuff formulated with byproduct on the fermentation characteristics and NDF disappearance. Dietary treatments were a commercial beef cattle feed-based sudan grass silage (Control) and soybean curd-based alcohol-fermented feedstuff (AFS). The control was composed of 70% commercial beef cattle feed and 30% sudangrass silage. Fifty percent commercial beef cattle feed and 50% soybean curd dreg were combined to make AFS with addition of 5% molasses and 0.5% yeast for fermentation. The ruminally cannulated Korean cattle were utilized to investigate the change of ammonia, pH, alcohol, volatile fatty acids, and NDF disappearance at 0, 2, 4, 8 and 12-h *in vitro* incubation. Ammonia concentrations and pH were similar for both dietary treatments during all incubation periods, although the decrease of pH was slightly less in AFS compared to control during later periods of incubation (pH 6.4 in control and pH 6.6 in AFS at 12-h incubation). The alcohol concentrations were significantly higher in AFS at all incubation times. Especially, the difference of alcohol concentrations between control and AFS was greatly increased with longer incubation time (0.5 mg/dl in control and 4 mg/dl in AFS at 2-h incubation vs 0.7 mg/dl in control and 7 mg/dl in AFS at 12-h incubation). The acetate concentration was

slowly decreased in AFS compared to control with longer incubation time. Lower concentrations of propionate and butyrate were observed in AFS at all incubation times ($p < 0.05$). The NDF disappearance did not differ between control and AFS, although AFS showed little higher NDF disappearance during initial periods of incubation (4% in control and 6% in AFS at 2-h incubation). It is concluded that an alcohol fermented feedstuff made of the industrial byproduct such as soybean curd dreg can be effective materials to substitute the conventional beef cattle feed and resulted in similar or better fermentation characteristics and NDF disappearance during *in vitro* incubation.

Key Words: *In Vitro*, Alcohol, Soybean Curd

W230 Comparison of chemical composition and digestibility among wheat straws treated by white-rot fungi. O. D. Montañez-Valdez*¹, J. H. Avellaneda-Cevallos², E. O. Garcia-Flores³, J. M. Tapia-Gonzalez¹, G. Rocha-Chavez¹, I. E. Morales-Zambrano¹, and E.C. Guerra-Medina³, ¹Centro Universitario del Sur de la Universidad de Guadalajara, Ciudad Guzman, Jalisco, México, ²Universidad Técnica Estatal de Quevedo, Quevedo, Los Rios, Ecuador, ³Centro Universitario de la Costa Sur de la Universidad de Guadalajara, Aulán de la Grana, Jalisco, México.

A study was conducted to evaluate the effect of *Pleurotus pulmonarius* on chemical composition and *in situ* digestibility of DM, OM, ADF, NDF of wheat straw. Wheat straw treated and untreated with *Pleurotus pulmonarius*, were obtained from a commercial facility. Ten samples were obtained at random and combined to analyze dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), hemicellulose (HC) and lignin (L) of each wheat straw. Data were analyzed by mean comparison using a T Student test. No differences ($P \geq 0.05$) between treatments were found for DM, CP and hemicellulose; however, treated straw ($P \leq 0.05$) showed higher percentages of OM, NDF, and ADF. There were no differences ($P \geq 0.05$) among treatments on *in situ* digestibility of DM, OM, ADF, NDF, CP or HC, but the highest coefficients of digestibility were observed in the treatment of treated straw. The growth of *Pleurotus pulmonarius* on wheat straw changes its chemical composition by increasing organic matter content and modifying cell wall components, this may improve the nutritional quality of agricultural byproducts. This process may allow using *Pleurotus pulmonarius*-treated straw for ruminant feeding.

Table 1. Chemical composition and *in situ* digestibility for untreated and *Pleurotus pulmonarius* treated wheat straws (%)

Component	NC ¹	TS ²
DM	96.43a	96.54a
OM	83.87b	88.07a
CP	4.42a	4.78a
ADF	40.38b	45.81a
NDF	61.44b	67.25a
HC	21.06a	21.44a
Lignin	11.45b	8.50a
Ash	16.13a	11.93b
Coefficients of digestibility <i>in situ</i>		
DM	60.23	63.40
OM	87.34	89.98
ADF	54.89	59.76
NDF	52.64	57.30
HC	51.06	57.66

¹ Negative control ²Treated wheat straw ^{a,b}Different letters in the same row differ ($P \geq 0.05$)

Key Words: Agricultural Byproducts, *Pleurotus*, Chemical Composition

W231 Effects of genetics and water management on corn plant NDF digestibility. I. Fusaro*¹, N. Brogna², A. Palmonari², G. Biagi², C. J. Sniffen³, and A. Formigoni², ¹Dipartimento di Scienze Degli Alimenti, Università di Teramo, Teramo, Italy, ²DIMORFIPA, Università di Bologna, Ozzano dell'Emilia, Bologna, Italy, ³Fencrest, LLC., Holderness, NH.

Objective of this study was to evaluate the NDF digestibility of three corn hybrids selected for silage: T (traditional), L and BMR (high digestibility hybrid provided by Long Island Cauliflower Association). The hybrids were grown in farms with different agronomic conditions in Northern Italy. Two farms had 55% gravel soil with a furrow irrigation system (F) while the other two had a sandy loam soil and a sprinkler system (S). The hybrids were seeded in March with a density of 7 plants/m². Nitrogen was applied as urea at 450 kg per ha, at the fifth leaf stage. The growing season had low rainfall (120 mm instead of 190 mm of the last thirty year); average and highest temperatures recorded were respectively 30.5 (May, June, July) and 38.6 °C (July). F irrigation system spread water 355 mm/m² for 6 times while 50 mm/m² for 5 times for S system. At the harvest time (last week of July) for each hybrid and from each farm 4 samples of chopped corn and 8 entire plants, randomly selected, were collected. The plants were separated into stalk, leaves and ear; the ears were then split into grain, cob and husk. The husks were analyzed with leaves, and grain has not been processed. All the samples were dried at 60°C and analyzed for chemical composition and *in vitro* NDF digestibility at 24h (IVNDFd), with Tilley&Terry technique. The results relative to irrigation system showed no statistical differences for IVNDFd in fresh corn samples and plant parts ($P > 0.05$). The IVNDFd was higher in BMR fresh corn samples than in T and L ($P < 0.05$), as L than T but without statistical differences. BMR cob and stalk showed the better results in IVNDFd than the L and T hybrids ($P < 0.05$). Cob IVNDFd was higher in L than in T hybrid ($P < 0.05$). Higher digestibility of L chopped corn than T one, could be a consequence of this characteristic. These results show that a proper choice of the corn hybrid is important to achieve a better corn silage digestibility over the irrigation strategy.

Key Words: Corn Hybrids, Irrigation, NDF Digestibility

W232 Please see abstract 53.

W233 Please see abstract 55.

Ruminant Nutrition: Proteins and Amino Acids - Beef, Sheep and Misc Ruminants

W234 Effect of dietary CP level on visceral organ mass and the protein expression of ATP synthase and Na⁺/K⁺-ATPase in steers. Y. J. Wang*, S. Holligan, H. Salim, M. Z. Fan, B. W. McBride, and K. C. Swanson, *University of Guelph, Guelph, ON, Canada.*

Twenty-four beef steers (510 ± 6.7 kg BW) predominately of Angus breeding were used to determine the effect of dietary CP levels on visceral organ mass and the protein expression of ATP Synthase and Na⁺/K⁺-ATPase. Steers were allotted to 6 pens (4 steers per pen, 1 from each treatment) in a randomized block (pen; week of slaughter) arrangement of treatments consisting of high-moisture corn based diets containing 8.8, 12.1, 13.2 or 15.4% of dietary CP (DM basis), respectively. The starting date of the experiment was staggered so that all steers were on treatment for 28 d, and 4 steers from the same pen were slaughtered per week for 6 weeks and visceral organs were removed. Liver, kidney, rumen and jejunum were sampled. Wet tissue weight and intestinal length were recorded. The protein expression of ATP synthase and Na⁺/K⁺-ATPase in liver, kidney, rumen and jejunum was analyzed by Western blotting. Final BW and ADG increased linearly (kg; P < 0.008) as CP increased. Kidney, liver, lung, and rumen weights (g) increased linearly (P < 0.05) with increasing CP. Lung weight on a BW basis (g/kg BW) was also linearly increased (P < 0.05) with increasing CP. The protein expression of ATP Synthase in liver increased as CP level increased from 8.8 to 12.1% and decreased as CP level increased from 12.1 to 15.4% (P < 0.05). Kidney ATP Synthase increased linearly (P < 0.05) as CP increased. There was also a linear increase (P ≤ 0.05) in jejunum Na⁺/K⁺-ATPase with increasing CP. These results indicate that increasing dietary CP level increases ADG and the mass of kidney, liver, lung and rumen, and alters expression of proteins involved with ATP production and utilization in liver, kidney, and small intestine.

Key Words: Dietary CP, Expression of ATP Synthase and Na⁺/K⁺-ATPase, Steer

W235 Intake and total and partial digestibility of nutrients, ruminal pH and ammonia concentration in beef cattle fed diets containing soybean silage. J. P. Rigueira, O. G. Pereira*, M. I. Leão, S. C. Valadares Filho, and R. Garcia, *Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.*

The intake and total apparent and partial digestibility of nutrients, ruminal pH and ammonia concentration were evaluated in beef cattle fed diets containing soybean silage (SS), SS with microbial inoculant (SSI), SSI with molasses (SSIM) and SS with molasses (SSM). Diets consisted of 40% soybean silage, 30% corn silage and 30% concentrate, being formulated to be isonitrogenous (13% CP, DM basis). The inoculant used was Sil All C4 (Altech, Brasil). Powder molasses was used in the ratio of 2.5% in natural basis. Four crossbred Holstein × Zebu steers, fistulated in the rumen and abomasum with 230 kg initial body weight, were assigned to a 4×4 Latin square design. Chromic oxide was used as a marker to estimate fecal and abomasal dry matter flows. The intakes (kg/day) and total, ruminal and intestinal apparent digestibilities of all nutrients were not influenced (P > 0.05) by diets. However, the intake of DM and NDF, as % BW, were affected (P < 0.05) by diets, where the animals fed the SSIM diet had higher intake than those fed SS diet. Mean values of 73.5 and 75.0; 70.4 and 44.0; 78.8 and 28.3; 73.3 and 86.2%, were calculated for the apparent total tract and ruminal digestibilities of DM, CP, EE and neutral detergent fiber correct

for ash and protein (NDFap), respectively. The ammonia concentration and ruminal pH were not influenced (P > 0.05) by diets and the mean values were 11.91mg/100ml and 6.45, respectively. Molasses, with or without microbial inoculant, in soybean silage did not affect intake and digestibility of nutrients, nor pH and ruminal ammonia concentration in beef cattle.

Financial support by CNPq and FAPEMIG

Key Words: *Glycine max*, Rumen Fermentation, Silage Additive

W236 Dry matter intake and performance of Nellore steers fed diets based on different proportions of soybean and corn silages. W. F. Souza¹, O. G. Pereira*¹, K. G. Ribeiro², S. C. Valadares Filho¹, A. S. Chaves¹, F. Zamuner¹, and G. A. Aguiar¹, ¹*Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.* ²*Universidade Federal dos Vales do Jequitinhonha e Mucuri, Diamantina, Minas Gerais, Brazil.*

A trial was conducted with 30 Nellore steers (372 kg), castrated, and distributed in 6 randomized blocks to evaluate the effects of different proportions of soybean (SS) and corn silages (CS) on dry matter intake, ADG, carcass gain, feed conversion and carcass yield. The diets consisted of 60% silage and 40% concentrate (DM basis), and were formulated to contain 12.5% CP (DM basis). Treatments consisted of different proportions of soybean and corn silage: 100:0; 75:25; 50:50; 25:75 and 0:100, respectively (DM basis). The experiment was conducted for 84 d (15 d for diet adaptation, and 3 periods of 28 d for data collection). Steers were individually fed for ad libitum intake twice daily at 0700 and 1500. There were no differences (P > 0.05) in the daily intake of DM (kg/d or % BW) among treatments (Table 1). Similarly, no treatments effects were observed on ADG, carcass gain, and feed conversion, which were, on average 0.683 kg/day, 1.16 kg/day, and 7.66, respectively. Although animal performance was similar among the diets, an economic evaluation is necessary.

Financial support by CNPq and FAPEMIG

Table 1. Effect of different proportions of soybean and corn silages on dry matter intake (DMI), average daily gain (ADG), carcass gain (CG), and feed conversion (FC)

SS:CS	DMI, kg/d	DMI, %BW	ADG, kg/g	CG, kg/d	FC
100:0	8.67	2.09	1.21	0.665	7.3
75:25	8.75	2.07	1.14	0.688	7.65
50:50	8.95	2.02	1.21	0.690	7.45
25:75	8.92	2.12	1.1	0.698	8.13
0:100	8.96	2.17	1.17	0.678	7.77

Key Words: Carcass Gain, Feed Conversion, *Glycine max*

W237 Efficacy of condensed glutamic acid fermentation solubles as a nitrogen source in ruminant diets. A. I. Soria-Flores* and L. L. Berger, *University of Illinois, Urbana.*

The efficacy of feeding a new condensed extracted glutamic acid fermentation solubles (GAFS) with GAFS containing *Corynebacterium*

in feedlot cattle. Twenty-four dairy-beef steers (425.8 ± 0.9 kgs) were randomly assigned to 6 pens (4 steers/pen). Steers were fed one of three diets: The Control diet was 72.5% cracked corn, 20.0% chopped hay, 5.0% molasses, 1.3% urea. The Old GAFS and New GAFS replaced the molasses and urea. Diets were formulated to meet NRC nutrient requirements for growing steers. Blood samples were collected to determine differences in metabolic profile due to diet. Steer performance was similar across diets (table). Significant differences in kidney heart and pelvic fat (KHP) percentage, and USDA yield grade are not considered to be biologically important. Metabolic profile showed that most measurements were within the normal range for healthy animals. However, blood Na concentrations decreased ($P < 0.01$) for GAFS diets (140.7 mEq/L) vs. Control (142.0 mEq/L) steers. GGT production was increased ($P = 0.03$) in GAFS diets (24.3 U/L) vs. Control (17.5 U/L). In summary, based on animal performance, carcass traits and metabolic profile of steers, New GAFS is similar to Old GAFS, and supported feedlot performance similar to a typical control diet.

Table 1. Carcass Data and Animal Performance

	Control	Old GAFS	New GAFS	SE	P
Initial Weight,kg	425.9	425.5	426.1	6.06	0.99
Final Weight,kg	560.7	547.0	551.6	12.45	0.73
DM Intake,kg/d	10.0	9.4	9.6	0.38	0.44
ADG,kg/d	1.36	1.23	1.27	0.10	0.66
Feed Efficiency,(G:F)	0.14	0.13	0.13	0.01	0.91
Hot Carcass Weight,kg	317.1	311.5	316.6	8.97	0.99
KHP fat,%	1.0 ^A	1.4 ^B	1.3 ^B	0.09	0.03
USDA Marbling ^C	412.5	450.0	487.5	14.94	0.01
USDA Yield Grade	2.0 ^A	2.0 ^A	1.5 ^B	0.11	0.01
Calc. Yield Grade	2.1	2.5	2.3	0.18	0.23

^{A,B}P < 0.05; ^C300=Standard;400=Select;500=Choice;800=Prime

Key Words: GAFS, Feedlot Cattle, AA Supplementation

W238 *In vitro* gas production kinetics of protein sources used in sheep nutrition. A. S. Juarez-Reyes*¹, M. Murillo-Ortiz¹, M. A. Cerrillo-Soto¹, J. F. Obregon², and F. G. Rios², ¹FMVZ-Universidad Juarez del Estado de Durango, Durango, Durango Mexico, ²FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico.

A study was conducted to evaluate the *in vitro* gas production characteristics of protein sources commonly used in sheep nutrition practices in the dry tropics of northwest Mexico. Samples (200 mg DM) of cotton seed meal (CSM), corn distiller dried with solubles (CDD), overheated sesame meal (OSM), safflower meal (SM), canola meal (CM), and soybean meal (SBM), were placed in 100 ml calibrated glass syringes by triplicate. Buffered and mineral solutions were mixed in a 2:1 proportion with rumen fluid collected from three rumen cannulated sheep fed alfalfa hay and a commercial concentrate (75:25). Thirty ml of buffered rumen fluid was dispensed to each syringe at the time incubation started. The gas volume was recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96 h. Data obtained were fitted to the equation: $p = a + b(1 - e^{-ct})$ using PROC NLIN. Metabolizable energy content from *in vitro* gas production was determined by: ME (Mcal kg⁻¹ DM) = (2.20 + 0.136 Gas Prod_{24h} + 0.057 Crude Protein + 0.0029 Crude Fat²)/4.184. Data were then analyzed using ANOVA for a completely randomized design. The gas produced

from the soluble (a) fraction in CM was significantly ($P < 0.05$) higher than other feeds. Corn distillers dried, followed by SBM, registered the higher ($P < 0.05$) gas produced from the slowly degraded b fraction. The constant rate of gas production (c) was higher ($P < 0.05$) in CM. The potential gas production a + b was higher in CDD. The ME content was higher ($P < 0.05$) in SBM followed by CM. Variables such as constant rate of gas production c might indicate a good availability of nitrogen in the rumen, whereas the ME content of analysed feeds shows a non negligible energy content.

Table 1. *In vitro* gas production characteristics of sources of protein used in sheep nutrition practices in northwest of Mexico

Feed	Parameters				ME
	a	b	c	a+b	
CSM	5.53 ^b	39.09 ^c	0.053 ^d	44.63 ^d	2.22 ^d
CDD	6.54 ^b	61.63 ^a	0.036 ^e	68.17 ^a	2.29 ^c
OSM	4.19 ^b	26.55 ^e	0.085 ^c	30.74 ^e	2.05 ^e
SM	7.27 ^b	33.86 ^d	0.097 ^b	41.13 ^d	2.19 ^d
CM	13.26 ^a	40.14 ^c	0.111 ^a	53.40 ^c	2.70 ^b
SBM	4.84 ^b	53.08 ^b	0.090 ^{bc}	57.92 ^b	2.88 ^a
Mean	6.94	42.39	0.079	49.33	2.386
SEM	0.77	2.85	0.006	2.95	0.072

^{a,b,c,d,e} Means within columns with different superscript differ ($P < 0.05$).

Key Words: Gas Production, Protein Sources, Sheep

W239 Effects of dried distillers grains with solubles as a replacement for soybean meal and corn in diets fed to Boer-cross feeder kids. R. Cox*, T. Hutchens, G. Rentfrow, and G. Anderson, *University of Kentucky, Lexington.*

One hundred sixty crossbred feeder kids were used to characterize the effects of replacing soybean meal (SBM) and whole corn (WC) energy with dried distillers grains with solubles (DDGS) on growth and carcass characteristics. Crossbred feeder kids were randomly assigned to 4 dietary treatments. All kids were given ad libitum access to water and a control diet (0%) containing WC, SBM, soybean hulls (SBH) and Kentucky 31 tall fescue hay (KY-31), or energy replaced with DDGS at 10, 15 and 25% of total diet. All kids were fed concentrates at 3% of live body weight. Each treatment had 2 replications with 20 kids per replication. Kids were allowed 14 d to acclimate to the diets prior to beginning of the trial. Kids in each treatment group were weighed at 0, 14, 28, 42 and 56 d. Feed concentrates were increased accordingly following each weight measurement in order to maintain the 3% of body weight feeding rate. Additionally, both leg and hock circumference was measured at 56d. A stratified random sample of 3 was taken from each pen for carcass evaluation. Energy replaced at 15% DDGS showed the highest average live weight value at 56 d (31.05 kg) as compared to energy replaced at 0%, 10% and 25% DDGS (27.86, 29.50 and 30.87 kg respectively). Values were not different for both leg circumference ($p = 0.35$) and hock circumference ($p = 0.34$) across all treatments. Additionally, there was no difference ($p = 0.41$) for hot carcass weight across all treatments in the harvest group. Average daily gain was highest for the 25% DDGS group (170g/d compared to 136, 159 and 163 g/d). Moreover, the 25% DDGS showed the highest percentage of gain on trial, gaining 7.56% more than the 0% DDGS treatment. These results

indicate that DDGS can be substituted for soybean meal and corn as an energy source with no detrimental effects on live animal weight gain or carcass weight.

Key Words: Distillers Grains, Boer-Cross

W240 Effect of substitution of canola meal by cotton seed meal on apparent digestibility of diets for hair sheep. J. F. Obregon*, L. E. Antonio, E. Vazquez, F. G. Rios, A. Estrada, and J. J. Portillo, *UASCA-205 FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico.*

With the objective of determinate the effect of substitution of canola meal for cotton seed meal on the apparent digestibility of isoproteic diets, a total faecal collection experiment was conducted. Four hair sheep (males; BW = 21.25 ± 0.96 kg), were used in a crossover design experiment, the sheep were assigned to consume one of two diets in that consisted the treatments: 1) Diet with 17.2 % of CP and 3.38 Mcal of DE/kg, containing (DM basis): canola meal 22.3%, corn 53 %, Sudan grass hay 15%, sugar cane molasses 7% and mineral premix 2.7% (CM); and 2) Diet similar to CM but containing 19.5% of cotton seed meal and 55.8% of corn (CSM). Diets were offered twice a day (0800 and 1600 h). Sheep were placed individually in metabolic crates (0.6 × 1.2 m). Experimental periods consist in six days adaptation period and four days for samples collection. From each diet treatment and period one kg of diet was sampled and the total faecal production was collected. DM and CP were assayed. DM intake was similar ($P = 0.69$) across the treatments (737.8 vs. 736.9 g/day) for CM and CSM. Cotton seed meal in diet increased ($P = 0.06$) DM excreted in faeces (158.4 vs. 139.1 g/day), and increased ($P = 0.02$) faecal excretion of crude protein (30.9 vs. 26 g/day). Apparent DM digestibility was reduced ($P = 0.06$) by CSM treatment (78.5 vs. 81.1 %), and diminished ($P = 0.02$) digestibility of dietary crude protein from 79.6 to 75.8 %. Digestible of the diets was decreased ($P = 0.07$) by CSM treatment (3.36 vs. 3.47 Mcal/kg). This data suggest that substituting canola meal for cotton seed meal, decrease the digestibility of dry matter and crude protein, and reduce energy content of diet for sheep.

Key Words: Apparent Digestibility, Protein Sources, Sheep

W241 Apparent digestibility of diets for hair sheep elaborated with cull chickpeas, cotton seed meal and overcooked sesame meal. J. F. Obregon*, S. Fernandez, E. Vazquez, F. G. Rios, J. M. Uriarte, and G. Contreras, *UASCA-205 FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico.*

To compare the apparent digestibility of isoproteic diets elaborated with cull chickpeas, cotton seed meal and overcooked sesame meal, were utilized four Katahdin-Pelibuey sheep, males (BW = 19.85 ± 0.208 kg), individually placed in metabolic crates (0.6 × 1.2 m), Agreement with a square of Jouden design experiment were assigned to consume one of three diets in that consist the treatments 1) Diet with 17% of CP and 3.5 Mcal of DE/kg, containing (DM basis): cull chickpeas 53.5%, corn 20%, Sudan grass hay 15%, sugar cane molasses 9% and mineral premix 2.5% (CHP), 2) Diet similar to CHP but containing 19.5% of cotton seed meal and 54% of corn (CSM), 3) Diet similar a CHP but with 17.7% of overcooked sesame meal and 55.8% of corn (OSM). Diets were offered twice a day (0800 and 1600 h), after six days of adapta-

tion period, samples of diets (1 kg) and the total faeces produced were collected during four continues days. Samples were dried and weighed. DM and CP were performed and apparent digestibility of DM and CP, as well DE content of diets was calculated. Apparent DM digestibility was higher ($P < 0.01$) for CHP vs. CSM and OSM with values of 83.96, 78.23 and 75.98% respectively. Similar situation was observed for apparent digestibility of CP ($P < 0.01$) with values of 75.1 vs. 64.73 and 64.67 % for CHP, CSM and OSM respectively. The content of DE of the diets was affected ($P < 0.01$) for treatments with values of 3.6 vs. 3.35 and 3.25 Mcal/kg for CHP vs. CSM and OSM respectively. It is concluded, that cull chickpeas can be included in isoproteic diets for sheep substituting sources of protein as cotton seed meal and overcooked sesame meal.

Key Words: Isoproteic Diets, Apparent Digestibility, Hair Sheep

W242 Oscillating dietary protein in finishing cattle rations to reduce nitrogen inputs, with or without subcutaneous implants does not affect performance or final carcass composition. C. R. Nightingale*, K. L. Swyers, H. Han, T. E. Engle, and S. L. Archibeque, *Colorado State University, Fort Collins.*

We hypothesized that oscillating dietary CP concentration would reduce total N inputs while yielding comparable performance in finishing beef steers, regardless of implant status. Angus steers (n = 118; 358 SEM 9 kg initial BW) were used in a completely randomized block design with a 2x2 factorial arrangement of treatments, and fed in 12 pens. The steers were fed either a 1) Control diet (11.7% CP; n = 6 pens), or 2) Control diet and a diet with no added urea (9.6% CP) oscillated on a 48-h interval for each feed (OSC, n = 6 pens). Additionally, steers received no implant (6 pens), or were implanted with Revalor S (n = 6 pens). Dry matter intake did not differ among dietary treatments ($P = 0.13$), but increased ($P = 0.003$) from 10.86 to 11.56 kg/d when cattle were implanted. By design, N intake was decreased ($P < 0.001$) from 0.276 to 0.249 kg/d when steers were fed the OSC diet instead of the Control diet. This equated to a total reduction ($P = 0.009$) in N intake from 32.01 to 28.86 kg/hd during the 116 d finishing period. There was no difference in final live weight due to diet ($P = 0.82$) or implant ($P = 0.16$). Implanted cattle had a greater ($P < 0.001$) ADG than non-implanted cattle, yet there was no diet x implant interaction ($P = 0.80$) or dietary ($P = 0.78$) effect on ADG. There was no diet x implant interaction ($P \geq 0.36$) on any measured carcass characteristics. There was no difference in corrected yield grade ($P = 0.44$), marbling ($P = 0.47$), fat thickness ($P = 0.10$), or rib eye area ($P = 0.43$), due to diet. Steers fed the OSC diet had no difference in premium value above base carcass value ($P = 0.17$), or total carcass value ($P = 0.93$) compared to steers fed the Control diet. Cattle that were implanted had a numerical increase ($P = 0.19$) in total carcass value from \$1099 to \$1157, even though there was a decrease ($P = 0.008$) in marbling score compared to non-implanted cattle. These data suggest that oscillating dietary protein will decrease N inputs without compromising productivity or quality of feedlot steers regardless of implant status.

Key Words: Beef Steer, Protein Oscillation, Feedlot

W243 Fractional protein synthesis rate (FSR) in intestinal mucosa of kids: Effect of a diet containing casein or soy protein. U. Schoenhusen¹, A. Floeter¹, S. Kuhla¹, P. Junghans¹, C. C. Metzges¹, K.

Huber², R. Zitnan³, and H. M. Hammon*¹, ¹*Research Institute for the Biology of Farm Animals (FBN), Dummerstorf, Germany*, ²*School of Veterinary Medicine Hanover, Hanover, Germany*, ³*Institute of Animal Production, Nitra, Slovakia*.

In pre-ruminants, feeding soy protein instead of milk protein leads to alteration in intestinal mucosal structure and absorption of digested nutrients, which is partially caused by a deficit of indispensable amino acids (AA). Supplementation of those AA to soy protein may stimulate epithelial growth and probably affect mucosal protein synthesis in the gut. The present study has investigated effects of feeding soy protein with or without AA supplementation on jejunal mucosa development and FSR in kids. Kids (14 d of age) were fed comparable milk protein-based diets, in which 50% of the crude protein was either casein (CA), soy protein isolate (SP) or soy protein isolate with supplementation of those AA known to be lower concentrated in soy protein than in casein (SPA) for 43 d (n=8/group). An oral dose of [1-¹³C]leucine (180 mg/kg BW, 99

atom% ¹³C) was administered 4 h after feeding the milk drink. Timed blood samples were collected between -15 and +45 min relative to the ¹³C-leucine administration for determination of plasma free AA and ¹³C ketoisocaproic acid. Kids were killed 5 h after feeding and mucosa was collected to measure protein-bound ¹³C-leucine and to calculate FSR. Data were analyzed by GLM of SAS with diet as fixed effect. In medial jejunum (MJ), villus height/crypt depth ratio was higher (P < 0.05) in CA than SP, and mucosal protein content and protein/RNA ratio were higher (P < 0.05) in CA than SP and SPA. The ¹³C-recovery in blood CO₂ tended to be lower (P < 0.1) in CA than SP. FSR of mucosal protein in MJ tended to be lower (P < 0.1) in CA than SP. Plasma concentrations of Met were lower in SP (P < 0.05) and of Thr were lower (P < 0.01) in SP and SPA than in CA. Feeding SPA does not ameliorate soy protein effects on intestinal mucosa in a significant manner. Supported by German Research Foundation (DFG: SCH 627/1-1).

Key Words: Kids, Soya Feeding, Protein Synthesis

Ruminant Nutrition: Management and Misc Additives - Dairy

W244 Lignocellulolytic activity of *Pleurotus ostreatus* solid culture on barley straw. L. Luna-Rodriguez¹, M. Meneses-Mayo¹, G. Mendoza-Martinez², C. Montalvo-Paquini³, S. S. Gonzalez-Muñoz^{*1}, and O. Loera-Corral⁴, ¹Colegio de Postgraduados, Montecillo, Edo. Mexico, Mexico, ²UAM Xochimilco, Mexico D.F., ³Universidad Politécnica de Puebla, Puebla, Mexico, ⁴UAM Iztapalapa, Mexico D.F.

The first objective of this study was to evaluate radial growth (Vr) of *Pleurotus ostreatus* (IE8 and CP50 strains) with N supplement (urea and ammonia sulfate) and 70 or 80% humidity, on barley straw. The experimental design was completely randomized, an analysis of variance was performed and means were compared with Tukey test ($P < 0.05$). The higher Vr were: 0.568 mm/h for CP50 control (80% humidity, distilled water only); 0.573 mm/h for IE8 and 80% humidity plus a saline solution (magnesium sulfate 25.0 g/L, ferrous sulfate 2.8 g/L, manganese sulfate 1.7 g/L, sodium chloride 1.6 g/L). For both strains, Vr was improved only by 80% humidity. Therefore, strain IE8 was selected to determine fibrolytic enzymes (xylanases, cellulases and laccases) activity and *in vitro* DM digestibility (IVDMD) for 30 d. Values were expressed in international units (IU): the amount of enzyme needed to release 1 μ mol product/min under the assay conditions. Activity was referred to initial substrate dry weight (IU/g dry wt). The higher activity was at 8 d for cellulases (15.95 IU/g dry wt) and at 12 d for xylanases (80.51 IU/g dry wt) and laccases (3.46 IU/g dry wt) which coincided with the maximum content of extracellular protein (0.12 IU/g dry wt). Further characterization of enzymatic activity (39°C; pH 6 and 7) showed the following: 1) higher stability at pH 6 with residual activity of 77.5, 49.1 and 27.5% for xylanases, cellulases and laccases; 2) at pH 7 residual activity was lower and similar (xylanases 41.1%; cellulases 36.8%; laccases 24.1%). After 30 d there was a significant decrease in the content of NDF (2.42%), hemicellulose (7.03%) and lignin (3.79%), whereas CP increased 0.86% and IVDMD also increased from 36.64% to 42.36%. It may be concluded that this rather simple biotechnological procedure improved IVDMD of barley straw.

Key Words: Fungi, Fibrolytic Enzymes, Crop Residues

W245 Feedlot performance, carcass characteristics and liver abscesses in heifers fed MGA, Rumensin and Tylan continuously or withdrawn the last 35 days on feed. G. E. Sides^{*1}, R. S. Swingle², R. C. Borg¹, and W. M. Moseley¹, ¹Pfizer Animal Health, Kalamazoo, MI, ²Cactus Feeders, Cactus, TX.

Experimental design: 2x2 factorial, randomized block, one location. Treatment groups: Rumensin, Tylan (RT), RT plus MGA (RTM), RT withdrawn 35 d pre-harvest (RTwd), and RTM withdrawn 35 d pre-harvest (RTMwd). Experimental unit: pen of heifers. Numbers per treatment group: 10 pens; 985, 997, 974, 1026 heifers in RT, RTM, RTwd, RTMwd, respectively. Diets: 30 g* t^{-1} (air dry basis) Rumensin; 90 mg*heifer⁻¹*day⁻¹ Tylan; 0.4 to 0.5 mg*heifer⁻¹*day⁻¹ MGA. Implants: Revalor-IH d 0; Revalor-200 d 60. Statistics: appropriate mixed model procedures including fixed effect of treatment and random effects of block and residual. Average days fed: 150.2 to 150.8. Percent died or removed: 2.7 to 3.9. Final BW (kg): greater ($P < 0.05$ to $P < 0.01$) for RTM (524) than RT (512), RTwd (511), RTMwd (516). DMI (kg): greater ($P < 0.01$) for RTM (8.1) and RTMwd (8.1) than RT (7.8), RTwd (7.9). ADG (kg): greater ($P < 0.01$) for RTM (1.45) than RT (1.39), RTwd

(1.38), RTMwd (1.40). ADG:DMI ratio (0.17 to 0.18). Dressing percent: groups ranged from 64.5% to 64.9%; greater ($P < 0.01$) for RTMwd than RTM and RT. RTM had greater ($P < 0.01$) HCW, marbling score, rib fat, calculated yield grade, and percent quality grade prime and choice but lesser ($P < 0.01$) color score, percent dark cutters, percent yield grade 1, 2, or 3, and rib eye area compared to RT, RTwd, and RTMwd. Withdrawal of RTM: significantly ($P < 0.05$ to $P < 0.01$) decreased HCW, marbling score, rib fat, calculated yield grade, and percent quality grade prime and choice; significantly ($P < 0.01$) increased color score, percent dark cutters, rib eye area and percent yield grade 1, 2, or 3 compared to continuous RTM. Liver abscesses: no difference among groups. MGA fed heifers: increased in both carcass weight and carcass quality traits of economic importance. Withdrawal of RT: no adverse affect on carcass weight or quality traits. Withdrawal of RTM: adversely affected economically important feedlot performance and carcass traits.

Key Words: Carcass, Feedlot, MGA

W246 Effects of feeding different dose levels of melengestrol acetate on feedlot performance, carcass characteristics and estrus activity of feedlot heifers. G. E. Sides^{*1}, O. A. Turgeon², W. C. Koers², M. S. Davis², K. Vander Pol², R. C. Borg¹, and D. J. Weigel¹, ¹Pfizer Animal Health, Kalamazoo, MI, ²Bos Technica Research Services, Inc., Salina, KS.

A randomized complete block design was used to compare the effects of feeding melengestrol acetate (MGA) at 0.4 mg*heifer⁻¹*d⁻¹ (0.4M) and 0.5 mg*heifer⁻¹*d⁻¹ (0.5M) on feedlot performance, health, and carcass characteristics of commercial beef heifers (n=1,418). Heifers were enrolled upon arrival at the feedlot (Bos Technica Research Inc., Syracuse, KS), randomly assigned to treatment, processed according to feedlot protocol and administered an abortifacient within 48 h of arrival. Enrollment date was used as the blocking factor with pen (n=10 per treatment) as the experimental unit. Heifers averaged 290.2 kg of BW at enrollment and were fed for an average of 176 d. Estrus activity was monitored twice daily and summarized as a count of heifers showing estrous within a pen over each 21 d interval throughout the feeding period. Linear mixed model procedures were used to compare treatment differences in feedlot performance parameters and all quantitative carcass measurements and included the fixed effect of treatment and the random effects of block and residual. A generalized mixed model was used to evaluate proportional measures of estrus activity (E), dark cutting carcasses (%DC), preliminary USDA Yield Grades ≤ 3 , and Quality Grades \geq Choice using the same model listed above. Repeated measures models for E also included fixed effects for time of measure and time by treatment and the random effect of block by treatment. Overall treatment effects were significant for E and %DC ($P < 0.05$ and $P < 0.10$, respectively). Least squares means of E were 3.2% and 2.1% in 0.4M and 0.5M, respectively, and for %DC were 3.0% and 1.7% in 0.4M and 0.5M, respectively. Dry matter intake, ADG, gain*feed⁻¹ and all other carcass measurements were not significantly different between treatments. The decrease in E and %DC may suggest an economic advantage of feeding a higher level of MGA to finishing heifers.

Key Words: Carcass Performance, Feedlot, MGA

W247 Effects of tannins supplementation on animal growth and in vivo ruminal bacterial populations associated with bloat in heifers grazing wheat forage. B. R. Min^{*1,4}, W. E. Pinchak¹, K. Hernandez², C. Hernandez³, M. E. Hume³, E. Valencia², and J. D. Fulford¹, ¹Texas AgriLife Research, Vernon, TX, ²University of Puerto Rico, Puerto Rico, ³USDA-ARS, Southern Plains Agricultural Research Center, Food & Safety Research Unit, College Station, TX, ⁴Ichthus Education Center, La Trinitaria, Chiapas, Mexico.

Two experiments were conducted to 1) enumerate the effect of tannins supplementation on bio-film production, in vitro gas and foam production, ADG, and bloat frequency; and 2) quantify the influence of tannins supplementation on ruminal bacterial populations of heifers grazing wheat forage. Molecular PCR enumeration was used to quantify 5 major ruminal bacterial strains in the rumen of heifers grazing wheat forage supplemented with tannins. Twenty-six heifers (286.1 ± 25.7 kg) were randomly allocated to 1 of 3 treatments that included a control (non-tannins group) and two types of tannins (mimosa, mainly condensed tannins vs. chestnut tannins, mainly hydrolysable tannins). Plant tannins (1.5% of DMI) were supplemented once daily (approximately 0800) mixed with a textured feed (500 g/animal). Heifers were visually monitored daily for bloat score (0 = no bloat, 3 = severe bloat). In Exp. 1, supplementation of tannins reduced the rate of frothy foam and biofilm production with chestnut being more efficacious than mimosa tannins. Chestnut tannin supplementation increased ADG. Mean bloat score and bloat day were greater ($P < 0.01$) for the control diet than for tannins treatment groups. In Exp. 2, phenotypic study shows that the dynamics of *Fibrobacter succinogenes*, *Streptococcus bovis*, and *Prevotella rumenicola* strains were relatively stable with time (d 0, 10, and 25) in the rumen of animals not receiving tannins supplementation. However, with supplementation of chestnut and mimosa tannins, populations of *P. rumenicola* and strains of both *F. succinogenes* and *Ruminococcus flavefaciencens* were increased, respectively. Conversely, populations of both *F. succinogenes* and *S. bovis* were decreased in chestnut tannins supplementation with time, indicating that different types of tannins have different mode of action on rumen bacterial population.

Key Words: Ruminal Bacterial Populations, Bloat, Plant Tannins

W248 Carcass traits of grazing young bulls. H. J. Fernandes^{*1,2}, A. G. Silva², J. Cavali², A. A. Rocha², M. F. Paulino², L. M. Paiva^{1,2}, and R. M. Paula², ¹State University of Mato Grosso do Sul / FUNDECT, Brazil, ²Federal University of Viçosa, Brazil.

The objective of this study was to evaluate the carcass measures of grazing young bulls in dry season, supplemented with concentrate rations with different urea levels. Twenty young bulls with initial weight of 220 kg were used, separated in four groups, housed in *Brachiaria decumbens* Stapf pastures and fed daily with one of the supplements: *ad libitum* mineral salt (control treatment); or 1.5 kg/animal of concentrated rations (32% of crude protein) formulated with corn, soybean meal and 0, 4 or 8% of urea. Two young bulls of each group were slaughtered after 90 days and the remaining after 180 days. After chilling, the carcasses were weighted. In the right half carcass, the lengths, and the loin eye areas (LEA) and the backfat thickness (BFT) in the 12th rib were measured. The effect of the supplementation with concentrate and the linear and quadratic effects of the urea level in the concentrate were evaluated by the partition of the sum of squares of treatment in orthogonal contrasts.

The significance level was 5%. The carcasses yields and lengths to the reference treatment and to the supplemented treatments (levels of 0, 4 e 8% of urea) were: 51.2, 51.8, 53.3 and 52.2 % (coefficient of variation - CV=3.9%); and 95.6, 101.3, 104.0 and 96.3 cm (CV= 6.7%). In the same way, the LEA and BFT were 38.3, 48.3, 51.4, 43.0 cm² (CV= 15.45%); and 0.70, 0.88, 0.87 and 1.15 mm (CV=46.2%). Only the LEA presented significant effect of the concentrate supplementation. The linear or quadratic effects of the urea levels in the supplement were not significant to none of the measures. Usually, grazing animals have low development in dry season because the low forage availability. This may explain these results. This study showed that the extra nutrients offered by the concentrate or the different urea levels in the supplement were not able to alter the carcass traits

Key Words: Carcass, Grazing, Supplementation

W249 Influence of feed restriction and oral vitamin D and E supplementation on meat quality of Canchim heifers. S. A. Matsuhara^{1,3}, M. Parrili¹, M. D. B. Arrigoni¹, C. L. Martins¹, D. D.s Millen¹, R. D. L. Pacheco^{*1}, M. V. Fossa¹, L. M. N. Sarti¹, J. P. S. T. Bastos¹, T. M. Mariani¹, H. N. de Oliveira¹, S. R. Baldin¹, T. C. B. da Silva², R. S. Barducci¹, R. d. O. Roça¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Faculdade de Zootecnia/UNESP, Dracena, São Paulo, Brazil, ³Apoio FAPESP.

This study, conducted at São Paulo State University (UNESP) feedlot, Botucatu Campus, Brazil, was designed to evaluate the influence of feed restriction (FR) and oral vitamin D and E supplementation (VIT) on meat quality of Canchim (5/8 Charolais, 3/8 Nellore) heifers. The experiment was designed as a 2x2 factorial arrangement, in which sixteen 7-mo-old heifers (227.4±23.7kg) were randomly assigned according to FR: Restricted (RT) and Non-Restricted (NR) fed one of two diets with (VDE) or without (WV) vitamins (D=7.5X10⁶ UI/head/d and E=1838 UI/head/d during 18 and 43 days prior to slaughter, respectively). During 48d RT heifers received 70% of amount fed to NR, but after this period all animals were fed 77 days ad libitum. Rib eye samples were harvested between 12th and 13th ribs for total lipids in % (TL), color (L*, a*, b*), vitamin concentration and tenderness analysis. Tenderness was evaluated by three methods: shear force (SF), miofibrillar fragmentation index (MFI) and sensory panel (using a scale from 1 (extremely tender) to 9 (extremely tough)). It was found a FR effect ($P < 0.05$) for meat tenderness, evaluated by sensory panel, where RT was more tender than NR (RT=2.9, NR=4.3), but no VIT effect ($P > 0.05$) was found (WV=4.0, VDE=4.2). Both FR and VIT did not affect ($P > 0.05$) TL (WV=1.99, VDE=2.07; RT=1.89, NR=2.18), meat tenderness evaluated by SF (WV=3.46, VDE=3.89; RT=3.60, NR=3.75) and MFI (WV=81.98, VDE=69.32; RT=77.50, NR=73.80). It was found ($P < 0.05$) VIT effect for L*, where WV heifers presented brighter meat than those VDE (WV=42.88, VDE=40.23), but no differences were observed ($P > 0.05$) for a* (WV=18.43, VDE=18.45) and b* (WV=10.60, VDE=10.30). There was not FR effect ($P > 0.05$) on color. No FR and VIT effects were observed ($P > 0.05$) on vitamin D (WV=0.07, VDE=0.07; RT=0.60, NR=0.80) and E (WV=4.27, VDE=5.91; RT=4.80, NR=5.38) concentration (%). No interactions were found ($P > 0.05$) between FR and VIT in this study. Thus, FR improved tenderness by sensory panel and VIT did not enhance meat quality of Canchim heifers.

Key Words: Feedlot, Feed Restriction, Heifers

W250 Influence of feed restriction on performance and carcass traits of Canchim heifers. M. Parrili^{1,3}, S. A. Matsuhara¹, M. D. B. Arrigoni¹, C. L. Martins¹, D. D. Millen^{*1}, R. D. L. Pacheco¹, H. N. de Oliveira¹, M. V. Fossa¹, L. M. N. Sarti¹, T. M. Mariani¹, J. P. S. T. Bastos¹, S. R. Baldin¹, R. S. Barducci¹, and T. C. B. da Silva², ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Faculdade de Zootecnia/UNESP, Dracena, São Paulo, Brazil, ³Apoio FAPESP.

This study, conducted at São Paulo State University (UNESP-Botucatu) feedlot, Brazil, was designed to evaluate the influence of feed restriction (FR) on performance and carcass traits of Canchim (5/8 Charolais, 3/8 Nellore) heifers. Sixteen 7-mo-old (253.4±23.7 kg) Canchim heifers were randomly assigned according to treatments: Restricted (RT) and Non-Restricted (NR). Heifers were fed in feedlot for 125d. During the first 48d RT heifers received 70% of amount fed to NR, but after this period all animals were fed 77 days ad libitum. Initial and final rib eye areas in cm² (REA) and initial and final back fat thickness in mm (BFT) were measured by ultrasound. After slaughter, visceral fat (VF) and livers were weighed and rib eyes scored for marbling (MB) using a scale from 1 to 6. During FR, NR presented greater (P<0.05) average daily gain in kilos (ADG) than RT (NR=1.16, RT=0.74), but no differences (P>0.05) were found when heifers were re-fed *ad libitum* (NR=0.96, RT=1.12). There was not difference (P>0.05) for total ADG, considering 125d on feed (NR=1.03, RT=0.95). FR did not affect (P<0.05) REA, BFT, final live weight (FBW), hot carcass weight (HCW), dressing percentage (DP), MB and weights of VF and liver (Table 1). Treatment had a significant impact (P<0.05) for percent hindquarter (NR=50.3, RT=51.58), but it was not found effect (P>0.05) for percent forequarter (NR=37.12, RT=36.38). Feed costs were reduced by 4.31% for RT heifers. FR could be useful for Canchim heifers in feedlot for reducing feed costs and presenting heavier hindquarter without affecting performance and carcass traits.

Table 1. Influence of FR on carcass traits of Canchim heifers

Item	NR	RT	SEM
Initial Live Weight (kg)	250.60	256.38	18.53
Final Live Weight (kg)	381.10	377.13	30.58
Initial REA (cm ²)	40.05	44.32	3.01
Final REA (cm ²)	64.24	62.21	3.50
Initial BFT (mm)	0.97	1.31	0.26
Final BFT (mm)	4.03	3.89	0.64
Hot Carcass Weight (kg)	206.99	199.91	18.50
Dressing Percentage (%)	54.25	53.00	1.25
Visceral Fat (kg)	5.44	6.39	1.38
Liver (kg)	4.82	4.74	0.51
Marbling (scale from 1 to 6)	1.90	1.50	0.45

Key Words: Feed Restriction, Heifers, Performance

W251 Supplementation frequency effects on performance of steers grazing tropical grass. J. A. S. Morais¹, T. T. Berchielli^{*1}, M. F. S. Queiroz¹, R. A. Reis¹, M. A. Balsalobre², G. Fiorentini¹, S. F. Souza¹, and P. H. M. Dian¹, ¹Faculdade de Ciências Agrárias e Veterinárias - Campus de Jaboticabal/UNESP, ²Bellman Nutrição Animal.

The objective of this research was to determine the effect of reduction in supplementation frequency over the performance of Nellore steers grazing palisade grass (*Brachiaria brizantha* cv. Marandu) pasture.

Twenty seven castrated steers, 270 kg average initial body weight (BW) were distributed in nine palisade grass paddock of two ha each. Each paddock still received a variable number of regulators animals to maintain the forage allowance approximately 8 kg DM/100 kg of BW. The animals were supplemented with 0.5% of BW/day of a concentrate composed by 65% of corn gluten-60, 25% of dry sugarcane yeast and 15% of citric pulp. The supplement was offered in 3 different frequencies: daily, from Monday to Friday or Monday, Wednesday and Friday. There was no interaction time*frequency supplementation effect (P > 0.05). The supplementation frequency didn't affect (P > 0.05) the animals performance, weight gain was in average 0.890 kg/day. However, the experimental periods affect animals performance (P < 0.05), in the first period (from February to March) it was observed highest daily animal BW gain compared to the other period (from March to May). Based on the experimental results it can be concluded that the supplementation frequency reduction from 7 to 3 days of the week doesn't affect the performance of steers grazing palisade grass pasture, becoming a viable alternative for reduction in the costs with labour and equipments. The experimental period has important effect on the performance of the steers grazing tropical pasture.

Table 1. Effect of supplementation frequency on performance (kg/an/day) of Nellore steers grazing palisade grass pasture (São Paulo – Brazil).

Supplementation frequency	Periods			Mean	SEM ¹
	Feb-Mar	Mar-Apr	Apr-May		
Daily	1.23	0.74	0.54	0.84	0.049
Monday to Friday	1.30	0.67	0.65	0.87	
Mon-Wed-Fri ²	1.29	0.75	0.66	0.90	
Mean	1.28 a	0.72 b	0.62 b	0.89	

¹ Standard error mean; ² Supplement offered Monday, Wednesday and Friday. Means values within rows with different letters are significantly different (P < 0.05).

Key Words: Nellore, Palisade Grass

W252 Comparative effects of virginiamycin supplementation on growth-performance and dietary energetics of calf-fed Holstein steers. E. Ponce^{*1,2}, J. Lenin^{1,2}, U. Sanchez^{1,2}, N. Torrentera¹, and R. Zinn², ¹UABC, Mexicali, BC, Mexico, ²University of California, Davis, CA.

One hundred forty-four Holstein steer calves (119 kg) were used in a 340-d trial. Treatments were: Control (no antibiotic); 2) 16 ppm virginiamycin; 3) 22.5 ppm virginiamycin; and 4) 28 ppm monensin. Calves received a steam-flaked corn-based growing diet, formulated to meet average nutrient requirements for the first 112 d, and thereafter were fed a finishing diet formulated to meet average nutrient requirements from d 112 until slaughter. Steers were divided into two weight groupings (light and heavy), and assigned within groupings to 24 pens (6 steers/pen). Fresh feed was provided twice daily. Virginiamycin supplementation did not affect (P > 0.10) ADG, but increased (linear component, P = .02) 340-d gain efficiency. Improvement in gain efficiency was attributable to enhanced energetic efficiency (linear component, P = 0.04). Improvements in dietary NE were most pronounced during the final 116 d of the feeding period (linear component, P = 0.04) that comprised the hot summer months (June through September). Mon-

ensin supplementation did not affect ($P > 0.10$) growth performance or dietary NE. There were no dietary treatment effects ($P > 0.10$) on carcass characteristics. Both virginiamycin (linear component, $P = 0.03$) and monensin ($P = 0.06$) supplementation reduced morbidity. There were no dietary treatment effects ($P > 0.10$) on mortality. Although average initial weight for the light and heavy groupings differed by only 4 kg, the heavy-weight grouping had greater carcass weight (13 kg, $P = 0.02$), LM area (5.4%, $P = 0.01$), ADG (4.3%, $P = 0.03$), and gain efficiency (2.3%, $P = 0.08$) than the light-weight grouping. Improvement in gain efficiency was due largely to increased (3.2%, $P = 0.01$) dietary NE. We concluded that virginiamycin supplementation can markedly enhance feedlot growth-performance and dietary energetic efficiency of calf-fed Holstein steers. Holstein calves that are lighter than group average for initial weight may have slightly slower growth rates as well as slightly reduced dietary energetic efficiency.

Key Words: Virginiamycin, Cattle, Performance

W253 The effects of dexamethasone and Revalor-S® on growth, carcass quality and visceral organ and fat mass of finishing beef steers fed cracked corn. S. E. Kitts*, S. W. El-Kadi, C. C. Taylor-Edwards, F. F. Korthaus, J. B. Cannon, A. F. Koontz, D. L. Harmon, E. S. Vanzant, and K. R. McLeod, *University of Kentucky, Lexington.*

Dexamethasone (DEX), a synthetic glucocorticoid, has been shown to alter site and rate of fat accretion in several mammalian species, including cattle. The current study was designed to investigate potential interactions between DEX and trenbolone acetate/estradiol (Revalor-S) administration on growth performance, carcass quality and visceral organ and fat mass of finishing beef steers fed cracked corn. Ninety-six crossbred steers (385 ± 1 kg) were assigned randomly to a 2×2 factorial arrangement of treatments consisting of either no implant or Revalor-S (d 1 and 56) and either no injection or i.m. injection of 0.09 mg/kg BW DEX (d 1, 28, 56 and 84). Steers received a 90:10 concentrate-forage diet ad libitum during the feeding period and were slaughtered ($n=60$) on d 113 for determination of carcass quality. A subset of steers (9/treatment) was slaughtered between d 106-119 for determination of visceral organ and fat wet mass and carcass quality. There were no interactions ($P \geq 0.05$) between implant and DEX for any variable measured. Over the feeding period, DMI was unaffected by treatment. However, ADG and efficiency of gain were both 13% greater ($P \leq 0.05$) with implant. Conversely, DEX lowered ADG by 10% ($P = 0.007$). Dexamethasone decreased ($P = 0.04$) and implant increased ($P = 0.04$) HCW. There were no effects ($P \geq 0.05$) of treatment on carcass quality. Implant resulted in greater ($P \leq 0.01$) digestive tract and liver weights which translated to greater ($P \leq 0.05$) small intestine (SI) and liver weights as a function of empty BW. Dexamethasone decreased ($P \leq 0.05$) digestive tract and liver weights and decreased ($P = 0.02$) SI weight as a function of empty BW. As expected, Revalor-S increased ADG and feed efficiency; however, DEX decreased ADG and had no effect on fat deposition. These results indicate that, in contrast to previous data, DEX does not alter site or amount of fat deposition in finishing beef cattle.

Key Words: Cattle, Fat, Dexamethasone

W254 Effect of feeding cinnamaldehyde essential oils and monensin on feedlot cattle performance. W. Z. Yang¹, C. Benchaar², M. L. He*¹, and K. A. Beauchemin¹, ¹*Agriculture and Agri-Food Canada,*

Research Centre, Lethbridge, AB, Canada, ²*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre, Sherbrooke, QC, Canada.*

A study was conducted to evaluate the effects of supplementing cinnamaldehyde essential oil (CIN) on growth performance of feedlot cattle. Seventy-five yearling steers (BW=390 kg) were assigned to a randomized complete block design with five treatments: control; 400; 800; 1600 mg/head/day CIN; or 330 mg monensin (MO)/head/day. At the start of the trial, steers were blocked according to BW and assigned to fifteen blocks of five cattle. The diets consisted of 9% barley silage, 86% dry-rolled barley grain, and 5% supplement (DM basis). Steers were housed in individual pens that allowed measuring feed intake individually, and weighed on days 0, 28, 56, 84 and 112. Cattle fed with CIN consumed more feed DM than the cattle fed control (7.7 vs 6.6 kg/d; $P < 0.01$) or MO diet (7.7 vs 7.1 kg/d; $P < 0.14$) in the first 28 days. However, feed intake (kg/d or % of BW) of cattle fed CIN was not different from those fed MO or control from day 29 to the end of the experiment even though a quadratic dose response to CIN was detected during the first 28 d ($P < 0.01$) and the overall experiment ($P < 0.11$). A general decrease in feed intake was observed the first week of the trial compared to the adaptation period, with the highest decrease for control (7.4 vs 5.3 kg/d), following by MO (7.4 vs 6.0 kg/d) and minimal decrease for CIN (7.2 vs 6.7 kg/d). The reduction of feed intake was likely due to the stress of weighing and bleeding on the day before starting the trial. The mean ADG (kg/d) overall ranged from 1.64 to 1.75 and was not affected by the treatments. In contrast, feed efficiency (gain/intake) tended ($P < 0.10$) to be lower for CIN (0.21) than for MO (0.22) with no difference between control and CIN. These results indicate that supplementation of a feedlot finishing diet with CIN improved feed intake of stressed beef cattle but had minimal effects on ADG or feed efficiency over the entire feedlot finishing period.

Key Words: Cinnamaldehyde Essential Oil, Intake and Growth, Feedlot Cattle

W255 Effect of a rumen buffer derived from calcified seaweed on ruminal disappearance and fermentation in steers. O. D. Montañez-Valdez*¹, J. M. Pinos-Rodriguez², J. H. Avellaneda-Cevallos³, E. O. Garcia-Flores⁴, and E. C. Guerra-Medina⁴, ¹*Centro Universitario del Sur de la Universidad de Guadalajara, Ciudad Guzmán, Jalisco, México,* ²*Universidad de San Luis Potosí, San Luis Potosí, México,* ³*Universidad Técnica Estatal de Quevedo, Ecuador, Quevedo, Los Ríos, Ecuador,* ⁴*Centro Universitario de la Costa Sur, Aulán de la Grana, Jalisco México.*

Effect of a rumen buffer derived from calcified seaweed on ruminal disappearance was evaluated in steers. Three ruminally cannulated steers (450 ± 15 kg body weight) with three treatments in a crossover design, were fed with a diet formulated with 30% forage (15% alfalfa hay and 15% corn silage) and 70% concentrate (47% ground sorghum, 8% soybean meal, 7% molasses cane, 6.8% corn gluten meal and 1.2% mineral premix). The treatments were: 1) control (without buffer); 2) 1% sodium bicarbonate; and 3) 0.5% rumen buffer derived from calcified seaweed. There were differences ($P \leq 0.05$) among treatments on ruminal pH; the values from steers fed diet without ruminal buffer were lower (5.98) than those fed buffer derived from calcified seaweed (6.34), but pH values from both treatments were similar than those fed sodium bicarbonate (6.14). This reduction of pH values induced by no addition of ruminal buffer did not affect ($P \geq 0.05$) ruminal disappearance of diet, ruminal volatile fatty acid (108.1 vs 97.8 vs 93.9), and N

ammonia (28.5 vs 33.3 vs 39.5) as compared to sodium bicarbonate or buffer derived from calcified seaweed. Buffer derived from calcified seaweed increase ruminal pH values in steer fed a diet with 30% forage and 70% concentrate, but did not changed the ruminal disappearance of diet, volatile fatty acid or N ammonia.

Key Words: pH, Ruminal Disappearance, Ruminal Buffer

W256 Net energy and protein requirements for maintenance and gain of Nellore steers estimated with deuterium oxide². G. Aferrri^{*1}, P. R. Leme¹, A. S. C. Pereira¹, R. R. P. S. Corte¹, M. Z. Moreira¹, and D. P. D. Lanna¹, ¹Universidade de São Paulo, Pirassununga, São Paulo, Brasil, ²FAPESP, São Paulo, São Paulo, Brasil.

Thirty six Nellore steers with a mean weight and age of 359 kg and 20 months at the beginning of the trial were individually fed to determine the energy and protein requirements for maintenance and gain. The steers were fed the same diet (76.43% TDN and 13.62% CP) in three levels of dry matter (DM) intake, *ad libitum*, 75 g DM/kg LW^{0.75} and 60 g DM/kg LW^{0.75}. The body composition was estimated with the marker deuterium oxide that allowed repeated water estimate in the same animal. Deuterium in blood samples was analyzed by mass spectrography. The empty body weigh (EBW) from shrunk body weigh (SBW), was obtained from equation: EBW(kg) = -15.74911+(0.98517×SBW), (R²=0.96, S_{y,x}=8.64). The following equations were used to estimate the empty body chemical composition: Water% = 65.9654+(0.0977×Deuterium Space)-(0.0909×SBW), (R²=0.83, S_{y,x}=1.33), Fat% = 93.92968-(1.27598×Water%), (R²=0.97, S_{y,x}=0.62). The relationships between protein and water and between ash and water in the empty body were 0.3009 and 0.0747, respectively. The net energy for maintenance (NEm) was calculated as the antilogarithm of the intercept of the linear regression of the logarithm of heat production on the metabolizable energy intake. The heat production of the steers was calculated by deducting energy retained from metabolizable energy intake. The net energy requirement for weight gain (NEg) was determined as the energy deposited in the gain. The net protein requirement for weight gain (NPg) was determined as the retained protein in the gain. The equations were calculated using the statistical program SAS. The NEm was 74 kcal/kg EBW^{0.75} or 70 kcal/kg LW^{0.75}. The NEg for steers with 450 kg weight was 4.47 Mcal. The net protein maintenance requirement was 186 g/kg LW and NPg was 133 g/kg LW gain.

Key Words: Nutrition, Ruminant

W257 Venous blood gas in Holstein steers fed diets differing in concentrate to alfalfa hay ratios. M. Danesh Mesgaran^{*}, A. R. Vakili, and A. Heravi Mousavi, *Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, Iran.*

The aim of the present experiment was to investigate the effect of diets providing different concentrate: lucerne hay ratios on venous blood gas in Holstein steers. Holstein steers (initial body weight= 261±15 kg, n=30) were adapted to experimental diets for one week. Then, for 120 days, steers were fed 10 kg of DM of diets differing in concentrate (155 g CP kg⁻¹ of DM; 30% maize, 34% barley, 8% soybean meal, 5% sugar beet pulp, 10% wheat bran, 12% cottonseed meal, 0.3% CaCO₃, 0.5% mineral and vitamin premix, 0.2% salt) to alfalfa hay ratios as 60:40 (C₆₀:A₄₀) and 80:20 (C₈₀:A₂₀) in a completely randomized design.

Animals were fed the experimental diets (ad lib) as total mixed ration twice daily at 0800 and 2000 h. At days 60 and 120 of the experimental period, blood samples were taken from jugular vein 4 h after the morning feeding. Samples were analyzed for venous blood gas by Automatic blood gas system (AVL 995, Switzerland). Data were analyzed as repeat measures using the PROMIX of SAS and the means compared by the Duncan test (P< 0.05). The results of the present study indicated that blood HCO₃⁻ and PaCO₂ were not significantly affected by time when steers were fed high concentrate diets. However, HCO₃⁻ was significantly affected by time (p< 0.05). Therefore it was concluded that the increasing of concentrate from 60 to 80 % could not cause a mixed metabolic acidosis in our condition.

Table 1. Venous blood gas in steers fed diets differing in concentrate: alfalfa hay ratios

Item	Sampling				Treatment effect		Time effect	
	60 days		120 days		SEM ¹	P ²	SEM	P
	Concentrate: alfalfa hay ratio							
	C ₆₀ :A ₄₀	C ₈₀ :A ₂₀	C ₆₀ :A ₄₀	C ₈₀ :A ₂₀				
pH	7.33	7.35	7.38	7.36	0.01	0.97	0.01	0.05
PO ₂ (mmHg)	37.31	35.41	35.33	38.37	1.17	0.76	1.02	0.67
PCO ₂ (mmHg)	56.95	57.28	55.85	65.80	2.63	0.19	2.35	0.22
HCO ₃ ⁻ (mEq/lit)	29.61	30.80	31.50	35.24	1.23	0.19	1.1	0.03
O ₂ Saturation (%)	62.34	60.67	60.23	64.16	1.84	0.74	1.46	0.05

1: SEM: Standard Error of Mean; 2: P: Probability

Key Words: Venous Blood Gas, Steer, Alfalfa Hay

W258 In vitro gas production kinetics of regional feedstuffs used in sheep diets in Northwest Mexico. A. S. Suarez-Reyes¹, G. Nevarez-Carrasco¹, M. A. Cerrillo-Soto^{*1}, J. F. Obregon², and F. G. Rios², ¹FMVZ-Universidad Juarez del Estado de Durango, Durango, Durango, Mexico, ²FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico.

Sheep production in Northwest Mexico represents an important potential. Agricultural products which are mainly produced for human consumption are also utilized for animal production. Thus, a study was carried out to determine the *in vitro* gas production (GP) characteristics of regional feedstuffs commonly used in sheep nutrition practices in the dry tropics of northwest Mexico. Samples (200 mg) of broom sorghum (BS), cull apple meal (CAM), cull raw chickpeas (CRC), cull cooked chickpeas (CCC), and cull cooked beans (CCB) were placed in 100 ml calibrated glass syringes by triplicate. Buffered and mineral solutions were mixed in a 2:1 proportion with rumen fluid collected from three rumen cannulated sheep fed alfalfa hay and a commercial concentrate (75:25). Thirty ml of buffered rumen fluid was dispensed to each syringe at the time incubation started. The gas volume was recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96h. Data obtained were fitted to the equation: p=a+b(1-e^{-ct}) using PROC NLIN. Metabolizable energy (ME) content from *in vitro* gas production was determined by: ME (Mcal kg⁻¹ DM) = (2.20 + 0.136 GP_{24h} + 0.057 Crude Protein + 0.0029 Crude Fat²)/4.184. Data were analyzed using ANOVA for a completely randomized design. Differences (P<0.05) were registered in the gas produced from the soluble (a) fraction of feeds. CRC registered the higher value while the lower was registered in BS. The higher (P<0.05) gas produced from the slowly

fermentable fraction (**b**) was accounted in CCB and the lower in CAM. The constant rate of gas production (**c**) was higher ($P < 0.05$) in CCC, CCB and CAM than in the other analyzed feeds. The higher values for the potential gas production (**a+b**) were registered in CCB, CRC, and CCC. The same pattern was observed for the ME content. *In vitro* gas production data supported the good potential of beans and chickpeas as feeds for sheep production in the subtropics of Northwest Mexico.

Table 1. *In vitro* gas production characteristics of regional feedstuffs used in sheep nutrition practices in northwest Mexico

Feed	Parameters				ME
	a	b	c	a+b	
BS	-7.26 ^c	70.01 ^c	0.046 ^b	62.76 ^b	2.03 ^b
CAM	-5.53 ^c	55.92 ^c	0.066 ^a	50.39 ^c	2.00 ^b
CRC	13.22 ^a	70.43 ^c	0.045 ^b	83.65 ^a	2.80 ^a
CCC	3.63 ^b	77.36 ^b	0.066 ^a	80.99 ^a	2.86 ^a
CCB	-7.08 ^c	91.01 ^a	0.069 ^a	83.93 ^a	2.96 ^a
Mean	-0.60	72.95	0.058	72.34	2.53
SEM	2.17	3.09	0.003	3.64	0.114

^{a,b,c} Means within columns with different superscript differ ($P < 0.05$).

Key Words: Gas Production, Feedstuffs, Sheep

W259 Effect of two doses of zilpaterol clorhidrate on productive performance and carcass characteristics of hair sheep in the feedlot. F. G. Rios*, F. Leon, J. F. Obregon, J. A. Felix, D. C. Acosta, and J. J. Portillo, *FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico.*

To determinate the effect of two doses of beta-agonists zilpaterol clorhidrate (HCl-Z) on productive performance and carcass characteristics of hair sheep in the feedlot, 36 ram lambs (37.34 ± 0.570 kg) were used in a randomized complete block experiment where block was initial weight. The lambs were assigned to one of three diets fed ad libitum: 1) control diet with 17% CP and 3.62 Mcal of DE/kg consisting of 62% whole corn grain, 14% soybean meal, 11.9% Sudan grass hay, 5.0% molasses cane, 2.0% meat meal, 2.0% animal fat, 2.5% mineral premix and 0.6% sodium bicarbonate; 2) diet similar to control but with the addition of 12 ppm of HCl-Z; and 3) Diet similar to control but with the addition of 18 ppm of HCl-Z. Feed intake (FI), average daily gain (ADG), feed efficiency (FE), carcass traits, and primary cuts weight were recorded. The data were analyzed with ANOVA for randomized blocks design; Tukey test were utilized to examine the effect of treatment. The final weight was higher in 4.49% (46.54 vs. 44.50 kg; 0.623 SEM) ($P < 0.07$), and FE was improved 24.25% (5.760 vs. 4.635 ; 0.249 SEM) for lambs fed diets with HCl-Z, but ADG (0.285 kg/d) not was modified and feed intake was similar (1.386 kg/d). Diet with beta-agonist increased ($P < 0.05$) hot carcass weight was improved in 6.65% by HCl-Z (27.07 vs. 25.384 ; 0.329 SEM) and the dressing carcass percent in 3.0%. Rib eye area (15.71 cm²); fat thickness (2.67 mm); retail product yield (47.9%), mesenteric fat weight (1.160 kg), kidney fat weight (0.871 kg), and empty body weight (44.29 kg) not were modified by treatments. Diets with beta agonists increased ($P < 0.01$) the weight of primal cuts: shoulder (1.92 vs. 1.59 kg; 0.057 SEM), leg (3.05 vs. 2.73 kg; 0.039 SEM), and rack (1.83 vs. 1.68 kg; 0.039 SEM). Loin (1.82 kg), breast (1.37 kg) and flank (0.912 kg), was not affected by diets. Its concluded that addition of 12 or 18 ppm de HCl-Z to diets of hair sheep increased feed efficiency, final, hot carcass, shoulder, leg and rack weight.

Key Words: B-Agonists, Hair Sheep, Carcass Characteristics

W260 Effects of feeding a polyclonal antibody preparation against *Escherichia coli* O157:H7 on performance, carcass characteristics and *E. coli* O157:H7 fecal shedding of feedlot steers. N. DiLorenzo*, C. R. Dahlen, and A. DiCostanzo, *University of Minnesota, St. Paul.*

Oral doses of avian-derived polyclonal antibody preparations (PAP) against *Streptococcus bovis* or *Fusobacterium necrophorum* were effective at reducing ruminal counts of target bacteria, and improving feed efficiency of feedlot steers. The objective of this study was to determine the effects of feeding a PAP against *E. coli* O157:H7 (PAP-Ec) on performance, carcass characteristics and *E. coli* O157:H7 fecal shedding of feedlot steers. Eighty four Angus and Angus crossbred steers (258 kg initial BW ± 22) were randomly allocated to one of two treatments: PAP-Ec or CTL. Steers received a basal diet (1.39 Mcal NE_g/kg DM, 12.5% CP, 0.7% Ca, and 0.35% P) comprised of high-moisture corn and dry ground corn (50:50 mix, DM basis), corn silage, and a supplement containing laidlomycin propionate and were supplemented (PAP-Ec) or not (CTL) with 2.5 mL PAP-Ec/d. Individual fecal samples were collected every 28 d for *E. coli* O157:H7 analysis. Steers receiving PAP-Ec tended ($P = 0.06$) to have greater feed efficiency (live basis). Carcass-adjusted feed efficiency did not differ ($P = 0.10$) between treatments. Steers receiving PAP-Ec had greater ($P < 0.05$) fat thickness than CTL. No differences ($P > 0.10$) were observed in *E. coli* O157:H7 fecal shedding at 0, 28, 84 and 165 d on feed. After 56 d on feed, a greater ($P < 0.05$) prevalence of *E. coli* O157:H7 was observed in steers fed PAP-Ec. Steers fed PAP-Ec had a lower ($P < 0.05$) prevalence of *E. coli* O157:H7 after 112 d on feed and tended ($P = 0.06$) to have reduced *E. coli* O157:H7 prevalence after 140 d on feed. The use of an avian-derived polyclonal antibody preparation against *E. coli* O157:H7 in feedlot diets may be a valid intervention to enhance cattle performance and reduce *E. coli* O157:H7 fecal shedding.

Key Words: Steers, Antibodies, *E. coli* O157:H7

W261 Selenoprotein expression is induced during oxidative stress in beef cows. E. Terry, K. Brennan, J. Michal*, K. Johnson, and R. Kincaid, *Washington State University, Pullman.*

Oxidative stress is increased during fat mobilization during weight loss. Selenoproteins, including glutathione peroxidase (Gpx), thioredoxin reductase (TrxR), and selenoprotein W (Sel-W), are potent antioxidants that protect against cellular damage and may be particularly important at times when oxidative stress is acute. Therefore, a study was conducted to examine the expression of selenoprotein mRNA in skeletal muscle 18 Angus-cross cows during weight loss and weight maintenance. Cows were fed at maintenance for 60 days in early-lactation to allow weight loss. The weight maintenance period (60d) took place shortly after weaning. Cows had access to trace mineralized salt with added selenium at all times. Muscle biopsies were aseptically collected from the *Biceps femoris* at the end of each period and immersed in liquid nitrogen. Total RNA was later extracted and cDNA synthesized. Primers were designed based on available sequences for Gpx1 (Accession No. AF532927), TrxR1 (Accession No. NM174625) and Sel-W (Accession No. AF380118) and real-time quantitative PCR used to determine expression of mRNA relative to β -actin. During the 60-d period following parturition, cows lost an average of 72.2 ± 4.97 kg, whereas, in the 60-d after weaning, cows gained 5.18 ± 4.97 kg. Gpx1 mRNA expression in skeletal muscle during weight loss was not changed when compared to expression during weight maintenance. However, skeletal muscle TrxR1 mRNA

was 10 fold higher ($P < 0.05$) and expression Sel-W mRNA was almost 3-fold greater ($P < 0.05$) during weight loss when compared to weight maintenance. The mammalian antioxidant system has evolved to protect against reactive oxygen species and the subsequent oxidative stress that an animal experiences. Increased expression of these antioxidant genes indicate these cows responded to increased oxidative stress.

Key Words: Beef Cattle, Selenium, Oxidative Stress

W262 Validation of a continuous in vitro system modeling the jejuno-ileal ecosystem of veal calves. M. Champod^{2,1}, S. Blanquet-Diot¹, D. Bravo², J. P. Meunier^{*2}, and M. Alric¹, ¹University of Auvergne, France, ²Pancosma Research, Geneva, Switzerland.

Since the European prohibition of antibiotics used as growth promoters in 2006, it is necessary to develop new feed additives able to maintain the intestinal microflora equilibrium of the veal calves. The aim of this work is to validate an in vitro system that has been set up to reproduce the intestinal ecosystem of veal calves.

This fermentor reproduces the anaerobic, pH and temperature conditions found in the jejuno-ileum of calves. It is inoculated with the jejuno-ileal contents of three 20 weeks-old Prim'Holstein veal calves slaughtered after 6h fasting. The fermentative content is continuously homogenized and renewed by addition of fresh nutritive medium (composition established from biochemical analyses of in vivo intestinal content). The main bacterial groups were followed by regular counting on selective culture media during 1 week. Fermentative samples were collected for lactate and ammonia analyses. The results were compared with in vivo data by one-way analysis of variance.

The levels of total anaerobic microflora, Enterococci, Bifidobacteria and lactate utilizing bacteria were not statistically different from in vivo ones. The concentrations of *Bacteroides* and *Escherichia coli* were significantly ($P \leq 0.001$) higher in vivo than in vitro whereas *Lactobacilli* were stabilized at 8.1 log compared to 6.9 log in vivo ($P = 0.001$). In vivo and in vitro lactate concentrations were not different ($P > 0.05$), whereas ammonia reached concentrations significantly ($P < 0.001$) higher in vitro than in vivo (3.39 vs 0.14 g/L).

These results show that most of the bacterial groups enumerated were stabilized in the in vitro system at their in vivo levels and that their metabolic activities were maintained. This model will be used to screen new feed additives by studying their action on the intestinal microflora equilibrium of the veal calves.

Key Words: Veal Calf, Intestinal Microflora, In Vitro System

W263 Maternal natural source vitamin E supplementation on suckling calf performance and immune response. M. J. Richardson^{*1}, S. L. Lake¹, S. D. Eicher², R. Lemenager¹, M. Einstein¹, and N. Pyatt³, ¹Purdue University, West Lafayette, IN, ²USDA-ARS, West Lafayette, IN, ³ADM Animal Nutrition Research, Decatur, IN.

The objective of this study was to determine the effects of maternally supplemented natural-source vitamin E (NSVE) on suckling calf performance and immune response. In a two-year study, one hundred twenty-five Angus-cross beef cows ($n = 75$ in year one, 50 in year two; initial BW = 607 kg; initial BCS = 5.3) were randomly assigned to one of two isocaloric dietary treatments: 1) corn-based supplement (CON) or 2) corn-based supplement formulated to contain 1000 IU/d NSVE

(NAT). Maternal supplementation began 5 wk prepartum and continued through wk 8 of lactation. Blood was collected from calves at 24 h of age for analysis of IgG concentration as an indicator of passive transfer and circulating α -tocopherol concentration. At 19 d of age, blood was collected from calves to determine the presence of CD14 and CD18 receptors on leukocytes. At 21 and 35 d of age, calves were injected with hen egg albumin (20 mg; OVA) and bled weekly until d 63 of age to determine total antibodies produced to OVA. No differences were seen in calf birthweight ($P = 0.59$), ADG ($P = 0.93$), or weaning weight ($P = 0.39$). Circulating α -tocopherol concentrations were increased at both 24 h ($P < 0.001$) and at the day of initial OVA challenge ($P < 0.001$). There was no difference in IgG concentration ($P = 0.36$) at 24 h or presence of CD14 ($P = 0.83$) or CD18 ($P = 0.84$) receptors at d 19 of age. Calves suckling NAT cows tended ($P = 0.19$) to have a greater overall titer response than calves suckling CON cows, however there was no treatment \times day interaction ($P = 0.59$). In conclusion, calves suckling cows supplemented with NSVE had increased circulating concentrations of α -tocopherol at 24 h which appeared to continue throughout maternal supplementation. Furthermore, calves suckling NAT dams tended to have increased overall titer response when compared with CON calves; however, calf performance was not affected.

Key Words: Beef Calves, Immune Response, Vitamin E

W264 The relation between plasma vitamin C, leptin and fat accumulation during the fattening period in Japanese Black steers. K. Hodate^{*}, M. Hayashi, and K. Kido, National Institute of Livestock and Grassland Science, Tsukuba, Ibaraki, Japan.

In this study, changes of plasma vitamin A and C, leptin and insulin were observed and investigated in relation to fat accumulation in fattening Japanese Black steers. Nine Japanese Black steers (334 ± 18 kg) were fattened for 56 weeks (from 14 to 28 months of age) and divided into three groups: vitamin A supplemented S group was supplemented with 296.8 (42.4×7) IU/BW kg vitamin A weekly from week 1 to week 56, vitamin A restricted R group was restricted vitamin A, keeping the plasma vitamin A level above 30 IU/dL, and the RS group was restricted vitamin A and treated as the R group from week 1 to week 44 and then supplemented with vitamin A weekly and treated as the S group from week 45 to week 56. Blood plasma samples were drawn every 4 weeks before feeding. Leptin and insulin concentrations were measured by RIA kit. Vitamin A and C concentrations were determined using HPLC and a colorimetric method, respectively. Backfat thicknesses were measured by real ultrasonography every 4 weeks. At the start of the experiment, plasma vitamin A and C concentrations were 127 IU/dL and 6.2 mg/L, respectively. At the end of the experiment, plasma vitamin A and C concentrations of the supplemented (S and RS) groups and the R group were 120 and 37 IU/dL ($p < 0.01$), and 3.5 and 2.7 mg/L ($p = 0.10$), respectively. Backfat thickness of the S and the R groups was 17.0 and 15.0 mm and had no correlations with plasma vitamin A concentrations. Plasma leptin and insulin concentrations increased with fattening and showed a high correlation to backfat thickness during the experimental period ($r = 0.93$ and 0.81 , $p < 0.01$). Cross-correlation coefficient between backfat thickness and plasma leptin concentration was at its maximum with a 4 week delay. Backfat thickness was reflected in the circulating leptin concentration 4 weeks later. There was a reciprocal correlation between plasma leptin and vitamin C concentration ($r = -0.93$, $p < 0.01$). Fattening cattle for a long term with high energy feed has decreased plasma vitamin C concentrations.

Key Words: Vitamin C, Steer, Fat Accumulation

W265 Performance, carcass characteristics and IGF-I plasmatic concentrations of feedlot young cattle from different genetic groups. C. L. Martins¹, M.D. B. Arrigoni¹, A. C. Silveira¹, H. N. de Oliveira¹, R. d. C. Cervieri¹, L. A. L. Chardulo¹, D. D. Millen^{*1}, R. D. L. Pacheco¹, T. M. Mariani¹, J. P. S. T. Bastos¹, T. C. B. da Silva², S. R. Baldin¹, L. M. N. Sarti¹, and R. S. Barducci¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Faculdade de Zootecnia/UNESP, Dracena, São Paulo, Brazil.

This study was designed to evaluate performance, carcass characteristics, meat tenderness and IGF-I plasmatic concentration (IGFPC) of *Bos indicus*-based types (BT). The experiment was designed as a 5X2 factorial arrangement, in which 80 8-mo-old bullocks (302.4±28.5kg) and 80 8-mo-old heifers (260.8±26.4kg) of five BT: 40 CH (1/2 Charolais, 1/4 Nellore, 1/4 Simmental), 40 GE (1/2 Gelbvieh, 1/4 Nellore, 1/4 Simmental), 40 AN (1/2 Angus, 1/4 Nellore, 1/4 Simmental), 40 HE (1/2 Hereford, 1/4 Nellore, 1/4 Simmental) and 40 SI (3/4 Simmental, 1/4 Nellore) were fed in feedlot for 150 days. Rib eye area (REA) and back fat thickness (BFT) were taken after slaughter to evaluate muscle and fat deposition. Meat samples were harvested between 12th and 13th ribs for shear force (SF) and intramuscular fat (IMF) analysis. Rib eyes were scored for marbling (MB) using a scale of 1 to 6. CH, HE and SI presented greater (P<0.05) average daily gain in kilos (ADG) when compared to GE and AN (CH=1.07, HE=0.97, SI=1.13, GE=0.84, AN=0.86). Bullocks (BL) had greater (P<0.05) ADG (1.09 vs. 0.85) than heifers (HF). No differences were observed (P>0.05) for dressing percentage and hot carcass weight during the study. AN presented smaller (P<0.05) REA in cm² (56.70) than CH (64.34), SI (62.30), HE (65.85) and GE (63.99). In the other hand, AN showed in mm (P<0.05) greater BFT (AN=3.8, HE=2.9, SI=2.6, GE=2.5, CH=2.6), higher (P<0.05) MB scores (AN=4.4, HE=3.4, SI=3.1, GE=3.1, CH=3.2) and greater (P<0.05) IGFPC in ng/ml (AN=245.6, HE=177.1, SI=197.4, GE=184.8, CH=178.5) and IMF in % (AN=4.27, HE=3.20, SI=3.06, GE=2.78, CH=2.96) between BT. It was found (P<0.05) lower SF (kilograms) values for AN (AN=3.95, HE=5.12, SI=5.63, GE=5.38, CH=5.27). HF had smaller (P<0.05) REA (57.85 vs. 67.42), greater BFT (3.1 vs. 2.6) and lower IGFPC (137.8 vs. 260.1) when compared to BL. No differences were observed (P>0.05) in MB, IMF and SF for HF and BL. Even presenting lower ADG, AN showed better carcass and meat quality with higher MB scores, greater BFT and IMF and better tenderness. BL performed better than HF, but without impacting carcass and meat quality.

Key Words: Carcass, Cattle, Feedlot

W266 Influence of chromium methionine addition during last days in feedlot on performance and carcass characteristics of finishing bulls. R. Barajas^{*1}, B. J. Cervantes^{2,1}, J. A. Romo¹, P. J. Rojas³, and E. A. Velazquez¹, ¹FMVZ-Universidad Autonoma de Sinaloa, Culiacán, Sinaloa, Mexico, ²Ganadera Los Migueles SA de CV, Culiacán, Sinaloa, Mexico, ³Tecnología de Máxima Producción, S.A. de C.V., Culiacán, Sinaloa, Mexico.

With the objective of determine the effect of addition of chromium methionine during last days in feedlot on performance and carcass characteristics of bulls, sixty bull calves (455.95 ± 2.19 kg) Brahman cross were used. Bulls from a same fattening lot, in a complete randomized block design, were assigned to received one of two diets during last 34

days in feedlot: 1) Diet with 13.17 % CP and 2.048 Mcal of NEm/kg, containing 87% de concentrate corn-soybean meal-based (Control); 2) Diet similar to control added with 0.2 ppm of chromium from chromium methionine. Chromium improved (P = .09) ending weight, and augmented (P = 0.09) ADG in 14.6%. Dry matter intake was not affected (P = 0.84). Chromium enhanced (P = 0.09) in 12% feed conversion, 8% NE retained from the diet and 11% NEm retained from diet. Chromium did not affected (P = 0.20) hot carcass weight, and tended (P = 0.11) to improved carcass dressing. Chromium not modifies (P > 0.20) back fat thickness, rib eye area, marbling score, KPH fat neither meat pH. It is concluded, that addition of chromium methionine at low dosages during last days in feedlot, could contribute to improve performance of finishing bulls.

Key Words: Chromium, Feedlot Cattle, Growth-Performance

W267 Influence of chromium-methionine supplementation level during last 32 days on feedlot performance, carcass characteristics, and blood cortisol of finishing bulls. V. Monterrosa^{1,2}, R. Barajas^{*3}, J. A. Romo³, and B. J. Cervantes^{3,4}, ¹Técnica Mineral Pecuaria, Guadalajara, Jalisco, Mexico, ²CUCBA-Universidad de Guadalajara, Guadalajara, Jalisco, Mexico, ³FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico, ⁴Ganadera Los Migueles, S.A. de C.V., Culiacan, Sinaloa, Mexico.

Forty five finishing beef bulls (487.7 ± SE 2.49 kg) were involved in an experiment to determine the influence of chromium-methionine supplementation level during last 32 days on feedlot performance and carcass characteristics. Animals were blocked by weight, and in groups of five were placed in ground pens. Within each block pens were randomly assigned to one of three dietary treatments: 1) Finishing diet 13% CP; NEm 1.9 Mcal/kg without additional chromium (CTRL); 2) Diet similar to CTRL but with 0.2 mg/kg of chromium added during last 32 days in feedlot (Cr-0.2); and 3) Diet similar to CTRL but added with 0.4 mg/kg of chromium added during last 32 days in feedlot (Cr-0.4). Chromium-methionine premix (MiCroplex TM; Zinpro, Co, Eden Prairie, MN) was used as source for additional Cr. All cattle received 60 mg/head/d of zilpaterol hydrochloride from day 33 to day 3 prior to slaughter. Ending weight was not affected by treatments (P > .40). Cr-0.4 increased ADG 4.8% (P = .04) with respect to control, and a linear increase in ADG as Cr level increased was observed (P < .05) with values of 1.898, 1.920 and 1.898 by CTRL, Cr-0.2, and Cr-0.4, respectively. Dry matter intake was not influenced by treatments (P > .25). Feed/gain ratio was improved 4% by Cr-0.4 (P < .05) with respect to CTRL. Feed/gain ratio was linearly reduced supplementary Cr was increased (P < .05), with values of 6.023, 5.917, and 5.785 kg/kg for CTRL, Cr-0.2, and Cr-0.4, respectively. NEm and NEm observed/expected ratio was not altered by Cr-supplementation (P > .15). Carcass characteristics and meat-pH were not altered by treatments (P > .40). Blood cortisol at slaughter time was decreased 28% by Cr-0.2 and Cr-0.4, relative to unsupplemented-Cr cattle (4.53, 3.23, and 3.23 mg/dL by CTRL, Cr-0.2, and Cr-0.4, respectively). The results suggest that chromium methionine supplementation during last 32 days in feedlot, improves daily weight gain and feed/gain ratio of finishing bulls without affecting carcass characteristics.

Key Words: Beef Cattle, Chromium Methionine, Feedlot Performance

W268 Effects of essential oils on ruminal environment and performance of feedlot calves. J. I. Geraci¹, A. D. Garcarena¹, D. Colombatto^{2,3}, D. Bravo⁴, and J. C. Burges¹, ¹EEA Balcarce INTA, Argentina, ²University of Buenos Aires, Argentina, ³CONICET, Argentina, ⁴Pancosma SA, Switzerland.

Essential oils (EO) have the potential to modify the ruminal environment and to replace the use of antibiotics for specific markets. Twenty four Aberdeen angus calves (135.4 kg initial weight) were blocked by weight in four groups and randomly allocated to 8 pens of 3 animals each. Treatments were EO (800 mg Xtract 7065 animal⁻¹ d⁻¹) or monensin (430 mg Rumensin[®] kg DM⁻¹) added into a mineral mixture. Diets were fed twice a day and consisted (DM basis) of 70% coarsely ground corn, 28% pelleted sunflower meal and 2% mineral mixture, plus 200 g alfalfa hay animal⁻¹ d⁻¹. The experiment lasted for 85 days, and DM intake, average daily gain (ADG), feed conversion ratio (FCR) and rate of subcutaneous fat deposition (RFD) were determined throughout the study. In addition, two ruminally fistulated steers were also used in a cross over design in order to examine ruminal variables (pH and NH₃) as affected by EO or monensin. Compared to monensin, EO did not alter DM intake (6.50 vs. 6.45 kg, $p=0.79$), ADG (1.31 vs. 1.23 kg d⁻¹, $p=0.35$), FCR (4.96 vs. 4.99, $p=0.91$) or RFD (1.80 vs. 1.68 mm month⁻¹, $p=0.65$) for EO and monensin, respectively. In addition, feeding behaviour was not altered by EO compared to monensin, as animals visited the feeders a similar number of times and the length of each visit was also similar (11.2 vs. 10.74; and 9.55 vs. 9.72 min for EO and monensin, respectively). Ruminal pH was lower with EO than with monensin (5.58 vs. 6.09, $p=0.002$), and the same held true for NH₃ (10.78 vs. 20.05 mg dl⁻¹, $p=0.01$). Lower NH₃ concentrations with EO addition can be partially explained by the lower pH, conducive to lower protein degradation, and perhaps due to some EO action on specific, deaminative bacteria in the rumen. Overall, this study shows that EO can replace monensin in high grain diets without any alteration in the productive response of feedlot cattle.

Key Words: Essential Oils, Monensin, Feedlot

W269 Body and ultrasound measurements, muscularity scores, blood physiology and behaviour in growing beef heifers differing in phenotypic residual feed energy intake. M. McGee^{*1}, M. J. Drennan¹, D. A. Kenny², and B. Earley¹, ¹Teagasc, Grange Beef Research Centre, Dunsany, Co. Meath, Ireland, ²University College Dublin, Belfield, Dublin, Ireland.

The effect of residual feed energy intake (RFI), an alternative measure of feed efficiency, on growth, body and ultrasound measurements, blood physiology and behaviour was determined in growing purebred Simmental and Simmental x Friesian-Holstein heifers (n=85; mean (± SD) initial age 299 ± 47 d and weight 311 ± 48.8 kg). They were individually offered grass silage ad libitum and 2.0 kg of concentrate once daily over 84 d using a Calan gate system. Live weight (consecutive days), body (withers height, chest depth and girth, pelvis width and back length) and ultrasound fat (13th rib), and fat and muscle (3rd lumbar) depth measurements were taken at the beginning and end, and additionally, a visual muscularity score was recorded at the end, of the feeding period. Blood samples were obtained on four occasions for analysis of albumin, creatinine, beta-hydroxy butyrate, globulin, glucose, non-esterified fatty acids, total protein, triglycerides, urea, aspartateaminotransferase, alkaline phosphatase, creatine kinase, fibrinogen, haptoglobin, anti-

oxidant status and total bilirubin. Expected energy intake (EI) (UFL/d) was calculated by regressing average daily EI on average daily live weight gain (ADG) and mean live weight^{0.75}, with a model which included genotype. Within genotype, heifers were then ranked by RFI and assigned to low (efficient), medium and high RFI groups. At the end of the study, time spent lying and standing was determined using pedometers on nine heifers with the highest and lowest RFI. Overall mean (± SD), ADG (kg/d), DMI (kg/d), EI (UFL/d) and RFI (UFL/d) were, 0.52 ± 0.20, 5.81 ± 0.73, 5.17 ± 0.58 and -0.00 ± 0.35, respectively. The RFI groups did not differ ($P>0.05$) in live weight, ADG, body and ultrasound measurements, muscularity score, blood variables or lying and standing time.

Key Words: Beef Cattle, Residual Feed Intake, Feed Efficiency

W270 The effect of mineral supplement delivery system on frequency, duration, and timing of use by beef cows grazing topographically rugged native range. N. A. Sproul^{*}, K. C. Olson, J. S. Drouillard, J. R. Jaeger, L. A. Pacheco, J. W. Bolte, M. D. Thomas, and J. J. Higgins, Kansas State University, Manhattan.

The study was conducted on 4 pastures (average size = 101 ha) from June to September. The pastures were grazed by 188 lactating beef cows and their calves (30-70 pairs/pasture). Treatments were mineral provided in dry granular form (DRY) or mineral provided in a low-protein, cooked molasses-based block (BLOCK). Both supplements were available ad libitum. DRY was supplied to cattle via 1 covered mineral feeder. BLOCK was supplied via 4 open-topped barrels spaced within 3 m of one another. Both DRY and BLOCK were deployed in each pasture and pasture constituted the experimental unit. No additional NaCl was supplied to cattle. Forage use in the vicinity of each supplement and the frequency and duration of herd visits to each supplement were measured during 7 14-d periods. Supplements were moved to new locations at the beginning of each period. BLOCK consumption was greater ($P<0.01$) than DRY in periods 1, 3, 5, and 7 but was not different ($P>0.1$) from DRY during periods 2, 4, and 6. The frequency of herd visits to BLOCK and DRY sites were similar ($P>0.1$) for periods 1 through 5; however, herds visited BLOCK about twice as often as DRY during periods 6 and 7 ($P<0.01$). Herd visits to BLOCK sites were longer than those to DRY sites (84 vs. 51 min/herd visit; $P<0.01$). The total length of nighttime visits (1800 to 0600) to BLOCK was greater than that for DRY (57 vs. 49 min/d; $P<0.01$); however, the percentage of all herd visits that occurred at night was similar ($P=0.38$) between treatments. Forage disappearance around supplement deployment sites was not influenced by treatment ($P=0.81$). Forage disappearance over time generally decreased (main effect of period, $P<0.01$). BLOCK influenced the behavior of grazing cattle more strongly than DRY. Influences extended to the amount of supplement consumed as well as to the frequency, duration, and timing of use.

Key Words: Beef Cattle, Grazing Behavior, Native Range

W271 Effects of the dose of capsicum extract on intake, water consumption and rumen fermentation of beef heifers fed a high-concentrate diet. M. Rodriguez-Prado¹, S. Calsamiglia^{*1}, A. Ferret¹, J. Zwieter¹, L. Gonzalez¹, and D. Bravo², ¹Universitat Autònoma de Barcelona, Spain, ²Pancosma, Switzerland.

Four beef Holstein heifers (BW = 438 ± 71 kg) fitted with a 1-cm i.d. plastic ruminal trocars were used in a 4 × 4 Latin square design to evaluate the effect of 3 doses of capsicum extract on intake, water consumption and ruminal fermentation in heifers fed a high-concentrate diet. Animals were fed (DM basis) 10% barley straw and 90% concentrate (32.2% barley grain, 27.9% ground corn, 7.5% wheat bran, 10.7% soybean meal, 10.7% soybean hulls, 7.2% corn gluten feed, 3.1% mineal-vitamin mix; 16.6% CP, 18.3% NDF). Treatments were: no additive (CTR), 625 mg/d of capsicum extract (CAP625), 1250 mg/d of capsicum extract (CAP1250), and 2500 mg/d of capsicum extract (CAP2500). Each experimental period consisted of 25 d (15 d for adaptation, 5 d of continuous measurement of DM intake, and 3 d for rumen sample collection). Animals had ad libitum access to water and feed offered once daily at 0800. Data was analysed using PROC MIXED for repeated measures (SAS), and differences were declared at $P < 0.05$. Intake of water (30.3 and 29.4 vs 27.4 L/d) was higher in CAP625 and CAP2500 compared with CTR, respectively. Intake of concentrate was also higher in CAP2500 vs CTR (8.40 vs 7.64, respectively). As a result of the higher intake, total volatile fatty acids tended ($P < 0.07$) to be higher in CAP625 and CAP2500 compared with CTR (144.8 and 142.9 vs 134.1 mM, respectively). However, the concentration of acetate (59.2 mM), propionate (23.8 mM), butyrate (14.2 mM), lactate (0.28 mM) and ammonia N (14.9 mg N/dL) was not affected by treatments. In spite of the higher intake, pH was not affected by treatments. Capsicum extract can be used in beef cattle diets to stimulate DM intake and water consumption without reducing ruminal pH.

Key Words: Intake, Capsicum, Fermentation

W272 Blood metabolic profile of feedlot cattle supplemented with monensin or polyclonal antibodies preparations against lactate-producing rumen bacteria during diet step-up. D. D. Millen^{1,3}, R. D. L. Pacheco¹, M. D. B. Arrigoni¹, A. DiCostanzo², C. T. Marino¹, N. DiLorenzo², S. A. Matsuhara¹, M. Parrili¹, M. V. Fossa¹, L. M. N. Sarti¹, S. L. Beier¹, H. N. de Oliveira¹, C. L. Martins¹, T. M. Mariani¹, J. P. S. T. Bastos¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²University of Minnesota, Saint Paul, ³Apoio FAPESP.

This study, conducted at the São Paulo State University feedlot, Botucatu Campus, Brazil, was designed to test polyclonal antibody preparation (PAP) against lactate-producing rumen bacteria on blood gas concentrations during diet transitions (58% to 85% concentrate; substituting corn silage and sugarcane bagasse for corn grain) of *Bos indicus*-based biotypes. The experiment was designed as a 3 X 2 factorial, replicated thrice (4 bullocks/pen), in which 24 8-mo-old bullocks (259.6±26.4kg) of each of three *Bos indicus*-based types: 3-way cross (1/2 Brangus, 1/4 Angus, 1/4 Nellore; TC), Canchim (5/8 Charolais, 3/8 Nellore; CC), or Nellore (NE) were fed one of two diets containing either monensin (MO) at 300 mg/head/d or RMT at 10 ml/head/d. Jugular venous whole blood was collected in 1 ml syringes and analyzed within 1 h. Over the step-up periods, greater ($P < 0.05$) O₂ pressure in mmHg (pO₂) and percentage O₂ saturation (O₂Sat) were observed in NE bullocks (33.5 and 63.8 vs. 30.2 and 57.6 and 31.1 and 58.7 for NE, CC, and TC, respectively). No differences ($P > 0.05$) were found in pH, bicarbonate concentration (BC) in mmol/l, CO₂ pressure in mmHg (pCO₂) and base excess in mmol/l (Beb) among biotypes. There were not differences ($P > 0.05$) in pH, BC, Beb, pCO₂ and O₂Sat when either PAP or MO was fed, but feeding MO led to greater ($P < 0.05$) pO₂ (32.2) than PAP (31.2). Within MO transitions, transition to 73% concentrate led to greater ($P < 0.05$) pCO₂ and a linear increase ($P < 0.05$) of O₂Sat during all diet transitions.

Lower ($P < 0.05$) pH, BC and Beb were observed during transition to 73% concentrate diet. Values for blood gas were in normal ranges (not representative of metabolic acidosis). Effects of diet transition were greater than those of biotype or feed additive.

Key Words: Blood Gas, Monensin, Antibodies

W273 Intake fluctuations of feedlot cattle supplemented with monensin or polyclonal antibodies preparations against lactate-producing rumen bacteria during diet step-up. D. D. Millen^{1,3}, R. D. L. Pacheco¹, M. D. B. Arrigoni¹, A. DiCostanzo², N. DiLorenzo², C. T. Marino¹, S. A. Matsuhara¹, M. Parrili¹, L. M. N. Sarti¹, M. V. Fossa¹, H. N. de Oliveira¹, S. L. Beier¹, C. L. Martins¹, T. M. Mariani¹, J. P. S. T. Bastos¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²University of Minnesota, Saint Paul, ³Apoio FAPESP.

The adaptation response to high-concentrate diet step-up in bullocks of three distinct biotypes (Nellore, NE; Canchim cross, 5/8 Charolais, 3/8 Nellore, CC; or a 3-way cross, 1/2 Brangus, 1/4 Nellore and 1/4 Angus, TC) supplemented with a polyclonal antibody preparation (PAP) against lactate-producing bacteria (10 ml/head/d) or monensin (MON; 300 mg/head/d) was measured in a 2 × 3 factorial design. Seventy-two bullocks (24 of each biotype; 259.6±26.4 kg) were randomly allocated to each of 18 pens (one biotype within treatment) for a 135-d (TC and CC) or 175-d (NE) feeding period. On the first 4 d of each step-up period (from 58% to 85% concentrate), daily DMI (kg and as percent of BW) and daily DMI fluctuation (DMIF; kg and as percent of BW; the absolute value of the difference in DMI between consecutive days) were measured. During step-up, corn grain replaced proportions of corn silage and sugarcane bagasse. Over the step-up periods, bullocks fed PAP consumed more ($P < 0.05$) DM than those fed MON (2.34% vs. 2.24%), but no differences were detected for DMI kg or DMIF. *Bos taurus*-influenced biotypes consumed more ($P < 0.05$) DM than pure *Bos indicus* biotypes (9.65 and 9.15 vs. 7.14 for TC, CC, and NE, respectively), but no differences in DMI fluctuation were observed. During the transition from 58% to 73% concentrate, bullocks fed PAP consumed more DM (8.34 kg and 2.69% vs. 7.38 kg and 2.38%, respectively), but no differences were observed in subsequent diet transitions. When comparing across diet transitions, the transition from 58% to 73% concentrate resulted in greater ($P < 0.05$) DMI (as percent of BW) and DMIF. A day effect was observed, where day 1 showed greater ($P < 0.05$) DMIF kg (1=0.73, 2=0.52, 3=0.43, 4=0.49) and DMIF BW (1=0.20, 2=0.14, 3=0.11, 4=0.13) when compared to the days 2, 3 and 4. It was not found ($P > 0.05$) interaction between days and feed additives for DMIF. Diet transition effects were greater than those elicited by use of either feed additives.

Key Words: Dry Matter Fluctuation, Monensin, Antibodies

W274 Effects of supplemental cobalt on site and extent of digestion in beef heifers consuming chopped grass hay. E. J. Scholljegerdes¹ and W. J. Hill², ¹USDA-ARS, Northern Great Plains Research Laboratory, Mandan, ND, ²Ralco Nutrition, Inc., Marshall, MN.

The objectives of this study were to determine if a mineral supplement containing a high level of organic cobalt would improve site and extent of digestion in beef cattle consuming a forage-based diet. Six ruminally cannulated Angus heifers (BW 432 ± 6.6 kg) were utilized in a triplicated

2 × 2 Latin square. Animals were fed chopped (2.54 cm) native grass hay (9.19% CP, 67.5% NDF on an OM basis) ad libitum. Cattle also received twice daily, 42.5g of a Bullseye™ All Purpose mineral-vitamin premix plus Suppli-mix® formulated to provide either 109 mg of Co/ kg or 283 mg of Co/ kg. Experimental periods lasted 21 d (17 d of adaptation with 4 d of sampling). Total DM, OM, N, and NDF intake did not differ ($P = 0.80$ to 0.85) across treatment. Likewise, no differences ($P = 0.54$ to 0.99) were noted for fecal DM, OM, N, and NDF flow (g/d) between cattle fed 109 mg of Co/ kg of supplement or 283 mg of Co/ kg. Therefore, Total tract DM, OM, N, and NDF digested (g/d) was not different ($P = 0.75$ to 0.79) across treatments. Increasing supplemental cobalt from 109 mg of Co/ kg to 283 mg did not improve ($P = 0.68$ to 0.91) total tract digestibility of any of the nutrients examined when expressed as a percent of intake. Dietary treatment did not affect ruminal pH ($P = 0.99$) or ruminal NH_3 ($P = 0.18$). Likewise, additional cobalt had no effect ($P = 0.40$) on total VFA production. However, feeding 283 mg of Co/ kg of supplement did tend ($P = 0.08$) to increase ruminal molar proportions of butyrate from 9.9 to 10.2 mol/100mol but did not influence any other ruminal VFA ($P = 0.36$ to 0.87). Due to the lack of differences in ruminal molar proportions of acetate and propionate, the acetate:propionate ratio did not differ ($P = 0.77$) across treatments. Overall, increasing the concentration of cobalt from 109 mg of Co/ kg of supplement to 283 mg of Co / kg did not improve diet digestibility. Nevertheless, more work needs to be done to elucidate the potential of supplemental cobalt to improve forage digestibility.

Key Words: Cobalt, Digestibility, Forage

W275 Effect of added dietary tannins on animal performance, carcass traits, and methane producing activity in finishing calves. W. K. Krueger^{1,2}, H. G. Bañuelos¹, W. E. Pinchak³, B. R. Min³, R. C. Anderson^{4,2}, G. E. Carstens^{1,2}, R. R. Gomez¹, and N. A. Krueger⁴, ¹Texas A&M University, College Station, ²Intercollegiate Faculty of Nutrition, TAMU, College Station, TX, ³Texas AgriLife Research, Vernon, TX, ⁴USDA-ARS-Food and Feed Safety Research Unit, College Station, TX.

The objective of the study was to characterize the effect of added dietary tannins on animal performance, carcass traits, and methane producing activities in finishing cattle. Thirty-six crossbred steers (414 ± 40 kg) were stratified by initial BW (IBW) and randomly assigned to one of three treatments (n = 12): control (Cn), mimosa (M), and chestnut (Ch) tannin. Tannins were supplemented at 1.5% of the diet. Calves were fed for 42 d in a Calan gate™ system; intake and BW were measured weekly. Rumen fluid and feces were collected on d 0, 7, 21, and 42 for methane producing activity, ammonia, and pH. There was no effect ($P > 0.05$) of tannins on IBW, final BW, ADG, DMI, feed to gain ratio, and DMI %BW. IBW was used as a covariate in carcass trait analysis. There was no effect ($P > 0.05$) of tannin on HCW, 12th rib fat thickness, LMA, and YG; there tended ($P < 0.10$) to be a tannin effect on KPH and marbling score. There was an IBW*treatment interaction in dressing percent (DP) and internal fat (IF). Estimates of treatment differences in DP and IF were computed as the mean covariate IBW, and mean ± 1 SD. At mean IBW, M had lower ($P < 0.05$) DP compared to Cn while Ch was intermediate. At heavy IBW, Ch and M had lower ($P < 0.05$) DP than Cn. At light IBW, Cn had more ($P < 0.05$) IF as compared to Ch and M; at heavy IBW, Ch had the most ($P < 0.05$) IF, M the least ($P < 0.05$) with Cn intermediate. Methane, ammonia and pH data were analyzed using repeated measures; d 0 was used as a covariate. Tannins had no

effect on rumen fluid or feces methane producing activity, rumen or fecal ammonia and rumen pH ($P > 0.05$). There was a treatment*d0 interaction on fecal pH. In low initial fecal pH calves, Ch and M increased fecal pH versus Cn calves. The expected decrease in methane producing activity did not materialize, which is in contrast to our previous findings with cattle grazing winter wheat pasture. There appears to be no detrimental or positive effects of adding tannins in finishing diets; however, site of digestion may be altered in some calves, evidenced by treatment effect on fecal pH.

Key Words: Tannins, Carcass Traits, Methane Producing Activity

W276 Evaluation of feed efficiency and feeding behavior traits in Angus and Red Angus growing bulls. Z. D. Paddock^{*1}, G. E. Carstens¹, P. A. Lancaster¹, L. R. McDonald², and S. Williams², ¹Texas A&M University, College Station, ²Midland Bull Test, Columbus, MT.

Objectives of this study were to characterize feed efficiency traits and to examine phenotypic relationships with feeding behavior traits in growing bulls. Feed intake and feeding behavior traits were measured in Angus (n = 243, initial BW = 366 ± 47 kg) and Red Angus (n = 87, initial BW = 364 ± 43 kg) bulls for 70 d using a GrowSafe feeding system. Bulls were fed a corn silage based diet (ME = 2.42 Mcal/kg DM), and BW measured at 14-d intervals. Residual feed intake (RFI) was calculated as the residual from the linear regression of DMI on mid-test BW^{0.75} and ADG within breed. Daily meal duration (min/d) and meal frequency (events/d) were averaged over the 70-d study, and eating rate (g/d) computed as DMI divided by meal duration. Red Angus bulls had higher ($P < 0.05$) ADG (1.52 vs 1.45 ± 0.03), consumed more ($P < 0.05$) DMI (10.64 vs 10.35 ± 0.13) and tended ($P < 0.10$) to lower feed:gain ratios (7.36 vs 7.06 ± 0.14) than Angus bulls. Overall (mean ± SD) RFI of Angus and Red Angus bulls were 0.0 ± 0.62 and 0.0 ± 0.74, respectively. RFI was positively correlated ($P < 0.05$) with DMI (0.54) and feed:gain ratio (0.35), but not with ADG or initial BW. Angus bulls had longer ($P < 0.01$) meal durations (193.4 vs 211.3 ± 2.50 min/d) lower ($P < 0.01$) meal frequencies (10.92 vs 11.75 ± 0.23 events/d) and higher ($P < 0.01$) eating rates (54.20 vs 50.82 ± 0.87 g/min) than Red Angus bulls. Meal Duration was more positively correlated ($P < 0.05$) with ADG (0.35) than DMI (0.23), such that meal duration was negatively correlated with feed:gain ratio (-0.22). Eating rate was not correlated with ADG, but was positively correlated ($P < 0.05$) with DMI and feed:gain ratio (0.58, 0.35). RFI was positively correlated with meal duration and eating rate (0.23, 0.24), but not with meal frequency. These results suggest that feeding behavior traits may be useful indicator traits for early identification of bulls with favorable phenotypes for RFI.

Key Words: Feed Efficiency, Feeding Behavior, RFI

W277 Effects of fish oil and sunflower oil supplementation on trans-10, cis-12 CLA and cis-9, trans-11 CLA contents of ruminal bacteria from beef cattle. D. P. Bu, S. L. Liu, J. Q. Wang*, S. Liang, L. Liu, H. Y. Wei, and L. Y. Zhou, State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, P.R. China.

The objective of this study was to evaluate fatty acids profile of ruminal bacteria in beef cattle fed the mixture of fish oil and sunflower oil.

Four steers with ruminal cannulas were randomly assigned to control (C, without additional oil supplement) or C with 3% sunflower oil plus 1% fish oil (SF1), 2.5% sunflower oil plus 1.5% fish oil (SF2) and 2% sunflower oil plus 2% fish oil (SF3) in a 4 × 4 Latin square with 12-wk durational periods. All diets (forage to concentrate ratio was 65:35) were isonitrogenous (average of 12.6 %). Ruminal digesta was collected every 4 h over a 24 h period on d 20 and 21 of each experimental period and pooled for each animal. Pooled samples were prepared for bacteria separation and fatty acids analysis according to M. Sönnichsen. All data were analyzed using the MIXED procedure of SAS 8.2. Compared with CK, stearic acid in ruminal bacterium was obviously changed with fish oil increasing ($P < 0.001$), and reduced by 41.36%, 65.69%, 73.15% in SF1, SF2 and SF3 treatments, respectively. Cis-9, trans-11 CLA in ruminal bacterium was not affected with dietary sunflower and fish oil supplementation. Compared with C, trans-11 C18:1 in ruminal bacterium increased by 2.88, 4.26 and 3.99 times in SF1, SF2 and SF3 ($p < 0.01$). When fish oil was added to diets, trans-10, cis-12 CLA proportion of mixed ruminal bacterium reached to average 1.02% of total fatty acids, yet was not detected in C ($p > 0.05$). In bacterium fatty acid profiles, cis-9 C18:1 and cis-11 C18:1 content did not change with dietary unsaturated fatty acids addition. These results showed that CLA content of rumen bacteria was affected by the supplementation of fish oil and sunflower oil.

Key Words: Ruminal Bacteria, Fish Oil, Conjugated Linoleic Acids

W278 Different levels and combinations of fish oil and sunflower oil do not alter fiber digestion in China Nooxi steers. S. Liang, J. Q. Wang*, D. P. Bu, S. J. Liu, L. Liu, H. Y. Wei, L. Y. Zhou, and K.L. Liu, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

Adding fish oil (FO) and sunflower oil (SFO) is one of the best established strategies to enhance conjugated linoleic acid content in ruminant products, while effect of combinations of fish oil and sunflower oil into diet on nutrient digestion was scarcely reported. Four rumen-cannulated China Nooxi steers, with initial weight of 600±20 kg, were used in a 4 × 4 Latin square study to determine the effects. Treatments were basal diet (forage to concentrate was 65:35, control), or basal diet with 3% SFO plus 1% FO (SF1), or basal diet with 2.5% SFO plus 1.5% FO (SF2), or basal diet with 2% SFO plus 2% FO (SF3). The steers were fed at maintenance level. Each experimental period lasted for 21 d. Ruminal fluid was collected every 2 h from 0730 to 1930 on d 15 of each experimental period. On d 20 and 21, duodenal digesta were collected every 4h over a 24-h period for a composited sample. All data were analyzed by MIXED procedure of SAS8.2. Statistical model included cow as random effect, and period and treatment as fixed effects. Ruminal acetic and butyric acid content decreased ($P < 0.05$), while propionic acid was remarkably enhanced ($P < 0.01$). DM, OM, ADF and NDF digestion across rumen was not affected statistically by treatments, averaged 43.94, 42.50, 47.72, 49.24%. Although SF3 tended to increase total tract digestion, the results from this study suggested fish oil inclusion did not decrease ($P > 0.05$) fiber digestion. It even seemed that dietary fish oil addition increased nutrient digestion of steers fed high forage diet. This result should be considered with caution, for steers used in this study have a relative lower DMI. Meanwhile, high forage in diets might be the main reason that masked the effect of combined oils.

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Key Words: Fish Oil, Sunflower Oil, Fiber Digestion

W279 Different combinations of fish oil and sunflower oil alter fatty acids profile in rumen fluid and duodenal fatty acid flows in China Nooxi steers. S. Liang, J. Q. Wang*, D. P. Bu, S. J. Liu, L. Liu, K. L. Liu, H. Y. Wei, and L. Y. Zhou, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

Adding fish oil (FO) and sunflower oil (SFO) is one of the best ways to enhance milk CLA content, while effect was not clear to beef steers. This experiment was designed to evaluate influence of combination of fish oil and sunflower oil on fatty acid profile in rumen fluid and duodenal fatty acids flow. Four rumen-cannulated China Nooxi steers, with initial weight of 600±20 kg, were used in a 4 × 4 Latin square study. High forage (60%) diets were fed. Treatments were basal diet (forage to concentrate was 65:35, control), or basal diet with 3% SFO plus 1% FO (SF1), or basal diet with 2.5% SFO plus 1.5% FO (SF2), or basal diet with 2% SFO plus 2% FO (SF3). Each experimental period lasted for 21 d. Ruminal fluid was collected every 2 h from 0730 to 1930 on d 15 of each experimental period and composited. On d 20 and 21, duodenal digesta were collected every 4h over a 24-h period for a composited sample. All data were analyzed by MIXED procedure of SAS 8.2. Statistical model included cow as random effect, and period and treatment as fixed effects. Compared with control (3.36% of total fatty acid), TVA content in rumen fluid highly increased ($P < 0.01$) when FO and SFO were added, but there was no significant difference ($P > 0.05$) among SF1, SF2 and SF3 with an average of 6.56% of total fatty acid. RA content was also similar among three oil-added treatments. Duodenal flow of TVA markedly increased ($P < 0.01$) when SFO and FO was added while there was no significant difference among SF1, SF2 and SF3 averaged 35.67 g/d vs. 9.45 g/d for control. The results from this study suggest that providing only 1% FO in diet is enough to maximize RA and TVA production in rumen and duodenum of China Nooxi steers.

Acknowledgement: Research supported by the Ministry of Science and Technology (2006BAD12B03).

Key Words: Fatty Acid Profile, Fish Oil, Sunflower Oil

W280 Changes in rumen bacterial flora in beef cattle fed fish oil. Y. X. He, J. Q. Wang*, D. P. Bu, P. Yu, S. J. Liu, H. Y. Wei, L. Y. Zhou, and K. L. Liu, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

Dietary cis-9, trans-11-conjugated linoleic acid (CLA) is generally thought to be beneficial for human health. Unsaturated fatty acid added to ruminant diets increases the CLA concentration of milk and meat. The aim of this study was to investigate the change of rumen bacterial floras after beef cattle were supplemented with 2% fish oil. Total genomic DNA was extracted from rumen fluid obtained before and after oil supplementation. 16S rDNAs were amplified with bacteria universal primer 27F/1492R and two 16S rDNA libraries were constructed. 384 clones were picked up randomly from each library and positive clones were evaluated by restriction fragment length polymorphism (RFLP) with *Hha*I. Representative clones in each RFLP class were sequenced. A phylogenetic tree was constructed to study the structural differences of rumen bacterial floras before and after oil supplementation. Cluster analysis identified 74 and 41 unique RFLP patterns in oil supplementation library and without oil supplementation library separately. It was indicated that CFB (*Cytophaga-Flexibacter-Bacteroides*) and LGCGPB (low G+C Gram positive bacteria) were the major taxa in both libraries.

The percent of LGCGPB declined and no *Fibrobacteres* were detected after oil supplementation. The sequencing results showed that the similarity of 50%-60% sequences obtained were ~97% to the 16S rRNA gene sequences reported in GenBank. Uncultured bacteria accounted for over 90%. The diversity of rumen bacteria flora was reduced after oil supplement. The percent of CFB in post-oil supplementation library was increased but the diversity decreased. Bacteria in LGCGPB and

Fibrobacteres phyla decreased. These results provided evidence for investigating mechanism of increasing the CLA concentration of milk and meat, controlling the fermentation of rumen and recognizing more uncultured bacteria.

Acknowledgement: Research funded by Ministry of Science and Technology (2006BAD04A08).

Key Words: Rumen Bacteria, 16S rDNA, RFLP

Swine Species

W281 Effect of wheat bran and zinc oxide on the microbiota of weanling pigs. F. Molist*, A. Gómez de Segura, J. Gasa, R. G. Hermes, and J. F. Pérez, *Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.*

This experiment was conducted to evaluate the effects of an antimicrobial agent such as zinc oxide (ZnO) and an insoluble fiber source like wheat bran (WB), and its interaction (WB-ZnO) on the gastrointestinal ecosystem in newly weaned piglets. A total of 64 piglets (24±0.77 days) were assigned randomly to 1 of 4 experimental groups. The dietary treatments consisted on a basal diet (STD) based on corn, barley and soybean meal which was supplemented with 4% WB (WB), 0.3% ZnO (ZnO) or 4% WB and 0.3% ZnO (WB-ZnO). On day 3, 6, 9 and 12 after beginning the dietary treatments, animal weight and feed intake were controlled and feces samples were taken for quantifying enterococci and *E.coli* population in agar plates and lactobacilli counts by real time PCR. As compared to the STD diet, dietary supplementation with ZnO increased ($p<0.05$) body weight (7157.2, 7261.5, 7509.5, 7385.4 g for the STD, WB, ZnO, WB-ZnO, respectively) and feed intake (2121.6, 2219.4, 2783.5, 2381.1 g/animal for the STD, WB, ZnO, WB-ZnO, respectively, $p=0.08$). The inclusion of WB and ZnO in the diet diminished ($p<0.05$) *E.coli* counts (5.7, 4.8, 4.6, 5.6 log cfu/ g FM for STD, WB, ZnO, WB-ZnO, respectively) in the feces compared to the STD diet and to the WB-ZnO combination. Diet containing ZnO decreased also lactobacilli loads (11.9, 11.7, 11.1, 11.5 log 16S rDNA gene copies/ g FM for STD, WB, ZnO, WB-ZnO, respectively, $p<0.05$). However, these effects were not observed when WB and ZnO were included in the same diet. No significant differences were observed in the enterococci population. It can be concluded that ZnO increased feed intake and productive performance associated with a reduction on the major groups of bacteria, including lactobacilli. On the other hand, WB inhibited *E.coli* and promoted the stability of beneficial bacteria namely lactobacilli.

Key Words: Piglets, Wheat Bran, Zinc Oxide

W282 Effects of wheat bran level and particle size on the intestinal microbiota composition and activity of early weaned piglets. F. Molist*, A. Gómez de Segura, J. Gasa, R. G. Hermes, and J. F. Pérez, *Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.*

The incorporation of insoluble fiber in the piglet diets during the early weaning period was evaluated as a strategy to promote feed intake and digestive adaptation of the intestinal microbiota. Two different studies were conducted. In Exp 1, 90 early-weaned (24±0.77 days) pigs were allocated to three dietary treatments: a STD diet based on corn, barley and soybean protein, and two fibrous enriched diets including 4 and 8% of wheat bran (WB-4 and WB-8). Animals and feed were weighed and feces sampled on d 3, 6, 9, 12 and 15 for the microbial activity and composition analyses. Results indicated that WB-4 showed the highest feed intake ($p=0.02$), averaging 211.6, 226.7 and 189.6 g/animal and

day for the STD, WB-4 and WB-8, respectively. The same diet tended to decrease enterococci (6.1, 5.3, 6.1 log cfu/g FM; $p=0.06$) and coliforms (6.9, 6.3, 6.7 log cfu/g FM; $p=0.08$ for STD, WB-4 and WB-8, respectively). The inclusion of WB in the diet increased ($p=0.02$) the fecal SCFA concentration on day 15 (93.6, 145.5, 141.1 $\mu\text{mol/g}$ FM, respectively). In the Exp 2, it was studied the likely influence of the WB particle size on the above referred effects. A total of 48 early-weaned (22±0.66 days) pigs were fed with the STD diet and diets containing 4% of WB, either as coarse particle size (WBc, 1135 μm) or finely milled (WBf, 406 μm). WB increased the BW of pigs compared to the STD diet (7156.6, 7360.9, 7463.1 g; $p=0.02$ for STD, WBc, WBf, respectively). Diet containing WBc decreased ($p=0.05$) *E.coli* counts in feces, averaging 5.7, 4.8, 5.2 log cfu/g FM for the STD, WBc and WBf, respectively. Results suggest that WB included at 4% in the diet increases the microbial activity and improves the microbial composition of early weaned piglets. This effect was independent of the particle size.

Key Words: Piglets, Wheat Bran, Microbial Population

W283 Effect of supplemental mixed *Saccharomyces cerevisiae* and *Lactobacillus acidophilus* 30SC on the growth performance of weaned pigs. J. P. Kim*¹, K. H. Kim¹, K. G. Kim², S. J. Oh¹, S. H. Kim², and K. Y. Whang², ¹Chonnam National University, Gwangju, Korea, ²Korea University, Seoul, Korea.

The objective of this study was to examine the effect of supplemental mixed *S. cerevisiae* and *L. acidophilus* 30SC (MSL) on the growth performance of weaned pigs. Forty-eight weaned barrows weighing about 10.78 kg were allotted to four dietary treatments with four replications. Experimental period was consisted of Phase I (14 days) and Phase II (14 days). The Phase I diet contained 3600 kcal/kg ME, 22.6 % CP, 1.56 % Lys, 0.54% Met, 0.82% Ca, and 0.75% P. The Phase II diet contained 3430 kcal/kg ME, 19.5 % CP, 1.30 % Lys, 0.47% Met, 0.80% Ca, and 0.55% P. Each diet was formulated to meet the NRC (1998) requirements. Dietary treatments were; 1) Basal diet (B, no antibiotics), 2) B + 0.2% antibiotics (AB), 3) B + 0.2% MSL, 4) B + 0.4% MSL. Pigs consumed feed and water *ad libitum*. Body weights and feed intakes of pig were measured at the end of each Phase, and average daily gain was calculated. The ADG of pigs was slightly increased by MSL supplementation, however, pigs in AB tended to grow slower than pigs in other treatments in Phase I. In Phase II, ADG was not affected by supplementation of MSL or antibiotics. The ADG of pigs tended to be higher in 0.2% and 0.4% MSL treatments at the end of experiment. Feed intake was not different among treatments through the experiment, but, slightly increased feed intake was found in 0.2% MSL treatment. AB and MSL were not effective to increase FE in whole experimental period, however, FE of basal diet and 0.4% MSL fed groups showed increased FE compared to that of AB fed group at Phase I. The results of this study indicated that supplementation of MSL could improve the growth and feed efficiency of weaned pigs in early phase; however, these beneficial effects of MSL were diminished as the pigs grew.

Table 1. The growth performance of pig fed the experimental diet

AB	0%	0.2%	0%	0%	SEM
MSL	0%	0%	0.2%	0.4%	
ADG, g/d					
Day 1-14	620 ^{ab}	582 ^b	633 ^{ab}	655 ^a	11
Day 15-28	650	669	656	642	13
Day 1-28	635	625	644	649	12
ADFI, g/d					
Day 1-14	727	724	764	763	8
Day 15-28	1096	1094	1133	1090	12
Day 1-28	912	909	949	926	11
Fe, g/kg					
Day 1-14	860 ^a	810 ^b	832 ^{ab}	869 ^a	14
Day 15-28	892	611	578	590	11
Day 1-28	696	687	678	700	12

a,b:p<.05

Key Words: Mixed Probiotics, Growth Performance, Weaned Pig

W284 Effect of supplemental mixed *Saccharomyces cerevisiae* and *Lactobacillus acidophilus* 30SC on the energy, nitrogen, Ca, and P digestibility of weaned pigs. K. H. Kim^{*1}, J. P. Kim¹, J. G. Kim², S. J. Oh¹, S. H. Kim², and K. Y. Whang², ¹Chonnam National University, Gwangju, Korea, ²Korea University, Seoul, Korea.

The effects of supplemental mixed *S. cerevisiae* and *L. acidophilus* 30SC (MSL) on the energy, nitrogen, Ca, and P digestibility were determined by using forty-eight weaned barrows (about 10.78 kg). The pigs were allotted to four dietary treatments with four replications. Experimental period was divided into Phase I (14 days) and Phase II (14 days). The Phase I diet contained 3600 kcal/kg ME, 22.6 % CP, 1.56 % Lys, 0.54% Met, 0.82% Ca, and 0.75% P. The Phase II diet contained 3430 kcal/kg ME, 19.5 % CP, 1.30 % Lys, 0.47% Met, 0.80% Ca, and 0.55% P. Each diet was formulated to meet the NRC (1998) requirements. Dietary treatments were; 1) Basal diet (B, no antibiotics), 2) B + 0.2% antibiotics (AB), 3) B + 0.2% MSL, 4) B + 0.4% MSL. Pigs consumed feed and water *ad libitum*. Cr₂O₃ (0.2%) included diets were supplied from day 12 and day 26 to day 14 and day 28, and feces was collected at the end of each Phase (day 14 and 28). Energy digestibility at day 14 was significantly increased by supplement of 0.4% MSL (p<.05), and AB supplementation had no effects on energy digestibility. There was no difference among treatments at day 28. Nitrogen digestibility at day 14 was increased by 0.4% MSL supplementation, but 0.2% supplementation was not effective to increase nitrogen digestibility. Nitrogen digestibility at day 28 was not changed by supplementation of MSL either AB. Ca and P digestibility was not affected by MSL or AB supplementation, however, MSL supplementation slightly increased Ca and P digestibility. The results of this study suggested that supplementation of MSL could improve the energy and nitrogen digestibility weaned pigs in early phase, however, these beneficial effects of MSL were diminished as the pigs grew

Table 1. Nutrient digestibility of pigs fed experimental diets

AB	0%	0.2%	0%	0%	SEM
MSL	0%	0%	0.2%	0.4%	
Energy, %					
Day 14	87.2 ^b	86.8 ^b	88.2 ^b	88.7 ^a	0.2
Day 28	85.7	85.7	85.4	85.5	0.3
Nitrogen, %					
Day 14	92.8 ^b	92.8 ^b	92.9 ^b	93.8 ^a	0.3
Day 28	88.4	87.9	87.9	88.3	0.2
Ca, %					
Day 14	62.3	63.2	34.3	64.8	0.7
Day 28	55.8	54.8	56.2	56.3	0.9
P, %					
Day 14	52.3	53.2	54.1	54.5	0.6
Day 28	48.3	48.9	48.1	49.3	0.8

a,b: p<.05

Key Words: Mixed Probiotics, Nutrient Digestibility, Weaned Pig

W285 Effect of supplemental mixed *Saccharomyces cerevisiae* and *Lactobacillus acidophilus* 30SC on the immunoglobulin G production of weaned pigs. S. J. Oh^{*1}, J. P. Kim¹, K. H. Kim¹, J. G. Kim², S. H. Kim², and K. Y. Whang², ¹Chonnam National University, Gwangju, Korea, ²Korea University, Seoul, Korea.

This study was done to investigate the effect of supplemental mixed *S. cerevisiae* and *L. acidophilus* 30SC (MSL) on the Ig G production of weaned barrows by vaccination. Forty-eight weaned pigs (about 10.78 kg) were used for a 28 days trial, and allotted to four dietary treatments with four replications. Experimental period was consisted of Phase I (14 days) and Phase II (14 days). The Phase I diet contained 3600 kcal/kg ME, 22.6 % CP, 1.56 % Lys, 0.54% Met, 0.82% Ca, and 0.75% P. The Phase II diet contained 3430 kcal/kg ME, 19.5 % CP, 1.30 % Lys, 0.47% Met, 0.80% Ca, and 0.55% P. Each diet was formulated to meet the NRC (1998) requirements. Dietary treatments were; 1) Basal diet (B, no antibiotics), 2) B + 0.2% antibiotics (AB), 3) B + 0.2% MSL, 4) B + 0.4% MSL. Pigs consumed feed and water *ad libitum*. Swine cholera vaccine was injected at day 7, and serum samples were taken from all individual pigs at the end of each Phase (day 14 and 28). ELISA was used to determine the total Ig G and cholera specific Ig G. AB supplementation reduced total Ig G production compared to no-AB fed groups at both day 14 and 28. Total Ig G of pigs fed 0.4% MSL was higher than other groups at both day 14 and 28 (p<.05), and supplementation of 0.2% MSL also increased total Ig G production, however, these effects was reduced at day 28. Cholera specific Ig G production was increased by MSL supplementation, and decreased by AB supplementation. At day 14, the cholera specific Ig G of 0.2% MSL fed group was similar to that of no-AB fed groups, but at day 28, 0.2% MSL fed group showed higher cholera specific Ig G than no-AB fed group (p<.05). These results indicated that supplementation of MSL could increase total Ig G and specific Ig G production, and this increased immune response might be helpful to increase the preventive effects of vaccination on specific disease.

Table 1. Serum Ig G concentration of pigs fed experimental diets

AB	0%	0.2%	0%	0%	SEM
MSL	0%	0%	0.2%	0.4%	
Total Ig G, mg/mL					
Day 14	8.2 ^{ab}	7.8 ^b	8.4 ^a	8.6 ^a	0.2
Day 28	10.3 ^{ab}	9.8 ^b	10.5 ^{ab}	11.2 ^a	0.3
Specific Ig G, mg/mL					
Day 14	2.1 ^b	1.8 ^c	2.3 ^{ab}	2.5 ^a	0.1
Day 28	1.6 ^b	1.5 ^b	1.9 ^a	2.0 ^a	0.1

a,b: p<0.05

Key Words: Mixed Probiotics, Immune Response, Weaned Pig

W286 The effects of seaweed extract inclusion on gut microflora and immune status of the weaned pig. P. Reilly¹, T. Sweeney¹, K. M. Pierce^{*1}, J. J. Callan¹, A. Julka², and J. V. O'Doherty¹, ¹University College Dublin, Ireland, ²Bioatlantis Ltd, Ireland.

An experiment (complete randomised design) was conducted to investigate the effects of *Laminaria hyperborea* (LH) and *Laminaria digitata* (LD) seaweed extract inclusion on gastrointestinal health and immune status of the weaned pig. Twenty eight piglets (24 days of age, 6.5± 1.4 kg live weight) were assigned to one of four dietary treatments for 7 days and then sacrificed: T1) basal diet (control); T2) basal diet and 1.5kg /tonne LH; T3) basal diet and 1.5kg /tonne LD and T4) basal diet and 1.5kg /tonne of a combination of LH and LD. The SE contained both laminarin and fucoidan. Digesta samples were taken from the caecum and colon to measure the Enterobacteria, Bifidobacteria, and Lactobacilli populations. Blood samples were taken to determine the cytokine gene expression profile and to measure the phagocytotic capacity of the blood cells. Data was analysed by GLM procedure (SAS). A contrast statement was used to compare T1 vs. T2, T1 vs. T3 and T1 vs. T4. Pigs offered diets containing LH had a lower population of Bifidobacteria in the colon (P<0.05) and Lactobacilli in the caecum (P<0.05) and colon (P<0.001). The inclusion of LD resulted in lower populations of Enterobacteria in the caecum and colon (P<0.01), Bifidobacteria in the caecum (P<0.05), and Lactobacilli in the caecum (P<0.05) and colon (P<0.001). Pigs offered the combination of LH and LD had a reduction in Enterobacteria (P<0.05) and Lactobacilli (P<0.01) in the caecum and colon. An increase in the expression of Interleukin-8 (IL-8) mRNA was observed on day six with the supplementation of the combination of LH and LD (P<0.05). The inclusion of LH resulted in an increase in total monocyte number (P<0.05). In conclusion, the supplementation of LH and LD seaweed extract alone and in combination acted as a powerful antimicrobial in reducing the Enterobacteria, Bifidobacteria, and Lactobacilli populations in the caecum and colon, while only marginal effects on the immune response was observed.

Key Words: *Laminaria hyperborea*, *Laminaria digitata*, Pig

W287 Yam on fermentation characteristics and immune function in pigs. M. J. Bo, Y. I. Yin*, X. F. Kong, Y. Z. Zhang, G. Y. Wu, and B. E. Tan, *Laboratory of Animal Nutrition and Human Health and Key Laboratory of Agro-ecology, Changsha, Hunan, P. R. China.*

The present study was conducted to determine in vitro fermentation characteristics and in vivo immune enhancement of the Chinese Yam

(CY) with the goal of developing a novel dietary additive for pigs. The terminal ileum digesta collected from fistula in Duroc × Landrace × Yorkshire barrows fed the corn- and soybean meal-based diet was used as inoculums, and CY served as a substrate for in vitro fermentation. The slurry was fermented for 48 h in an in vitro anaerobic system. Fermentation products were determined. The maximum volume of gas production in the CY-containing medium was higher (P < 0.05) compared with the non-supplemented and glucose-supplemented media. The rate of gas production in the CY-supplemented medium was lower (P < 0.05) than that in the glucose-supplemented medium but higher (P < 0.05) than the value for the non-supplemented medium. The pH and NH₃ concentration were higher (P < 0.05) in the CY-supplemented medium, compared with the glucose-supplemented medium but lower (P < 0.05) compared with the non-supplemented medium. Concentrations of acetate, propionate, and butyrate in the CY-supplemented medium were higher (P < 0.05) than those in compared with the glucose- and non-supplemented media. For the feeding trial, 4 barrows were fed the basal diet, supplemented with 0.1% CY powder for 8 d. On days 0, 4 and 8 after initiation of the treatment, total and differential counts of leucocytes, lymphocyte proliferating activity, and serum levels of antibodies were measured. Dietary supplementation with CY increased (P < 0.05) the numbers of leukocyte, lymphocytes, monocytes, and neutrophils in plasma on day 8 compared with days 0 and 4, as well as lymphocyte proliferation. In summary, CY may be a good source of carbon and energy for intestinal microbial metabolism, therefore contributing to enhancement of immune function in barrows.

Key Words: Fermentation Characteristics, Chinese Yam, Immune Function

W288 Effect of Chinese herbal ultra-fine powder as a dietary additive on digestion and absorption of amino acids in early-weaned piglets. X. F. Kong¹, Q. H. He¹, F. G. Yin¹, Y. L. Yin^{*1}, G. Y. Wu^{1,2}, B. E. Tan¹, and R. L. Huang¹, ¹Laboratory of Animal Nutrition and Human Health and Key Laboratory of Agro-ecology, Changsha, Hunan, P. R. China, ²Texas A&M University, College Station.

To study the effects of Chinese herbal ultra-fine powder (CHUP) as a dietary additive on digestion and absorption of amino acids, sixty piglets weaned at 21 days of age were randomly assigned to 3 treatment groups, representing supplementation with 0 or 2 g/kg of CHUP, or 0.2 g/kg of colistin to corn- and soybean meal-based diets (n = 20 per group). Blood samples were collected from 5 piglets per treatment group on days 7, 14 and 28 to determine serum concentrations of amino acids. Digesta at terminal ileum was collected to determine amino acids after piglets were sacrificed under anesthesia with intraperitoneal administration of sodium pentobarbital. The results showed that plasma concentrations of total amino acids in CHUP-supplemented pigs were higher (P < 0.05), compared with the control group on days 14 and 28. Concentrations of total amino acids at terminal ileum were lower (P < 0.05) in CHUP-supplemented pigs, when compared with the other two groups of pigs on day 28. These findings indicate that the Chinese herbal product could enhance digestion and absorption of protein or amino acids in early-weaned piglets.

Key Words: Dietary Additive, Herbal Product, Amino Acids

W289 Effects of dietary supplemental Chinese herbal formula on immune responses in weaned piglets. X. F. Kong, B. E. Tan, Y. L. Yin*, H. J. Liu, F. G. Yin, and M. J. Bo, *Laboratory of Animal Nutrition and Human Health and Key Laboratory of Agro-ecology, Changsha, Hunan, P.R. China.*

The study was conducted to evaluate the effects of dietary supplemental Chinese herbal formula (CHF) on immune responses in piglets. A total of 60 three-way crossbred piglets weaned at 21 days of age were randomly assigned to three treatments which were replicated twenty times with one piglet. Corn-soybean meal based diet was used in the control group, while CHF and colistin were used at 0.2 and 0.02 percent of the total diets in the other two groups to substitute for equal cornstarch, respectively. On days 7, 14 and 28 after initiation of the addition, the total and differential counts of leucocytes, and lymphocyte proliferation conversion efficiency, and serum concentrations of immunoglobulin and cytokines, as well as immune organ index, were determined. The results showed that dietary supplementation with the formula increased ($P < 0.05$) the ratio of middle cell to leukocyte and concentrations of serum IL-2 and IL-6 compared with the control groups after 7 days trial, and the concentrations of serum IL-2 was higher ($P < 0.05$) while of IL-6 and TNF were lower ($P < 0.05$) in the formula-supplemented piglets than those of the colistin groups. On day 14, the index of spleen and groin lymphonodues, and number of middle cell in piglets of the formula groups were higher ($P < 0.05$) compared with the control groups and leukocyte number was higher than that of the colistin group, and the concentration of serum IL-6 decreased ($P < 0.05$) compared with the other two groups. Dietary supplementation with the formula for 28 days decreased ($P < 0.05$) the numbers of the middle cell and granulocyte, while increased ($P < 0.05$) the ratio of lymphocleukocyte to leukocyte compared with the control groups. The concentrations of serum IgG and IgM in the CHF piglets increased ($P < 0.05$) compared with the others. The higher ($P < 0.05$) proliferation conversion efficiencies of peripheral lymphocytes in the CHF piglets were observed on days 14 and 28 compared with the other two groups. Collectively, these findings indicated that the CHF as dietary additive could be beneficial to immune responses in the weaned piglets.

Key Words: Chinese Herbal Formula, Weaned Piglet, Immune Responses

W290 Level of management affects finisher growth and pig composition. J. S. Fix* and M. T. See, *North Carolina State University, Raleigh.*

Differences in finisher growth and composition of pigs from three sire lines in a high management research facility (SES) compared to a commercial facility (COM) were evaluated. Pigs were farrowed over 2 wk at COM sow farm. At weaning 400 pigs were randomly selected across sire lines (B, G, R) and sex and placed in SES. Remaining pigs were transferred to COM nurseries. At 66 d of age SES pigs ($n = 336$) and COM pigs ($n = 538$) began finish phase. Pigs were randomly assigned within sire line and sex to pens of 4 pigs at SES and 20-22 at COM. Body wt, fat depth (BF) and loin muscle area (LMA), measured using real-time ultrasound, collected at 20 kg, 50 kg, 75 kg, 100 kg and 115 kg (178 d of age) on all SES pigs and 10 pigs from each COM pen. Feed allotment was recorded daily. Feed weigh back (SES) and feed estimate (COM) was done at BW measurement. Pigs raised at SES were heavier entering the finisher (21.0 vs. 19.2 kg; $P < 0.01$) and at off-test

(118.9 vs. 95.8 kg; $P < 0.01$). Sire line x management interaction was observed for G:F ($P < 0.05$) where pigs at COM did not differ between sire lines (0.418, 0.409, 0.401 ± 0.006) but SES pigs from sire line R had the poorest G:F (0.432, 0.427, 0.392 ± 0.004). This is supported by a sire line x management interaction ($P = 0.06$) for ADFI where SES pigs consumed more feed (2.16, 2.08, $2.36 \text{ kg/d} \pm 0.03$) than COM pigs (1.68, 1.73, 1.82 ± 0.05). Pigs raised at SES had greater ADG (0.87 vs. 0.68 kg/d; $P < 0.01$), ADFI (2.2 vs. 1.7 kg/d; $P < 0.01$), G:F (0.42 vs. 0.41; $P < 0.05$) and lean ADG (0.35 vs. 0.28 kg/d; $P < 0.01$) Pigs raised at SES had less ($P < 0.01$) BF depth and greater ($P < 0.01$) LMA at 20 kg (0.65 vs. 0.73 cm; 11.14 vs. 10.02 cm²), 50 kg (0.99 vs. 1.06 cm; 23.55 vs. 21.90 cm²) and 75 kg (1.33 vs. 1.47 cm; 33.08 vs. 31.39 cm²). At 100 and 115 kg BW SES pigs had greater ($P < 0.01$) LMA (43.26 vs. 36.93 cm²; 48.31 vs. 45.33 cm²). However, at 100 kg COM pigs had less BF (1.59 vs. 1.76 cm; $P < 0.01$) and did not differ at 115 kg. Raising pigs in a high management vs. commercial facility resulted in increased LMA, ADFI, ADG and G:F. However, higher management resulted in increased ADFI resulting in decreased efficiency for one sire line.

Key Words: Pigs, Growth, Management

W291 *In vivo* antioxidant activity of peptide fractions from porcine plasma albumin in rats. J. Z. Wang*^{1,2}, H. Zhang¹, S. S. Zeng², and F. Z. Ren¹, ¹*College of Food Science & Nutritional Engineering, China Agricultural University, Beijing, China,* ²*American Institute for Goat Research, Langston University, Langston, OK.*

Our previous research showed that porcine plasma peptide fractions (A5, MW < 3 KDa) had antioxidant effect *in vitro*. In the present study, the effect of A5 on antioxidant activity, lipid peroxidation, and total antioxidant capacity (TAOC) in rats was investigated *in vivo*. Thirty five male Sprague Dawley rats (3 month old, BW 366 ± 24 g) were randomly divided into five groups. The five feeding treatments were control, 100, 200, 400 mg of A5/kg BW, and 10 mg of vitamin E/kg BW (as positive control). Blood samples and organ tissues (liver, heart, spleen, thymus, and lung) were collected one month after daily treatments were started. TAOC, activities of superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px), and level of malondialdehyde (MDA) in serum and organ tissues were determined. ANOVA was treated by GLM procedure using SAS software. $p < 0.05$ was considered as significant. The results showed that A5 treatments increased TAOC and the activities of SOD and GSH-Px ($p < 0.05$), and decreased the level of MDA in all the organ tissues tested ($p < 0.05$). It is concluded that the peptide fractions A5 can enhance the TAOC and antioxidant activities, reducing the risks of lipid peroxidation in rats.

Key Words: Porcine Plasma Peptide Fractions, Rats, Lipid Peroxidation

W292 Influence of weaning age and number of weaning per week on productive performance of sows and piglets. N. Simal¹, A. Fuentetaja², M. Nieto², M. P. Serrano¹, and G. G. Mateos*¹, ¹*Universidad Politécnic de Madrid, Spain,* ²*Copese, Segovia, Spain.*

A total of 320 crossbred sows (LW x LR) between the second and seventh lactation were used to study the influence of weaning age (21 vs. 28 d) and number of weanings per week (1 vs. 2) on productive performance

of sows and piglets. The 4 treatments arranged factorially and each treatment was replicated five times. The experimental unit was a room with 16 lactating sows. Number of weaning per week did not affect any of the productive traits studied. Age at weaning had little effect on productive performance of piglets during lactation. Sows weaned at 28 d tended to lose more weight (27.1 vs. 24.8 kg; $P \leq 0.10$) and lost more fat thickness (2.85 vs. 2.44 mm) during lactation than sows weaned at 21 d but daily BW losses were smaller ($P \leq 0.05$). Piglets weaned at 28 d were heavier (8.3 vs. 6.4 kg; $P \leq 0.05$) than piglets weaned at 21 d but the uniformity of the litters decreased with increases in weaning age. A positive relation was observed between fat thickness at farrowing and loss of fat during lactation. For sows with a fat thickness lower than 15 mm backfat, fat loss was less than for sows with a fat thickness higher than 18 mm (1.89 and 3.47 mm; $P \leq 0.05$). Also, piglet growth was higher in sows with a fat thickness lower than 20 mm at farrowing than in sows with fat thickness higher than 20 mm ($P \leq 0.05$). Sows with heavier litters at weaning lost more weight during lactation than sows with lighter litters ($P \leq 0.05$). In the next gestation, weaning to oestrus interval tended to be reduced (6.8 vs. 8.0 d) in those sows weaned at 28 d. Number of piglets born alive tended to increase (12.5 vs. 11.3; $P \leq 0.10$) in sows that were weaned at 21 d. It is concluded that weaning at 28 d had a positive effect on sow productivity but that number of weanings per week did not have any effect.

Key Words: Weaning Age, Weaning Number, Sow Productivity

W293 Sow parity and number born alive influence piglet birth weight along with subsequent growth, composition, mortality and endpoint value. J. S. Fix* and M. T. See, *North Carolina State University, Raleigh.*

Piglets ($n = 1472$) were weighed and identified within 24 h of birth to determine effect of parity and number born alive (NBA) on piglet birth weight (BWT), within litter variation, along with growth, composition, mortality and endpoint value. Sows ($n = 217$) were mated via AI with pooled semen from 3 sire lines, resulting in 163 litters. The commercial sow farm experienced a clinical PRRS outbreak during the trial and used a high level of cross fostering which may have contributed to the severity. Individual BWT along with mean litter BWT, BWT SD, and BWT CV were evaluated. At 18 d of age pigs were weaned and 421 were transported to the NCSU Swine Evaluation Station (SES) and BW was measured; remaining pigs were placed in 3 commercial nurseries. At approximately 66 d of age pigs at SES were placed in pens of 4 and pigs in commercial nurseries were placed in pens of 20-22 at a commercial finisher. Body weight, at placement and off-test, along with fat depth (BF) and loin muscle area (LMA), using real-time ultrasound at off-test, were collected on all pigs at SES and 10 pigs from each pen at commercial finisher. At time of final BW a value was given to all pigs (2 = dead; 1 = $BW < [\text{mean BW} - \text{one SD}]$; 0 = $BW > [\text{mean BW} - \text{one SD}]$). This was done to simulate levels where price discounts based on wt occur at local packing plants. A range 0.45 to 2.45 kg, with a mean of 1.28 kg was observed for BWT. Individual and mean litter BWT increased quadratically with increasing parity ($P = 0.07$, $P < 0.01$) to parity 5 and increasing NBA ($P < 0.01$) to 9 pigs. Pig wean wt decreased quadratically with increasing NBA ($P < 0.05$) to 6-7 pigs born alive. Increasing parity also had a quadratic effect on LMA ($P < 0.01$) and BF ($P = 0.07$) both reaching a minimum at parity 4. As NBA increased pigs had 1.09 ($P < 0.01$) and 1.12 ($P < 0.05$) times greater odds of being alive vs. dead at placement and full value vs. non-full value or dead at harvest. As parity increased pigs had 1.10 ($P < 0.01$) times greater odds

of being alive vs. dead at placement. These findings indicate parity and NBA affect birth weight, growth, composition and survival.

Key Words: Parity, NBA, Pigs

W294 Influence of a live yeast on the faecal microflora of gestating and lactating sows. N. Walker*¹, M. Cintora¹, H. Durand², and Y. le Treut², ¹*Lallemand Animal Nutrition, Montreal, Canada*, ²*Lallemand Animal Nutrition, Toulouse, France.*

Live yeast products have been shown to have significant effects on the health and performance of production farm animals, both ruminants and monogastrics. They may have this effect by stabilizing the beneficial gut microflora, particularly during periods of stress, leading to the competitive exclusion of opportunistic pathogens and reducing incidences of diarrhea. The use of *Saccharomyces cerevisiae* type *boulardii* (CNMC I-1079) as a feed additive for improving performance and health of animals has been well documented. The aim of the current work was to determine whether the inclusion of CNMC I-1079 in two different diets had any effect upon the faecal microflora and whether a stress event like farrowing altered the structure and composition of the gut microbial community. Faecal samples were collected from 80 animals which had been randomly assigned to 4 different treatment groups on d-21, d-3 and d+7 in relation to farrowing. Treatment 1, high corn-soy, no yeast; treatment 2, high corn-soy plus yeast; treatment 3, high fibre, no yeast; and treatment 4, high fibre plus yeast. Total DNA was extracted and PCR-TTGE was used to generate a DNA fingerprint of the faecal bacterial community for each treatment group. GelComparII with the DICE similarity indice and UPMGA was used to generate the dendrogram and determine the relatedness of each profile. Not surprisingly, 2 distinct clusters due to diet were observed, indicating an effect of diet on the microbial community. Within each diet, in the days before farrowing, control and yeast treated groups clustered together, indicating an effect of yeast on the composition of the microbial population. Farrowing caused a dramatic change in the fingerprint profile for each treatment indicating that this stress event had a direct effect on the microbial community. It should be noted however that the yeast treated animals tended to have a population which was more closely related to the original microflora, indicating a degree of stabilization. To conclude, several different factors eg diet, inclusion of yeast and stress events may influence the composition of the gut microflora and yeast may help to stabilize the normal microflora.

Key Words: Yeast, PCR-TTGE, Microflora

W295 Effect of lactation length of on herd-level performance of breeding sows. S. S. Anil*, L. Anil, and J. Deen, *University of Minnesota, Saint Paul.*

Reducing lactation length in sows results in an improvement in the number of litters farrowed per year. However, early weaning has been suggested to influence the subsequent reproductive performance of the sow along with the performance of its litter. At the herd level, the crucial point is to maintain a lactation length that does not reduce the reproductive performance of sows while enabling maximum utilization of farrowing facilities. However, most of the studies on this aspect have focused on sow-level performance. The present study evaluates the

effect of lactation length on the overall performance at the herd level. Data pertaining to the performance in 2006 of 493 US swine herds were collected from the Pigchamp datashare database. Based on the average lactation length (19.02 days), these herds were divided into 2 groups and compared in terms of performance and longevity variables (proc MEANS, SAS V 9.1). The average number of piglets per litter, average number of piglets born alive per litter and average litter weaning weight were higher ($P \leq 0.05$ for all) in the herds with average lactation length ≥ 19.02 days. However, these farms also had higher average stillborn piglets per litter and preweaning piglet mortality ($P \leq 0.05$ for both). The groups were similar in terms of farrowing rate, pigs weaned per mated female per year, culling and death rates. The results indicate that farrowing and post-partum management should be improved to make full benefit of an increased lactation length on herd performance.

Key Words: Sow, Lactation Length, Herd Performance

W296 Association between claw lesions and farrowing performance of sows. S. S. Anil*, L. Anil, and J. Deen, *University of Minnesota, St. Paul.*

Lameness is a major reason for reduced sow longevity in swine breeding herds. Claw lesions, especially severe white line and side wall lesions are reported to lead to lameness. Claw lesions are very common in pigs. Despite a high prevalence, studies focusing on claw lesions and their adverse effects sow performance are scanty in the US. At present, it is less clear whether claw lesions are linked to sow performance. The objective of the present study conducted at the University of Minnesota was to analyze the associations between claw lesions and performance variables such as number of piglets born alive (≤ 10 or greater), mummies, stillborn and preweaning piglet mortality (present or absent) and wean to service interval (≤ 5 or greater), along with parity (≤ 3 or greater). Claws of 257 sows were examined for lesions while the sows were in the farrowing crates prior to farrowing. Lesions included erosions, cracks, and overgrowths. Areas on the claw were categorized as side wall, heel, overgrown heel, sole, heel-sole junction and white line. The number of lesions in these areas was counted. The associations between number of lesions in different claw areas with performance variables and parity were analyzed using logistic regression analysis (Proc logistic, SAS V 9.1). Results indicated a positive association ($P \leq 0.05$) between piglets born alive and white line and side wall lesions (Odds ratios, OR 1.29 and 1.60 respectively). Heel-sole lesions were negatively associated ($P \leq 0.05$) with mummies (OR 0.62). White line lesions were negatively ($P \leq 0.05$) associated with stillbirth and preweaning piglet mortality (OR 0.74 and 0.79 respectively). Parity was positively associated ($P \leq 0.05$) with heel and heel-sole lesions (OR 1.26 and 1.40 respectively) and negatively ($P \leq 0.05$) associated with white line lesions (OR 0.72). The positive association between lesions and production performance may be indicative that high producing sows are more susceptible to lesions especially white line and side wall lesions.

Key Words: Sow, Claw Lesions, Performance

W297 Evaluation of welfare of gestating sows in conventional gestation stalls and in gestation stalls with widths defined by the sow height. L. Anil*, S. S. Anil, and J. Deen, *University of Minnesota, St. Paul.*

Sow welfare guidelines have indicated that pregnant sow in gestation stalls should have at least the minimum space to lie down without its teats extending into the adjacent stalls and its hind quarters not in contact with the back of the stall. Increasing the stall dimensions in relation to sow dimensions will increase the dynamic space available to the sow to make movements, thus minimizing injuries. A study was conducted to evaluate welfare of pregnant sows housed in conventional gestation stalls (control $n = 46$) and in stalls with width of the stall at least 75% of the height of the sow in it (treatment $n = 40$). Body measurements (length and height) of sows were taken before weaning and sows were allotted after weaning to either control or treatment group. Injury scores of all sows and behavior of focal sows (24 in control and 27 in treatment) were recorded on day 6 post-breeding and on days 70 and 105 of the gestation. Farrowing performances were also recorded. Data were analyzed using repeated measures ANOVA, two sample proportion tests and two sample test for means. Width of stalls had no significant effect on various postural behaviors studied except on the average duration of getting up (from either lying or from sitting posture) which showed a trend ($p = 0.061$) towards lower duration in the treatment group. Higher % of time lying in lateral recumbency and standing and lower % of sitting were noticed at day 105 than at other time periods. The groups did not differ significantly in terms of injuries. Farrowing performances were also similar among the treatments. The results indicate that ensuring the width of the stall at least 75% of the height of the sow may not be sufficient to improve welfare in terms of behavior and injury scores when compared to the existing conventional stalls.

Key Words: Sow, Welfare, Gestation Stall

W298 The relationship between distance of pig farms to roads and its seroprevalence to Aujeszky's disease. G. Rocha-Chavez¹, O. D. Montañez-Valadez¹, R. Santibañez-Escobar¹, J. G. Michel-Parra¹, and M. A. Pinto-Jacobo^{*2,3}, ¹CUSUR, Univ de Guadalajara, Cd Guzman, Jalisco. Mexico, ²Private practice, Zapotiltic, Jalisco. Mexico, ³URPJ, El Salto, Jalisco Mexico.

Aujeszky's disease is a viral infection of pigs transmitted through aerosols. Western Mexico is still struggling with this disease and there are a lot of small improvised farms rising up to 30% of pigs in that area. It is hypothesized that the closer the farms are to a busy road, the greater the possibility of acquiring this disease. The purpose of this study was to determine the relationship between the distance from the farm to an interstate highway and its level of prevalence of Aujeszky's disease. A total of 15919 blood samples from 297 small sow farms (20-100 sows) were analyzed for this disease. Farms were divided according to their location into four groups: (a) 35 farms located from 0 to 300 meters of a road; (b) 108 farms 300-1000 meters away; (c) 70 farms between 1 and 3 kilometers and (d) 83 farms with more than 3 km away from a road. Serology was done with the ELISA method and the prevalence was expressed as a percentage of positive sera of those sent for analysis. Pearson's correlation was used to compare distance and prevalence and Chi squared was used for comparison between means. Prevalence of 3.4 ± 5.9 , 7.21 ± 6.7 , 3.42 ± 2.29 and 8.4 ± 6.2 were found for Groups A, B, C, and D respectively with no significant difference between groups ($p > 0.05$). The correlation between distance and seropositivity was 0.07 indicating that there is no interaction between the two parameters studied. Contrary to what we were expecting, it was observed that under the conditions of this study, the distance from the farm to an interstate highway has no influence on their likelihood of acquiring this disease.

Key Words: Aujeszky's Disease, Interstate Roads, Prevalence

W299 Expression of Dicer and Ago-2 in Porcine Ovarian Tissue. H. M. Barton* and S. L. Pratt, *Clemson University, Clemson, SC.*

MicroRNA (miRNA) is hypothesized to have fundamental roles in mammalian embryonic development. miRNAs are short, non-coding RNA, processed by a ribonuclease enzyme known as Dicer and then loaded into the RNA-induced silencing complex (RISC), to be guided to its target. The argonaute gene family has been identified as key proteins in RISC, and Argonaute-2 (Ago-2) has been identified as the only member of this family possessing endonuclease activity. The nucleotide sequence for Dicer and Ago-2 has yet to be identified in pigs. Our objective is to identify the cDNA sequence for porcine Dicer and Ago-2, and verify their expression in reproductive tissue. Total cellular RNA was isolated from bovine and porcine ovaries using mirVana miRNA isolation kit (Ambion, Austin, TX). RNA was then subjected to endpoint RT-PCR using SuperScript™ III First-Strand Synthesis Super Mix for qRT-PCR (Invitrogen, Carlsbad, CA). The first strand reaction was utilized for PCR with GoTaq (Promega, Madison, WI). To generate PCR primers, the cDNA sequences for bovine, human and rodent Dicer (accession numbers XR027590, NM177438, and NM148948, respectively), and Ago-2 (BC151491, NM012154, and BC096465, respectively) were aligned. Primers were generated from highly conserved regions for each respective cDNA by using the Vector NTI program (Invitrogen, Carlsbad, CA). Reactions were subjected to non-denaturing slab gel electrophoresis and visualized using EtBr staining and UV-light exposure. PCR products were subcloned into pDrive Cloning Vector using Qiagen PCR Cloning Kit (Qiagen, Valencia, CA), transformed into *E. coli*, plasmid propagated, purified and subjected to dideoxy-sequencing at the Clemson University Genomics Institute. A 489 bp product and a 346 bp product were visible in both bovine and porcine samples. Sequencing verified the porcine products as Dicer and Ago-2, respectively, showing a 97.6% and 93.9% sequence identity to bovine Dicer and Ago-2, respectively. These data show that Dicer and Ago-2 are present in porcine ovary and that the sequences are highly similar to those reported for other species.

Key Words: Pigs, Argonaute, Dicer

W300 Association of gene markers affecting the principal components of skeletal design and feet and leg soundness in pigs. B. Fan, S. Onteru, B. Mote, T. Serenius, M. Nikkilä, K.J. Stalder, and M.F. Rothschild*, *Iowa State University, Ames.*

Identifying and culling the replacement gilts with poor skeletal and leg and feet conformation is helpful to reduce replacement and mortality rates in breeding stock. Recent replacement and mortality rates have averaged around 50% and 10% respectively in US commercial swine herds in 2007 according to PigCHAMP reports. Due to the low to moderate heritability of conformation and soundness traits, molecular markers would be useful selection aids. In our recent candidate genes studies, several promising significant associations between SNPs and 6 body conformation traits and 10 leg structure traits and overall leg action were observed. However, it was difficult to determine which SNPs were overall associated with total structural soundness. Using the PRINCOMP procedure of SAS, 6 body conformation traits could be primarily combined into two principal factors, each explaining greater than 20% of the total variation, and which accounted for body volume and side-view, respectively. The other 11 feet and leg traits were summarized into three principal factors, which generally described leg movement, leg defects and uneven toes, respectively. The subsequent

association analyses between the SNPs and the principal factors were implemented using the MIXED procedure of SAS. The raw P values were further adjusted using the false discovery rate (FDR) method from the MULTTEST package of the R program. SNPs in the following genes COL9A1, hDBP, APOE, DK, PPARGP and PAPPB were associated with body volume ($P < 0.05$). SNPs in COL1A2, CALCR, FBN1 and OXTR were associated with side-view. Leg movement was significantly associated with SNPs in COL1A2, CALCR, BMP8, OPG, PTHR and OXTR. Leg defects were significantly associated with SNPs in ALOX15, ALOX5, COL9A2 and WNT16. It appears that, genes involving cartilage development and fatness seem to function in skeletal structure, and genes relevant to cartilage and bone formation are likely to play important role for feet and leg soundness in pigs.

Key Words: Body Conformation, Feet and Leg Structure, Candidate Gene

W301 Effects of the sex and the halothane genotype on carcass and meat quality characteristics in Duroc and Landrace crossbred pigs. L. L. Lo*¹, C. C. Tsai¹, M. C. Huang², R. S. Lin³, and T. H. Huang⁴, ¹*Chinese Culture University, Taipei, Taiwan, ROC*, ²*National Chung-Hsing University, TaiChung, Taiwan, ROC*, ³*National ILan University, ILan, Taiwan, ROC*, ⁴*Taiwan Farm Industry Co., Ltd., Pingtung, Taiwan, ROC.*

Two hundred and thirty crossbred Duroc×Landrace pigs of two halothane genotypes (NN=185, Nn=45) of 107 kg live weight were slaughtered to detect the effects of sex (barrows=116, gilts=114) and halothane genotype on carcass and meat quality characteristics. All data were analysed using a linear model that included fixed effects of year, farm, sex, halothane genotype, and the important two way interactions ($P < 0.20$). Carcass weight was used as a covariable. Sex and halothane genotype were important sources of variation for most carcass and meat quality traits. Compared with barrows, gilts had larger 10th rib longissimus muscle area (LMA, $P < 0.01$), but lower marbling score ($P < 0.05$), higher protein percentage ($P < 0.01$), and lighter Hunter value ($P < 0.05$). For eating quality, LM from barrows had higher scores on juiciness, flavour, tenderness and overall acceptability ($P < 0.01$). Halothane genotype significantly affected the dressing percentage, carcass length, 10th rib backfat thickness, and the 10th rib LMA. Carcasses from Nn pigs had a higher dressing percentage ($P < 0.05$); longer carcass ($P < 0.01$); and larger LMA at the 10th rib ($P < 0.001$) than that of the NN pigs. Fat thickness and the lean percentage; however had no differences between the two halothane genotypes ($P > 0.10$). LM of Nn halothane genotype had lower ultimate pH ($P < 0.001$), higher drip loss ($P < 0.001$), and lighter Hunter L value ($P < 0.05$). As for sensory evaluation, LM from Nn genotype had lower scores on juiciness ($P < 0.01$) and tenderness ($P < 0.05$). These results suggest that LM from barrows had better meat quality and pigs from Nn halothane genotype had better carcass characteristics but poor quality with regard to ultimate pH, drip loss, reflectance values, and the eating quality of juiciness and tenderness.

Key Words: Halothane Genotype, Meat Quality, Crossbred Pigs

W302 Identification and quantification of miRNA expression in porcine sperm cells. E. Curry* and S. L. Pratt, *Clemson University, Clemson, SC.*

MicroRNAs (miRNA) are short, non-coding, single-stranded, ribonucleic acids which are transcribed by RNA polymerase and down-regulate or prevent RNA translation. miRNAs have been shown to play roles in diverse biological processes such as insulin secretion, regulation of adipocyte differentiation, B-cell development, and tumorigenesis. More importantly, it is theorized that miRNAs are important for embryonic development, but little information is known as to the identity of miRNA in porcine gametes or their potential involvement in reproductive failure. Previous investigations have demonstrated that sperm messenger RNA (mRNA) are introduced into the oocyte during fertilization and may play a role in early embryonic development, but the presence and/or identity of miRNA in porcine sperm cells has not been thoroughly investigated. The objective of this study was to determine the presence and identity of miRNA in porcine sperm cells. In this experiment, RNA was isolated from porcine sperm cells using TRIzol[®] Reagent (Invitrogen; Carlsbad, CA) and was used to hybridize to commercially available arrays (LC

Sciences, LLC; Houston, TX) to identify the known miRNA present. The arrays were constructed from 1260 known miRNA sequences from 19 different species and, because many miRNAs are highly conserved among species, allowed for efficient hybridization. Of the miRNAs probed, results showed that 73.7% (n= 929) were non-detectable, 12.4% (n= 154) had low detection, and 12.2% were moderately (7.4%; n= 93) to highly expressed (4.8%; n= 60) in porcine sperm cells. In particular, the majority of the let-7 family, a highly conserved group of heterochronic miRNAs shown to play critical roles in developmental timing in non-mammalian species, was present and highly expressed in porcine sperm cells. Results of this study suggest that sperm miRNAs may play a fundamental role in spermiogenesis. In addition, if delivered along with mRNA to the oocyte at fertilization, miRNAs may have a function in early embryonic development.

Key Words: microRNA, Sperm, Swine

SYMPOSIA AND ORAL SESSIONS

Animal Behavior and Well-Being: Swine

240 ASAS Centennial Presentation: Animal behavior and well-being: What does the future hold? A. K. Johnson*, *Department of Animal Science, Iowa State University, Ames.*

Compared to the more traditional sciences of nutrition, physiology and reproduction, farm animal behavior and well-being science is quite young. Seven colleagues who are considered to be the future generation of ethologists were asked several questions on the challenges and opportunities facing the field. The information collected was pooled for anonymity. The average time working in the field was 10 yr. Species that are regularly worked with were beef (5), swine (5), dairy (2), poultry (1), and sheep (1). Challenges identified by the group were (1) are we making progress and if so how can we define this? (2) the demand for information has outpaced the science (3) pressures from stakeholders (4) individuals in the field of research, teaching and extension are over-worked and (5) the need to address basic ethological questions has been lost. Solutions were (1) to continue providing sound science that has been validated, measured objectively and is reliable, (2) to separate behavior and well-being into their own research funding categories and for a percentage of this funding to be directed towards the basic science and (3) for animal science and veterinary medicine departments to continue to employ faculty trained in ethology. Highlights for the future are the willingness and acceptance for ethologists to work across disciplines within their department, across departments within the same institution, and across state lines. There is also interest in continuation and expansion of new teaching models that bring together a critical mass of experts and students and the innovative researchers who are discussing questions in regards to animal cognition, emotions and pain. In conclusion, new and innovative tools, personalities and dedication to the field of animal behavior and well-being will continue to provide scientific information and direction. ASAS has a critical role in bringing together scientists in this field to deliver new and invigorating findings to the scientific community and beyond.

Key Words: Behavior, Future, Well-Being

241 Effects of facility design on the stress response of market weight pigs during loading and unloading. A. Johnson*¹, L. Sadler¹, M. Faga², C. Feuerbach², H. Hill², R. Bailey³, and M. Ritter⁴, ¹*Department of Animal Science, Iowa State University, Ames,* ²*Iowa Select Farms, Iowa Falls, IA,* ³*Swift and Co., Marshalltown, IA,* ⁴*Elanco Animal Health, Greenfield, IN.*

Thirty three loads of market weight pigs (n = 5,901) were used in randomized complete block design to determine the effects of 2 different facility designs on stress responses and transport losses at the plant. The new (NEW) design had 192 pigs/pen and internal swing gates that were used to manually pre-sort market weight pigs on the day before loading. Traditional (TRAD) design had 32 pigs/pen; it was not feasible to pre-sort market weight pigs prior to loading. This design confounds the effects of facility design with pen size and pre-sorting, but this is how the 2 facility designs are being utilized under commercial conditions. Three sites were used in this study. Each site had 2 rooms and both facility designs were represented in each room. During loading, treatments were randomly assigned to trailer decks. Pigs were moved in groups using sort boards and prods, when necessary. Pigs were loaded onto straight deck trailers, mixed with unfamiliar pigs, provided with ~0.41 m²/pig and were transported ~1 h to a commercial plant. During loading and unloading, the number of pigs displaying open mouth breathing (OMB), skin discoloration (SD) and muscle tremors (MT) were recorded. At the plant, dead and non-ambulatory pigs were recorded during unloading, and total losses were defined as the sum of dead and non-ambulatory pigs at the plant. Data were analyzed by Proc Glimmix of SAS. NEW pigs had lower (P ≤ 0.05) percentages of OMB, SD and MT during loading and unloading compared to TRAD pigs. NEW pigs had fewer (P < 0.05) dead pigs (0.01 vs. 0.23 ± 0.05%), non-ambulatory pigs (0.29 vs. 0.66 ± 0.12%) and total losses (0.30 vs. 0.89 ± 0.14%) at the plant compared to TRAD pigs. In summary, utilizing large pens and pre-sorting prior to loading, reduced physical signs of stress during loading and unloading, and reduced total losses at the plant by 66% compared to pigs from traditional pens.

Key Words: Facility Design, Pig, Transportation Stress

242 Effect of trailer design on the behavior of market weight pigs during unloading and lairage. S. Torrey^{*1}, H. Gonyou^{2,3}, J. A. Correa⁴, R. Bergeron⁵, T. Widowski⁵, N. Lewis⁶, T. Crowe², C. Dewey⁵, and L. Faucitano¹, ¹Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada, ²University of Saskatchewan, Saskatoon, SK, Canada, ³Prairie Swine Centre, Saskatoon, SK, Canada, ⁴Université Laval, Quebec City, QC, Canada, ⁵University of Guelph, Guelph, ON, Canada, ⁶University of Manitoba, Winnipeg, MB, Canada.

Trailer design has been implicated with influencing in-transit mortality and carcass quality in market weight pigs, although little is known about its effect on behavior during unloading or lairage. Therefore, the objective of this experiment was to determine if trailer design influenced behavior during unloading and lairage at a commercial facility. Over the course of 6 wk, 1,596 pigs (BW=118.4±0.4 kg) were transported on either a 3-deck pot-belly truck with internal ramps to upper and lower levels (PB; n=181 pigs per week in 8 experimental compartments; 0.40 m²/pig) or a double-decker hydraulic truck without internal ramps (DD; n=85 pigs per week in 4 compartments; 0.40 m²/pig) for 2 h to a commercial abattoir. Pigs were unloaded by compartment at the abattoir and driven into lairage pens segregated by truck compartment. Behavior during unloading (slips and falls), time to unload each compartment (adjusted for number of pigs per compartment), latency to rest (75% of pen lying) and total time lying during the first hour of lairage were observed. Behavior data were analyzed using the mixed model procedure in SAS. Accounting for the number of pigs, unloading from PB was significantly longer than from DD ($P<0.001$; PB: 2.9±0.1 sec/pig; DD: 2.1±0.2 sec/pig), although there was no difference in the number of slips and falls during unloading ($P=0.48$; PB: 0.04±0.01 incidence/pig; DD: 0.05±0.01 incidence/pig). During lairage, there was no difference between trucks in latency to rest after transportation ($P=0.96$; PB: 35.3±2.4 min; DD: 35.1±3.9 min), although pigs from DD tended to spend more time lying than PB pigs ($P=0.06$; PB: 45.2±2.0% of time lying; DD: 51.4±3.0% of time lying). Although trailer design did not influence latency to rest, pigs from PB took longer to unload and spent less time lying in lairage. Further analyses will determine the effect of location within truck on behavior and welfare.

Key Words: Pig, Transportation, Behavior

243 Space requirements of weaned pigs during transport in summer. M. A. Sutherland^{*1,2}, P. J. Bryer^{1,2}, B. L. Davis^{1,2}, and J. J. McGlone^{1,2}, ¹Pork Industry Institute, Lubbock, TX, ²Texas Tech University, Lubbock.

Currently there are no trucking quality assurance recommendations for space allowance of weaned pigs during transport. The objective of this research was to establish an estimate of the space requirements of weaned pigs during transport in summer based on measures of animal well-being. A commercial semi-trailer was fitted with compartments that provided 0.05, 0.06, and 0.07 m²/pig (on both upper and lower decks) with 100 pigs per compartment. Cameras were placed in each compartment to record behaviors and postures of the pigs during transport. The frequencies of standing, lying, sitting, standing on another pig, and lying or huddling on top of another pig were recorded using 1 min scan samples during the entire duration of transport. Blood samples were taken and weights and lesion scores recorded from 4 pigs (5.1 ± 0.10 kg) per compartment for performance and physiology measures before and after transport (n=8 pigs/treatment). Pigs were transported for 60 min to the wean-to-finishing site using the same route for each 4 replicates

during summer (28.4 ± 1.23 ° C and 59.8 ± 4.42% humidity). Data were analyzed by Proc MIXED of SAS. The trailer was the experimental unit. Cortisol, hematocrit, blood urea nitrogen, total protein, albumin, aspartate aminotransferase, creatine kinase, and gamma glutamyl transferase were increased ($P<0.05$) during transport regardless of space allowance. Glucose and body weight were decreased ($P<0.05$) during transport regardless of space allowance. The neutrophil to lymphocyte (N:L) ratio was greater ($P<0.005$) in pigs transported at 0.05 m²/pig compared with pigs transported at 0.06 and 0.07 m²/pig. Pigs transported at 0.05 m²/pig laid down less ($P<0.05$) than pigs transported at 0.06 and 0.07 m²/pig between 30 and 60 min of transport. In conclusion, increased N:L ratio and decreased lying behavior in pigs transported at 0.05 m²/pig suggest that space allowances of 0.06 or 0.07 m²/pig are preferable when transporting weaned pigs during summer.

Key Words: Animal Welfare, Pigs, Transport

244 The effect of 30-hour transport at two space allowances on physiological measures of stress in breeding gilts. P. J. Bryer^{*}, M. A. Sutherland, B. L. Davis, J. Smith, and J. J. McGlone, *Pork Industry Institute, Texas Tech University, Lubbock.*

Long duration transport is an important welfare issue. Little experimental work exists on the effects of long duration transport on breeding gilts. The goal of this study was to evaluate the effects of a 30-h transport on acute physiological measures in breeding aged gilts. Two space allowances were constructed 5 times in a commercial semi-trailer allowing 0.334 and 0.409 m²/pig. The experiment was repeated twice in October 2007 in Lubbock, TX, USA and included 120 pigs (91.4kg ± SE1.40). In addition to 4 gilts per experimental treatment on the trailer, 4 control gilts remained in the home pen. Control gilts had access to food and water within their 3.05 by 4.27 m pen. Every 6 h, pigs in one pair of compartments were sampled by removal from the trailer. Blood samples (10 mL via jugular venipuncture) and body weights were collected from gilts and their respective controls before and after transport (at -24, 6, 12, 18, 24, and 30 h). The MIXED procedure in SAS with repeated measures was used with individual gilts as the experimental unit. Weight loss was greater ($P<0.05$) among transported pigs relative to controls at the first 6-h measure, however after the initial weight loss, body weights were not different ($P>0.05$) in transported pigs from 12 through 30 h. Additionally, no differences ($P>0.05$) were observed in weight between space allowances. Transient changes were seen in glucose, total protein, albumin, lymphocytes, granulocytes, neutrophil:lymphocyte ratio, hematocrit, and platelets. Cortisol, creatine kinase, and aspartate aminotransferase did not differ between treatments. Transported gilts experienced only transient compromises of health or welfare based on the parameters evaluated. Overall, these data indicate that the 28-h law may be too conservative to be broadly applied to all classes of livestock as we found no negative health trends at 30 h in gilts transported 12 to 24 h vs. gilts not transported.

Key Words: Transportation, Animal Welfare, Pigs

245 Responses to weaning and transport in pigs: Influence of sex and weaning weight. T. A. Cooper^{*}, M. P. Roberts, C. J. Kojima, and H. G. Kattesh, *University of Tennessee, Knoxville.*

Pigs (n=64; 22±0.3 d of age) were blocked by sex and weight and allocated into transported (T) or non-transported (NT) groups at weaning (d 0). All NT pigs were weaned into 1.2 m² pens (4 pigs/pen, 2 pens/factorial group) while T pigs were transported as a group for 3 h in a small livestock trailer before being similarly placed in pens. Pigs were weighed and a blood sample collected on d 0 (pre-weaning), 1, and 7. Data were analyzed using a mixed model with a factorial design and repeated measures; fixed effects were transport, sex, and time. Weaning weight was used as a covariate. Plasma concentrations of corticosteroid-binding globulin (CBG) decreased (P<0.001) by d 1 and remained lower through d 7 in both T and NT pigs. A sex*time interaction occurred (P=0.003) such that while cortisol concentrations in males increased from d 0 to d 1 and then decreased to pre-weaning levels by d 7, females had higher preweaning cortisol levels which did not change on d 1 but decreased by d 7 to lower levels than in males (P<0.05). The free cortisol index (FCI; a ratio of cortisol to CBG) was elevated (P<0.001) on d 1 in all groups but returned to pre-treatment levels by d 7. Regardless of

treatment, lighter weight pigs had lower CBG concentrations (r=0.330; P=0.010) and higher FCI (r=-0.305; P=0.018) as measured on d 1. Total white blood cell number increased from d 0 to d 1, then decreased by d 7 (P<0.001). The percentage and absolute number of neutrophils followed a similar pattern, whereas lymphocyte percentage and number changed in an opposite manner. The number of neutrophils present on d 1 also varied by sex (P<0.05) such that females had higher numbers of neutrophils than males. Correlation analysis revealed that, regardless of treatment, lighter weight pigs had greater numbers of neutrophils (r=-0.304, P=0.025) and percentages of neutrophils (r=-0.403, P=0.002) in circulation than did the heavier pigs prior to weaning but not after. The process of weaning appears to uncouple the relationship between body weight and circulating immune cell populations. The physiological response due to weaning is greater, especially in lighter weight pigs, than is the response to transport.

Key Words: Swine, Stress, Weaning

Animal Health IV

246 Metabolic disorders and immune response in farm animals.

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Metabolic regulation and immune response are highly integrated systems and the proper function of each is dependent on the other. It is widely recognized that the immune system requires energy and substrates to maintain its function, and mounting an immune response likely requires using resources that could otherwise be allocated to other biological functions. Reproduction, lactation, growth, thermoregulation represent some of the energetically-demanding functions that in farm animals are likely to compete with immune system for resources. Studies carried out in different animal species revealed that activation of the immune response may cause perturbation of metabolic status, and suggested that understanding the cost of immune function in terms of energy or single nutrients is essential for more accurate characterization of nutrient budgets of animals and better understanding of the role of immunity in the evolution of life strategies. On the other hand, several papers described an association between disorders of energy, lipid, vitamins or minerals metabolism and perturbation of immune response. In particular, recent studies carried out in domestic ruminants revealed an association between energy deficit and related loss of body condition and increase of plasma non esterified fatty acids, impairment of immunoresponsiveness and increased susceptibility to infections. From a biochemical point of view, metabolic disorders and related deficiency or excess of nutrients or metabolites may regulate immunity by causing perturbation of both innate and adaptive immune pathways. From an ecological perspective, the immune system may be considered as an energetically costly system that may or may not have priority over other uses of energy available. The hypothesis of a trade-off between immune and other biological functions in farm animals would deserve to be investigated with particular emphasis for those physiological circumstances, as it is the case of the periparturient period, characterized by high demands, low feed intake, frequent occurrence of metabolic disorders and immunosuppression.

Key Words: Metabolism, Immunity, Farm Animals

247 Administration of a *Staphylococcus aureus* bacterin to dairy heifers reduces new infection rate and somatic cell counts at time of calving. S. C. Nickerson¹, E. Hovingh², C. Peterson³, S. Brannock³, E. Schaffer³, and P. W. Widel⁴, ¹University of Georgia, Athens, ²Pennsylvania State University, College Park, ³James River Correctional Facility, Goochland, VA, ⁴Boehringer Ingelheim Vetmedica, Inc., St. Joseph, MO.

Use of a *Staphylococcus aureus* bacterin as a means of preventing intramammary infections (IMI) in dairy heifers was evaluated. At approximately 6 to 18 months of age, Holstein heifers from the James River Correctional Center Dairy in Goochland, VA were processed for vaccination and to collect mammary secretions for microbiological analysis. Fifty-three heifers were immunized with a commercial bacterin (Lysigin, Boehringer Ingelheim Vetmedica, Inc.) using a 5-ml dose intramuscularly in the semimembranosus muscle of the rear leg; 53 heifers served as unimmunized controls. The vaccine was a lysed culture of polyvalent *S. aureus* somatic antigens of 5 phage types in an aluminum hydroxide base. Fourteen days after initial processing and at

6-month intervals until calving, vaccinates were processed for boosting. At 2-month intervals after trial initiation and through calving, mammary secretion samples were collected for bacteriological culture and somatic cell counts (SCC). Microbiological examination of mammary samples collected from bred heifers over gestation demonstrated that 19.8% of heifers (9.4% of quarters) were infected with *S. aureus*, 68.9% (34.3% of quarters) were infected with coagulase-negative staphylococci (CNS), 6.6% (2.3% of quarters) were infected with environmental streptococci, and 1% (0.3% of quarters) were infected with coliforms. Vaccine efficacy data showed that the percentage of heifers with *S. aureus* IMI at calving was lower in vaccinates (13.3%) compared with controls (34.0%). Likewise, IMI with CNS were lower in vaccinates (64.2%) compared with controls (69.8%). The SCC in samples collected during first week of lactation from uninfected heifers for vaccinates and controls were 66,095 and 132,754/ml; a 50.2% reduction; and for infected heifers, SCC were 441,764 and 892,176/ml; a 50.5% reduction. Results demonstrated that administration of a commercial bacterin to breeding age and pregnant Holstein heifers reduced the prevalence of *S. aureus* mastitis as well as the SCC at time of calving.

Key Words: *Staphylococcus aureus*, Mastitis, Vaccination

248 Serum non-esterified fatty acid and beta-hydroxybutyrate in the transition period and their associations with disease in dairy cows.

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The objective of this study was to characterize the relationship of serum NEFA and BHB concentrations in the transition period with clinical disease in dairy cows across different regions of North America. A field study was conducted with 2316 Holstein cows in 56 dairy herds in 4 regions of Canada and the United States. Once weekly, after the morning feeding, blood was collected from cows in the week before their expected calving date, and again from the same cows in weeks 1, 2, and 3 postpartum. Serum was stored at -20°C within 8 hours of collection. NEFA, BHB and Ca were measured using a Hitachi 911 auto-analyzer. Considered alone and assuming equal weight on sensitivity and specificity, the optimal cut-points for prediction of displaced abomasum (DA) and retained placenta (RP) were calculated. The 23% of cows with NEFA ≥ 0.5 in week -1 were 2.8 times more likely to subsequently have DA than cows below this cut-point. Multivariable logistic regression models of the probability of DA were made using information available before and after calving. Accounting for the random herd effect and region, pre-calving NEFA ≥ 0.5 mmol/L (odds ratio (OR) = 1.8, P = 0.02), week 1 postpartum NEFA ≥ 1.0 (OR = 3.0, P < 0.001) and week 1 Ca ≤ 2.2 mmol/L (OR = 2.5, P = 0.0003) predicted risk of DA for serum data obtained at or prior to week 1 postpartum. BHB did not remain in the week 1 model when pre- and postpartum NEFA were included. Cows that did not have elevated NEFA pre- or postpartum or sub clinical ketosis (SCK) had the lowest risk of DA (0.8%). For serum obtained during the week prior to calving, multivariable logistic regression models accounting for the random herd effect found pre-calving NEFA ≥ 0.3 mmol/L (OR = 1.7, P = 0.0032), twins (OR = 5.9, P < 0.0001) and dystocia (OR = 2.3,

P=0.0002) to be important predictors of the risk of RP. These data confirm the associations of NEFA with health and support their use as tools for monitoring or investigation of transition dairy cows.

Key Words: Metabolic, NEFA, Transition

249 Intramammary pathogens from 3755 dairy goats and sheep and farm characteristics from New York State. D. J. Wilson*¹, R. N. Gonzalez², P. M. Sears³, L. H. Southwick⁴, H. F. Schulte², and G. J. Bennett², ¹Utah State University, Logan, ²Cornell University, Ithaca, NY, ³Michigan State University, East Lansing, ⁴Lee H. Southwick Consulting, Virgil, NY.

Prevalence of mastitis pathogens of dairy sheep and dairy goats and mean SCC in bulk milk are not the same as in bovines. Mastitis control practices used on small ruminant farms have limited documentation. Milk samples were aseptically collected for milk culture from 3164 dairy goats (36 herds) and 591 dairy sheep (6 flocks) from 1993-2004 in New York State. Lactating doe numbers averaged 88 (median 30.5); milking ewes averaged 99 (median 83.5). Most common goat breeds when specified were French Alpines and Saanens. Mean number of dry animals was 23 does and 258 ewes.

Mean bulk tank SCC was 425,000/ml for sheep, 835,258/ml for goats. Mean estimated milk production per 305 d was 1102 lb (500 kg) for sheep and 1856 lb (843 kg) for does. Pathogens were isolated from milk of 64 ewes (10.8%) and 864 does (27.3%). The most common pathogens were coagulase-negative staphylococci (CNS), from 6.8% of ewes and 23.0% of does, non-agalactiae streptococci (Strep spp.), from 3.2% and 0.8%, and *S. aureus* from 1.2% and 1.5%, respectively.

33 of the 36 goat farms (92%) used udder preparation; 50% predipped, most with 0.5% titratable iodine dip, 31% used udder wash, 11% dry wiped, and 69% stripped for abnormal milk. 89% broke vacuum and 83% postdipped, most with 0.5% iodine or 0.5% chlorhexidine. Teat end vacuum averaged 13.7 inches Hg. 78% infused antibiotics during lactation, 78% dry treated all does and 6% selectively dry treated.

2 of the 6 sheep farms did no udder preparation, the rest used various methods that usually included dry wipe. All broke vacuum before unit removal and used postdip. Mean teat end vacuum was 12.5 inches Hg. Milking system features and performance test results will be discussed further. The most common mammary pathogen isolated from both sheep and goats was CNS, accounting for 63% and 84% of isolates, respectively. The prevalence of mammary pathogens in goats was low compared with that for dairy cows, despite the fact that goats have markedly higher mean bulk milk SCC than cows. Adoption of mastitis control practices was similar to that for cow farms, except that sheep owners did minimal udder preparation before milking.

Key Words: Ovine, Caprine, Mastitis

250 Ability of an immunomodulatory feed additive to reduce infection of the murine mammary gland with *Streptococcus uberis*, *Escherichia coli* and *Staphylococcus aureus*. A. Rowson*¹, Y. Q. Wang¹, E. Aalseth², N. E. Forsberg¹, and S. B. Puntteney¹, ¹OmniGen Research, Corvallis, OR, ²Aalseth Consulting, Lake Stevens, WA.

Four experiments were completed to assess ability of OmniGen-AF to reduce the infection of the murine mammary gland with 3 bovine isolates: *S. uberis*, *E. coli* and *S. aureus*. Pregnant mice were received from Charles River and housed in pairs. Animals were assigned to either

a powdered control diet (Teklad 8604) or to the same diet supplemented with OmniGen-AF (Prince-Agri Products; 0.5% w/w). Animals consumed diets during gestation (from approximately Day 15) and into lactation (to approximately Day 10). On the day of the experiments, pups were removed and euthanized. Lactating mice were anesthetized with ketamine and xylazine and the abdomen sterilized. The terminal 0.5 mm of the L4 and R4 teats were removed via sterile technique after which pathogens in 50 ul of PBS were infused into the teat canals via 33 gauge needles. Control mice received infusion of PBS only. Experiment 1 consisted of infusing mice with 50 CFU of a bovine isolate of *S. uberis* and an infection period of 48 hr. Experiments 2 and 3 consisted of infection of glands with 100 and 25 CFU of a bovine isolate of *E. coli* and infection periods of 48 and 24 hrs, respectively. Experiment 4 consisted of infusion of glands with 50 CFU of a bovine isolate of *S. aureus* and an infection of 36 hrs. After progression of the infection, lactating mice were anesthetized, blood taken via cardiac puncture and euthanized. L4 and R4 mammary tissues were taken. DNA was extracted from mammary and blood (Qiagen) and concentrations of pathogen DNA determined using quantitative PCR. Genomic DNA from each pathogen was used to generate a standard curve for each pathogen. OmniGen-AF caused significant (P<0.05) reductions (>95%) in *S. uberis* and *S. aureus* DNA in mammary tissues. Further, OmniGen-AF reduced (P<0.05) *S. uberis* DNA concentration in blood by >95%. Feeding OmniGen-AF caused a numerical reduction in (P>0.05) in *E. coli* detection (60% reduction) in mammary tissue. *E. coli* and *S. aureus* DNA were not detectable in blood. In summary, feeding OmniGen-AF reduced infection of the murine mammary gland by bovine mastitic pathogens.

Key Words: Mastitis, OmniGen-AF, Murine Model

251 Evaluation of selective, chromogenic media in an on-farm culture kit. D. W. Rensburg*, B. I. Smith, and M. A. Kristula, *University of Pennsylvania, Kennett Square.*

Identification of mastitis causing organisms through microbiological culture has been suggested as a first step in successful mastitis treatment. This process is particularly important in mastitis caused by *Staphylococcus aureus* (SA), where rapid identification and segregation of infected animals is critical to an effective control program. The goal of this study was to evaluate the sensitivity and specificity of a commercially available culture media compared to culture performed in a diagnostic microbiology lab. HyLabs AP059 (marketed as IdentMast) is a commercially available mastitis culture paddle with two sides of selective chromogenic media. Chromogenic media differentiates between bacterial species by changing the color of the bacterial colony and surrounding media. In this project composite milk cultures were aseptically collected from 163 lactating Holstein dairy cows at University of Pennsylvania Veterinary School's dairy farm. The AP059 paddles were immersed into the milk sample and then incubated for 24 hours. The remaining milk was submitted to the University of Pennsylvania Veterinary Microbiological Laboratory (PVML) for routine aerobic bacterial culture. Results from the HyLabs AP059 paddle were compared to results from the microbiology lab to determine the sensitivity, specificity and accuracy. The sensitivity, specificity and accuracy of the HyLabs AP059 compared to the PVML results were 100%, 94% and 95%, respectively. The positive predictive value and negative predictive values of the HyLabs AP059 were 74% and 100%, respectively. These results are based on an interpretation of any pink colonies being described as SA. All false positive samples were cultured by the PVML as a coagulase negative Staph sp.(CNS). Additional CNS colonies were observed on the SA

selective media as clear and green colonies. The results demonstrate that the HyLabs AP059 mastitis culture paddle can be an effective screening tool for mastitis caused by SA but positive cultures should be confirmed through traditional laboratory culture.

Key Words: Mastitis, Culture, Dairy Cow

252 Evaluation of a novel chlorine dioxide teat dip on teat end and teat skin health. L. L. Timms*, Iowa State University, Ames.

The purpose of this study was to evaluate the teat end health and skin conditioning performance of an experimental chlorine dioxide teat dip vs. commercial dips and best management practices at the ISU Dairy. A teat dip trial was conducted from late August through early November 2007. An experimental teat dip utilizing a no mix chlorine dioxide germicidal mode and containing 15% emollients was evaluated (Boumatic, Madison, WI). Herd standard post-milking teat dip used was a 0.5% iodine, 10% emollient product (Quadraplex, IBA), while the pre milking teat dip was a 0.25% iodine, 2% skin conditioning product (BacStop, IBA). The trial used a split udder design. Left teats of 56 cows were pre and post dipped with current herd dips (control) while right side teats were dipped with the chlorine dioxide dip (treatment). Teat skin and teat end scoring were performed using a variation of the Goldberg and Timms methods, respectively, by trained graders. Scoring was performed twice per week. Results were compiled and analyzed using SAS. Teat end and skin scores were analyzed using a 2 sample t-test while proportion of rough/cracked teat ends were analyzed using a 2 sample test of equality of proportions. There were no significant differences in teat skin score between treated and control teats, and skin condition was excellent (mean near score 1). Within 3 days of dipping, average teat end score started to trend higher with significantly higher ($p < .01$) average teat end scores in treated vs. control quarters by 6 days post dipping through end of the trial. Average teat end scores and % rough teats were significantly higher in chlorine dioxide dipped teats, with this reaction occurring more on teats that had higher hyperkeratosis at the start. Marked changes in teat end scores were measured over time and periods as short as days in all groups signifying other factors besides teat dips also influence teat health.

Key Words: Chlorine Dioxide Teat Dips, Teat Skin, Teat End

253 Sodium chlorite lactic acid teat dip contaminated with *Serratia liquifaciens*. D. J. Wilson*, J. D. Trujillo, R. T. Skirpstunas, and K. B. Cavender, Utah State University, Logan.

This report describes bacterial contamination of sodium chlorite lactic acid (SCLA) teat dip, which has not been reported previously. A commercial dairy farm had two apparently healthy cows that died within 48 h following intramammary (IMM) infusion of dry cow treat-

ment at the end of lactation. Teat dip containing SCLA had been stored for 2 years on the farm, and was used only to dip teats following IMM infusion with dry cow treatment.

The original container storing the SCLA teat dip was visibly soiled externally. The dip was found culture-positive for *Serratia liquifaciens*. A plan for follow up milk cultures was recommended, but no samples were received. All remaining teat dip was discarded. Further herd history was lost to follow up.

Only when BHI rinse of the original teat dip container was incubated and then streaked for culture was *Serratia liquifaciens* isolated from the film on the inside of the container. In addition to previous reports of contamination of other types of teat dips, the risk of contamination with potential mastitis pathogens, especially *Serratia* spp. applies to SCLA teat dip. Soiled containers of teat dip should be cultured to monitor for contamination with bacteria, or preferably discarded.

Key Words: Teat Dip, Contamination, *Serratia marcescens*

254 Teat end and skin conditioning evaluation of two experimental heptanoic acid teat dips during winter. L. L. Timms*¹ and J. Morelli², ¹Iowa State University, Ames, ²Ecolab, Inc., St. Paul, MN.

The purpose of this study was to evaluate the teat end health and skin conditioning performance of two experimental heptanoic acid based teat dips vs the commercial product Remain Gold[®] using a split udder design during the winter season under best management winter milking practices. Two separate teat dip trials were conducted simultaneously at the Iowa State Dairy Farm from late October 2006 through March 2007. Experimental teat dips KX-6185 and KX-6186 were provided by Ecolab (St Paul MN). Both products contained 1% heptanoic acid and 10% skin conditioners. All trials used a split udder design. In trial 1 (Pen 1 Free Stalls), left teats of 56 cows were pre-dipped with 0.25% iodine teat dip (IBA) and post dipped with Remain Gold[®]. Right side teats were pre and post dipped with KX-6185. In trial 2 (Pen 2 Free Stalls) 56 cows had teats pre-dipped with a 0.25% iodine dip. Left teats were post-dipped with Remain Gold[®] and right teats were post-dipped with experimental teat dip KX-6186. Teat skin and teat end scoring were performed using a variation of the Goldberg and Timms methods, respectively, by trained graders. Scoring was performed twice per week. Results were compiled and analyzed using SAS. Teat end and skin scores were analyzed using a 2 sample t-test while proportion of rough/cracked teat ends were analyzed using a 2 sample test of equality of proportions. There were no significant differences in teat end and teat skin condition between udder halves for all products in all trials. However, there was significant teat changes within udder halves across time, signifying other factors beside teat dips contributing to teat condition issues. Marked changes in teat end scores were measured over time and periods as short as days. Product treatment comparisons frequently showed parallel trends in score averages. This illustrates the importance of a split udder design to evaluate skin conditioning performance.

Key Words: Teat Dipping, Teat Skin, Teat End

Symposium: Bioethics: How Do We Integrate Bioethics into Our Food Animal System?

255 ASAS Centennial Presentation: History and future perspectives of bioethics in food animal agriculture. W. R. Stricklin*, *University of Maryland, College Park.*

During the past 100 years, American animal agriculture has experienced a rapid transformation. Husbandry practices changed more dramatically than during the previous 15 thousand years of human-animal relationships. This transformation freed Americans from stoop-labor once needed for food production and made safe, healthful food available at relatively low costs. But modern confinement practices also brought forth ethically-based concerns about animal welfare, environmental impact, loss of the rural community, and the possible impact of new genetic technologies. Some persons contend that science and technology have been used in an ever striving effort for cheaper food, with the concepts of stewardship and shepherding having been given over to that of dominionism over animals and the environment. In short, some critics contend that ethical costs such as animal suffering, environmental pollution, etc. have been largely ignored by animal scientists who have instead tended to focus more on increased productivity per animal unit. A common response has been that such issues should be resolved by "science alone." Animal scientists can best serve American animal agriculture by acknowledging that ethical considerations are critical, and always included, in decisions about current and future practices in food animal systems. Ultimately, ethics is said to be about "doing the right thing" and from the time of Socrates it has argued that the right thing to do is that with the best reasons for doing. Thus, appropriate ethical decisions are consistent with scientific information but also extend appropriate consideration to animals, the environment, and to persons associated with animal agriculture at the farm level.

Key Words: Bioethics, Animal Welfare, Animal Science

256 Bioethics from 1995-2008: How far have we come? R. Anthony*, *University of Alaska, Anchorage.*

Three prominent varieties of bioethics (broadly construed), namely moral humanism, humane moralism and holism, inspired our moral imagination during the mid-nineties and the decade to follow. They continue to underpin much of how we think about the meaning and form of our obligations to others, including nonhuman animals, and how we perform the complex balancing of different moral concerns. In terms of animal agriculture, the meaning and moral structures of these varieties have had a significant impact on contemporary "animal liberation" ethic, agrarianism, pastoralism and environmental holism. As a way to assess just how far we have come in terms of our commitment towards a more just and compassionate animal food system two important questions remain:

- a. How should we address diffusion of moral responsibility, procrastination and bystanding in the food system, that is, the problem of moral denial?
- b. How should we respond to our current philosophy of technology? That is, how should we explore the epistemological and framing assumptions behind the relationship between ethics and technology in order to provide a just and humane policy response to technology's opportunities and challenges?

Key Words: Bioethics, Animal Ethics, Food Animal Welfare

257 Bridging the DVM and PhD Gap. P. Ruegg*, *University of Wisconsin, Madison.*

The objective of this paper is to discuss similarities and differences in attitudes about animal use between veterinarians and animal scientists. There is a shrinking pool of professionals that serve animal agriculture and their domains are increasingly overlapping. The interests of students that select careers as food animal veterinarians tend to be different from students that focus on research careers. While there are few differences in personality characteristics, students interested in becoming veterinarians tend to be more interested in clinical activities associated with individual animals and less interested in research. These differences can translate into significant differences in interpretation of welfare criteria and may create tension when evaluating animal well-being or research usage. Important welfare issues vary by species but overall attitudes of veterinarians and animal scientists tend to be fairly consistent when evaluating philosophical concepts. However, academic veterinarians seem to indicate that they are more concerned about welfare aspects of many common agricultural practices as compared to faculty in animal science departments. Many practicing veterinarians are uncomfortable discussing animal welfare issues with their clients because of perceived lack of interest or negative economic impact. The official welfare statement of the American Association of Bovine Practitioners states: "Bovine veterinarians are expected to simultaneously represent the individual and herd welfare, the economic and production interests of producers and consumer concerns." The tension produced by this statement is lived everyday by veterinarians and is probably not well appreciated by animal scientists. The American Association of Bovine Practitioners' statement on tail docking is representative of this tension as it minimizes a coherent body of existing research in favor of perceived client preferences. In general, increased communication and respect along with enhanced cooperative activities related to training of future food animal veterinarians & animal scientists should be pursued in order to fully optimize both professions and ultimately animal well-being.

Key Words: Bioethics, Animal Welfare, Animal Use

258 How to talk truthfully with the public regarding bioethical and animal welfare issues. W. Jamison*, *University of Florida, Gainesville.*

Agriculturalists should be truth-tellers who overcome the incongruence between the reality of animal production/processing and the perception of animals and their role in society. Conversely, many successes of animal protection groups derive from their prowess in illuminating this gap. Market capitalism and economic rationalism force animal producers to maximize economies and minimize costs in order to maintain competitive advantages, while consumers increasingly view animals as idealized repositories of human values. This creates centrifugal forces within animal agriculture, which must maximize production efficiencies while withdrawing images of production and processing that would cause cognitive dissonance among consumers. This 'legitimacy gap' is unsustainable, and therefore leaders in animal agriculture should use two-way symmetry to communicate the reality of modern animal production and processing.

Key Words: Incongruence, Bioethics, Alignment

259 Roles of surveys and foundation reports in policy decisions. F. B. Norwood* and J. L. Lusk, *Oklahoma State University, Stillwater*.

Farm animal welfare policy emerges from a complex mix of industry interests, interest group pressure, and consumer concerns. To some extent, the interests of industry and interest groups represent consumer concerns, but in other cases do not. This research discusses how industry

and interest group foundation reports and consumer surveys influence policy and set the tone for farm animal welfare debates.

The paper will discuss consumer survey results that have important implications for farm animal welfare policy, and how the results are used and misused by different industry and livestock groups.

Key Words: Farm Animal Welfare, Foundation Reports, Surveys

Symposium: Breeding and Genetics: Genome Wide Selection

260 Genome wide selection: Potential and pitfalls. B. Hayes* and M. Goddard, *University of Melbourne, Attwood, Victoria, Australia.*

Genomic selection exploits dense marker information to calculate genomic breeding values (GEBV) as the sum of the effects of all quantitative trait loci (QTL) across the genome, thereby potentially exploiting all the genetic variance for a trait. The QTL effects, either inferred from haplotypes or individual single nucleotide polymorphism (SNP) markers, are first estimated in a large reference population with phenotypic information. In subsequent generations, only marker information is required to calculate GEBV. Computer simulation suggested that accuracies of GEBV calculated for animals with marker information only could be as high as 0.85. Results from analysis of real data from the Australian Holstein Friesian population suggest that to achieve this level of accuracy, particularly for young animals with no performance records, a number of challenges must be met. In order for single SNP or haplotype effects used in calculating the GEBV to persist across the population and across generations, the SNP or haplotypes must be in high linkage disequilibrium (LD) with the QTL. This requires adequate marker density and methods for estimating QTL effects which distinguish between contributions from LD as opposed to pedigree tracing or linkage. Another challenge is recent reports in both livestock and human whole genome association studies suggest even the largest QTL effects on some traits may only account for 1-2% of the phenotypic variance. The implications of such a distribution of QTL effects is that a large number animals will be required in the reference population. Finally, ensuring long term genetic gain with genomic selection will be challenging. Particularly if the marker density is not high enough to ensure all QTL are captured, long term gain from genomic selection may be less than from a traditional BLUP based breeding. One solution to this problem is to include a polygenic component in the GEBV. Breeding programs based on genomic selection do however offer the prospect of reducing the rate of inbreeding, as greater emphasis will be placed on individual selection as opposed to family selection, particularly for traits of low heritability.

Key Words: Genome Wide Selection, Genomic Breeding Values, GEBV Reliability

261 Reliability of genomic predictions for North American dairy bulls. P. M. VanRaden*¹, C. P. Van Tassell^{1,2}, G. R. Wiggans¹, T. S. Sonstegard², R. D. Schnabel³, and F. Schenkel⁴, ¹*USDA Animal Improvement Programs Laboratory, Beltsville, MD*, ²*Bovine Functional Genomics Laboratory, Beltsville, MD*, ³*University of Missouri, Columbia*, ⁴*University of Guelph, Guelph, ON Canada.*

Genetic progress will increase when breeders examine genotypes instead of only pedigrees and phenotypes. Genotypes for 39,835 markers and August 2003 genetic evaluations for 2609 Holstein bulls born before 1998 were used to predict January 2008 daughter deviations for 510 bulls born 2001-2. Genotypes were from the Illumina Bovine SNP50™ chip and semen contributed by U.S. and Canadian AI organizations to the Cooperative Dairy DNA Repository. Genomic predictions for 5 yield traits, 5 fitness traits, 16 conformation traits, and net merit were computed by a linear model with an assumed normal distribution for marker effects and also a nonlinear model with a heavier tailed prior to account for major genes. The official parent average from 2003 and a 2003 parent average computed from only the subset of genotyped

ancestors were combined with the genomic predictions by selection index. The combined predictions were significantly ($P < .0001$) more accurate than official parent averages for all 27 traits. Squared correlations were 0.03 to 0.22 higher with linear genomic predictions included than those from parent average alone. Nonlinear genomic predictions had R-square similar to linear except for a few traits such as fat percentage, with maximum additional increase of 0.08. Squared correlations were converted to realized reliabilities by dividing by the average reliability of 2008 daughter deviations and by adding the difference between published and observed reliabilities of the 2003 parent averages. When averaged across all traits, combined genomic predictions had realized reliabilities 18% higher than reliabilities of parent average (48% vs. 30%), and gains in information were equivalent to 9 daughter records. Reliability increased more by doubling the number of bulls genotyped than the number of markers genotyped. Genomic selection can decrease generation interval and greatly increase accuracy by tracing the inheritance of minor genes.

Key Words: Genotype, Genomic Selection, Marker Assisted Selection

262 Data optimization techniques for large phenotypic and molecular data sets. R. Rekaya*, *University of Georgia, Athens.*

Recent advances in high throughput technologies have lead to the generation of massive amounts of genomic/molecular data in addition to the already extensive phenotypic recording. Over the years several creative statistical and computational optimization techniques have been developed to successfully analyze phenotypic data; achieving some success in the area of quantitative genomics. However, for the ultimate objective of marker assisted or genomic selection to be realized, serious challenges must still be met in order to optimally combine these two sources of information. The complexity of this task stems in part from the huge imbalance of genomic and phenotypic information in selection candidates. In fact, genomic information, although extensive at an individual level, is only available on a small number of animals. By contrast, the phenotypic information is limited at the individual level, but it is extensively recorded on a large number of animals. This situation creates two major problems: 1) an NxP problem in which the number of parameters to be estimated is far greater than the degrees of freedom available to estimate them and 2) inferring the genotypes of untyped individuals and the selective sampling of animals to be genotyped. Theoretically both problems are simple to solve; however, they are computationally intractable. Consequently, some dimension reduction techniques and/or feature selection procedures need to be developed and implemented prior to analysis. In this study a machine learning procedure, often implemented to select optimal subsets of features, was developed to deal with both problems. Ant colony algorithm (ACA) was developed to efficiently search large sample spaces for optimal solutions, making it ideal for applications on high dimension data sets. This algorithm is based on the natural process of communication between real ants, and utilizes simple units to perform complex tasks. When used in applications to disease diagnosis, features identified by ACA yielded increases in prediction accuracy from 13.94 to 43.97% over filter methods. For optimal genotyping strategies, ACA yielded at least 5% superiority compared to any other method.

Key Words: Ant Colony, Feature Selection

263 The next steps in genomic selection: An industry perspective.

J. P. Chesnais*¹, F. Schenkel², and N. Caron¹, ¹*Semex Alliance, Guelph, ON, Canada*, ²*University of Guelph, Guelph, ON, Canada*.

Recent results from genomic selection projects indicate that significant increases in the accuracy of evaluation of young dairy animals can be obtained by combining genomic data from high-throughput SNP panels with traditional pedigree data. In a recent project based on a 50K SNP panel, the reliability of prediction increased by an average of 18 points over parent average across all traits. As expected, the increase is proportionally larger for traits with low heritability such as fertility or longevity. These results are still far from those of several simulation studies. In theory, the proportion of genetic variance explained by the SNP markers does not have to be very high to justify moving from a traditional progeny-testing scheme to one where animals are selected at a younger age based on their SNP genotype. The ensuing reduction in the generation interval more than compensates for the decrease in selection accuracy. In practice, however, dairy producers are accustomed to proven

bull reliabilities that are significantly higher than those currently obtained with genomic selection. Dairy cattle breeding companies are therefore likely to first use genomic selection to pre-select bull dams and young bulls rather than as a replacement for organized progeny testing. Over time, as the number of genotyped animals and SNP density increase, and methods of data analysis are refined, reliability may improve. An increasing number of young genotyped bulls will then be used as sires of sons and to commercially breed cows. The use of genomic selection is not necessarily synonymous with an increase in homozygosity. First, large SNP panels can be used to provide better estimates of homozygosity than current measures of inbreeding. Second, genomic selection may lead to the selection of more genetically diverse candidates than BLUP selection based only on phenotypes. Finally, the use of optimum genetic contribution methods may become more common among breeding companies, which would prevent the selection of only very few animals with top genomic breeding values as parents of future generations.

Key Words: Genomic Selection, Dairy Cattle, Genetics

Symposium: Food Safety: Assuring Food Safety in a Globalized Market

264 Quality and safety concerns of outsourced foods. M. W. Griffiths*, *University of Guelph, Guelph, ON, Canada.*

The increased global trade in food commodities and ingredients requires a rethink in the way we approach ensuring the safety of these materials. Recent incidents involving feed ingredients produced in China and contaminated with melamine have triggered changes in the attitude of the U.S.A and Canada towards imported foods and have prompted both countries to propose new guidelines and legislation to address consumer concerns. The industry, in conjunction with Codex Alimentarius, also have proposed a new global standard, the ISO 22000 standard for managing food safety in processing plants; with the intent to make it easier for companies worldwide to implement the Codex HACCP system. This standard has been adopted by many companies, including Wal-Mart. Despite these initiatives, a movement has developed to promote locally grown food and this has been supported by the publication of books such as "The 100 Mile Diet" and "In Defense of Food". As well as involving safety and quality issues, eating local food is perceived to be more environmentally friendly. However, as climate changes affect agricultural production we shall be increasingly reliant on global markets which makes it even more important that the safety and quality of imported and exported foods are beyond reproach.

Key Words: Food Safety, Imported Foods, Control

265 Melamine contaminated animal feed recalls. M. G. Alewnse*, *U.S. Food and Drug Administration.*

Menu Pet Foods notified FDA on March 16, 2007 of a pending recall due to adverse events reported to the firm. Menu suspected wheat gluten was linked to the problem. Within 24 hours of the company's notification, FDA investigators were at the company's manufacturing sites. Investigators were sent to all involved pet food/ feed manufacturers and to many retailers. In addition, FDA monitored the effectiveness of the recalls. In late March, scientists discovered that the contaminant in the wheat gluten was melamine and related analogs. Later, melamine was also detected in rice protein concentrate. Melamine is an unapproved food additive causing animal foods that contain it to be adulterated. Adding to the complexity of FDA's investigation of the reported adverse events was that melamine by itself is not very toxic, but can cause some damage to the renal system in laboratory animals. By April, there was a strong association between melamine in the kidneys of cats and the contaminated pet foods. The likely toxicological mechanism is that melamine and its analogs are concentrated in the renal filtrate where melamine combines with one of its analogs (cyanuric acid) resulting in crystal formation in, and damage to, the renal tubule. Food producing animals were also exposed to melamine through pet food scraps, but at much lower levels. FDA laboratory specialists screened hundreds of samples of pet food and animal feed for melamine and its analogs. In late April, FDA issued an import alert that required the detention of 11 different vegetable protein supplement products from China. From March to May, FDA received more than 18,000 consumer calls. Protecting the safety of feed and food is becoming more difficult, as the melamine recalls demonstrated that an action taken by only a few protein supplement firms in China could create a nationwide problem. The Menu recall alone involved 60 million packages of pet food from approximately

100 companies. The contaminated rice protein concentrate necessitated the recall of 155 metric tons of pet food. Eventually, a total of 1,051 melamine-related product recalls were conducted.

Key Words: Melamine, Recalls, Feed Safety

266 FDA's food protection plan and import safety plan. S. A. Benz*, *Center for Veterinary Medicine, Food and Drug Administration, Rockville, MD.*

As global trade expands and the food and feed chain become more complex, protecting the safety of feed and food is becoming increasingly difficult. The contamination of pet food with melamine in 2007 demonstrated the impact that a few companies can have on the animal feed supply. An intergovernmental task force suggested strategies to improve import product safety that focus on prevention, intervention, and response. For prevention, the government must work with companies to build safety into the manufacturing and distribution processes to prevent harm. If a problem does occur, intervention needs to involve not only the FDA but state and local authorities and foreign governments. The response to an identified problem must be quick and effective to limit any further exposure to humans and animals to prevent additional harm. FDA has an ongoing effort to write process control regulations for animal feed manufacturers that will cover the procurement, receipt, manufacture, and distribution of all animal feed including pet food. Traceability of distributed feed is an important component of the process when an unsafe feed must be located and recalled, diverted, or destroyed.

Key Words: Food Safety, FDA, Imported Feed

267 The global threat of foreign animal diseases and their role in food safety. T. McKenna*¹ and A. Torres², ¹*Wisconsin Veterinary Diagnostic Laboratory, Madison, WI,* ²*Cornell University, Ithaca, NY.*

The term foreign animal diseases refers to a large number of known animal diseases, or new emerging animal diseases that are not present in our country. Many of these diseases have never been found in the US, while many others were eliminated from our nation after long and expensive eradication campaigns.

Globalization has resulted in increased travel and trade at an unprecedented rate. Animals and animal products are traded legally and illegally around the world at increasingly higher numbers and at a faster and faster pace. There are many reasons for the recent increase in frequency and severity of serious animal disease outbreaks: animal industry consolidation; increased density of animals per production unit; decreasing animal genetic variability; mixing of species; environmental degradation; and livestock-wildlife habitat encroachment. Many of these outbreaks have serious public health consequences.

This paper highlights a number of foreign animal diseases that pose a significant threat to human food safety. The most notable recent examples are the emergence of Bovine Spongiform Encephalopathy; of highly pathogenic avian influenza, particularly the Asian H5N1 strain; and of Rift Valley Fever. The increasing human consumption of bush meat harvested from sick or dead wildlife in many parts of the world

has resulted in a food safety crisis leading to outbreaks of anthrax, Ebola and other hemorrhagic diseases.

Key Words: Foreign Animal Diseases, Food Safety

268 BSE: Risk communication lessons learned in North America.

R. R. Ulmer*¹, W. D. Hueston², and A. Millner¹, ¹*University of Arkansas, Little Rock*, ²*University of Minnesota, St. Paul*.

The discovery of BSE in North America (Canada and later the US) presented the most powerful lesson in animal health risk communications seen in our lifetimes. From the initial Canadian case of BSE in 1993 in a cow imported from the United Kingdom through the identification of the first indigenous North American case in 2003 and the later “atypical” BSE cases, important lessons continue to be learned and risk communications strategies improved. The seminal lessons are:

1. Everyone eats, therefore food supply issues that involve diseases that affect both animal and human health, like BSE, will garner tremendous media attention for extended periods of time.

2. Making government officials readily accessible to media early and often decreases media skepticism and increases the dissemination of accurate information to the widest possible audience.

3. Multiple “publics” exist and different publics want and need different information, therefore no single set of messages and no single delivery format can ever address everyone’s needs.

4. Planning and practice are critical to successful risk communication strategies and plans must be regularly revised.

5. Outbreaks of disease in other countries offer the opportunity for “vicarious rehearsal” and improvement of risk communications plans

6. Acknowledging what is not known and what is being done to address those remaining questions is as important as sharing what is known.

7. “Never say never” – the progression of disease outbreaks can not be predicted with any certainty and the natural tendency of animal health officials and politicians to share a positive perspective on prevention and control activities will almost always underestimate the number of cases thereby creating mistrust.

8. New science will appear, therefore response strategies and answers to questions may change during the period of media interest. Preparing the media, and hence the public, for these changes will increase credibility of the government and industry officials.

Symposium: Forages and Pastures: Forage-Based Systems for Beef and Dairy Cattle Production: Regional Challenges and Opportunities

269 Northeast opportunities and challenges for forage-based beef and dairy production. K. J. Soder*, *USDA-ARS, Pasture Systems & Watershed Mgmt. Research Unit, University Park, PA.*

Forage-based livestock systems generate nearly two-thirds of current agricultural income in the northeastern U.S. Much of the agricultural land in this region is best suited for forage production due to soil, site, and climatic limitations for other agricultural practices. Many opportunities exist to promote forage-based dairy and beef systems. Research has shown that grazing systems require less grain and fuel inputs than those relying heavily on cropping and confinement feeding systems. Potential exists to utilize abandoned land for grazing enterprises which may present a low-cost option to lease or buy this land while maintaining a 'greenscape' desired by the general populace. The Northeast is situated among several high-population areas that are becoming more aware of food origin and are willing to pay more for actual or perceived benefits from locally- and forage-produced food. Specialty and direct markets exist in the Northeast, some growing at a rate of 20-40%/yr, including organic production, community-supported agriculture (CSA) and farmers markets where locally-produced products are marketed directly to the consumer. While opportunities are plentiful, there are also formidable challenges to Northeast agriculture. Even though abandoned land may be available for grazing, this land is often in very small parcels and surrounded by urban development. Urban pressure challenges animal agriculture, including inflated land prices, animal welfare/rights issues, and non-farm public concerns with inputs, nutrient management, and odors associated with farming practices. Lack of custom processing facilities is causing a bottleneck in the direct market trade, particularly for beef operations. Current consumer economic trends may be a concern if disposable income decreases, as the ability or desire to purchase value-added products may decrease. Sustainability of agriculture in the Northeast depends on keeping forage-based livestock systems competitive and profitable while protecting the environment. Final thoughts will include potential future directions for research and management improvements.

Key Words: Challenges, Forage-Based, Northeast

270 Forage-based systems for the Upper Midwest. W. K. Coblenz*, *US Dairy Forage Research Center, Marshfield, WI.*

Recently, the dynamics of agricultural production have changed, particularly as prices for cash-grain crops, such as corn (*Zea Mays* L.) increase with demand for ethanol production. Other changes likely will be needed to meet increasing public demands for environmentally responsible nutrient management, as well as expanding markets for grazing-based and/or organically produced milk and meat products. Our objectives are to discuss how these external pressures may affect forage systems throughout the region, and identify potential focus areas for future forage research. Excepting corn silage, potential focus areas for research can be divided into five areas: i) improving alfalfa (*Medicago sativa* L.) and other legumes; ii) improving grazing systems; iii) unique forage needs of specific livestock classes; iv) harvest and storage of forage crops; and v) strategies for improved nutrient management.

Within each of these broad areas, it is possible to identify specific needs that are both traditional, as well as new and unique. For alfalfa, new research may evaluate alfalfa varieties or management schemes that permit less-frequent harvests, harvest by plant part for multiple end uses (livestock and energy), improved grazing tolerance, and reduced proteolysis during silage fermentation. Grazing initiatives may include assessment of long-term health benefits of grazing, supplementation strategies for grazing dairy cows, strategies to supply adequate forage during the summer slump or gap, and forage options that extend the grazing season. Continued research will be required to assess proper agronomic management of low-cation grass forages for nonlactating dry cows, as well as viable low-energy forages to dilute replacement-heifer diets comprised primarily of corn silage or by-products of ethanol production. Finally, improving nutrient management will require increased opportunities for summer spreading, as well as evaluation of new application methods engineered to reduce volatilization and runoff. Addressing changing forage research needs will require creativity and diligence by scientists, but such efforts are essential for the long-term stability of the dairy and beef industries.

Key Words: Forage Systems

271 Opportunities and obstacles for forage-based dairy and beef production in the Southeastern U.S. J. Andrae*, *Clemson University, Clemson, SC.*

Increasing feed, fuel and fertilizer costs are pressuring dairy, cow-calf, and stocker producers to manage forages more efficiently. High rainfall and moderate winters in the southeastern U.S. are perhaps the regions biggest competitive advantage. These provide a long growing season with minimal stored feed requirements. High quality, productive forage species like novel endophyte-infected tall fescue and winter annuals are widely grown. Summer conditions are favorable for subtropical legumes and grasses which can support moderate animal performance with minimal input costs. The availability of dependable and relatively inexpensive irrigation in some areas has fueled recent foreign investments in grazing dairies. Regional metropolitan areas also provide direct marketing opportunities for both milk and meat products. Forage-based beef and dairy production also face several obstacles in the southeast. Acidic soils often limit legume production. The lack of a persistent, perennial cool season grass species for the Coastal Plain increases reliance on annual grasses and creates a severe forage gap from late October through December. Much of the forage produced across the region is inefficiently utilized due to a widespread ignorance of grazing management practices. However, the largest impediment to southeastern forage-based operations is a producer resistance to accept risk or modify traditional management practices. Most prior forage research in this region has focused upon the extensive management of traditional species. Integrated system-wide grazing research is needed to explore multiple forage species under intensively managed dryland and irrigated scenarios. The development and improved management of high quality complimentary forages (both grasses and legumes) could further extend the grazing season, minimize nitrogen inputs, decrease risk, and improve profitability of stocker and dairy operations in the southeastern U.S.

Economic and environmental impacts of these management practices also warrant investigation.

Key Words: Grazing, Forage, Southeast

272 Forage-based systems for beef and dairy cattle production: Challenges and opportunities in the South Central region. W. A. Phillips*¹, G. W. Horn², and B. K. Northup¹, ¹*USDA-ARS Grazinglands Research Laboratory, El Reno, OK*, ²*Oklahoma Agricultural Experiment Station, Stillwater, OK*.

The states of Kansas, Oklahoma, Texas, Missouri, Arkansas and Louisiana comprise the South Central Region (SCR) and contain 106 million ha of agricultural land, with roughly equal halves under crop and forage production. The region is also home to 33 million beef cows and calves and 0.7 million dairy cows. The SCR is a mosaic of eco-regions varying from sub-tropic to temperate and humid to dry domains, supporting a diverse range of plant communities. In the future, forage-based production systems in the SCR will have to compete with cropping enterprises for land, water and inorganic N, and utilize perennial forages more than annual species. Further, the region's most productive agricultural land will see increased use for grain production, to meet the increasing demands for ethanol as bio-fuel. Therefore, forage-based beef- and dairy-production systems will have to use marginal lands and employ limited amounts of expensive inorganic N. Forage-based systems have the potential to play important roles in agricultural production in the SCR. Opportunities for improving production in forage-based systems exist in utilizing bio-fuel byproducts as a feedstock, incorporating legumes as a renewable N source, extending the grazing season with combinations of cool- and warm-season swards, developing drought tolerant cultivars, increasing forage yields per unit of fossil fuel input, integrating management strategies to maximize revenue for sequestering carbon, and applying precision agricultural tools to production systems.

Key Words: Forages, Pasture, Grazing

273 Forage-based systems for beef production: Western regional challenges and opportunities. K. C. Olson*¹ and B. L. Waldron², ¹*South Dakota State University, Rapid City*, ²*USDA-ARS Forage and Range Research Laboratory, Logan, UT*.

There are two divergent forage-based production systems in the western U.S. based on land type and ownership. The first system is based on native rangeland. Much of this is public land but some is privately owned. The other system is based on tame pastures on privately-owned land, much of which is irrigated. These two land types lend themselves to extensive vs. intensive management systems, respectively. Public rangelands are managed based on multiple use, meaning that livestock grazing is only one of many uses and services this land must provide. Thus, management of the land and the forage base is not limited just to livestock production. These rangelands are spatially and temporally diverse. This lends grazing management to seasonal patterns of use based on the suitability of the forage as a nutrient resource. The most typical seasonal-suitability grazing pattern is based on the elevation gradient in the mountain west wherein cattle forage at lowest elevations (valley floors) in winter, middle elevations (foothills) in spring and fall, and upper elevations (mountains) in summer. This allows livestock to graze when forage nutritional value and vegetation tolerance of grazing are both high. Challenges to these systems include invasion by noxious, weedy species of limited or no forage value. Research opportunities include developing alternative forage species that not only contribute forage to overcome bottlenecks in seasonal suitability grazing, but also provide other ecological uses and services. On intensive-managed irrigated-pasture systems, forage productivity and nutrient density may exceed the requirements of a typical cow-calf enterprise. Opportunities exist to develop pasture-based growing and finishing systems that may focus on producing beef for natural and organic niche markets. An array of research questions need to be answered for these novel systems, including pasture, nutritional, breeding, and reproductive management, as well as production alternatives such as calving and weaning dates. Alternatives should be evaluated in a systems approach to ascertain overall system response and not just response of the specific alternative.

Key Words: Beef Cattle, Grazing, Forages

Growth and Development: Historical Perspective and Future Direction

274 ASAS Centennial Presentation: The history of growth biology research - A reflection on the episodic nature of science. T. Etherton*, *Penn State University, University Park.*

Evans and co-workers were the first to demonstrate the presence of a substance in the anterior pituitary that increased the growth rate of rats in the 1920's. Subsequent research established the active compound was growth hormone (somatotropin; ST). In the ensuing 80 years much has been learned about the endocrine system and how it regulates animal growth, and nutrient partitioning. Products of biotechnology, such as growth hormone and beta-agonists, have been developed and approved for commercial application. A "reflection over the past eight decades of research is telling. In the early days of recombinant DNA technology (late 1970's), numerous hypotheses could be tested that were not feasible with purified pituitary preparations of ST. Recombinant bovine ST (rbST) was approved for use by the FDA in 1993, with great excitement in the scientific community. A contemporary reflection on research is revealing. We have developed numerous and wondrous scientific breakthroughs, and the ability to manufacture recombinant proteins in large scale. Yet, the agricultural scientific community has not been actively involved in the "public discussion" about the need for and benefits of "biotechnology in the barnyard". Activist groups have attacked science and the application of science. A recent "episode" that illustrates this is the attack on rbST use in the dairy industry. The point of their misguided attacks being that rbST is a risk to consumers! We are standing at a point in time where the next pulse is not associated with the secretory profile of a circulating hormone, but rather a concerted "push" by the academic community to defend science and the freedom to use products of science.

Key Words: Growth Biology, Endocrine Regulation, Somatotropin

275 ASAS Centennial Presentation: Future needs and directions in animal growth and development research. M. A. Mirando*, *Cooperative State Research, Education, and Extension Service, United States Department of Agriculture, Washington, DC.*

As the 21st century progresses, the increased rate of societal, economic and environmental changes occurring at the global, national, regional and local levels will significantly impact animal agriculture and require even greater commitment to research to solve new problems that arise. Research in the area of animal growth and development, in particular, can yield solutions to many of those problems. A variety of needs and approaches will dictate future directions in animal growth and development research. Changes in land use and global climate will provide additional impetus for greater environmental stewardship, reduced nitrogen output and decreased carbon footprint of generating animal products. Research will continue to focus on increasing production efficiency, thereby reducing input of resources, while continuing to improve quality of animal products. Areas of research emphasis will include, but not be limited to, studying mechanisms regulating muscle growth, adiposity and marbling of meat, fetal programming of postnatal growth and development, and removal or replacement of dietary antimicrobial growth promotants. Future studies will take advantage of genome

sequences that have been or will be obtained for agricultural animals, and research will include transcriptional profiling and proteomic approaches. However, although the latter approaches are incredibly powerful, they only yield information on which genes are involved but not how those genes products act or are utilized in cellular or tissue responses. Thus, research will continue to include biochemical and physiological studies to elucidate specific actions and functions of individual gene products, as well as their roles in metabolic and signaling pathways. Finally, there will be continued need for a balance between basic and applied research. Because the private sector, including commodity groups, funds primarily applied research, the fundamental discoveries that lay the groundwork for future applied research will need to be supported by Federal funding sources.

Key Words: Development, Growth, Research

276 The role of microRNA on murine mammary epithelial cell and mammary gland. Q. Z. Li* and C. M. Wang, *Northeast Agricultural University, Harbin, Heilongjiang, China.*

MicroRNAs (miRNAs) are encoded small RNAs that hybridize with messenger RNAs, resulting in degradation or translational inhibition of targeted transcripts. The potential for miRNAs to regulate cell proliferation or differentiation from murine mammary epithelial cell or mammary gland is unknown, and the mechanism of miRNA on mammary development is also not clear. We used microarrays and qRT-PCR to evaluate miRNA expression in mammary tissue during development and functional states of the murine mammary gland. Physiological stages evaluated were that miRNAs was differentially expressed the different developmental stages of the mouse mammary gland. Bioinformatic programs were used to predict targets for miRNA that were identified as significant features of differential expression during developmental and functional cycles of the mammary gland. Antagomirs were used to assess the function and targets of miR-138, miR-292-5p and let-7g in vivo and in vitro. Stage-specific expression patterns on miRNA were evident. miRNAs such as miR-138 and miR-431 were downregulated ($P < 0.05$) some miRNAs such as miR-133, miR-133a, miR133b were upregulated ($P < 0.05$) during pregnancy and lactation compared with expression during mammary involution or expression tissue from virgin mice. It also displays that Prolactin-receptor, STAT5 protein, MAPK protein were up-regulated after treatment with miR-138 antagomir ($P < 0.05$), and PKC protein was (spell out up or down)-regulated by antagomirs for miRNA-292-5p and let-7g ($P < 0.05$). Treatment with antagomirs demonstrated that miR-138 inhibited viable and proliferation of mouse mammary epithelial cells ($P < 0.01$). Venous injections of antagomir for miR-138 into mice on the second day of lactation increased milk production at 12 h followed by a decrease at 48 h ($P < 0.01$). Finally, assembling miRNA networks helped to predict miRNA targets. In conclusion, we demonstrated that different networks of miRNA are expressed during development, lactation and involution of the mouse mammary gland, and that these miRNAs play important roles during these physiological states.

Key Words: MicroRNA, Mammary Pregnancy Cycle, Target

277 Effect of AMP-activated protein kinase (AMPK) and insulin-like growth factor-1 (IGF-1) on expression of muscle-specific ubiquitin ligases in C2C12 myotubes. J. F. Tong*, K. R. Underwood, X. Yan, M. J. Zhu, and M. Du, *University of Wyoming, Laramie.*

INTRODUCTION: AMP-activated protein kinase (AMPK) is a key cellular energy sensor. A mutation in AMPK leads to Rendement napole (RN) phenotype in pigs characterized by superior lean growth. AMPK regulates protein synthesis in skeletal muscle, but its role on myofibrillar protein degradation is unclear. Two newly identified muscle-specific ubiquitin ligases (UL), MAFbx and MuRF1, are crucial for myofibrillar protein breakdown. The insulin-like growth factor-1 (IGF-1) pathway induces muscle hypertrophy in part through inhibition of MAFbx and MuRF1 expression, mediated by protein kinase B (PKB). C2C12 myotubes are commonly used for studying skeletal muscle growth. **HYPOTHESIS:** AMPK interacts with IGF-1 to control the expression of UL in C2C12 myotubes. **METHODS:** C2C12 cells were incubated in DMEM medium with 10% fetal bovine serum. Fusion was induced by 2% horse serum. Myotubes were treated with 5-Aminoimidazole-4-carboxamide-1- β -D-ribo nucleoside (AICAR, 0, 0.1, 0.3 and 1 mM), and/or IGF-1 (100 ng/ml). After 4, 12 and 24 h treatments, myotubes were collected for real-time PCR and immunoblotting analyses. Four independent experiments were conducted (n=4). **RESULTS:** Activation of AMPK by AICAR, a specific AMPK activator, increased MAFbx and MuRF1 mRNA expression, accompanied by an increase in their protein levels. As expected, IGF-1 activated PKB and reduced the expression of UL ($P < 0.01$). Intriguingly, activation of AMPK synergized IGF-1-induced PKB activation; however, the expression of UL was not attenuated, but strengthened by AMPK activation. These data indicate that a PKB independent mechanism exists through which AMPK induces the expression of UL, surpassing the inhibitory effect of IGF-1/PKB pathway on UL expression. In addition to regulating IGF-1/PKB signaling pathway and protein synthesis in muscle cells, AMPK also mediates protein degradation through enhancing the expression of UL. These data indicate that AMPK may be an important molecular target for enhancing lean growth in livestock.

Key Words: Skeletal Muscle, AMPK, Degradation

278 Metabolic gene networks in longissimus muscle of early-weaned Angus and Angus \times Simmental steers fed high-grain or high-byproduct diets during the growing phase. D. E. Graunard*, P. Piantoni, M. Bionaz, L. L. Berger, D. B. Faulkner, and J. J. Loor, *University of Illinois, Urbana.*

mRNA abundance and expression profiles of lipogenic and intracellular energy metabolism gene networks were evaluated via quantitative PCR in longissimus muscle (LM) of early-weaned (~142 d age) Angus (n = 3/diet) and Angus \times Simmental steers (AxS; n = 3/diet) fed a high-grain (HiE) or high-byproduct (HiF) diet for 112 d. LM biopsies were collected at 0, 56, and 112 d of feeding. We evaluated 32 genes associated with lipogenesis (e.g., *G6PD*, *ACACA*, *FASN*), intracellular FA activation (*ACSL1*), esterification (*GPAM*, *DGAT1*, *DGAT2*), desaturation (*SCD*, *FADS2*), intracellular energy metabolism (AMPK subunits, *PRKAA1* and *PRKAA2*), TCA-cycle (*MDH2*), mitochondrial biogenesis (*PPARGC1A*), nuclear receptor signaling (*PPARG*, *PPARD*), transcriptional regulation of lipogenesis (*SREBF1*, *THRSP*, *INSIG1*),

as well as insulin-regulated glucose transport (*GLUT4*) and signaling (*INSR*, *IRS1*). *MDH2*, *SCD*, *GLUT4*, *IRS1*, *ACSL1*, *FASN*, and *PRKAA2* had the greatest relative mRNA abundance averaging 26, 16.5, 7.9, 6.9, 5.4, 5.3, and 4.8%, respectively, of total genes measured. Among those, there was a diet \times steer type \times time ($P < 0.05$) effect for *PRKAA2* whose expression was 2-fold greater in AxS steers namely on d 56. A similar response was observed for *THRSP* in AxS steers fed HiE during the first 56 d (~60-fold greater mRNA relative to d 0). A diet \times steer type effect was found for *SREBF1*, *PPARG*, and *PPARGC1A*, with HiE inducing greater expression in Angus and HiF in AxS steers. Angus steers had greater ($P < 0.05$) expression of lipogenic genes (*ACACA*, *FASN*, *G6PD*, *GLUT4*, *SREBF1*), which might have been associated with numerically greater marbling score (4.49 vs. 4.16, $P = 0.20$) during the 112 d feeding period. Feeding HiE resulted in greater ($P = 0.05$) *IRS1*, *PPARGC1A*, and *ACSL1*, as well as a tendency ($P < 0.15$) for greater *SREBF1*, *THRSP*, and *GLUT4*. Results indicate that lipogenic and intracellular energy metabolism gene networks have different temporal expression patterns in crossbred vs. purebred steers. Further, these patterns could be altered by level of dietary energy during the rapid-growth phase.

Key Words: Genomics, Nutrition, Skeletal Muscle

279 Enhanced skeletal muscle protein synthesis rates in pigs treated with somatotropin requires fed amino acids levels. F. A. Wilson*, A. Suryawan, R. A. Orellana, H. V. Nguyen, A. S. Jeyapalan, M. C. Gazzaneo, and T. A. Davis, *Baylor College of Medicine, Houston, TX.*

Chronic somatotropin (pST) treatment in pigs increases skeletal muscle protein synthesis and circulating insulin, a known promoter of protein synthesis. Previously, we showed that the pST-mediated rise in insulin alone could not account for the pST-induced increase in protein synthesis. This study aimed to determine whether the pST-induced increase in insulin promotes skeletal muscle protein synthesis when amino acids are not limiting and are provided at fed levels, and whether the response is associated with enhanced translation initiation factor activation. Growing pigs were treated with pST (180 μ g/kg/day, n=18) or saline (n=18) for 7 days, then pancreatic-glucose-amino acid clamps were performed to obtain plasma insulin levels equivalent to fasted or fed-pST treated pigs. Amino acids were raised to fed levels at both fasted and fed insulin concentrations; glucose was maintained at fasting levels throughout. Treatment with pST decreased plasma urea nitrogen and increased insulin-like growth factor⁻¹ levels ($P < 0.001$), confirming effectiveness of treatment. Skeletal muscle protein synthesis was increased by pST treatment and by insulin and/or amino acid infusion ($P < 0.001$). When amino acids were raised to fed levels, in the presence or absence of fed insulin concentrations, muscle protein synthesis rates were higher in pigs treated with pST than saline ($P < 0.02$). Fed amino acids, with or without raised insulin concentrations, increased the phosphorylation of S6K1 and 4EBP1, decreased the inactive 4EBP1•eIF4E complex association and increased active eIF4E•eIF4G complex formation ($P < 0.02$). However, treatment with pST did not alter translation initiation factor activation. We conclude that the pST-induced stimulation of muscle protein synthesis requires fed levels of amino acid, but this response is not mediated by mRNA binding to the ribosomal complex. (Supported by USDA NRI 2005-35206-15273).

Key Words: Growth Hormone, Mammalian Target of Rapamycin

280 Changes in the transcriptome of adipose tissue of the dairy heifer during late pregnancy and lactation as measured by gene array analysis: Global changes and cell control. J. Sumner*, C. Schachtschneider, and J. McNamara, *Washington State University, Pullman.*

Metabolic adaptations in adipose tissue are a critical part of establishment and maintenance of lactation in dairy cattle. Adipose tissue stores and releases energy and also secretes a number of metabolic regulators and cytokines. The objective was to obtain a more in-depth understanding of the transcriptomic adaptations in adipose tissue of Holstein heifers from 30 d prepartum to 14 DIM. Adipose tissue was obtained at 30 d prepartum and 14 DIM, extracted for RNA, and hybridized to the Affymetrix Genechip® Bovine Genome Array. There were 20 animals and of those 12 animals provided a quantity and quality of RNA for gene array analysis. Animals averaged 29.8 (SEM = 1.3 kg/d of milk for the first 60 DIM (range 18.6 to 44.8 kg/d). They lost 42.6 kg of BW (SEM 8.4, range +9.1 to -113.6) and 0.38 BCS units (SEM 0.10, range 0 to -1.0) from 0 to 14 DIM. Chip quality backgrounds averaged below 50 units, and 3/5 bias on control genes < 2.0. Correlations among replicates were > 0.85. Approximately 433 genes increased 100% or more, 3406 increased 25 to 100%; 1951 decreased 25 to 50 %, 337 decreased 75% or more. Genes expressed in greatest amounts (signal > 6000, average signal 125) included collagen, and ribosomal proteins, and FABP4. Lipoprotein lipase was expressed at 4261 (SEM 509), the most highly expressed gene regulating nutrient flux. Leptin receptor expressed at 734 (50) prepartum and fell 12 % at 14 DIM. Genes involved in cell synthesis, transcriptional control and inflammation increased 5-fold or more, including beta-defensin, 10-fold, cytokine inducible nuclear protein, 8-fold; chromosomal reading frame 4; 6-fold; sarcoplasmic Ca ATP-ase, 4-fold; leucine-rich repeat-containing 2, 3.5-fold; voltage-dependent calcium channel subunit, 3.5-fold. Bos taurus uncoupling protein 3 increased 3-fold, indicating possible proton uncoupling in white adipose tissue. These data provide some initial insight into the global transcriptomic response of adipose tissue to lactation.

Key Words: Lactation, Adipose, Transcriptome

281 Changes in the transcriptome of adipose tissue of the dairy heifer during late pregnancy and lactation as measured by gene array analysis: changes in specific metabolic control genes. J. Sumner*, C. Shachtschneider, J. Vierck, and J. McNamara, *Washington State University, Pullman.*

Metabolic adaptations in adipose tissue are a critical part of establishment and maintenance of lactation. Adipose tissue stores and releases energy and secretes a metabolic regulators and cytokines. Previous work determined that several enzymes and pathways are controlled gene transcription for enzyme synthesis, and hormonal and neurocrine regulation of enzyme activity. Our objective was to obtain a more in-depth understanding of the gene transcriptome changes underlying the adipose response to lactation. We tested the hypothesis that genes encoding for proteins regulating metabolism changed expression in adipose tissue of Holstein heifers from 30 d prepartum to 14 DIM. Adipose tissue biopsies were obtained, tissue extracted RNA, and hybridized to the Affymetrix Genechip® Bovine Genome Array. Animals averaged 29.8 (SEM = 1.3 kg/d of milk for the first 60 DIM (range 18.6 to 44.8 kg/d). They averaged 33.0 (1.6) kg/d for d 53-60 (range 25 to 46 kg/d). They lost 42.6 kg of BW (SEM 8.4, range +9.1 to -113.6) and 0.38 BCS units (SEM 0.10, range 0 to -1.0) from 0 to 14 DIM. Anabolic pathway genes decreased ($P < 0.05$), including (mean (% change), (SEM)): SREBP, -25.1, (6.2); GLUT1, -57.3 (14.1); THRSP14, -30.8 (7.4); LPL, -48.4 (7.7) and AcCoA Carboxylase, -60.6 (13.0). The regression of transcript change on milk production was 0.18 for AcCoA carb and 0.26 for ATP-CL ($P < 0.05$). Lipolytic control elements increased, with much variation among animals, including Ca channel subunit 338 % (203); B2AR 52.0 (8.8); PKC receptor 10.1 (2.6) and HSL mRNA 23.0 (17.9). The regression of transcript change on milk was 0.30 and 0.25 for B2AR and HSL mRNA. We now have a more complete picture of the adaptive mechanisms to lactation. Reductions in lipogenesis are primarily due to a systemic reduction in enzyme synthesis, while increases in lipolysis are a combination of increases in transcription and metabolic flux control through previously reported changes in hormonal and nervous system activity.

Key Words: Lactation, Adipose, Transcriptome

Horse Species I

282 ASAS Centennial Presentation: Historical review and future outlook of equine reproductive technology. D. Sharp*, *University of Florida, Gainesville.*

The twentieth century was a rich and fascinating time for those with an interest in equine reproductive biology. The birth of equine reproductive research might properly be marked as the first Symposium on Equine Reproduction held at King's College, Cambridge, 1973. Seen as a summation of equine reproductive research up to that point, the symposium also provided moral support for those daring to venture into the sometimes unpopular field. In the more-than a quarter of a century elapsed since then, equine reproductive research has benefited and grown as a result of technological advances that touched all areas of biological research. Key to the growth of that research was the introduction and utilization of but five major technological advances; radioimmunoassay, novel surgical procedures, ultrasound, molecular biological approaches, and acquisition of the equine genome. The latter has yet to prove its worth, but likely will pass the test. The allotted space cannot serve to point out the many milestones and conceptual leaps accomplished in our understanding of equine reproduction. Nor can this short abstract list the players who contributed. The rate of knowledge gain has roughly paralleled that of other domestic species; sometimes lagging, sometimes ahead, but definitely advancing. Suffice it to say here, that horses deserve a place in the texts and in the universities of those who would understand the underlying mechanisms of reproductive biology. The many departures by horses from central scientific dogma provide perspective on the problems of reproduction, and often prove the rule by their exception. Often, the unique anatomical and physiological features of horses, mares especially, lend themselves to development of new approaches which return the investment manifold in knowledge. Certainly one cannot long work with these animals without a sense of awe at their invention. New technologies alone cannot guarantee progress. Those who employed new technologies in the study of equine reproduction, and those yet to do so have a responsibility to ask intelligent, pertinent, questions of the fundamental principles, and direct new technologies appropriately.

Key Words: Equine, Reproduction, Technology

283 Pituitary responsiveness to continuously-administered native GnRH at the winter solstice in anovulatory mares and mares with residual ovarian activity. I. C. Velez^{1,2}, M. Amstalden^{1,2}, J. D. Pack^{1,2}, and G. L. Williams^{1,2}, ¹Texas AgriLife Research, Beeville, TX, ²Texas A&M University, College Station.

Mares exhibit profound reproductive seasonality in North America, and varying strategies have been used to regulate this phenomenon in order to promote earlier foaling during the calendar year. Previous work in our laboratory has shown that low doses of continuously-administered, native GnRH (2.5-5 µg/h s.c.) are unable to prevent the development of or to reduce the length of winter anovulation. However, similar doses in April successfully induce follicular development and ovulation in approximately 80 % of persistently anovulatory mares, suggesting that the anterior pituitary may be less responsive before or near the winter solstice than after. Moreover, results of other studies in our laboratory have questioned whether GnRH secretion is limiting during the anovulatory season. Because of these limited and controversial findings, we examined dose-related effects of GnRH on anterior responsiveness just

before the winter solstice (December 6 through 20). Fifteen mares (5/grp) were used, with 12 of 15 confirmed anovulatory and assigned randomly to: 1) Control, saline; 2) GnRH-20, 20 µg/h GnRH; 3) GnRH-100, 100 µg/h GnRH. Three mares with residual ovarian activity were distributed equally across groups. Treatments were administered s.c. for 14 d using Alzet osmotic minipumps (model 2ML2; 5 µL/h). Repeated measures ANOVA was used to analyze data. Mean concentrations of serum LH (0.3 ± 0.08 ng/mL) did not differ among groups on d 0, but increased (P < 0.001) in a dose-dependent manner within 24 h. On d 14, least squares mean concentrations of LH averaged 0.1, 0.8, and 1.8 ng/mL (SEM = 0.14) for control, GnRH-20 and GnRH-100 groups, respectively (P < 0.001). Maximum follicle sizes did not exceed 25 mm in controls and ranged from 21 to 38 mm in GnRH groups. By d 14, 0/5 control, 1/5 GnRH-20 and 4/5 GnRH-100 had ovulated. Anterior pituitary responsiveness to GnRH at the winter solstice appeared adequate to support follicle development and ovulation.

Key Words: Equine, LH, Seasonality

284 Patterns of pituitary venous LH release in the luteal and follicular phase mare: Effects of continuous treatment with native GnRH. I. C. Velez^{1,2}, M. Amstalden^{1,2}, J. D. Pack^{1,2}, and G. L. Williams^{1,2}, ¹Texas AgriLife Research, Beeville, TX, ²Texas A&M University, College Station.

Continuous administration of high-dose GnRH to most mammals results in GnRH receptor down-regulation and reduced secretion of LH. However, in the horse, continuous GnRH exposure remains stimulatory. Little is known about the hypothalamic-pituitary interrelationships that subserves this unique phenomenon. Herein, we tested the hypothesis that endogenous circulating patterns of LH, as measured in pituitary venous effluent of the intercavernous sinus (ICS), retain their pulsatile character in the face of continuous GnRH exposure. Twelve cyclic mares were assigned randomly to one of two groups (n = 6/group): 1) Control, saline, and 2) GnRH, 100 µg/h. Between 3 and 6 d after ovulation (d 0 of expt.), Alzet osmotic minipumps (Model 2ML1) containing saline or GnRH were placed s.c. and connected to a jugular infusion catheter. On d 3, the ICS of 10 of 12 mares (5/group) were catheterized for 5-min sampling during 8 h on d 4, followed immediately by treatment with prostaglandin F₂-alpha to cause luteal regression. A similar intensive sampling period (6 h) was performed 36 h later (d 6). A pulse detection algorithm was used to identify pulses. Data were analyzed by one-way and repeated measures ANOVA. Mean jugular concentrations of LH on d 0 (2.2 ± 0.7 ng/mL; n=12) did not differ between groups; however, within 24 h, a 2.8-fold increase in mean LH was observed in GnRH-treated mares (P < 0.001). Values in treated mares remained greater (P < 0.001) than controls in both daily peripheral (4.1 vs 1.6 ng/mL; SEM = 0.3) and ICS plasma of luteal (6.9 vs 1.3 ± 0.1 ng/mL) and follicular phases (5.5 vs 1.2 ± 0.1 ng/mL). The luteal phase pattern of pituitary venous LH in 4/5 controls was characterized by infrequent (0.175 ± 0.07/h), secretory episodes of long-duration, punctuated by small secondary pulses. Continuous GnRH exposure eliminated this pattern, producing a chronically-elevated baseline of high-frequency, low-amplitude pulses. Moreover, follicular phase pulse frequency (1.2 ± 0.3 episodes/h) was accelerated (1.6 ± 0.3 episodes/h; P < 0.05) further by GnRH treatment. Results provide additional insight into unique mechanistic features of the equine hypothalamic-hypophyseal axis.

Key Words: Equine, LH, GnRH

285 Effect of centrifugation technique on post storage characteristics of stallion spermatozoa. M. M. Dean and G. W. Webb*, *Missouri State University, Springfield.*

Three ejaculates were collected from each of 4 stallions and used to compare the effects of 3 centrifugation methods on motility, percent harvest and intact acrosomes following both storage at 5°C for 48 h and freezing in liquid nitrogen. Following collection 2 aliquots per treatment were diluted with skim milk-glucose (SKMG) extender to a final concentration of 50×10^6 , placed in 50 ml conical bottom tubes, and centrifuged at either $700 \times g$ for 15 minutes or $600 \times g$ for 12 minutes. A third aliquot was diluted 1:1 with SKMG, placed in 15 ml conical tubes and centrifuged at $400 \times g$ for 7 minutes. Following centrifugation aliquots were again split with subsamples from each stored at 5°C in Equine Express® shippers (Exodus Breeders Supply, York, PA) for evaluation after 24 and 48 h. Another aliquot of each centrifugation treatment was diluted with INRA 96® (IMV International) supplemented with 4% egg yolk and 4% glycerol, loaded into 0.5 ml straws and frozen. Following storage, aliquots were evaluated for motility using CASA (CEROS®, Hamilton Research Inc, Beverly, MA). Data were analyzed using a GLM procedure with a one-way ANOVA and Tukey's used to test differences between centrifuge treatments. Post storage percentages of intact acrosomes and detached heads were evaluated after staining with Spermac Stain™ (FertiPro, Beernem, Belgium). Percentage of spermatozoa harvested was determined by hemacytometer and was higher ($P \leq 0.05$) for aliquots centrifuged in 15 ml tubes at $400 \times g$ for 7 min vs. $600 \times g$ for 12 min in 50 ml tubes. Spermatozoal damage, measured by percentage of detached heads or intact acrosomes, was not different between treatments. Following cold storage total motility was higher ($P \leq 0.05$) for aliquots which were centrifuged in 15 ml tubes compared to those centrifuged in 50 ml tubes at higher speeds and longer amounts of time. Post thaw motility of frozen spermatozoa was not different between treatments. Use of 15 ml vs. 50 ml centrifugation tubes allows centrifugation at slower speeds and shorter times without affecting the % harvest of available spermatozoa. This may result in less damage to the spermatozoa due to centrifugation.

Key Words: Stallion, Semen, Centrifugation

286 Effect of selenium supplementation and dietary energy manipulation on mares and their foals: Selenium concentrations and glutathione peroxidase activity. B. J. Karren*¹, J. F. Thorson², C. A. Cavinder¹, C. J. Hammer², and J. A. Coverdale¹, ¹Texas A&M University, College Station, ²North Dakota State University, Fargo.

To investigate maternal plane of nutrition and role of Se yeast on muscle Se concentration, plasma glutathione peroxidase (Gsh-Px) activity, and colostrum Se concentration in mares and their foals, 28 Quarter Horse mares were utilized in a randomized complete block design. Mares were blocked by expected foaling date and assigned randomly within block to dietary treatments. Dietary treatments were arranged as a 2x2 factorial with two levels of nutrition, pasture or pasture plus grain (fed at 0.75% BW) and two levels of Se supplementation (0 or 0.3 mg/kg BW) equaling four treatment groups: pasture (P), pasture + grain (PG), pasture + grain + Se (PGS), or pasture + Se (PS). P and PS mares received approximately 100% of calculated NRC DE requirements, while PG and PGS received 120%. Selenium supplementation began 110 d prior to estimated foaling (d 0) and all dietary treatments were terminated at

parturition. Plasma and muscle were collected on d 0 with plasma continuing every 14 d and muscle every 28 d until parturition. Additionally, BW, BCS, and rump fat measurements were observed every 14 d. At parturition colostrum, foal plasma and muscle samples were collected and continued every 14 d for plasma and 28 d for muscle until day 56. All data were analyzed using PROC MIXED of SAS. Mare BW, BCS, and rump fat was affected by nutrition ($P < 0.02$) but not Se ($P > 0.40$). Mares fed grain (PG and PGS) had greater BW, BCS, and rump fat measurements throughout the trial. Mare plasma, muscle, and colostrum Se concentrations were greater ($P < 0.01$) in mares fed Se (PS and PGS). Mares fed grain (PG and PGS) also had greater plasma Se ($P < 0.01$) than mares fed pasture. Mare and foal plasma Gsh-Px concentrations were unaffected by treatment ($P \geq 0.25$). Foal plasma and muscle Se concentrations were greater when dams were fed supplemental grain ($P = 0.03$, $P = 0.01$ respectively) and supplemental Se ($P = 0.0002$, $P < 0.0001$ respectively). Data indicate maternal plane of nutrition and Se supplementation influences mare and foal plasma, muscle, and colostrum Se concentrations but not Gsh-Px activity.

Key Words: Se, Maternal Nutrition

287 Effect of selenium supplementation and dietary energy manipulation on mares and their foals: Equine colostrum quality and passive transfer of IgG. J. F. Thorson*¹, B. J. Karren², M. L. Bauer¹, C. A. Cavinder², J. A. Coverdale², and C. J. Hammer¹, ¹North Dakota State University, Fargo, ²Texas A&M University, College Station.

To investigate maternal plane of nutrition and role of Se yeast on colostrum quality and passive transfer of Immunoglobulin G (IgG), 28 quarter horse mares were used in a randomized complete block design. Mares were blocked by expected foaling date and assigned randomly within block to dietary treatments. Dietary treatments were arranged as a 2x2 factorial with two levels of nutrition, pasture or pasture + grain (fed at 0.75% BW) and two levels of Se supplementation (0 or 0.3 mg/kg BW). This resulted in four treatments: pasture (P), pasture + Se (PS), pasture + grain (PG), and pasture + grain + Se (PGS). P and PS mares received approximately 100% of calculated NRC DE requirements, while PG and PGS received 120%. Selenium supplementation began 110 d prior to the estimated foaling (d 0) and all dietary treatments were terminated at parturition. Colostrum samples were obtained at parturition for fat, protein, milk urea nitrogen (MUN), somatic cell count (SCC) and IgG analysis. Foal serum samples were collected at 0, 6, 12, 18, and 24 h after parturition for IgG analysis. All data were analyzed using a mixed model of SAS. There was no effect ($P \geq 0.77$) of Se or level of nutrition on foal birth weight. There was also no effect ($P \geq 0.18$) of Se or level of nutrition on colostrum fat, protein, MUN, or SCC. Mares fed grain had lower ($P = 0.03$) colostrum IgG levels (76.46 mg/ml) compared to mares on pasture (126.64 mg/ml). Foals from mares fed grain tended ($P = 0.07$) to have lower serum IgG (13.66 mg/ml) compared to foals from mares on pasture (15.26 mg/ml). In summary, grain supplementation to mares during the last trimester of pregnancy resulted in decreased IgG concentrations in colostrum and tended to lower foal serum IgG. However, volume of colostrum was not measured and thus further studies are needed to determine if changes in colostrum IgG are due to alterations in colostrum volume.

Key Words: Equine, IgG, Passive Immunity

288 Differential mRNA expression of amino acid transporters in the equine small and large intestine. A. D. Woodward*, S. J. Holcombe, C. Colvin, J. Liesman, and N. L. Trottier, *Michigan State University, East Lansing.*

The role of cationic and neutral amino acid absorption in the large intestine of equids is unknown. The objective of this study was to determine the relative abundance of amino acid transporter mRNA in the proximal jejunal mucosa (JM) and left ventral colon mucosa (LVM) in the adult horse. It was hypothesized that transporters capable of cationic and neutral amino acid trans-membrane uptake are equally expressed in the JM and LVM of the adult horse. Tissue from the proximal jejunum and large ventral colon was obtained from three adult horses shortly following euthanasia. The mucosa was gently separated from the seromuscular layer, flash-frozen in liquid N, and stored at -80 °C for RNA isolation. Concentration and quality of RNA was determined, and Relative Quantitative Real Time-PCR (Q-RT-PCR) was conducted using amino acid transporter specific primers and the standard curve method. Primers were designed and complementary DNA was synthesized for amino acid transporters B^{0,+} (GenBank, XM001489968), CAT-1 (GenBank, XM001492839), and LAT-2 (GenBank, XM001493818); GAPDH (GenBank, XM001496020) was used as a housekeeping gene. Analysis of variance was done on cycles for the gene of interest adjusted by the cycles for the housekeeping gene. Abundance of the amino acid transporter B^{0,+} mRNA was similarly expressed in the JM compared to the LVM (P = 0.38). Compared to the LVM, amino transporter LAT-2 relative abundance was higher (P < 0.05) in the JM. The amino acid transporter CAT-1 was expressed in the JM but showed little expression in the LVM (P < 0.001). The data indicate both the JM and the LVM may be equally capable of sodium-dependent uptake of neutral amino acids through the B^{0,+} amino acid transporter. Sodium-independent uptake of neutral amino acids through the LAT-2 transporter occurs predominantly in the JM. However, uptake of cationic amino acids via the CAT-1 transporter may occur within the JM but not in the LVM. In conclusion, amino acid transporter mRNA expression will vary depending on location within the intestinal tract of adult horses.

Key Words: Horse, Amino Acid Transporter, PCR

289 Differential gene expression in two segments of the equine intestinal tract using a bovine long oligo microarray. A. D. Woodward*, S. S. Sipkovsky, S. J. Holcombe, J. Liesman, and N. L. Trottier, *Michigan State University, East Lansing.*

Gene expression profiling along the equine intestine is critical in order to identify genes related to nutrient digestion and gastrointestinal dysfunction. This study was conducted to 1) determine whether or not equine intestinal tissue hybridizes to a bovine long oligo microarray (BLO), and 2) determine whether or not genes are differentially expressed between the small and large intestinal tract. We hypothesized mRNA expression will be shown on the BLO, and genes of interest will differ in relative abundance between the small and the large intestine. Tissue from the proximal jejunum and large ventral colon was obtained from three adult horses shortly following euthanasia. The mucosa was gently separated from the seromuscular layer, flash-frozen in liquid N, and stored at -80 °C for RNA isolation. Dye-labeled cDNA was synthesized for hybridization to the BLO, which was comprised of 8400 oligos. Expression of mRNA was detected on all three microarrays, indicating equine mRNA hybridized to the BLO. Differences in expression intensity ratios of the jejunal mucosa (JM) compared to the left ventral colon mucosa (LVM) were found for 750 genes (P ≤ 0.05). Of those, 60 genes showed greater than a three-fold difference in intensity of mRNA expression in the JM compared to the LVM. In regards to genes known to be involved in amino acid transport, mRNA abundance for CAT-3 was higher in the JM compared to the LVM (P < 0.05), and tended to be higher for the excitatory amino acid transporter 1 (EAA1, P = 0.08). Several amino acid transporters showed similar mRNA expression in both the JM and the LVM. Among these were CAT-7 (P = 0.41), LAT-1 (P = 0.44), LAT-3 (P = 0.26), amino acid transport system N2 (P = 0.50) and solute carrier family 3 (P = 0.70). These results indicate cationic amino acid uptake may occur predominately in the JM compared to the LVM, while uptake of other amino acids may occur similarly in both the JM and LVM in the adult horse.

Key Words: Horse, Microarray, Amino Acid Transporter

Meat Science and Muscle Biology: Measuring and Manipulating Pork Quality

290 Oxidation results in formation of an intramolecular disulfide bond in μ -calpain. R. Lametsch², E. Huff-Lonerger¹, and S. M. Lonergan^{*1}, ¹Iowa State University, Ames, ²University of Copenhagen, Copenhagen, Denmark.

Examination of mechanisms that regulate calcium dependent protein degradation in muscle continues to be a significant area of inquiry in muscle biology. The active site cysteine of calpain not only facilitates effective catalysis, it also makes the enzyme sensitive to oxidation as characterized by its decreased activity in the presence of an oxidant. It is hypothesized that oxidation of the active site cysteine residue of μ -calpain is responsible for the reversible inactivation of calpain that has been observed. Oxidation of cysteine is very complex and more than 10 different sulfur oxidation states are found *in vivo*. Porcine μ -calpain contains 11 cysteines, which are all likely to be subject to oxidation. This makes it clear that sulfur oxidation state may contribute to regulation of calpain proteolytic activity. These experiments utilized LC-MS/MS analysis to determine the specific consequence of the oxidation of porcine μ -calpain by hydrogen peroxide (H_2O_2). The effect of different oxidative and reducing conditions on μ -calpain activity was examined by incubating μ -calpain with either with 200 μ M H_2O_2 , 0.03%, 0.1%, or 0.2% 2-mercaptoethanol (MCE) or without H_2O_2 and MCE. Activity was determined in the presence (0.2%) or absence (0%) of MCE. Pre-incubation with H_2O_2 resulted in an inhibition of autolysis, activation and activity. However, when activity was evaluated under reducing conditions, the effects of incubation with H_2O_2 were reversed. The LC-MS/MS analysis of the oxidized μ -calpain revealed a peak at m/z 1032.5 that was not present in the control. The MS/MS data revealed that the peptide 105-133 likely contains a disulfide bond between Cys(108) and Cys(115). The disulfide bond was confirmed by reduction of the peptide. The finding that the active site cysteine in μ -calpain is able to form a disulfide bond has to our knowledge not been reported before. It is hypothesized that this is part of a unique mechanism for regulation of μ -calpain.

Key Words: Calpain, LC-MS/MS, Oxidation

291 Developmental changes in tissue skatole levels and hepatic activity of cytochrome P4502E1 and P4502A6 in local and exotic pigs. C. Y. Li*, C. Wu, T. Z. Shan, J. X. Liu, Y. Z. Wang, and J. K. Wang, Ministry of Education Key Laboratory of Molecular Animal Nutrition, Zhejiang University, Hangzhou, P.R. China.

The objective of this study was to evaluate the developmental changes in tissue skatole levels and hepatic activity of cytochrome P4502E1 (CYP2E1) and P4502A6 (CYP2A6) in local Jinhua and exotic Landrace pigs. Eighteen intact male pigs (nine for each breed) were slaughtered at 30, 90 and 150 days of age, when samples were taken from blood, backfat, abdomen fat and liver and analyzed for skatole levels. CYP2E1 and CYP2A6 activities were evaluated for liver samples. For both breeds, tissue skatole contents elevated with the increasing age ($P < 0.01$), but the two breeds showed different developmental changes with age. Compared with Jinhua pigs, plasma skatole levels were significantly lower in Landrace, at all ages ($P < 0.05$). Skatole levels in liver and abdomen fat were lower in Landrace only at d 90 ($P < 0.05$) and d 150 ($P < 0.05$), respectively. No significant difference was found in backfat skatole levels between the two breeds ($P > 0.05$). There were significant breed \times age interactions ($P < 0.05$) in plasma and abdomen skatole levels, but not

in liver and backfat skatole content. The CYP2E1 activity was not different among d 30, 90 and 150 in Landrace, but decreased ($P < 0.05$) from d 90 to 150 in Jinhua pigs. At d 30, CYP2E1 activity in Landrace was significantly higher than that in Jinhua pigs ($P < 0.05$), while CYP2A6 activity was not different between the two breeds. For pigs at d 90, no significant difference existed in both CYP2E1 and CYP2A6. For pigs at d 150, CYP2E1 activity was not different between the two breeds, but CYP2A6 activity were significantly higher ($P < 0.05$) in Landrace than that in Jinhua pig. The lower tissue skatole levels in Landrace pigs appear to be associated with higher CYP2E1 or CYP2A6 activities. However, CYP2E1 or CYP2A6 was not involved in the mechanism of age-related increase in skatole levels of Landrace pigs. Factors other than CYP2E1 or CYP2A6 may play a role.

Key Words: Skatole, Pig, Breed

292 Objective and sensory measures of meat quality and fatty acid profile of *longissimus* intramuscular lipid from pigs fed crude glycerol. P. Lammers^{*1}, B. Kerr², T. Weber², K. Bregendahl¹, S. Lonergan¹, K. Prusa¹, D. Ahn¹, W. Stoffegen³, W. Dozier, III⁴, and M. Honeyman¹, ¹Iowa State University, Ames, ²Swine Odor and Manure Management Research Unit, USDA-ARS, Ames, IA, ³Bacterial Diseases of Livestock Research Unit, USDA-ARS, Ames, IA, ⁴Poultry Research Unit, USDA-ARS, Mississippi State, Mississippi.

The effect of inclusion of crude glycerol on pork loin quality and composition was examined. Barrows (48) and gilts (48) were fed corn-soybean meal based diets containing 0, 5, or 10% crude glycerol for 138-d. Crude glycerol was obtained from AG Processing Inc., Sergeant Bluff, IA and contained 84.51% glycerol, 11.95% water, 2.91% sodium chloride, and 0.32% methanol. Diets were fed in 5-phases with each diet within a phase formulated to be equal in ME, NaCl, and Lys with other AA balanced on an ideal AA basis. On d-138, all pigs were weighed (133 ± 6 kg BW) and on the morning of d-139, pigs were transported to a commercial abattoir. Loins from the left side of each carcass (87) was removed, vacuum packaged, placed on ice, transported to Iowa State University, and stored at 0°C until subsequent analysis. Loin marbling scores, color scores, purge loss, and drip loss were determined following 12 d of storage. Lipid was extracted and quantified from a sample of each loin (87), with fatty acid profile being determined using authentic standards. Two 2.54 cm thick loin chops were removed from the center of 48 loins (24 barrows, 24 gilts) for sensory and instrumental texture analysis. Data were analyzed using a regression model to test for effect of dietary treatment, pig gender, and diet \times gender interaction. Neither diet nor gender affected any meat quality or sensory evaluation measure of loin chops ($P \geq 0.10$). There was no diet \times gender interaction for any measure examined. There was a trend ($P = 0.06$) for loins from pigs fed 5 or 10% crude glycerol to have a greater ultimate pH than loins from control animals. Eicosapentaenoic acid increased with increasing crude glycerol supplementation ($P = 0.02$) and pigs fed 10% crude glycerol had lower levels of linoleic acid than the other dietary treatments ($P = 0.01$). The results of this study demonstrate that up to 10% crude glycerol can be fed to pigs with little to no effect on meat quality. The noted differences in fatty acid profile and trend in ultimate pH may warrant further examination.

Key Words: Crude Glycerol, Fatty Acid Profile, Pork Quality

293 Correlation of pork texture characteristics determined using different instrumental texture analysis methods. M. J. Anderson*, R. M. Smith, E. Huff-Lonergan, and S. M. Lonergan, *Iowa State University, Ames*.

Warner-Bratzler shear (WBS) force and star probe (SP) are two regularly used methods of instrumental texture analysis. Previously, little research has focused on the relationship of measurements made with these two methods. The objective of this study was to determine consistency of correlations between these instrumental texture methods and specific quality attributes. Forty pork loins aged 10-12 days postmortem were cut into chops from the blade end, center, and sirloin end. Quality attributes were measured on the longissimus dorsi at each location. Hunter L*, a*, and b* values as well as drip loss were measured in duplicate. Intact desmin and pH were also measured in each location. Correlations were run between instrumental methods and quality attributes. Linear regression between SP and WBS was also calculated. SP and WBS were positively correlated at $r = 0.67$ ($P < 0.01$). Drip loss tended to be positively correlated to SP ($r = 0.16$, $P = 0.08$) and WBS ($r = 0.17$, $P = 0.07$). L* values were negatively correlated to SP ($r = -0.47$, $P < 0.01$) and WBS ($r = -0.34$, $P < 0.01$). a* values were negatively correlated to SP ($r = -0.38$, $P < 0.01$) and WBS ($r = -0.22$, $P = 0.014$). b* values were negatively correlated to SP ($r = -0.47$, $P < 0.01$) and WBS ($r = -0.31$, $P < 0.01$). WBS tended to be positively correlated to the intensity of the intact desmin band ($P = 0.076$). SP was positively correlated with intact desmin ($r = 0.26$; $P = 0.02$). Linear regression between SP (kg) and WBS (kg) was used to calculate the model: $SP = 1.5 + 1.47(WBS)$. The data show that there was a very strong correlation between the two instrumental measures of texture. While not significant, there was a high consistency between the correlations of both SP and WBS to drip loss. For all color measurements, SP had a stronger correlation than WBS, and also had a correlation to the intensity of the intact desmin band whereas WBS did not. The linear regression between SP and WBS is the beginning of a prediction model of the two instrumental texture methods that will allow us to better interpret data from either source.

Key Words: Pork Quality, Star Probe, Warner-Bratzler

294 Effect of different dietary levels of natural-source vitamin E in grow-finish pigs on pork quality and shelf life. D. D. Boler*¹, S. R. Gabriel¹, H. Yang², R. Balsbaugh², D. C. Mahan³, M. S. Brewer¹, F. K. McKeith¹, and J. Killefer¹, ¹*University of Illinois, Urbana*, ²*ADM Alliance Nutrition, Inc., Quincy, IL*, ³*The Ohio State University, Columbus*.

Feeding high levels of DDGS in the diet will result in increased levels of poly-unsaturated fatty acids in adipose tissue which increases lipid oxidation. This project evaluated the effects of natural source vitamin E (NSVE; Nova-E) compared with synthetic vitamin E on pork quality, shelf life, and color stability. One hundred forty-three pigs were used in the experiment. Six diets were fed for 95 d prior to harvest at 120 kg BW in a complete randomized block design. Six pens per treatment with 4 pigs per pen were assigned to the following treatments: 10 mg/kg NSVE, 40 mg/kg NSVE, 70 mg/kg NSVE, 100 mg/kg NSVE, 200 mg/kg NSVE, and 200 mg/kg synthetic vitamin E. Carcass evaluations, objective color, and NPPC color, marbling, and firmness were recorded for all loins. One pig per pen was randomly selected for estimations of shelf life, color stability, and lipid oxidation. Thiobarbituric acid reactive substances (TBARS) was used to estimate amounts of lipid oxidation of fresh loin chops and ground pork packaged in high oxygen modified

atmosphere packages. Serial loin chops were taken posterior to the 10th rib and displayed for 1, 8, and 15 d post-fabrication. A sample of longissimus muscle anterior to the 10th rib was collected from each pig; samples were pooled by pen forming 36 homogenous samples. Samples were ground, packaged, and displayed for 0, 6, and 12 d post-fabrication. NSVE had no effect on carcass characteristics or meat quality when compared to synthetic E. Increasing dietary NSVE decreased TBARS ($P < 0.01$) for loin chops and for ground pork. High levels of vitamin E did not appear to prevent discoloration of loin chops. Lower levels of NSVE might be used in pig diets with the same benefit of higher doses of synthetic vitamin E.

295 Comparison of dose and durations of ractopamine on late finishing pig carcass characteristics and meat quality. L. W. Kutzler*¹, S. F. Holmer¹, D. D. Boler¹, S. N. Carr², M. J. Ritter², C. W. Parks², F. K. McKeith¹, and J. Killefer¹, ¹*University of Illinois, Urbana*, ²*Elanco Animal Health, Greenfield, IN*.

The study objective was to compare various doses and durations of ractopamine hydrochloride (RAC; Paylean®, ELANCO Animal Health, Greenfield, IN) on pig carcass weight, cutability, and meat quality. Late finishing pigs with an average starting weight of 93 kg were allotted to 12 treatments, 35 d prior to market. Treatments consisted of two control diets: negative control diet (NEG; 13.1 % CP, 0.64 TID Lys), positive control diet (POS; 17.8 % CP, 0.94 TID Lys); two RAC diets 5 ppm (4.5 g/ton) or 7.4 ppm (6.75 g/ton) with pigs on RAC for 7, 14, 21, 28, or 35 d prior to market. Durations intended for RAC were fed at NEG until incorporation of RAC when CP was increased to 17.77 % to comply with label requirements. At harvest, five pigs closest to pen average (240 pigs total) were selected for carcass, cutability and meat quality measurements. Eleven orthogonal contrasts were used to compare treatments with significance at $P \leq 0.05$. Overall, carcass trait contrasts between 5 ppm and 7.4 ppm were not significant. Carcass weight for RAC was 5.56 kg greater than NEG, $P = 0.0002$. Increasing linear duration effects on carcass weight were significant for 5 ppm and 7.4 ppm, $P = 0.0002$ and $P = 0.003$ respectively. Percent lean for RAC was 1.00 greater than NEG, $P = 0.004$. An increasing linear duration effect on percent lean was significant for 5 ppm, $P = 0.02$. Carcass cut yield for RAC was 1.24 % greater than NEG, $P = 0.001$. An increasing linear duration effect on carcass cut yield was significant for 5 ppm, $P = 0.03$. Subjective marbling score for RAC was 0.49 less than NEG, $P = 0.001$. Linear duration effects on marbling score were not significant for 5 ppm or 7.4 ppm. Subjective color values were not significantly different, nor were shear force aging curves significantly different from NEG. Overall, RAC at both levels of 5 ppm and 7.4 ppm had greater responses in carcass weight and cutability than NEG, and had minimal affect on meat quality.

Key Words: Ractopamine, Cutability, Meat Quality

296 Comparison of growth performance, carcass characteristics, and meat quality of barrows, immunocastrated pigs and entire males. C. Pauly² and G. Bee*¹, ¹*Agroscope Liebefeld-Posieux Research Station ALP, Posieux, Switzerland*, ²*Swiss College of Agriculture, Zollikofen, Switzerland*.

In Switzerland, castration of piglets without anesthesia will be banned in 2009. Two alternatives, which allow avoiding surgical castration

under anesthesia are immunocastration or entire male production. Thus, the study's objective was to compare the growth performance, carcass characteristics, and meat quality as well as to evaluate by a trained sensory panel the incidence of boar taint in the LM of barrows (B), immunocastrated pigs (IP), and entire males (EM). At weaning 36 Swiss Large White pigs were blocked by BW into 12 blocks and assigned to B, IP, and EM. All pigs were group-penned from weaning to 107 kg BW and had ad libitum access to standard diets. The 2 IMPROVAC® injections were applied to the IP at an average BW of 22.2 and 74.3 kg, respectively. Because ADG did not differ among the experimental groups (IP: 0.92; EM: 0.88; B: 0.93 kg/d; $P > 0.05$) but EM and IP consumed less feed than B (IP: 191; EM: 185; B: 202 kg; $P < 0.05$), IP and EM were more efficient than B (G:F: IP: 0.42; EM: 0.43; B: 0.39 g/g; $P < 0.01$). However, carcass leanness was greatest ($P < 0.05$) in EM (57.5%) followed by IP (56.3%) and B (54.5%). As expected the level (expressed per g lipid of the backfat) of androstenone was higher ($P < 0.01$) in EM (1.2 µg) than IP and B (0.2 µg) whereas skatole level was higher ($P < 0.05$) in both the EM (0.31 µg) and IP (0.08 µg) than the B (0.05 µg). On a scale from 1 (weak) to 9 (strong), sensory scores for boar odor and flavor were lower ($P < 0.01$) in the LM of B and IP than EM, whereas juiciness and tenderness scores did not ($P > 0.05$) differ. Initial and ultimate pH, color, percentage drip, thaw and cooking loss did not differ among the experimental groups ($P > 0.05$), whereas shear force values were higher ($P < 0.01$) in the LM of B and EM compared to IP (3.7, 3.8, and 3.5 kg, respectively). Although carcasses of EM were leaner, the similar feed efficiency and especially the lower sensory scores for boar odor and flavor in the LM of IP, confirm that immunocastration might be the best alternative to avoid castration under anesthesia.

Key Words: Boar Production, Immunocastration, Sensory Quality

297 Effect of gender and slaughter weight on meat quality and weight loss of hams during ripening in Iberian pigs reared under intensive production systems. M. P. Serrano¹, D. G. Valencia¹, R. Lázaro¹, D. Menoyo¹, A. Fuentetaja², and G. G. Mateos^{*1}, ¹Universidad Politécnica de Madrid, Spain, ²Copese, Segovia, Spain.

Iberian (IB) pigs, a native breed of Spain, have been traditionally reared under free range conditions, fed on grass and acorns, and slaughtered at heavy weights (160 to 180 kg body weight, BW). Currently, to meet the increasing demand for IB products, 80% of IB pigs are reared indoors, fed on concentrates, and slaughtered at 140–150 kg BW. Originally, males (CM) and females (CF) were castrated, but intact females (IF) might also be used. An increase in slaughter weight (SW) increases intramuscular fat which benefits the production of high quality cured products. However, excessive BW results in overly fat pigs which penalizes the acceptability of the end products. A total of 96 IB dam × Duroc sire pigs were used to study the influence of gender (coded CM, CF, IF) and SW (145 and 156 kg BW) on meat quality, fatty acid (FA) profile of backfat (BF), and ham weight losses during ripening. There were four pens of four pigs each per treatment. Meat samples were taken from the Longissimus dorsi at the level of the last rib and BF samples were taken at the tail insertion. Ripening of hams lasted for 719 d (19 d for salting, 63 d for postsalting, 28 d for drying, and 609 d for cellar phase). Meat quality (except chroma value), FA profile of BF, and ham weight losses during ripening were not affected by gender or by SW. Chroma (c*) was higher in meat from CF than in meat from CM with meat from IF being intermediate (15.5 vs. 14.9 vs. 13.6; $P \leq 0.05$). We conclude that based on meat quality and weight losses during the drying process, intact females are a good alternative to castrated females to produce high quality Iberian cured products. Also, Iberian pigs can be slaughtered at either 145 or 156 kg body weight without any loss in meat quality or in ham weight losses during ripening.

Key Words: Iberian Pigs, Gender, Slaughter Weight

Nonruminant Nutrition: Past and Future of Nonruminant Nutrition

298 ASAS Centennial Presentation: Landmark studies in swine nutrition during the past century. G. L. Cromwell*, *University of Kentucky, Lexington.*

During this centennial year of the American Society of Animal Science (ASAS), it is of interest to look back over the history of our Society and, in particular, to the many contributions made by researchers in the area of swine nutrition. A great number of basic and applied research studies involving the nutrition of weanling, growing, and finishing pigs, and gestating and lactating sows have been conducted by swine nutritionists during the past 100 years. Most of these studies were conducted at universities by scientists or graduate students under their leadership. Others were conducted by nutritionists in the feed and pharmaceutical industries as well as government scientists at ARS/USDA sites. Important contributions also were made by animal scientists beyond our borders. Many of the important findings have been reported in the *Journal of Animal Science* during its 66 years of existence. Before the first issue of the *Journal* was published in 1942, some of the earlier studies were reported in the Proceedings of the Annual Meeting of the Society of Animal Production, the forerunner of ASAS. These research studies have progressively led to a better understanding of the utilization of energy, protein, amino acids, carbohydrates, fats, minerals, and vitamins by pigs and have helped to quantify the nutrient requirements of pigs for various stages of growth, for sows during gestation and lactation, and to a limited extent, for boars. Determining the nutritional value of a wide array of feedstuffs, evaluating feeding strategies, and assessing the value of growth promoting and carcass enhancing agents have been important research contributions as well. To identify the particular studies that were among the most instrumental in contributing to our present knowledge of swine nutrition is, to say the least, a daunting assignment. To aid in this task, a survey of swine nutritionists was conducted in which they were asked to identify and rank the 10 most significant findings in swine nutrition during the past 100 years. The results of that survey will be presented.

Key Words: Swine Nutrition, History, Research

299 ASAS Centennial Presentation: Nonruminant nutrition - A proud past but uncertain future. R. A. Easter*, *University of Illinois, Urbana.*

Nonruminant nutrition is a sterling example of multidisciplinary scholarship requiring practitioners to integrate knowledge from fields as diverse as animal biology, ingredient composition, housing environments, experimental design and analysis, animal feeding behavior, meat quality and production system management. For the past 100 years academic and industry research programs have steadily advanced the science leading to improved animal well-being, increased production efficiency and more nutritious products for human consumption. University programs have provided a reliable supply of graduates well-prepared for careers in industry, government and academia. Global consumer demand for food products derived from nonruminant species is projected to expand at roughly three percent per annum for the foreseeable future. At same time, the market for companion animal feeds is reliably linked to growth in economies in many developing countries. Yet the future of nonruminant nutrition cannot be assumed. Across the developed world public support for educational programs in applied agriculture, especially in animal agriculture, is declining and student interest continues to diminish. Increasingly, the direction of academic research is a function of state and national funding priorities. Applied nonruminant nutrition research, which has been the mainstay of graduate student preparation, is rarely identified as a priority. The situation is not hopeless. The need for high-quality research and education in nonruminant nutrition is very real. The challenge is for industry and academic leaders to jointly develop an implementable strategy for the future.

Key Words: Nutrition, Nonruminant, Future

Symposium: Physiology and Endocrinology: Emerging Concepts on Dietary Components that Influence the Physiology and Endocrinology of Domestic Farm Animals

300 Reproductive consequences of nutritionally-induced changes in the pH of the bovine reproductive tract. G. A. Perry*, *South Dakota State University, Brookings.*

During some production situations cattle are fed excess protein. However, increased protein intake during early pregnancy has been associated with decreased fertility and increased embryonic mortality. Increased protein intake elevated blood urea nitrogen and decreased uterine pH, during the luteal phase, but did not influence pH of other bodily fluids. Ionic composition of both oviduct and uterine fluids is derived from ions from the blood and ions secreted from oviduct and uterine epithelium. The oviductal and uterine microenvironment plays a central role in pregnancy success. At the initiation of estrus uterine pH declines to that of semen (≈ 6.8); pH at this time likely plays a role in sperm survival. Uterine pH can influence sperm motility and longevity and has been associated with pregnancy success following fixed-time AI. This decrease in pH at the initiation of estrus appears to be estradiol dependent since elevated concentrations of estradiol prior to ovulation, even when estrus was not induced, decreased uterine pH. Intake of excess protein (UIP or DIP) did not influence uterine pH at estrus; however, it decreased uterine pH during the luteal phase. Following the pH nadir during estrus, pH increased prior to ovulation and remained neutral (≈ 7.0) during the luteal phase. During early embryonic development, the embryo is dependent on nutrients provided by oviduct and uterine fluids for growth and survival. Alterations in pH during these early stages of embryonic development when the embryo's ability to regulate pH is limited can likely influence distribution of mitochondria as well as membrane permeability and severely inhibit embryo development. When embryos that were not able to regulate pH (blocking of NA^+/H^+ antiporter or $\text{HCO}_3^-/\text{Cl}^-$ exchanger) were exposed to acidic or alkaline conditions, embryonic development to the blastocyst stage was significantly reduced. In summary, excess dietary protein can influence uterine pH during early embryo development, and changes in pH during early pregnancy, a time when the embryo can not adjust pH, can greatly reduce pregnancy success.

Key Words: Uterine pH, Pregnancy Success

301 Performance, metabolism and immunity in domestic animals fed diets contaminated with *Fusarium* mycotoxins. T. K. Smith*, *University of Guelph, Guelph, ON, Canada.*

A series of experiments was conducted with gestating and lactating sows, mature horses and lactating dairy cows to determine the effect of feed-borne *Fusarium* mycotoxins on performance, metabolism and immunity. Blends of naturally-contaminated corn and wheat were found to contain deoxynivalenol (DON, vomitoxin) as the major contaminant. In all experiments, animals were fed: (1) control diet (2) diet containing contaminated grains or (3) contaminated grains + 0.2% polymeric glucomannan mycotoxin adsorbent (GMA, Mycosorb, Alltech Inc., Nicholasville, KY). Sows were fed experimental diets for 21 days before farrowing and for 21 days post-farrowing. Horses were fed the experimental diets for 21 days. Dairy cows were fed test rations for 56 days. The feeding of diets containing contaminated grains significantly reduced sow weight gain during gestation and this was partially prevented by the feeding of GMA. The feeding of contaminated grains significantly

increased the incidence of stillborn piglets, however, this was prevented by the feeding of GMA. The feeding of diets containing contaminated grains in the lactation period resulted in significantly reduced feed intake and greater weight loss compared to controls. Horses fed contaminated diets significantly reduced feed intake and had elevated blood activity of gamma-glutamyltransferase compared to controls. The feeding of GMA prevented these effects. There was no effect of diet on milk production, feed intake, milk somatic cell counts or milk composition when fed to dairy cows. The feeding of contaminated feedstuffs, however, significantly reduced serum concentrations of IgA and also resulted in a significant elevation of serum urea concentrations. The feeding of GMA prevented these effects. It was concluded that mature pigs, horses and dairy cows are all adversely affected by feed-borne *Fusarium* mycotoxins and that contaminated feeds should be fed only with caution and with an appropriate mycotoxin adsorbent.

Key Words: *Fusarium* Mycotoxins, Pigs, Dairy Cows

302 Effectiveness of supplemental antioxidants for enhancing reproductive function in cattle. P. J. Hansen*, *University of Florida, Gainesville.*

Production of reactive oxygen species (ROS) is an inherent feature of oxygen metabolism. About 1-2% of the oxygen consumed by cells is incompletely reduced to water. The ROS formed as a result can damage plasma membranes, proteins, and DNA. An increase in oxygen consumption, for example during lactation, hyperthermia or following exercise, results in increased ROS production. The major source of ROS is the mitochondrion but specific enzymes such as myeloperoxidase and cyclooxygenase also cause generation of ROS. Reproductive responses to supplementation are likely to depend upon the magnitude of ROS generation, the efficacy of the supplement for altering redox status and the availability of antioxidants in the control diet. One period in which supplemental antioxidants can affect reproduction is the periparturient period. At this time, dry matter intake is reduced, antioxidants are secreted into the colostrum, and ROS generation from leukocytes is high because of the need for placental expulsion, clearance of lochia from the postpartum uterus, and immunological adjustments to lactation. Administration of vitamin E and selenium alone or in combination can reduce incidence of retained placenta and uterine infectious disease. Similar effects have been reported for administration of β -carotene. Fertility responses to vitamin E and selenium have been mixed; there is some evidence for greater responses for second service than for first service. Another condition that may increase ROS generation is heat stress. One study found increased ROS metabolites in erythrocytes in cows during summer as compared to winter. Feeding supplemental β -carotene increased the proportion of cows pregnant by 120 d postpartum in the summer but not the winter. However, administration of other antioxidants in the summer, including vitamin E or vitamin E and selenium, did not affect fertility. Future research into effectiveness of antioxidant supplementation in cattle is likely to involve nutraceutical molecules that may be more effective in affecting tissue redox status than antioxidant supplements that are commonly used today.

Key Words: Antioxidants, Reproduction, Cattle

303 Phytase: Not just for environmental protection-novel roles in system physiology. X. G. Lei*¹ and J. M. Porres², ¹*Cornell University, Ithaca, NY*, ²*University of Granada, Granada, Spain*.

Phytase is a phosphohydrolytic enzyme that initiates the stepwise removal of phosphate from *myo*-inositol hexakisphosphate or phytate. The heightened environmental awareness of phosphorus pollution originating from animal manure during the past two decades has led to an exciting era of phytase research and a widespread application of the enzyme in animal feeding. It is well-documented that supplemental phytase improves bioavailability of phytate-phosphorus to swine and poultry by 20-45%. This improvement results in up to 50% reduction in manure phosphorus excretion by animals and prevents nearly 22,000 tons of manure phosphorus from entering the environment annually in the USA from marketing pigs alone. However, potentials of phytase are far beyond just environmental protection. This presentation will review

past research on the unique roles of phytase in system physiology, and explore novel application of the enzyme in improving animal and human health. Alleviation of iron-deficient anemia by phytase depicts its roles in the circulatory system. Releasing the phytate-chelated zinc enables phytase to modulate growth and immune function. While hydrolysis of phytate into various forms of inositol phosphates may produce bioactive signal transducers, it could also alter the susceptibility of digestive system to oxidative stress. Impacts of phytase on the skeleton system have been focused on its benefits to bone strength and mineral content in animals fed low-phosphorus diets. In fact, dietary phytase affects bone metabolism-related hormones, and still can improve bone property and function even in animals fed a high-phosphorus diet. These intriguing actions of phytase underscore its broad and complex roles in physiology.

Key Words: Anemia, Immune, Phytase

Production, Management and the Environment: Nutrient Management and the Environment

304 Development of methane conversion factors for US cattle using mechanistic models. E. Kebreab*¹, K. A. Johnson², S. L. Archibeque³, D. Pape⁴, and T. Wirth⁵, ¹University of Manitoba, Winnipeg, Manitoba, Canada, ²Washington State University, Pullman, ³Colorado State University, Ft. Collins, ⁴ICF International, Washington, DC, ⁵Environmental Protection Agency, Washington, DC.

Methane is one of the greenhouse gases emitted from livestock and up to 23 times more potent than carbon dioxide in its ability to trap heat in the atmosphere. In most countries, national estimates of enteric methane emissions are based on models developed by the Intergovernmental Panel for Climate Change (IPCC). For countries for which livestock emissions are important, the IPCC recommends a more complex approach which incorporates country-specific information and use of sophisticated models that consider diet composition in detail. Therefore, the objectives of this study were to (1) evaluate models for their prediction ability using measurements made on individual cattle and (2) develop methane conversion factors (Y_m) for US cattle. The mechanistic models chosen were MOLLY, a whole-animal model developed at the University of California, Davis and COWPOLL, a largely rumen model for lactating dairy cows developed in Europe. Diet details from experiments conducted in the US were used as inputs to the models. Mean square prediction error (MSPE) was used to evaluate the models statistically. In dairy cattle, COWPOLL had the lowest root MSPE (12.5% of mean) but in feedlot, MOLLY had the lowest root MSPE (11.2% of mean). Both models had little mean bias or deviation from line of unity and over 90% of errors were random. The models were then used to estimate Y_m from cattle fed different diets in various states across the US. The average Y_m in dairy cows was 5.63% of gross energy (range 3.78 to 7.43%) compared to 6.5% ± 1% recommended by IPCC. In feedlot cattle, the average Y_m was 3.88% (range 3.36 to 4.56%) compared to 3% ± 1% recommended by IPCC. The models were able to pick up differences in diet composition such as fat supplementation or amount and source of starch inclusion. Due to significant effect of diet on Y_m, it is recommended that national inventories with large animal populations use diet specific Y_m values estimated by mechanistic models to calculate methane emissions from cattle.

Key Words: Methane, Ruminant, Modeling

305 Characteristics and use of separated manure solids following anaerobic digestion for dairy freestall bedding in three Iowa dairy herds. L. L. Timms*, Iowa State University, Ames.

Study objectives were to evaluate the characteristics of separated manure solids and impact on herd performance in 3 dairy herds. All herds had mattresses in freestalls and used separated manure solid following anaerobic digestion from herd 1. Samples were collected on a biweekly basis for 1 year and included 1) raw manure 2) manure effluent post anaerobic digestion but prior to separation; 3) fresh separated manure solids; 4) piled separated solids; and 5) separated solids bedding samples from freestalls. Samples were analyzed for dry matter content and environmental mastitis pathogens. Bulk tank milk samples were taken for bacterial analysis and both creamery and DHI data was available. Dry matter content of fresh separated solids was 28-41% (avg. 34%) with piled solids running ~2-5% higher DM. DM% of solids in stalls averaged 65-75% during summer-fall, and 50-60% during winter. Total gram negatives and alpha streps., and coliforms post digestion and in

stalls were 100,000 and 100, and 1-10 million/g and 1 million, 100,000, and 1000 for herds 1-3, respectfully. Herd 1 averages 250-350,000 and has declined slightly since solids use. Herd 2 averages 200-300,000 and has maintained that average. Herd 3 averages 100-200,000 SCC, and had maintained that average. All herds had no Strep. ag. and some evidence of Staph. aureus (contagious). Herds 1 and 2 had very high levels of environmental streps., coagulase negative staphs., and some high Coli counts (> 200) indicating issues with milking preparation and teat cleanliness prior to unit attachment. This combined with some Staph. aureus may be the reason for higher SCC in these dairies. Herd 3 showed very good bulk tank results for environmental and skin bacteria indicating excellent premilking sanitation and a major reason for lower SCC. This data shows that composted manure solids can provide a comfortable, effective, economical bedding source if a consistent product is generated and managed properly, and stall, alley, and milking management areas are optimized.

Key Words: Separated Manure Solids, Anaerobic Digestion, Animal Performance

306 Aerobic composting or anaerobic stockpiling of beef feedlot manure. M. K. Luebbe*, G. E. Erickson, T. J. Klopfenstein, and J. R. Benton, University of Nebraska, Lincoln.

Two manure management and storage methods, manure stockpiled anaerobically or composted aerobically for 111 d, were evaluated for nutrient recovery. In July, manure from 11 open pens was scraped, sampled, and weighed before constructing three anaerobic stockpiles and four aerobic windrows. Windrows were turned on d 14, 35, 61, and 90 while stockpiles were not disturbed. Manure core samples and temperature were collected on d 0, 36, 62, and 111. Nutrient recoveries were calculated using total ash as an internal marker. Ammonium N was measured on samples as-is and after drying for 24 h in a 100°C oven. Dry matter and OM recovery was not different (P>0.70) on d 111. Total N concentration was greater (P<0.01) on d 111 for stockpiled manure than compost (6.0 and 5.0 g/kg DM, respectively). Total N recovery was greater (P<0.01) for stockpiled manure than compost on d 111 (75.8 and 65.6%, respectively). Organic N (% of total N) was greater (P<0.01) for compost than stockpiled manure on d 36, 62, and 111. Ammonium N (% of total N) for fresh samples was greater (P<0.01) for stockpiled manure than compost on d 36, 62, and 111. Nitrate N was greater (P<0.01) for compost than stockpiled manure on d 62 and 111. Total N recoveries calculated using oven dried samples tended to be greater (P=0.10) for stockpiled manure than compost on d 111 (70.5 and 65.0%, respectively). Recovery of P₂O₅ was not different (P=0.81) for composted and stockpiled manure at d 111 (97.0 and 95.8%, respectively). Concentration of P₂O₅ was similar (P=0.40) for stockpiled manure and compost on d 111 (9.0 and 8.7 g/kg DM, respectively). The N:P ratio was greater (P=0.01) for stockpiled manure than compost on d 111 (1.54 and 1.32, respectively). When manure samples were dried down completely to simulate hot, dry conditions during field application, the amount of ammonia N lost from stockpiled manure was not great enough to offset the total N recovery advantage of this method. When evaluated on a nutrient basis, stockpiled manure has greater value as a fertilizer compared with composted manure.

Key Words: Nitrogen, Cattle, Compost

307 Effect of dietary protein level and degradability and energy density on ammonia losses from manure in dairy cows. M. Agle¹, A. N. Hristov*¹, S. Zaman¹, C. Schneider¹, P. Ndegwa², and V. K. Vaddella², ¹University of Idaho, Moscow, ²Washington State University, Pullman.

Two trials with lactating dairy cows were conducted to investigate the effect of dietary CP level and degradability (Trial 1) and dietary energy density (Trial 2) on ammonia losses from manure. Experiments were replicated Latin square design with 2-wk adaptation periods. Three diets were tested in Trial 1 and 2 diets in Trial 2. Concentrations of CP, RDP, and RUP (NRC, 2001) in Trial 1 diets were (% DM basis): 17.6, 12.2, and 5.4 (HighCP); 15.2, 9.8, and 5.4 (LowCP); and 14.4, 8.3, and 6.1 (ExtraLowCP). RDP supply exceeded requirements in HighCP, was adequate in LowCP, and was deficient in ExtraLowCP. In all diets, metabolizable protein intake met the requirements of the cows. Dietary NE_L concentration was similar between diets (1.54 to 1.57 Mcal/kg DM). Diets in Trial 2 had similar CP (and RDP/RUP) concentration (17.8-17.9% DM), but differed in NE_L density: 1.65 (LowEnergy; 50% forage) vs. 1.83 (HighEnergy; 30% forage) Mcal/kg DM. In both trials, diets were offered at ad libitum intake. Average DMI and milk yield in Trial 1 were 24.2 and 30.8 kg/d (respectively) and were not affected ($P = 0.153$ and 0.453) by diet. In Trial 2, average DMI and milk yield were 26.0 and 33.4 kg/d and did not differ between diets ($P = 0.502$ and 0.191). At the end of each experimental period, fresh urine and feces were collected from the cows and stored frozen at -80°C. After thawing, reconstituted manure (1 part by weight urine and 1.7 parts feces) was analyzed for ammonia emitting potential *in vitro*. In Trial 1, two weeks cumulative ammonia losses were reduced ($P = 0.001$) with LowCP and ExtraLowCP compared with HighCP (1.7, 1.4, and 2.3 g N, respectively). Diet had no effect ($P = 0.207$) on ammonia losses in Trial 2 (2.0 and 2.3 g N; LowEnergy and HighEnergy, respectively). This study demonstrated that manipulation of dietary CP/RDP, but not energy, can significantly reduce ammonia losses from dairy manure.

Key Words: Dietary Protein, Ammonia Losses from Manure, Dairy Cow

308 Simulating effects of grass management on methane emission in lactating cows. A. Bannink*¹, M. C. J. Smits¹, J. A. N. Mills², E. Kebreab³, J. L. Ellis⁴, J. France⁴, and J. Dijkstra⁵, ¹Animal Sciences Group, Wageningen University Research Centre, Lelystad, The Netherlands, ²University of Reading, Reading, United Kingdom, ³University of Manitoba, Winnipeg, Canada, ⁴University of Guelph, Guelph, Canada, ⁵Wageningen University, Wageningen, The Netherlands.

The type and rate of degradation of carbohydrates in the rumen affect methane production. Because experimental data for grass based diets are essentially lacking, the objective was to simulate the effect of grass characteristics on methane emission from enteric fermentation. A dynamic model of rumen and hindgut fermentation processes (Mills et al., JAS 79:1584-1597) was used. Stoichiometry of yield of volatile fatty acids from different types of carbohydrates and protein was updated based on a recent analysis of *in vivo* data from lactating cows. Methane yield was calculated from predicted hydrogen balance. Various types of ryegrass products were evaluated: fresh grass (G) and grass silage (GS), high (HF) and low (LF) N fertilization level, and early (EC) and late (LC) cutting. Simulations were performed with various levels of DM intake (DMI), and low (10%) or high (60%) level of concentrate on a DM basis. The results demonstrated a strong impact of DMI, proportion

of concentrate and type of grass consumed on methane emission rate and milk yield (FCM). At constant DMI of 17 kg/d, methane loss per kg FCM increased with a reduced N fertilization level (LF vs. HF) and delayed cutting (LC vs. EC). Lowest emissions were predicted for HF fresh grass and HFEC silage. The higher concentrate level decreased losses with LFEC but not with HFEC. Increasing DMI level strongly reduced methane loss per kg FCM.

Table 1. Simulated methane yield from ryegrass diets

% concentrate	10	10	10	10	10	10	60	60	60
DMI kg/d	17	17	17	17	17	17	17	17	23
Grass type	GS	GS	G	GS	GS	G	GS	GS	GS
Management	HFEC	HFLC	HF	LFEC	LFCL	LC	HFEC	HFLC	HFEC
Methane									
g/d	320	318	345	347	330	366	353	349	399
g/kg DMI	18.8	18.7	20.3	20.4	19.4	21.5	20.8	20.5	17.3
g/kg FCM	13.5	15.0	13.5	15.7	16.1	15.7	13.7	14.1	10.5
% GEI	5.8	5.6	6.1	6.5	6.0	6.7	6.4	6.2	5.3

Key Words: Grass Quality, Methane, Modeling

309 Application of computer models in evaluating alternatives to reduce excess nutrients on a beef farm. M. J. Baker*¹, D. G. Fox¹, and L. O. Tedeschi², ¹Cornell University, Ithaca, NY, ²Texas A&M University, College Station.

A two part study was conducted to evaluate the use of the Cornell Net Carbohydrate and Protein System (CNCPS) and the Cornell Value Discovery System (CVDS) in predicting animal performance and in designing a cropping and feeding system that minimizes land applied nutrients while optimizing profitability on a Holstein steer feeding operation. Study 1 utilized farm records to compare several cropping and feeding strategies to baseline data. Replacing alfalfa silage with corn silage (strategy 1) or grass haycrop silage (strategy 2) was predicted to reduce excess nitrogen (N) due to increased utilization by the crop and reducing imported N due to N fixation by alfalfa. However soil erosion control and soil fertility maintenance required that alfalfa be part of the crop plan. Over 19 months (Study 2), complete data was collected on animal (n=450), environment, feed and manure nutrients for four groups of Holstein steers. The average arrival and harvest weight was 149 kg and 597 kg, respectively. Cattle were managed in three weight phases: light, middle and heavy and marketed at thirteen months. Using observed DMI, the CNCPS was able to predict animal ADG within 0.20 kg, 0.07 kg and 0.06 kg for the light, medium and heavy groups, respectively. The CVDS accurately predicted the DM required for the observed gain (predicted DM required was 101% of actual DM fed). Correlations between dietary and manure N, phosphorous (P) and potassium (K) were variable, possibly due to sampling procedure and the interaction of temperature and manure ammonia volatilization. Compared to a dairy, purchased feed was less resulting in lower imported N, P and K. Nutrient efficiency was also low due to the small amount of product that leaves the farm as meat compared to milk. Increasing nutrient efficiency will be difficult because there is little excess dietary N and the increases in product for export will be small. We conclude computer models can be used to aid farmers in designing feeding systems that optimize nutrient utilization.

Key Words: Nutrient Modeling, Holstein Steer

310 Challenges in using flux chambers to measure ammonia and VOC flux from simulated feedlot pen surfaces and retention ponds. N. A. Cole*¹, R. W. Todd¹, D. B. Parker², M. B. Rhoades², and E. Caraway², ¹USDA-ARS-CPRL, Bushland, TX, ²West Texas A&M University, Canyon, TX.

Few methodologies currently available to estimate ammonia and volatile organic compound (VOC) emissions from livestock operations have been adequately validated for accuracy. Flow-through flux chambers and wind tunnels are sometimes used; however, ammonia and VOC flux from pen or pond surfaces are affected by atmospheric turbulence, atmospheric concentration, and temperature, all of which are altered by a chamber. Two lab-scale studies were conducted to determine the effects of flux chamber air exchange rate (0 to 4 turnovers/minute) on ammonia flux from a simulated retention pond or feedlot pen surface. Buffered ammonium sulfate solutions (pH = 7.6, 8.6, and 9.6) were used as a surrogate ammonia source to simulate a feedlot retention pond. Similar buffer solutions were added to a cellulose media to simulate a feedlot pen surface. With both simulated surfaces, ammonia flux increased with increasing air turnover rate. Flux rates at 4 turnovers/minute were approximately 2x flux rates at 0.5 turnovers/minute and 50% of flux rates from "unaffected" containers placed outside the flux chambers. In a third lab experiment, VOC flux was measured from fresh cattle feces and retention pond effluent using a wind tunnel with air flow rates ranging from 0.5 to 9.7 meters/second (approximately 1 to 32 turnovers/minute). In general, VOC flux doubled for each 2-fold increase in air flow rate. Previous chamber studies have noted a large spatial variability in ammonia flux from pen and lagoon surfaces with CV ranging from 23 to 192%. Based on 11 chamber studies, the number of ammonia flux estimates required to be 95% confident that the estimated mean is within 20% of the true mean (determined as $CV^2/100$) ranges from 5 to 369; with a mean of approximately 75. These findings suggest that flux chambers will not give accurate estimates of ammonia or VOC flux from pen or lagoon surfaces and that large numbers of samples may be required when using chambers for treatment comparisons.

Key Words: Ammonia, VOC, Flux Chamber

311 Odorant production and persistence of generic *E. coli* in manure slurries from cattle fed 0, 20, 40, and 60% wet distillers grains with solubles (WDGS). V. H. Varel*¹, J. E. Wells¹, E. D. Berry¹, M. J. Spiels¹, D. N. Miller², C. L. Ferrell¹, S. D. Shackelford¹, and M. Koochmaria¹, ¹USDA-ARS, US Meat Animal Research Center, Clay Center, NE, ²USDA-ARS, Agroecosystem Management Unit, Lincoln, NE.

Ethanol production from corn removes starch and concentrates the remaining nutrients including CP and minerals. When WDGS are fed to cattle in place of corn, CP and minerals exceed dietary needs. This may increase N emission, P run-off, and odor production. Crossbred steers (n = 160; 434 kg) were assigned in a completely randomized block design to 9 × 9 m pens with concrete floor (10 animals/pen; 4 pens/trt). Steers were fed a finishing diet that contained either 0, 20, 40, or 60% WDGS on a DM basis, and provided 13.4, 14.6, 18.7 or 22.8% CP, respectively. One kg of manure slurry (14 to 23% DM) was

randomly collected across each pen (Aug. 20, Sept. 24, and Oct. 22). Samples were analyzed immediately for odorants, DM, pH, ammonia, L-lactate, and level of generic *E. coli*. After incubation of the samples at 22°C for 2, 4, 7, 10, 14, 21, and 28 d, samples were analyzed for the above parameters plus methane production. Ammonia, reduced sulfur, indole, phenol, isovalerate, isobutyrate and acetate increased ($P < 0.01$) with increasing amounts of WDGS in the diet. Other odorants, skatole, caproate, valerate, butyrate, and propionate were greater ($P < 0.01$) in manure slurries from cattle fed either 20 or 40% WDGS, compared to 0% WDGS. L-lactate was greater ($P < 0.01$) in slurries from cattle fed 0% WDGS (447 $\mu\text{mol/g DM}$) compared to the other treatment slurries (14-15 $\mu\text{mol/g DM}$). L-lactate lowered slurry pH (6.3, 7.1, 7.6, and 8.2, respectively, for 0, 20, 40, and 60% WDGS) which inhibited microbial fermentation, generic *E. coli* persistence, and methane production. Because of the favorable pH in the 40 and 60% WDGS slurries, most of the odorant compounds were rapidly converted to methane during a 28 d static incubation. These data indicate feeding WDGS can increase odorants in manure slurries and extend the persistence of generic *E. coli*.

Key Words: Distillers Grains, Feedlot Cattle, Manure Odor

312 Quantification of nutrient excretion and volatile fatty acid production from a swine wean-finish facility. D. M. Sholly*, D. T. Kelly, A. L. Sutton, B. T. Richert, and J. S. Radcliffe, *Purdue University, West Lafayette, IN.*

A total of 1,920 pigs were used in a 2 × 2 factorial, wean-finish experiment to determine the effects of diet (control, CTL vs. low nutrient excretion, LNE) and manure pit management (6 mo. deep-pit, DP vs. monthly pull plug, PP) on nutrient excretion and VFA production. Pigs were housed in a 12-room environmental building where quantitative manure collection in 24 pits (2/room) was available. Each room housed 30 barrows and 30 gilts (3 pens each), which were split-sex and phased to meet or exceed the nutrient requirements of pigs (NRC, 1998) at different stages of growth. The CTL and LNE diets were corn-SBM based and had equal Lys:calorie. The LNE diets had reduced CP and P, increased synthetic amino acids, phytase, non-sulfur TM premix and added fat. Regardless of manure storage, manure generation was reduced by 0.39 L/pig/d when pigs were fed the LNE diet vs. the CTL diet (4.05 vs. 4.44 L/pig/d, $P < 0.008$). Excretion of total N, P, and K was reduced ($P < 0.001$) by 27.5, 42.5, and 20.4%, respectively, from LNE fed pigs. Pigs fed the LNE diet also had a 25.5, 23.8, 32.3, 18.5, 35.8, and 26.7% reduction ($P < 0.05$) in acetate, iso-butyrate, butyrate, iso-valerate, valerate, and total VFA production, respectively, compared to CTL fed pigs. Ammonium N production was reduced (16.5 vs. 18.4 g/pig/d, $P < 0.002$) with PP manure strategy compared to DP strategy. The PP strategy also reduced total VFA production by 20.5% (26.0 vs. 32.7 mM/pig/d, $P < 0.001$) compared to DP strategy. There was no interaction ($P > 0.05$) of diet and storage for nutrient or VFA production. In summary, implementing LNE diet formulation or using a monthly pull plug strategy can significantly decrease nutrient excretion and VFA production.

Key Words: Nutrient Excretion, Volatile Fatty Acids, Pigs

Production, Management and the Environment: Young Stock, Environment and Management

313 Supplements for replacement beef heifers grazing dry summer California foothills annual range. R. D. Sainz^{*1}, L. F. B. Carvalho^{1,2}, L. R. A. Sodré^{1,3}, G. D. Cruz¹, D. M. Myers¹, J. W. Oltjen¹, and M. Arana⁴, ¹University of California, Davis, ²Federal Rural University of Pernambuco, Recife, PE, Brazil, ³University of São Paulo, Pirassununga, SP, Brazil, ⁴A. L. Gilbert Company, Oakdale, CA.

California beef producers depend upon foothill rangelands forage, but due to the Mediterranean climate there are marked seasonal variations in forage availability and quality. Low forage quality during summer requires costly feed supplementation to maintain adequate performance. A previous study showed benefits from use of a high protein supplement for replacement heifers in the summer (Monteiro et al., 2007, J. Anim. Sci. 85 (Suppl. 1):257). This study evaluated two low-cost supplements for 60 weaned Angus-Hereford heifers grazing dry summer range: a dry high protein/energy/mineral mix (UCD-DR; 58% CP) and a home-made low-moisture molasses-based tub supplement (UCD-TUB; 48% CP). Heifers (222 ± 2.2 kg BW) were stratified by BW and allocated randomly to six groups of 10: two supplement types, with three replicates (pastures) each. Heifers were allowed free-choice access to both supplements (using self-feeders for UCD-DR) at all times. Supplement intakes and daily costs averaged 441 and 425 g/d (± 29, P = 0.55) and \$0.229 and \$0.173 (± 0.015, P = 0.01) for the UCD-DR and UCD-TUB groups, respectively. Heifers' ADG were 434 and 284 g/d (± 7.5, P = 0.07) for the UCD-DR and UCD-TUB groups, respectively. Supplementation with high protein, plus energy and minerals for heifers grazing dry summer range maintained ADG as expected. The dry mix tended to produce greater ADG, despite being consumed at a similar rate to the molasses-based tubs. On the other hand, the cost of the tub supplement (\$369/ton) was lower than the dry mix (\$471/ton), and the labor requirement was lower for the tubs as well. Producers can maintain performance and reduce costs of production on California annual range by formulating and mixing their own feed supplements.

Key Words: Cattle, Range, Supplementation

314 Feed intake, gain and feed efficiency of Suffolk ram lambs from a flock emphasizing performance traits. M. E. Benson^{*2}, A. B. Culham¹, and G. M. Hill¹, ¹Michigan State University, East Lansing, ²Washington State University, Pullman.

There is little data available on the feed intake and conversion of feed to gain associated with sheep selected for and attaining high levels of growth performance. This study was conducted to identify animal variation in daily feed intake (DFI), average daily gain (ADG), feed conversion ratio (FCR) and feeding behavior. Thirty Suffolk ram lambs born from January 27 to March 6, 2007 were used in this 42-44 d growing study. Rams were creep fed from birth, weaned at approximately 60 d of age (DOA), and fed a corn, soybean meal based diet from weaning throughout the test period. The diet was offered ad libitum and met or exceeded all NRC (1985) requirements for early weaned lambs with rapid growth potential. An Osborne FIRE electronic feed intake monitoring system was used to measure individual feed intakes and lamb weights, and to record intake behavior. Each ram was fitted with a RFID eartag transponder and was randomly allocated to a pen,

each with one electronic feeder resulting in 7 or 8 rams/feeder. Over the growth period, rams gained an average of 23.7 kg resulting in ADG of .55 ± 0.02 kg/d. ADG ranged from .13 to .77 kg/d. Rams consumed an average of 1.9 ± 1.0 kg of feed/d. Rams that grew faster consumed more feed. ADG and DFI were positively related with an r² of .66, P < .0001. Very efficient feed conversion rates (FCR) were attained by rams with an average FCR of 3.6 ± .20. FCR was negatively and most highly correlated with ADG (r² = -.44, P = .02) which resulted in the cost of gain being most economical in some of the fastest gaining rams. The r² of FCR with DFI was .33; P = .08. Rams visited the feeders an average of 16.1 (± 8.0) times/d and spent 55.6 (± 4.1) minutes /d in the feeders. Rams were identified in this study that had similar rates of high ADG yet widely different feed conversion ratios. This variation within a flock selected for high growth rates indicates the potential to improve growth performance and nutrient utilization simultaneously.

Key Words: Sheep, Growth, Feed Conversion

315 Variation in total mixed rations on farms utilizing feed management software. B. House^{*}, L. Holden, and G. Varga, Pennsylvania State University, University Park.

Providing a consistent and adequate supply of nutrients is an important factor in optimizing health and production of dairy cattle. The total mixed ration feeding system is widely utilized as a tool to provide a consistent supply of nutrients; however nutrient variability is still a concern. The objective of this study was to quantify nutrient variation as it compares to balanced rations on five Pennsylvania dairies. Herd size averaged 650 (327) cows with an average production of 33.1 (.98) kg/d. Twelve weekly samples were taken from May through July 2007 for twelve different rations. Samples were analyzed for DM, CP, ADF, NDF, and some minerals. The sampled rations were checked for mixing accuracy using feed management software. Using paired t-tests, the mean composition of formulated rations were compared with actual ration analyses. Across all herds, analyzed rations differed significantly (P < .01) from formulated rations with less CP, and more ADF and NDF. Analysis within herds showed a difference (P < .05) in DM% between formulation and analysis in three farms. The average nutrient coefficient of variation ranged from 5 to 10%. Using the average variation and average sample analysis, resulting average variation expected in rations were calculated. Variation in ration composition between actual analyses and formulation is due to several different sources. Values for CP, ADF, and NDF differed for analyzed compared to formulated rations in herds using feeding management software.

Table 1. Nutrient deviations and variation for 12 rations across five herds

Across All Rations (%)	DM	CP	ADF	NDF	P
Avg. Formulation –					
Avg. Analysis	-0.52	1.14	-2.97	-3.58	-0.006
P-value	0.0521	<.0001	<.0001	<.0001	0.2369
Std. Dev. of Difference	3.03	1.00	2.18	2.77	0.026
n	130	130	130	111	29

Coefficient of Variation within a Ration					
Avg.	0.047	0.054	0.093	0.074	0.068
Max	0.084	0.066	0.133	0.091	0.127
Min	0.024	0.026	0.074	0.050	0.041
Avg. Sample Analysis	48.98	16.51	22.34	33.62	0.37
Avg. Variation	2.31	0.89	2.09	2.48	0.025

Key Words: Ration Variation, Feeding Management

316 Residual feed intake of pre- and post-pubertal heifers of diverse breed types. A. N. Loyd*, A. W. Lewis, R. D. Randel, and C. R. Long, *Texas AgriLife Research, Overton, TX.*

With the rising costs of feedstuffs, reducing feed expenses is important for livestock producers. Residual feed intake (RFI) is a measure of feed efficiency developed to identify animals which may require less feed to achieve the same performance as their cohorts. This retrospective analysis of RFI used data collected during 1973 and 1974 from the McGregor location of the Texas Agricultural Experiment Station. Heifers were obtained from a large crossbreeding program involving a five-breed diallel of Angus, Brahman, Hereford, Holstein and Jersey. Breed groups were Dairy (D; n = 16) comprised of Holstein, Jersey, and their crosses, English (E; n = 16) comprised of Angus, Hereford, and their crosses, D x E crosses (n = 19), D x Brahman (B) crosses (n = 12), E x B crosses (n = 9), and B (n = 5). At approximately six months of age, pre-pubertal heifers (n = 77) were individually penned and received ad libitum access to a balanced ration. Feed intake and body weight data collected 84 days prior to puberty and 90 days post-puberty were utilized for this study. The ration was changed at puberty to provide a lower energy density. Considering all females as cohorts, RFI was calculated for each heifer for each period. A moderate, positive correlation ($r = 0.48$; $P < 0.0001$) was found between pre-pubertal and post-pubertal RFI. A difference in RFI among breed types was also detected ($P = 0.11$ for pre-pubertal and $P < 0.0001$ for post-pubertal). This implies that RFI may not be an accurate method to compare feed efficiency of individuals of diverse breed types. When RFI was covaried with the breed type specific NEm, differences in RFI among breed groups, both pre- and post-pubertal, were no longer significant ($P > 0.05$). This implies that a portion of the variation in RFI is accounted for by NEm, thus supporting the argument that RFI may not be a good method to compare cattle of diverse breed types. It is possible that RFI determined during the post-weaning period is only a moderate predictor of variation in RFI during the post-pubertal period.

Key Words: Cattle, Residual Feed Intake, Puberty

317 Effect of feeding method and temperament on measures of feed efficiency and age at puberty in Brahman bulls. N. D. Ramirez*¹, D. A. Neuendorff³, A. W. Lewis³, S. T. Willard⁴, R. C. Vann⁷, S. Bowers⁴, T. H. Welsh, Jr.⁵, T. D. A. Forbes⁶, R. L. Stanko^{1,2}, and R. D. Randel³, ¹Texas A&M University, Kingsville, ²Texas AgriLife Research Station, Beeville, TX, ³Texas AgriLife Research and Extension Center, Overton, TX, ⁴Mississippi State University, Starkville, ⁵Texas

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The objective of this study was to determine the effect of feeding method, limited (LF) or ad libitum (AL), and temperament on measures of efficiency in spring-born Brahman bulls. Bulls (n=32) were randomly allocated to either be LF or AL fed for 70 d (P1). Following a 7-d rest, treatments were exchanged in a cross-over design and bulls were fed an additional 70 d (P2). Bulls were blocked by BW and assigned to pens (n=11, 2 to 5 bulls/pen). Pen score (PS) and exit velocity (EV: m/s) were used to qualify temperament. Mean (\pm SEM) age and BW at the beginning of the trial were 343 ± 4 d and 327 ± 8 kg. Bulls were individually fed twice daily a 12% CP (NEm=0.291 Mcal/kg and NEg=0.272 Mcal/kg) pelleted ration. Bull BW was recorded and amounts fed were adjusted daily during AL and weekly during LF. RFI was calculated as the residual from the linear regression of DMI on mid-test BW^{0.75} and ADG. Feeding method did not effect ($P > 0.1$) RFI, ADG, DMI, and feed efficiency (FE; G:F, g of ADG/kg of DM). However, feeding period influenced ($P < 0.06$) ADG (1.06 ± 0.04 and 0.95 ± 0.04 kg/d) and DMI (8.4 ± 0.2 and 9.4 ± 0.4 kg). Order of feeding treatment influenced ($P = 0.06$) FE. Overall, RFI was correlated ($P < 0.001$) with FE in LF (-0.56) and AL (-0.65) bulls, and PUB was correlated ($P < 0.05$) with DMI (-0.37) in LF bulls only. Mean (\pm SEM) RFI and ADG in LF and AL were -0.52 ± 0.3 and 0.54 ± 0.8 , and 1.00 ± 0.04 and 1.01 ± 0.04 kg/d, respectively. Treatment influenced RFI in P1, but not in P2, LF (RFI=-0.62 \pm 0.42) were more efficient ($P < 0.01$) than AL (RFI=0.66 \pm 0.1) bulls. In P1, RFI was correlated ($P < 0.05$) with FE (-0.56) in LF but not AL bulls; ADG was correlated ($P < 0.05$) with DMI (0.71), and EV was correlated ($P < 0.05$) with PS (0.56) in LF but not AL bulls. In P2, RFI was correlated ($P < 0.01$) with FE in LF (-0.65) and AL (-0.74) bulls. These data suggest that there may be a relationship between method of feeding and measures of feed efficiency and thus selection for efficiency (low RFI). Limit feeding spring-born Brahman bulls may be more appropriate than AL feeding to establish accurate measures of efficiency.

Key Words: Residual Feed Intake, Reproduction, Brahman Bulls

318 Effect of reflective insulation on calves in polyethylene hutches. B. H. Carter*, T. H. Friend, J. H. Matis, J. E. Sawyer, and M. A. Tomaszewski, *Texas A&M University, College Station.*

Radiant heat load on calf hutches may add to heat stress by increasing interior hutch temperature. A summer trial was conducted on a Texas Panhandle dairy to determine if covering polyethylene hutches with reflective insulation would reduce heat load on individually housed Holstein-Friesian calves. Twenty of 38 hutches were covered with a 2.5 x 2.2 m sheet of reflective aluminum and polyethylene double bubble film insulation (8 mm thick) over the top and two sides of hutches. Interior hutch temperature was recorded for 72 h at 10-min intervals. Body (ear canal) temperature (BT) was measured for two 72-h periods at 10-min intervals when calves averaged 35 and 56 d of age. Respiration rate was recorded by observation at 2-h intervals for 48 h of each period. Results for the two periods were pooled. Effects of ambient thermal heat index (THI) on the rate of body and hutch temperature change were modeled for each calf and hutch using linear regression. The slopes for body and hutch temperature were compared for insulation effect using 2-sample t-tests. Estimated mean respiration rate, calf

BT and interior hutch temperature were calculated for each calf at high (> 72) and moderate (< 72) THI. Effects of insulation on respiration rate, BT and hutch temperature were tested at high and moderate THI using 2-sample t-tests. Calf BT was similar ($P=0.16$) among insulation treatments at high THI, but was higher ($P=0.05$) for calves in insulated hutches at moderate THI. Insulation had minimal effect on the rate of BT change ($P=0.11$). Respiration rates were lower ($P=0.04$) for calves in insulated hutches at high THI, and tended to be lower at moderate THI ($P=0.17$). Covering hutches reduced ($P<0.01$) interior temperatures by $1.4 \pm 0.14^\circ\text{C}$ at high THI but increased ($P<0.01$) interior temperatures by $0.58 \pm 0.09^\circ\text{C}$ at moderate THI. The rate of temperature change for insulated hutches was lower than control hutches ($P<0.01$). Covering polyethylene hutches with reflective insulation moderated temperature and its change within hutches, reduced respiration rate of calves, and may benefit calves by retaining heat in cooler temperatures.

Key Words: Dairy, Hutch, Reflective

319 Changes in newborn calf and colostrum management on U.S. dairy operations 1991-2007. J. E. Lombard*, C. A. Kopral, B. A. Wagner, and G. W. Hill, *USDA:APHIS:VS:Centers for Epidemiology and Animal Health, Fort Collins, CO.*

The National Animal Health Monitoring System has conducted 4 studies evaluating the dairy industry – 1991, 1996, 2002 and 2007. One objective of this study was to evaluate changes in newborn calf and colostrum management over this time period. States were selected in each of the study years to represent at least 75% of dairy operations and dairy cows with responses statistically weighted to make inferences back to the population from which the sample was selected. The percentage of operations where newborn calves were separated from their dam immediately after birth increased from 28.0% in 1991 to 55.9% in 2007. For operations that hand-fed colostrum, the percentage of operations that evaluated the quality of colostrum has increased from 5.2% in 2002 to 13.0% in 2007 and its use increased as herd size increased. The practice of pooling colostrum has decreased from 27.0% in 2002 to 21.0% in 2007. More operations are storing colostrum in a refrigerator in 2007 (11.1%) compared to 7.8% in 2002; however, most operations that hand-fed colostrum, did so without storing it. Colostrum was primarily hand-fed from a bucket or bottle from 1991 to 2007. There have been no changes in the percentage of operations by the method of delivering the first feeding of colostrum. Approximately one-third of operations allowed calves to obtain colostrum at first nursing. The percent of operations by quantity of colostrum fed during the first 24 hours has not changed since 1991 with about 30% providing 4 or more quarts. Two or less quarts were normally fed on approximately one-quarter of operations from 1991–2007. Although more operations are removing calves from their dams immediately after birth, the quantity of colostrum administered on dairy operations hasn't changed since 1991. The importance of feeding 4 quarts of high quality colostrum to every calf is an opportunity for continued producer education.

Key Words: Colostrum, Calves

320 Relationship between temperament and chute exit velocity of Senepol calves after weaning. R. W. Godfrey* and R. C. Ketring, *University of the Virgin Islands, Agricultural Experiment Station, Kingshill, VI.*

The objective of this study was to evaluate the relationship between temperament and growth in weaned Senepol calves. Bull ($n=22$) and heifer ($n=31$) calves were evaluated at weaning (211 ± 3 d of age), 90 d post-weaning (302 ± 2 d of age) and as yearlings (374 ± 3 d of age) using chute score (CS) and exit velocity (EV) as indicators of temperament. Calves were weighed at each evaluation and scrotal circumference (SC) was measured for bulls as yearlings. The CS was determined on a 1 to 5 scale with 1 being calm and 5 being extremely agitated and EV, reported in m/sec, was measured as the animals exited the chute using an electric timing system. None of the calves received a CS greater than 4 at any time. At weaning there was no difference ($P>0.10$) in CS between bulls and heifers (1.6 ± 0.2 vs. 1.9 ± 0.1 , respectively). At 90 d and as yearlings heifers had higher ($P<0.002$) CS than bulls (2.4 ± 0.1 and 2.5 ± 0.2 vs. 1.7 ± 0.2 and 1.7 ± 0.2 , respectively). The CS increased ($P<0.004$) over time in heifers but not in bulls. Heifers had greater ($P<0.0001$) EV than bulls at weaning, 90 d and as yearlings (3.2 ± 0.1 , 3.2 ± 0.1 and 2.9 ± 0.2 vs. 2.7 ± 0.2 , 2.6 ± 0.2 and 2.4 ± 0.2 m/sec, respectively). The EV did not change over time in either bulls or heifers ($P>0.10$). In bulls with a CS of 3 ADG from weaning to 90 d was greater ($P<0.04$) than ADG from weaning to yearling. There was no difference ($P>0.10$) in ADG from weaning to 90 d and weaning to yearling in bulls with a CS of 1 or 2. In heifers there was no difference ($P>0.10$) in ADG during any time period among any of the CS groups. Overall CS and EV had a moderate correlation ($P<0.001$, $r=0.424$). The CS and EV had a moderate correlation at weaning ($P<0.0001$, $r=0.518$), 90 d ($P<0.005$, $r=0.383$) and at yearling ($P<0.005$, $r=0.446$). Weight and EV were correlated at 90 d ($P<0.001$, $r=-0.434$) but not at any other time and CS was not correlated with weight at any time ($P>0.10$). These results show that the temperament of Senepol calves does not change over time after weaning and heifers are more temperamental than bulls.

Key Words: Temperament, Cattle, Behavior

321 The effect of severe winter weather on net energy required for maintenance by yearling steers. P. T. Grubb*, J. J. Wagner, and T. L. Engle, *Colorado State University, Fort Collins.*

Severe winter storms in southeast Colorado resulted in 38 cm snow accumulation over Christmas weekend in 2006 and an additional 96 cm snow accumulation over New Years weekend in 2007. This snow was accompanied by strong winds which caused excessive drifting. Economic losses suffered by the cattle feeding industry were severe and several research trials were lost at SECRC. Enough data from one of the studies were salvaged to provide an interesting look into the effect of severe winter weather on net energy requirements for maintenance. A set of 214 steers were weighed on December 26, 2006 and average weight (minus four percent pencil shrink) was $558 \text{ kg} \pm 21.7$. Over the following 58 day period there was a 7.0% death loss and average daily gain was $-0.13 \text{ kg} \pm 0.21$ for these steers. Average steer weight (minus four percent pencil shrink) was $550 \text{ kg} \pm 18.7$ on February 22, 2007. During the worst days of the storms, pen feed delivery records were not maintained. However, for accounting purposes, records of total feed delivered to each lot of cattle at SECRC were maintained. This allowed for calculations of net energy required for maintenance based on overall performance and total feed delivered. Total DM delivered to these steers was 53,436.7 kg and average NEM concentration in the diet was 2.263 mcal/kg DM. Daily dry matter intake averaged 9.67 kg/hd/d. Net energy equations published by the National Research Council (1996) were used to calculate average empty body weight (EBW, 497.7 kg), empty body

gain (EBG, -0.00686 kg/d), and retained energy (RE, -0.038 mcal/d). The negative RE value showed that the steers were not recovering enough energy from the diet to meet maintenance requirements. Net energy required for maintenance was 21.927 mcal/hd/d or 0.208 mcal per kg EBW^{0.75}. Statistical analyses of these results were not possible due to the inability to recover pen dry matter intake estimates. However, these data indicate that NEm required during and in the aftermath of a major winter weather event may be 2.7 fold higher than NEm required (0.077*EBW^{0.75}) under thermal neutral conditions.

Key Words: Net Energy for Maintenance, Cold Stress, Retained Energy

322 Hoop buildings vs. conventional feedlots for steers: Effects on growth and performance. P. Lammers*¹, A. Johnson¹, S. Lonergan¹, J. Harmon¹, R. Baker¹, S. Shouse², W. Busby², and M. Honeyman¹, ¹Iowa State University, Ames, ²Iowa State University Extension, Ames.

As the cattle feeding industry focuses on environmental management, there is increasing interest in facilities that minimize runoff such as deep-bedded hoop barns. The objective of this study was to compare the performance of yearling steers between housing treatments: pens inside a deep-bedded hoop barn with a partial concrete floor (HP) vs. pens in a conventional, outside feedlot with shelter (FD). Results are from 2

complete yr. Each yr, 2 groups of yearling steers were fed. Summer/fall groups were put on test in August and marketed in November. Winter/spring groups were put on test in December and marketed in April/May. Steers (422 kg) were randomly allotted to 3 pens within each housing treatment with approximately 40 hd per pen (HP = 4.65 m²/steer; FD = 14.7m²/steer). A description of the hoop barn is reported in Hoop Barns for Beef Cattle 2004, MidWest Plan Service AED-50. All steers were fed a complete and balanced ration and had ad libitum water access from 1 drinker/pen. Cattle in HP received corn stalks for bedding year-round (2-3 kg/d) and FD cattle were supplied bedding only during the winter/spring season (0.5-1 kg/d). Cattle weights and feed disappearance were recorded and used to calculate performance. Carcass data were recorded at the time of harvest (608 kg). Gain-to-feed (kg gain/kg feed) was more for steers in FD than HP (0.15 vs 0.14; *P* = 0.04). There were also trends for FD cattle to have greater ADG (1.90 vs 1.83 kg/d; *P* = 0.05) and larger total gains on test (190.4 vs 182.2 kg; *P* = 0.06). Housing did not affect ADFI, hot carcass wt, marbling, or carcass grade. Summer/fall steers were heavier, had greater ADG and G:F, and produced larger carcasses than winter/spring steers. There were no differences in marbling score or carcass grade between the 2 seasonal periods. There were no housing × season interactions for any measure examined. The difference in G:F and trend for lower ADG for steers fed in hoop barns warrants additional study. Overall the cattle performed similarly with similar carcass data for both housing systems.

Key Words: Deep-Bedded Hoop Barns, Feedlot Beef Cattle

Ruminant Nutrition: Fats and Fatty Acids

323 Effect of supplemental fat source on immunity of periparturient Holstein cows. B. C. do Amaral*, C.R. Staples, O. de F. Zacaroni, S. A. Sennikov, L. Badinga, F. Silvestre, J. D. Arthington, and W. W. Thatcher, *University of Florida, Gainesville*.

The study objective was to evaluate if dietary supplemental polyunsaturated fatty acids, enriched in omega-6 or omega-3 fatty acids, can regulate and improve the immunosuppressive state that is typical of periparturient Holsteins heifers (n=16) and cows (n=29). Treatments were: 1) Control (CO, no fat supplement), 2) Ca salts of fatty acids made from safflower oil (Omega-6, 63% C18:2), and 3) Ca salts of fatty acids made from palm oil and fish oil (Omega-3, 11% eicosapentaenoic acid plus docosahexaenoic acid, StrataG™). Supplemental fats (Virtus Nutrition, Corcoran, CA) were fed at 1.5% of dietary DM during pre and postpartum periods. Blood samples were taken thrice weekly for 7 wk for determination of acute phase proteins. Phagocytotic and oxidative burst activities of neutrophils were measured using flow cytometry in whole blood samples taken at -18, 0, 7, and 40 DIM. Multiparous cows fed Omega-6 had greater concentrations of fibrinogen (259 vs 206 mg/dl) compared to Omega-3-fed cows, but values were not different for primiparous cows (226 vs. 254 mg/dl; treatment by parity interaction $P < 0.05$). Heifers fed omega-3 had reduced concentrations of ceruloplasmin compared to omega-6-fed heifers (10.5 vs. 11.9 mg/dl) but values were not different for cows (11.4 vs. 11.1 mg/dl; treatment by parity interaction; $P < 0.05$). Multiparous cows fed fat supplements had greater (59.8 $\mu\text{g/ml}$) concentrations of acid soluble protein in plasma during the first 3 wk postpartum compared to CO cows (42.9 $\mu\text{g/ml}$), but this was reversed for primiparous cows (51.7 vs. 45.0 mg/dl; treatment by parity by DIM interaction; $P = 0.06$). Concentrations of WBC (8796 vs 11,492 WBC/ μl ; $P = 0.06$) and neutrophils (2463 vs 3495 per μl ; $P < 0.01$) were lower for omega-3 fed cows compared to cows fed CO or omega-6. Based on median fluorescence intensity, the average neutrophil from omega-3-fed cows phagocytised less *E. Coli* than those from CO or omega-6-fed cows. Omega-3 attenuated immune responses compared to Omega-6-fed animals.

Key Words: Fat, Immunity, Dairy

324 Effect of supplemental fat source on production, metabolism, and milk composition of periparturient Holstein cows. B. C. do Amaral*, C. R. Staples, O. F. Zacaroni, S. A. Sennikov, L. Badinga, and W. W. Thatcher, *University of Florida, Gainesville*.

Objective was to evaluate two sources of supplemental lipid enriched in omega-6 or omega-3 fatty acids for influence on production, metabolism and milk composition of periparturient Holsteins heifers (n=16) and cows (n=29). Treatments were the following: 1) Control (no fat supplement), 2) Ca salts of fatty acids made from safflower oil (Omega-6, 63% C18:2), and 3) Ca salts of fatty acids made from palm oil and fish oil (Omega-3, 11% eicosapentaenoic acid plus docosahexaenoic acid, StrataG™). Supplemental fats (Virtus Nutrition, Corcoran, CA) were fed at 1.5% of dietary DM. Blood was taken daily for 10 DIM for PGFM analysis and thrice weekly thereafter until 49 DIM for measures of plasma metabolites. Milk yield was recorded twice daily and weekly samples were taken for milk composition. Milk samples from wk 5, 6, and 7 were pooled for fatty acid analysis. Orthogonal contrasts were 1 vs. 2+3, and 2 vs. 3. The mean DMI postpartum (13.4, 13.7, and 13.5

kg/d; SE = 0.6) and postpartum (18.0, 18.7, and 16.9 kg/d; SE = 0.8), mean milk yield (32.8, 34.4, and 31.2 kg/d; SE=1.4), mean milk protein concentration (3.0, 2.9, and 2.9%; SE=0.1), mean BW (603, 593 and 593 kg; SE = 18), mean BCS (3.12, 3.26, and 3.15; SE = 0.10), plasma glucose (68.8, 69.5, and 69.5 mg/dl; SE=1.8), plasma NEFA (459, 391, and 433 $\mu\text{Eq/l}$; SE=38), and plasma BHBA (5.7, 5.7, and 5.9 mg/dl; SE=0.5) for treatments 1, 2, and 3, respectively were not different among treatment groups. Heifers fed Omega-3 had greater plasma concentration of PGFM at 6 DIM compared to Omega-6-fed heifers (treatment by parity by DIM interaction; $P < 0.05$). Concentration of milk fat from cows fed omega-6 (3.52 %) or omega-3 (3.21%) was lower than that from control cows (3.76%). Cows fed fats had greater milk concentrations of CLA isomers and C18:1 trans-10, and Omega-3-fed cows had greater concentrations of these FA compared to Omega-6-fed cows. Fat supplementation changed the fatty acid profile of milk without changing milk yield or plasma metabolites.

Key Words: Fat, Milk, Fatty Acid

325 Effects of supplemental flaxseed or corn on site and extent of digestion in beef heifers grazing summer rangelands in the northern Great Plains. E. J. Scholljegerdes* and S. L. Kronberg, *USDA-ARS, Northern Great Plains Research Laboratory, Mandan, ND*.

Six Angus heifers (367 \pm 8.0 kg) fitted with ruminal and duodenal cannulas were used in a split-plot designed experiment to determine the effects of ground flaxseed or corn and advancing season on site and extent of digestion when beef heifers grazed summer range in the northern Great Plains. Starting on June 9, 2006 heifers were rotationally grazed on three 12 ha native pastures and were randomly allotted to one of three treatments being: no supplement (CON); a cracked corn-soybean meal supplement fed at 0.35% of BW once daily (CRN); or a ground flaxseed supplement fed at 0.2% of BW once daily (FLX). Supplements were formulated to be isonitrogenous and isocaloric on a TDN basis. There were three experimental periods that were 28 days in length with 18 d for diet adaptation and 10 d for intensive sampling. Provision of supplement did not affect ($P = 0.22$) masticate IVOMD, however, between supplemented treatments, cattle fed FLX tended ($P = 0.08$) to select a lower quality masticate than CRN. Forage OM intake was not affected ($P = 0.12$) by supplementation nor was there a difference ($P = 0.49$) between CRN and FLX. A quadratic ($P = 0.001$) response was observed for forage OM intake as the grazing season advanced. Duodenal and fecal OM flow was not different ($P = 0.39$) across treatments. Therefore, true ruminal and total tract OM digestibility (% of intake) did not differ ($P = 0.37$ to 0.56) between CON and supplemented treatments and total tract digestibility was greater ($P = 0.01$) for CRN than FLX. Total duodenal N flow did not differ ($P = 0.16$) across treatments but responded quadratically ($P = 0.03$) with advancing season. True ruminal N digestibility was not affected by supplementation ($P = 0.16$ to 0.26). Likewise, ruminal NDF digestibility also did not differ ($P = 0.26$) with supplementation and CRN was not different ($P = 0.22$) from FLX. Total ruminal VFA decreased with supplementation ($P = 0.04$) and ruminal molar proportion of acetate was greater ($P = 0.02$) for FLX than CRN. Therefore, ground flaxseed appears to be a suitable energy supplement for cattle grazing summer rangelands.

Key Words: Digestibility, Flaxseed, Grazing

326 The influence of single essences on conjugated linoleic acid and vaccenic acid content in cows milk. S. La Terra^{*1}, M. Manenti¹, F. La Terra¹, M. Caccamo¹, G. Azzaro¹, S. Carpino¹, and G. Licitra^{1,2}, ¹CoRFiLaC, Regione Siciliana, Ragusa, Italy, ²D.A.C.P.A., Catania University, Catania, Italy.

Milk from cows fed fresh green forage, especially those grazing grass, had a much higher unsaturated: saturated FA proportion, with more poly-unsaturated FA and more Conjugated Linoleic Acid (CLA). Rumenic acid, in particular, was higher in milk from silage-fed cows. *Anthemis arvensis*, *Calendula arvensis*, *Sinapis arvensis*, *Chrysanthemum coronarium* and Geraniaceae species were evaluated individually for their capacity to influence the content of CLA in milk. The plant species were collected at flowering age, and part of the forage was dried to produce hay. A single dose of both, fresh and dried forage was fed individually, ad libitum to two Holstein cows of similar lactation and milk production. The cows were adapted to a TMR ration, and TMR was given to the cows at the middle and at the end of the experiment as controls. A minimum time of seven days among treatments was maintained. Animals were held off feed for five hours before offering treatments. Feed intake was recorded by weighing provided forage or TMR and refusal. Milk was sampled the day before and the day of the treatment during the evening milking before and after treatment feeding, respectively. Generally, more hay was ingested compared to fresh forage. CLA level increased after treatment feeding with *Calendula arvensis* from 13.55 to 18.65 (nmol/mg fat), *Chrysanthemum coronarium* from 8.7 to 11.2 (nmol/mg fat), and *Anthemis arvensis* from 6.1 to 9.45 (nmol/mg fat). Vaccenic acid followed the same trend of CLA 38.19-43.3 (nmol/mg fat) in *Calendula arvensis*; 26.83-29.73 (nmol/mg fat) in *Chrysanthemum coronarium*; and 25.93-28.93 (nmol/mg fat) in *Anthemis arvensis*. Our data also shows that concentration of the total CLA and the Vaccenic acid do not have variations with *Sinapis arvensis* and Geraniaceae species. These differences may be due to fresh forage composition or the lesser amounts fed. We also found higher levels of Vaccenic acids and Rumenic acid in milk from fresh forage compared to milk from hay.

Key Words: Essence, CLA, Vaccenic Acid

327 Dietary coconut oil and animal fat blend decrease lactational performance of Holstein cows fed a high starch diet. M. Hollmann* and D. K. Beede, Michigan State University, East Lansing.

Medium-chain fatty acids in coconut oil (CO) are known to suppress methane generation in the rumen. However, little is known about the impact of CO on lactational performance. Our objectives were to evaluate the supplementation of dietary lipids in a high-starch diet fed to mid-lactation Holstein cows and to compare the incremental replacement of an animal fat blend (AFB) with CO. Thirty-two multiparous cows were adapted for 4 wk to a basal diet (CONTROL) with 60% concentrate: 28% corn silage: 12% alfalfa silage and hay, dry basis. CONTROL was formulated to contain: 16.5% CP (10.1% RDP and 6.4% RUP), 27.4% NDF (67% of NDF from forage), 3.0% fat, and 36.8% starch, dry basis. During the last week of adaptation, covariates of performance were measured daily (Table 1). Cows were blocked by covariate MY and assigned to one of four iso-nitrogenous diets (n = 8 per trt): CONTROL; 5% AFB; 2.5% AFB:2.5% CO; or, 5% CO, dry basis. When fat was substituted for dry ground corn, corn gluten meal was added to maintain N content of all diets. Measurements of cow performance and milk composition monitored during wk 3 of feeding treatment diets are presented in Table 1. However, DMI and MY dropped 39% and 24%,

respectively, within 3 d with 5% CO and those cows were removed from the trial on d 6; their data were excluded from statistical analysis. Fat supplementation reduced DMI, MY and milk component yields and depressed milk fat and lactose concentrations. Replacing AFB partially with CO additionally lowered milk fat content and yield.

Table 1.

	Covariate	Diets		Contrasts (<i>P</i> <)		
		Control	AFB	AFB-CO	Control vs. AFB, AFB-CO	AFB vs. AFB-CO
DMI, kg/d	25.0	27.1	24.2	22.7	0.01	0.19
MY, kg/d	43.9	42.8	39.0	36.8	0.02	NS
ECM yield, kg/d	46.2	39.6	33.1	30.7	0.01	NS
Milk fat, %	3.02	3.06	2.59	2.11	0.01	0.02
Milk fat, kg/d	1.37	1.30	1.06	0.74	0.01	0.02
Milk protein, %	2.97	3.03	3.12	3.05	NS	NS
Milk protein, kg/d	1.36	1.30	1.20	1.10	0.02	0.12
Milk lactose, %	4.77	4.95	4.80	4.76	0.02	NS
Milk lactose, kg/d	2.20	2.14	1.84	1.76	0.01	NS
SNF, %	8.65	8.92	8.84	8.69	NS	NS
SNF, kg/d	3.98	3.85	3.39	3.18	0.01	NS

Key Words: Coconut Oil, Milk Fat Depression, Feed Intake

328 Effect of supplementation with sunflower oil (SO) or seeds (SS) combined or not with fish oil (FO) on milk production in grazing dairy cows. G. A. Gagliostro^{*1}, D. A. Garciarena¹, F. Luparia¹, A. Ferlay², and Y. Chilliard², ¹Instituto Nacional de Tecnología Agropecuaria, INTA, Balcarce, Buenos Aires, Argentina, ²Institut National de la Recherche Agronomique, Saint Genès Champanelle, France.

After a covariate period (2 wk) without lipid supplement sixty four Holstein cows were assigned to four treatments (16 cows/treatment) during 5 experimental weeks. During each milking cracked corn grain (1.3 kg DM/cow) and a mineral-vitamin premix were consumed. Between the morning and the afternoon milkings cows grazed a pasture (*Avena sativa* L) at an herbage allowance of 11 kg DM/cow/day. Pasture DM intake was estimated by group within treatments and averaged 6.28, 5.51, 5.10 and 5.44 kg/cow/day in SS, SS-FO, SO, and SO-FO. After the p.m. milking, cows received four TMR diets: 1) SS = 74.7% corn silage (CS); 25.3% SS, 2) SO = 76.7% CS, 12.3% sunflower meal (SM), 11% SO; 3) SS-FO = 72.4% CS, 24.5% SS, 3.1 % FO and 4) SO-FO = 74.3% CS, 11.9% SM, 10.6% SO, 3.2% FO. SS were roughly ground before mixing. Intake of TMR was estimated by group resulting in 7.52, 7.33, 3.45 and 4.63 kg DM/cow/d for SS, SO, SS-FO and SO-FO respectively. FO represented 0.91 and 1.14% of total DMI in SS-FO and SO-FO. Cows were weighed at the start (wk -2) and the end (wk 5) of the trial and the subcutaneous fat depth (SFD) between the 12th and 13th ribs was also measured (scanner). Data were analyzed as a completely randomized design with repeated measures adjusted by covariable. Significant interactions between sources of vegetable oil

(SS or SO) and FO were not detected. No differences in milk yield (15.4 kg/d) were detected ($P>0.10$). Milk fat content (29.95 vs 28.05 g/kg, $P<0.01$), 4%FCM (13.22 vs 12.52 kg/d, $P<0.04$) and milk fat yield (0.47 vs 0.43 kg/d, $P<0.01$) were higher in SO than in SS diets. Feeding FO decreased ($P<0.01$) milk fat content (25.5 vs 32.5 g/kg), 4%FCM (11.9 vs 13.8 kg/d), milk fat yield (0.39 vs 0.50 kg/d), milk protein content (36.0 vs 37.2 g/kg) and yield (0.54 vs 0.57 kg/d) and lactose content (48.0 vs 49.35 g/kg). Cows lost BW only when FO was included in the diet (-0.203 vs +0.138 kg/d, $P<0.01$). Changes in SFD were not detected ($P>0.29$). Effects of FO are more important on milk production and composition than those of C18:2n-6 source.

Key Words: Milk Yield, Sunflower Oil, Fish Oil

329 Effects of particle size of calcium salts of fatty acids on rates of biohydrogenation and disappearance of essential fatty acids in sacco. E. Block^{*1}, E. Evans², C. J. Sniffen³, and N. Clark⁴, ¹Church & Dwight Co Inc, Princeton, NJ, ²Technical Advisory Services Inc, Bowmanville, ON, Canada, ³Fencrest LLC, Holderness, NH, ⁴Atlantic Dairy and Forage Institute, Fredericton Junction, NB, Canada.

Calcium (Ca) salts of fatty acids (FA) can be produced to contain varying quantities of unsaturated fatty acids, yet remain in the solid form. The Ca salt must dissociate into free Ca and FA before biohydrogenation (BH) takes place, thus impacting the rate of BH. Estimates of rate of dissociation and BH are widely varied in the literature. The purpose of this research was to assess the relative effects of particle size on net BH. A sample of the commercial product MEGALAC-R[®] (Church & Dwight Co., Inc., Princeton, NJ) was obtained from a local feed mill. A portion was ground to pass through a 1 mm screen. Samples (5 g) of intact and ground MEGALAC-R were placed in 10 cm X 15 cm Ninex bags and quadruplicate samples were incubated in the rumens of two rumen cannulated lactating dairy cows for 1, 6, 12 and 18h. FA recovery was determined for the samples. Regression of total of each FA recovered vs. incubation time was used to compute rate functions. A paired T test was used to compare intact and ground rates. Rates of increase in saturated fatty acids and rates of decline in unsaturated fatty acids were higher ($P<0.05$) with the ground Ca salt sample (Table 1). Additionally, these rates varied for the individual fatty acids in the samples. Calculated passage rates for unsaturated fatty acids averaged 53.0% higher with intact samples. This trial demonstrates that particle size of Ca salts of FA is an important factor for reducing BH and improving unsaturated fatty acid supply past the rumen.

Table 1. Rates of change of Fatty Acids, %/h

Fatty acid	Intact rate	Ground rate	Intact R ²	Ground R ²
C16:0	+0.872	+1.779	0.786	0.813
C18:0	+1.230	+3.775	0.839	0.961
C18:1	-0.521	-2.469	0.716	0.681
C18:2	-2.850	-8.755	0.851	0.823
C18:3	-2.895	-8.583	0.831	0.837

Key Words: Biohydrogenation, Fatty Acids, Fatty Acid Kinetics

330 Calcium status influences the periparturient cow's ability to consume and utilize high levels of supplemental ruminal inert fat and is potentially mediated by insulin. L. M. Norat-Collazo*, A. Lukose, P. G. Smith, L. O. Ely, and M. A. Froetschel, *The University of Georgia, Athens.*

The mechanism for calcium status to influence the transition cow to utilize greater supplemental fat postpartum was investigated using a factorial designed experiment (2 X 2) with 12 multiparous Holstein cows. Cows were fed 2 weeks prepartum diets containing either 0 (+DCAD) or 9.3 % (-DCAD) of an anionic salt product (Biochlor[®]) to provide a cation-anion difference of 138 VS -143 meq/kg DM. Postpartum diets contained either 0 (LF) or 5.3 % (HF) of rumen inert fat (Megalac-R[®]). Daily intake and milk were measured for 12 weeks postpartum. At hourly intervals intake and diurnal circulating concentrations of hormones and metabolites (insulin, glucose, blood urea nitrogen (BUN), non-esterified fatty acids (NEFA), and plasma calcium) were measured during a 24 h period within week 1, 4 and 8 postpartum. Digestibility and energy balance were measured on week 6 and 12 postpartum. Cows fed HF diets consumed 9.8-16.3% less DM as compared to LF. Cows fed -DCAD had 13.8 to 15.2% lower DMI week 1-2 and increased DMI 7.8 to 10.7 % from week 7-11 postpartum. Cows fed +DCAD and HF produced 18% less milk week 1-9; whereas, cows fed -DCAD and HF produced 28.6% more milk during week 8-12 as compared to controls. Insulin decreased in -DCAD fed cows whereas it was increased in cows fed HF. Insulin sensitivity appears to increase with prepartum -DCAD and decrease with HF. Feeding -DCAD did not counteract effects of fat supplementation on circulating insulin concentrations. Insulin was more related to meal feeding than other blood parameters measured. Insulin taken at h intervals during meal feeding was negatively correlated with meal size and this relationship increased as smaller meal size data was removed from the data set. Endocrine and metabolic parameters were influenced by dietary treatments indicating that differences in productivity and intake were related to greater insulin responsiveness, dietary fat utilization, and adipose tissue mobilization of cows in early lactation.

Key Words: Transition Cow, Intake, Calcium

331 Fat from corn germ compared with corn distillers grains and corn oil in dairy cow diets. M. M. Abdelqader*, A. R. Hippen, D. J. Schingoethe, and K. F. Kalscheur, *South Dakota State University, Brookings.*

The objective of this study was to determine the effect of feeding fat from corn germ compared with fat from distillers grains and corn oil on milk production and composition of dairy cows. Eight multiparous and eight primiparous lactating Holstein cows were used in a replicated 4 x 4 Latin square with 4-wk periods. Dietary treatments were a control (CON) diet containing 2.5% of ruminally inert lipid (Energy Booster 100[®]; Milk Specialties Co., Dundee, IL), 14% corn germ (CG), 30% distillers grains (DDGS), and 2.5% corn oil (CO). All diets were formulated to be isonitrogenous (18.0% CP, DM basis) and isolipidic (6.0% EE, DM basis). Dry matter intake was increased by feeding CG compared with CON; however, no difference in DMI was observed among CG, DDGS, and CO. Treatments had no effect on milk yield or energy-corrected milk. Feeding CG had no effect on milk fat percentage when compared with CON; however, DDGS tended to decrease ($P = 0.10$) milk fat percent-

age, and CO decreased ($P < 0.01$) milk fat percentage when compared with CG. Both DDGS and CO decreased ($P < 0.01$) concentrations of de novo synthesized fatty acids and increased ($P < 0.01$) the concentrations of preformed fatty acids in milk when compared with CON. Feeding DDGS and CO increased the concentration of vaccenic and conjugates of linoleic acid in milk fat. In conclusion, feeding dried distillers grains at 30% of DM decreased milk fat compared with a control diet, though fat from corn germ appeared to have minimal impact on milk fat when compared with dried distillers grains and corn oil.

Table 1.

	CON	CG	DDGS	CO	SEM
DMI, kg/d	24.8 ^b	27.2 ^a	26.3 ^{ab}	25.2 ^{ab}	0.88
Milk yield, kg/d	33.6	34.7	35.5	34.7	1.48
ECM, kg/d	35.6	36.3	36.4	34.8	1.43
Fat, %	3.88 ^a	3.80 ^{ab}	3.59 ^{bc}	3.50 ^c	0.12
Protein, %	3.24 ^a	3.19 ^{ab}	3.21 ^{ab}	3.15 ^b	0.06
Fatty acids, g/100g					
C18:1 <i>t</i> -10	0.57 ^c	0.66 ^b	0.66 ^b	0.79 ^a	0.02
C18:1 <i>t</i> -11	1.11 ^b	1.33 ^b	2.11 ^a	2.08 ^a	0.10
C18:2 <i>t</i> -10, <i>c</i> -12	0.05 ^b	0.06 ^b	0.09 ^a	0.10 ^a	0.01
C18:2 <i>c</i> -9, <i>t</i> -11	0.53 ^b	0.60 ^b	0.91 ^a	0.94 ^a	0.04

^{a-c}Means within a row with different superscripts are significantly different ($P < 0.05$).

Key Words: Corn Germ, Fat, Distillers Grains

332 Duodenal flow and intestinal disappearance of fatty acids in lambs fed canola, brown mustard, or camelina seeds. P. L. Price*, V. Nayigihugu, C. M. Murrieta, D. C. Rule, J. M. Krall, and B. W. Hess, *University of Wyoming, Laramie.*

Four black-face wether lambs (77.5 ± 4.2 kg BW) fitted with ruminal, duodenal, and ileal canulae were used to compare site and extent of fatty acid digestion of diets with canola, brown mustard, or *Camelina sativa* seeds. Experimental design was a 4×4 Latin square and experimental diets consisted of 18% ground (2.54 cm) bromegrass hay, 65.2% cracked corn, 15% soybean meal, and 1.8% limestone (as-fed basis, Control) with oil seeds replacing enough of the soybean meal to provide 3% added fatty acid from each of the whole oil seeds. Urea was added to produce isonitrogenous diets. A 7-d adaptation period was followed by 2 d of duodenal and ileal sampling. Duodenal flow of 18:0 was greater ($P = 0.001$) for lambs fed canola and brown mustard than lambs fed the Control and camelina diets. Duodenal flow of 18:1 *c*9 was greater ($P < 0.001$) for lambs fed canola than lambs fed Control with lambs fed brown mustard and camelina being intermediate. Duodenal flow and apparent small intestinal disappearance (g/d) of 18:1^t11, 18:3^c9^c12^c15,

and 22:1^c11 were greatest ($P \leq 0.003$) in lambs fed camelina. Intestinal disappearance (% entering the duodenum) of 18:1^c9 ranked ($P = 0.001$) canola < brown mustard < camelina = Control. Lambs fed Control and camelina had a greater ($P < 0.001$) percentage of total fatty acids digested in the small intestine than lambs fed canola; lambs fed brown mustard were intermediate. Although lambs fed canola or brown mustard had greater ($P = 0.007$) amounts of 18:0 disappearing from the small intestine, a lesser ($P = 0.001$) percentage of 18:0 disappeared from the small intestine of lambs fed brown mustard or canola. We conclude that the likelihood of enhancing unsaturated fatty acid content of food products derived from lamb is greatest for diets containing camelina seeds. Furthermore, total energy available from fatty acids digested in the small intestine would not be comparable among the various oil seeds.

Key Words: Lambs, Fat Supplementation, Oil Seeds

333 Effect of a dietary antioxidant AGRADO® Plus on production performance of early lactation dairy cows. G. R. Bowman*¹, M. Vazquez-Anon¹, and J. Nocek², ¹Novus International, Inc., St. Charles, MO, ²Spruce Haven Research, Union Springs, NY.

The objective of this study was to evaluate the effect of feeding a dietary antioxidant (AOX, AGRADO® Plus) on milk production and milk constituents during early lactation. Thirty multiparous lactating Holstein cows (30 days postpartum) housed in a tie stall facility were randomly assigned to one of the two treatments. Cows were balanced for DIM, milk yield at 30 days postpartum, and body condition score. All cows received the same basal diet throughout the 12 week study; however, cows assigned to AOX treatment received 250 mg/kg DM of the dietary antioxidant. Cows receiving the AOX significantly ($P = 0.01$) increased DMI by 2.3% over control (22.7 vs 22.2 ± 0.15) and tended to increase milk yield ($P < 0.10$). Both 3.5% fat corrected milk and energy corrected milk increased with AOX supplementation by 5.5% ($P < 0.01$; 44.8 vs 42.5 ± 0.4) and 4.8% ($P < 0.01$; 43.7 vs 41.7 ± 0.4), respectively. Milk fat percent was 3.3% for cows receiving the control diet and increased to 3.5% for AOX supplementation. No significant changes were observed in milk protein yield and percentage. Although mammary health was excellent throughout the study there was a decline in somatic cell count (SCC; 220,780 control and 129,480 AOX, $\pm 28,260$) when the dietary antioxidant was fed ($P = 0.02$). No changes were observed in blood plasma concentration for the antioxidant enzymes superoxide dismutase and glutathione peroxidase or total antioxidant status between cows supplemented with and without AOX. The dietary antioxidant, AGRADO® Plus, increased feed intake, FCM, fat yield, fat percent, and tended to increase milk yield. This study also indicated that AOX may have a positive influence on the immune system as indicated by the decline in SCC.

Key Words: Antioxidant, Milk, Fat

Ruminant Nutrition: Rumen Fermentation and Microbiology

334 Chemotaxis toward glucose and xylose by mixed ruminal protozoa and dose-responsive insulin recovery from wortmannin inhibition by entodiniomorphid cultures. H. L. Diaz*¹, J. L. Firkins¹, M. A. Lyons¹, and J. R. Knapp², ¹The Ohio State University, Columbus, ²Fox Hollow Consulting, LLC, Columbus, OH.

Isotrichid (IS) protozoa migrate toward sugars after feeding and then sink ventrally. We hypothesized that entodiniomorphids (EN) also sense glucose and xylose (end-products of glucanases and xylanases). Two blood capillary tubes (75 mm) were not filled (positive control, POS) or filled with 0 (negative control, NEG), 1, 10, 100, or 1000 mM of glucose or xylose in saline and then placed in 3 replicate beakers with 20 mL of rumen fluid from a dairy cow withheld feed for 12 h or repeated 3 h after feeding. IS counts in the tubes peaked for 1000 mM glucose when feed was withheld but 100 mM after feeding (interaction $P < 0.01$). There was no interaction ($P > 0.20$) for EN. IS were 3 fold more chemotactic toward xylose than glucose, with the reverse for EN. Combining 2 studies for the fed cow, tubes contained 2.1, 6.5, 25.5, 140.2, 65.7, and 22.1 IS counts for NEG, 1, 10, 100, and 1000 mM glucose, and POS, respectively ($140.2 > 65.7 > \text{rest}$, $P < 0.06$); and for EN, 7.0, 12.0, 23.1, 6.4, 33.1, and 115.8 ($115.8 > 33.1 > 23.1 > \text{rest}$, $P < 0.09$). IS depleted the sugar gradient or physically blocked the tube entrance from EN for 100 mM. Chemotaxis and phagocytosis by higher eukaryotic cells is mediated by phosphatidylinositol-3-kinase, a component in insulin signaling inhibited by wortmannin (WORT). Cryopreserved *Entodinium caudatum* (Ento) and *Epidinium caudatum* (Epi) were incubated with 0.2 or 2.0 μM WORT 30 min prior to stimulation by insulin. Counts at 24 h (proportion of 0-h counts) for Ento were 1.54, 1.30, 1.12, 1.54, 1.91, 0.94, 0.87, 1.18, and 1.00 for control; 0.2 μM WORT + 0, 0.1, 0.5, and 2.5 μM insulin; and 2.0 μM WORT + 0, 0.1, 0.5, and 2.5 μM insulin. Normalized Epi counts were 1.32, 0.92, 1.22, 1.19, 1.16, 0.84, 0.91, 1.19, and 0.97. Insulin linearly ($P < 0.08$; corrected for unequal spaces) rescued Ento from 0.2 μM WORT, with no effect at 2.0 μM . Insulin recovery for Epi was $P > 0.15$ for 0.2 μM but $P < 0.05$ quadratic for 2.0 μM WORT. These data justify future research to coordinate chemotaxis with nutrient sensing signals that stimulate rumen protozoal growth rate.

Key Words: Rumen Protozoa, Chemotaxis, Glucose

335 Influence of disodium fumarate on ruminal fermentation and microbial growth in sheep fed high-forage diets. Y. W. Zhou*, J. X. Liu, and L. Zhou, Zhejiang University, Hangzhou, P.R. China.

The present study was conducted to examine the effects of disodium fumarate (DF) addition on fermentation and microbial populations in the rumen of sheep fed high-forage diets. In Experiment 1, six Hu sheep fitted with ruminal cannulae were randomly allocated to a 2 × 2 cross design involving two dietary treatments: added with 0 or 20g DF daily. Animals were maintained in individual pens with basal diet (concentration/forage=30:70) and free access to water. Each period lasted for 15d. Rumen samples were taken for determination of fermentation parameters, and microbial populations in fluid and solid samples were analyzed using real-time PCR method. Ruminal pH decreased sharply in the DF group compared with the control ($P < 0.05$). Total volatile fatty acid ($P < 0.001$) and acetate ($p < 0.05$) were increased significantly, but butyrate decreased ($P < 0.01$) by adding DF. Addition of DF tended

to decrease ammonia N production ($P = 0.081$). The populations of methanogens, protozoa, fungi and *R. flavefaciens* decreased ($P < 0.001$) in fluid samples by DF addition, whereas *R. albus* populations increased both in fluid ($P = 0.011$) and solid ($P < 0.001$) samples. Experiment 2 was conducted to observe the dynamics of DF addition on rumen fermentation and bacterial growth. Three cannulated sheep were fed continuously for 42 d on a diet (concentration/forage=30:70) added with 20g/d DF. Rumen samples were collected every 7 d after the first 14d for adaptation. No apparent effects were observed ($P > 0.05$) of DF on pH, acetate and butyrate. Addition of DF produced dynamic changes in propionate ($P = 0.043$), ammonia N ($P = 0.0006$), and growth of fluid-and-solid-associated microorganisms. The populations of methanogens and *R. flavefaciens* decreased ($P < 0.0001$) linearly in fluid samples, but the *R. albus* populations increased in both fluid and solid samples ($P < 0.0001$). These results demonstrated the ability of DF addition to improve *in vivo* rumen fermentation by increasing total VFA production, and to influence bacterial populations of the rumen in sheep under high-forage diets in a positive way by increasing *R. albus* and decreasing methanogens.

Key Words: Disodium Fumarate, Ruminal Metabolism, Microbial Populations

336 Extract from *Larrea tridentata* reduces growth of rumen bacteria. J. Browne-Silva, S. L. Lodge-Ivey*, J. Petersen, R. Reyna-Islas, and M. B. Horvath, New Mexico State University, Las Cruces.

Larrea tridentata plant extract (CBPE) has antioxidant and antimicrobial properties. The use antimicrobials for growth promotion in livestock has been criticized and resulted in an interest in the use of natural plant extracts as rumen modifiers. The effect of the consumption of CBPE on rumen bacteria and fermentation has not been documented. An *in vitro* experiment was conducted to evaluate the effect of CBPE on growth of pure cultures of rumen bacteria and microbes found in whole rumen fluid from a cow. Varying levels of CBPE were dissolved in ethanol and added to pure culture incubations at 0, 5, 10, 50, and 100 $\mu\text{g}/\text{mL}$. Similarly, CBPE was added to growth medium with microbes from whole rumen fluid at 0, 10, 20, 30, 40, 50, 60, 70, 80, 100, 150, 200, 250, 300, 400, 500 $\mu\text{g}/\text{mL}$. Growth was monitored by optical density (OD) at 600 nm. Independent of species, additions of (0 vs 100 $\mu\text{g}/\text{mL}$) to pure cultures of rumen bacteria caused a 35 fold decrease in OD (0.71 vs 0.02; $P < 0.001$). Addition of 10 $\mu\text{g}/\text{mL}$ CBPE caused a 62% decrease in OD compared with 0; $\mu\text{g}/\text{mL}$. Ethanol control was similar (0.57 vs 0.71) to 5 $\mu\text{g}/\text{mL}$ CBPE (0.51; $P > 0.10$). Growth of *Butyrivibrio fibrisolvens* H17E, *Prevotella ruminicola* GA33, and *Ruminococcus albus* 8 was most affected by CBPE compared to *P. ruminicola* 118B, *R. flavefaciens* FD1, and *Streptococcus bovis* JB1 (0.01, 0.20, 0.10 vs 0.59, 0.58, 0.65, respectively). Growth of microbes in whole rumen fluid was not affected until 100 $\mu\text{g}/\text{mL}$ of CBPE was added to the growth medium ($P > 0.05$). There was a 133% reduction in OD between 0 vs 100 $\mu\text{g}/\text{mL}$ CBPE (0.60 vs 0.08) and a 50% reduction when comparing 50 vs 100 $\mu\text{g}/\text{mL}$ CBPE ($P < 0.001$). Addition of CBPE greater than 100 $\mu\text{g}/\text{mL}$ did not result ($P > 0.05$) in a decrease in OD. These data suggest that CBPE is toxic to rumen bacteria. Level of toxicity is dependent upon species and mixture of bacteria present. The bioconversion of CBPE by rumen bacteria is currently under investigation.

Key Words: Rumen Bacteria, Antibiotics, Plant Extract

337 Effects of a combination of feed additives on methane production, diet digestibility and animal performance in lactating dairy cows. S. M. van Zijderveld^{*1,2}, B. C. J. Fonken^{1,2}, J. R. Newbold³, W. B. Fokkink³, J. Dijkstra², W. J. J. Gerrits², and H. B. Perdok¹, ¹Provimi B.V., Rotterdam, the Netherlands, ²Animal Nutrition Group, Wageningen University, Wageningen, the Netherlands, ³Provimi Research and Innovation Centre, Brussels, Belgium.

An experiment was conducted to study the effects of a mixture of lauric acid (C12:0), myristic acid (C14:0), linseed oil and calcium fumarate on methane production, diet digestibility and milk production. Inclusion rates of the additives were 0.4, 1.2, 1.5 and 0.7% of DM, respectively. The basal diet comprised (DM basis) 37.1% grass silage, 37.1% corn silage, 1.7% wheat straw and 42.0% concentrate. The experiment was designed as a randomized block design and conducted using 20 lactating Holstein-Friesian dairy cows (FPCM production 32.8 ± 4.9 kg/d, 176 ± 76 DIM at the start of the experiment). Cows were assigned to either the control treatment (CON) or the treatment receiving the additives (ADD) for treatment periods of 22 days. In the ADD ration, rumen-inert fat from palm oil was substituted for lauric acid, myristic acid and linseed oil to maintain diets isolipidic. Cows were housed in 2 identical, open-circuit, indirect climate respiration chambers (2 cows per chamber) during experimental observations in the third week. As a consequence of restricted feeding, DMI did not differ between treatments (16.7 and 16.5 kg DM/day for CON and ADD, respectively). Apparent digestibility of OM, N, starch and sugar were unaffected, apparent fat digestibility was higher for ADD (65.6 vs 75.6%, P= 0.01). Daily milk yield did not differ between treatments (27.8 vs. 27.2 kg/day, P=0.70). Milk fat concentration tended to be lower (P = 0.06) in ADD (41.0 g/kg) than in CON (46.3 g/kg). FPCM production was lower for ADD as a result of the lower fat content for this treatment (29.4 vs 27.4 kg/d, P= 0.02). MUN levels were significantly lower for ADD (10.3 vs. 8.0 mg/dl, P=0.02), possibly reflecting a defaunating effect of the additives, with a consequentially lower rumen ammonia production. Methane production was lower for ADD relative to CON (362 vs. 326 g methane/cow/day, P = 0.02).

Key Words: Methane, Digestibility, Dairy Cows

338 Ruminal parameters of cattle drenched with a placebo or live cultures of *Megasphaera elsdenii* strain CH4. M. R. McDaniel^{*1}, J. J. Higgins¹, J. M. Heidenreich¹, M. K. Shelor¹, G. L. Parsons¹, P. H. Henning², and J. S. Drouillard¹, ¹Kansas State University, Manhattan, ²KK Animal Nutrition, Centurion, South Africa.

A metabolism study was conducted to evaluate ruminal parameters in cattle intraruminally dosed with 0, 1x10¹⁰, 1x10¹¹, or 1x10¹² CFU of *Megasphaera elsdenii* strain CH4 following an abrupt change from an all-forage diet to a 66% concentrate diet. Angus steers (n=20; average BW=253 kg) fitted with ruminal fistulas were blocked by BW and assigned randomly to treatments. Cattle were allowed free access to alfalfa hay and water, which were removed for 12 h prior to administering treatments. *Megasphaera* treatments were dosed via the rumen cannula as a liquid suspension containing 10⁹ viable cells/mL of *M. elsdenii* strain CH4. The placebo consisted of 100 mL of autoclaved culture. On the morning of the diet change, cattle were administered their treatments and then allowed free access to a diet consisting of 34% alfalfa hay and 66% concentrate. Ruminal pH and concentrations of lactate and VFAs were monitored following introduction of the concentrate diet. Ruminal lactate concentrations increased in response to

the diet change (P<0.05), but concentrations were lower for cattle that received *M. elsdenii* compared to the placebo group (P<0.05). Compared to the placebo group, cattle administered *M. elsdenii* maintained higher ruminal pH 24 h after feeding the concentrate diet (P<0.05). Dosing cattle with *M. elsdenii* before introduction of a concentrate diet may reduce the risk of acidosis by preventing accumulation of lactic acid and avoiding severe depressions in ruminal pH.

Table 1. Ruminal VFA, lactate, and pH of cattle intraruminally dosed with 0, 1x10¹⁰, 1x10¹¹, or 1x10¹² CFU of *M. elsdenii* strain CH4.

	Colony forming units of <i>M. elsdenii</i> strain CH4								
	0		1x10 ¹⁰		1x10 ¹¹		1x10 ¹²		
Hours post-challenge	0	24	0	24	0	24	0	24	SEM
Acetate, mM	24.5	29.3	26.0	34.0	26.6	32.6	22.5	40.3	6.03
Propionate, mM	4.6	17.4	5.0	17.1	5.6	28.1	3.9	19.7	3.93
Butyrate, mM	2.5	13.3	2.0	9.6	3.2	16.0	2.1	19.3	2.77
Lactate, mM	0.0	49.8	0.0	24.6	0.1	3.5	0.0	3.0	7.57
pH	7.4	5.3	7.4	6.0	7.3	5.7	7.4	6.0	0.18

Key Words: *Megasphaera elsdenii*, Lactate, VFA

339 Quantitative detection of bacterial genomes following intraruminal dosing of cattle with *Megasphaera elsdenii* strain CH4. M. R. McDaniel^{*1}, J. J. Higgins¹, J. M. Heidenreich¹, M. K. Shelor¹, G. L. Parsons¹, P. H. Henning², and J. S. Drouillard¹, ¹Kansas State University, Manhattan, ²KK Animal Nutrition, Centurion, South Africa.

Angus steers (n=20; average BW=253 kg) fitted with ruminal fistulas were used to quantify changes in bacterial populations following intraruminal dosing with *Megasphaera elsdenii* strain CH4. Treatments consisted of inoculation with a placebo (100 mL of autoclaved culture) or 1x10¹⁰, 1x10¹¹, or 1x10¹² CFU of *M. elsdenii* strain CH4. Cattle were blocked by initial BW, assigned randomly to treatments, placed into individual pens, and allowed *ad libitum* access to alfalfa hay, salt, and water for a 3-wk adaptation period. Treatments were administered via the ruminal cannula following 12 h of feed and water deprivation. Immediately after dosing, steers were given *ad libitum* access to a diet consisting of 34% roughage and 66% concentrate. Ruminal samples were collected at 0, 2, 4, 6, 8, and 24 h after feeding for quantitative rt-PCR detection of native and introduced strains of *M. elsdenii*, as well as total bacterial genomes. Capacity for metabolism of lactic acid was evaluated by inoculating 0.2 mL of strained ruminal fluid into anaerobic culture tubes containing 15 mL of semi-defined lactate media. Tubes were incubated at 39C, and turbidity changes were determined by measuring absorbance at 2-h intervals for 12 h. Total number of bacterial genomes 24 h after inoculation was unaffected by intraruminal dosing of *M. elsdenii* strain CH4 (P>0.05). Populations of total *M. elsdenii* and *M. elsdenii* strain CH4 increased to 3.6 x 10⁸ and 2.4 x 10⁸ genomes/mL, respectively, by 24 h after inoculation (P<0.05). Turbidity of cultures containing lactate media increased in response to *M. elsdenii* administration (P<0.05), suggesting a greater capacity for lactate utilization

in inoculated cattle compared to the placebo group. Inoculating cattle with *M. elsdenii* is effective in bolstering populations of ruminal lactate utilizers, and may be useful in preventing ruminal lactate accumulation in grain-fed cattle.

Key Words: *Megasphaera elsdenii*, Lactate, Acidosis

340 Bacterial population shifts in the rumen of lactating dairy cows within and across feeding cycles. D. G. Welkie¹, D. M. Stevenson², and P. J. Weimer^{*1,2}, ¹University of Wisconsin, Madison, ²USDA-ARS, Madison, WI.

While species composition of the ruminal microflora is thought to change during the feeding cycle due to variations in feed intake and ruminal environmental conditions, no studies have systematically characterized these purported population shifts. We used PCR amplification and automated ribosomal intergenic spacer analysis (ARISA) of bacterial DNA from bulk liquid and solid samples to profile changes in bacterial community composition (BCC) in 2 rumen-cannulated lactating cows over 4 successive 12-h feeding cycles. Cows were fed a TMR based on corn silage, alfalfa haylage, dry corn, and soybean meal. Ruminal samples were collected 2, 4, 6, 9, and 12 h post-feeding within each cycle. Cows did not differ in ruminal pH patterns and displayed only slight differences in VFA profiles, but displayed considerable differences in BCC. On average, samples contained 119 phylotypes (unique PCR amplicon lengths), of which 82 exceeded 1% of the peak height of the most abundant amplicon on capillary electrophoresis. Mean number of phylotypes did not differ ($P>0.05$) by sample type (solid or liquid), cycle number, or sampling time across cycles. Of 257 total phylotypes detected, only 19 were unique to a one cow. Between cows, 29 phylotypes were detected only in the liquid phase, and 24 of these were common to both cows. By contrast, only 5 phylotypes were detected only in the solid phase, 2 of which were common to both cows. Principal component analysis revealed that bacterial population shifts within and across cycles were much greater in liquid samples than in solid samples. Bacterial populations generally returned to near their pre-feed compositions by the end of each cycle, suggesting that feeding resets BCC.

Key Words: Bacteria, Rumen

341 Effect of lauric acid and coconut oil on ruminal fermentation, digestion, ammonia losses from manure, and milk fatty acid composition in dairy cows. A. N. Hristov^{*1}, M. Vander Pol¹, M. Agle¹, S. Zaman¹, C. Schneider¹, P. Ndegwa², V. K. Vaddella², K. Shingfield³, and K. Johnson², ¹University of Idaho, Moscow, ²Washington State University, Pullman, ³MTT Agrifood Research Finland, Jokioinen.

Six multiparous Holstein cows were used in a replicated 3 × 3 Latin square design trial to investigate the effect of lauric acid (LA) or coconut oil (CO) on ruminal fermentation, nutrient digestibility, and ammonia losses from manure in dairy cows. Treatments consisted of intra-ruminal doses of 240 g/d stearic acid (SA; control), 240 g LA, and 530 g CO administered once daily, before feeding. Between periods, cows were inoculated with ruminal contents from donor cows and allowed a 7-d recovery period. Treatment did not affect ($P = 0.56$ to 0.82) DMI (26.4

kg/d), milk yield (30.2 kg/d), or milk composition. Ruminal pH was slightly increased ($P = 0.04$) by CO compared with the other treatments and ruminal ammonia concentration was decreased ($P = 0.03$) by LA and CO compared with SA (7.9, 7.9, and 10.1 mM, respectively). Protozoal counts were decreased ($P < 0.01$) by LA and CO relative to SA (26.1, 20.0, and 75.4×10^4 , respectively). Methane production rate in the rumen was lowered ($P = 0.05$) by CO compared with LA and SA (2.5, 7.1, and 6.4 g/h, respectively). Total tract apparent digestibility of DM, OM, N, and NDF was not affected ($P = 0.37$ to 0.66) by treatment. Compared with SA, cumulative (15 d) *in vitro* ammonia losses from manure were reduced ($P < 0.01$) by LA, but not by CO ($P = 0.35$). Milk fat 12:0 concentration was increased ($P < 0.001$), while 16:0, 18:0, and total cis 18:1 content was decreased ($P < 0.01$) by LA and CO compared with SA. CO also enhanced ($P < 0.001$) milk 14:0 concentration relative to SA and LA. Treatments had no effect ($P = 0.15$) on milk fat CLA content. Current data confirmed the antiprotozoal activity of LA and CO in the rumen, which was accompanied by decreased ammonia concentration, and for CO reduced methane production. Addition of LA and CO in the rumen significantly altered milk fatty acid composition.

Key Words: Lauric Acid, Coconut Oil, Dairy Cow

342 Effect of esterified linolenic acid addition on methanogenesis, fermentation and microbes in the rumen of sheep fed diets with different forage to concentrate ratios. C. M. Zhang^{*}, J. X. Liu, Z. P. Yuan, X. W. Yi, W. T. Li, and Y. Q. Guo, Zhejiang University, Hangzhou, P.R. China.

This study was conducted to investigate the effect of esterified linolenic acid (ELA) addition on methane production, fermentation characteristics and ruminal microbes in the rumen of sheep fed diets with different forage to concentrate ratio (F/C). The experimental design was a 4 × 4 Latin square with 2 × 2 factorial arrangement of treatments. Four groups of sheep were fed a forage-rich diet without (F/C=70:30, DM basis) or with ELA (F/C=70:25, 5% ELA), a concentrate-rich diet without (F/C=30:70) or with ELA (F/C=25:70, 5% ELA). Methane emission was reduced by addition of ELA markedly. A significant interaction was observed among the basal diet, ELA addition and methane production. Diet type had minor effect on total volatile fatty acids, while ELA addition decreased total volatile fatty acid significantly ($P < 0.05$). Inclusion of ELA decreased molar proportion of acetate and butyrate, and increased molar proportion of propionate in concentrate-rich diet ($P < 0.05$), but had little effect on the fermentation pattern in forage-rich diet ($P > 0.05$). Methanogen and protozoa populations were decreased markedly by ELA addition, but not affected by F/C or their interaction. Growth of fungi was inhibited by the reducing F/C ratio, but little affected by ELA addition and their interaction. Addition of ELA promoted the growth of *R. flavefaciens* and *R. albus* markedly, but had little effect on *F. succinogen* numbers. Reducing F/C ratio decreased *R. albus* population markedly, but had minor effect on growth of *R. flavefaciens* and *F. succinogen*. There were no interactions between F/C and ELA addition on all the determined microbes. It is inferred that interactions of fat with the basal diet have to be taken into consideration to develop effective feeding strategies against ruminal methanogenesis.

Key Words: Esterified Linolenic Acid, Methanogenesis, Rumen Microbes

343 Summary of the effect on ruminal fermentation of Protein Edge® supplementation in continuous culture experiments. C. S. Mooney*, H. M. Dann, C. S. Ballard, K. W. Cotanch, and R. J. Grant, *William H. Miner Agricultural Research Institute, Chazy, NY.*

The objective of this analysis was to determine the effect of feeding bacteria and fungal fermentation extracts, Protein Edge® (PE; Agri-formulations, Inc., Waddington, NY), on *in vitro* fermentation across six continuous culture experiments conducted at Rumen Fermentation Profiling Laboratory (West Virginia University, Morgantown, WV). The six experiments varied in liquid dilution rate (12.0, 12.0, 12.0, 12.0, 13.0, and 8.6%/h), solids dilution rate (3.6, 3.6, 3.6, 3.6, 4.6, and 3.3%/h), measured dietary crude protein (14.6, 14.3, 14.4, 16.5, 18.4, and 14.0%), and measured dietary neutral detergent fiber (35.1, 40.3, 36.8, 38.1, 32.1, and 39.5%), respectively. Within each experiment, treatments were a basal diet (control) and a basal diet supplemented with PE (equivalent to 14.2 to 42.5 g/animal/d) with the number of replicates being ≥3 per treatment. The dataset was analyzed with Analyze Model function of JMP® using fixed effect of experiment, fixed effect of treatment, and experiment by treatment interaction. Supplementation with PE did not affect ($P > 0.14$) digestibility of carbohydrate fractions, chemical composition of the microbial mass exiting the fermenter, or molar proportion and daily production of most volatile fatty acids. However, PE supplementation increased crude protein digestibility (81.7 vs. 74.3%; $P < 0.01$) when compared to control. Overall, PE supplementation affected N metabolism by decreasing bypass N in effluent (0.5 vs. 0.7 g/d; $P < 0.01$) while increasing microbial N (MN) in effluent (1.9 vs. 1.7 g/d; $P < 0.01$) indicating greater capture or retention of N within the microbial mass. Supplementation with PE increased ($P < 0.01$) MN production efficiency (g MN/kg substrate) +10% per kg dry matter, +13% per kg organic matter, and +14% per kg carbohydrate. Across experiments, PE altered N metabolism leading to greater microbial N production efficiency in a continuous culture system. Based on this result, adjustment of microbial efficiency constants within ration balancing programs may be warranted.

Key Words: Nitrogen Efficiency, Continuous Culture, Feed Additive

344 Effect of controlled *in vitro* pH on fermentative activity of ruminal contents from finishing cattle adapted to supplemental dried distiller's grains. S. Uwituzo*, J. M. Heidenreich, T. G. Nagaraja, J. J. Higgins, and J. S. Drouillard, *Kansas State University, Manhattan.*

Ruminal pH typically is lower in cattle fed flaked grain diets compared to cattle fed rolled grain diets; leading us to hypothesize that low ruminal pH may restrict digestion of dried distiller's grains with solubles (DDG) in flaked grain diets. A study was conducted to investigate effects of pH on *in vitro* fermentative activity of ruminal contents from cattle adapted to a finishing diet containing 25% (DM basis) DDG. The study was a randomized complete block design with a 3×4 factorial treatment arrangement. Factors were pH (5, 5.5, or 6) and incubation time (6, 12, 24, and 48 h). A 50:50 mixture of DDG and dry-rolled corn was used as substrate. Fermentations consisting of a 2:1 mixture of McDougall's buffer and ruminal fluid were adjusted to target pH using citric acid. Fermentations were duplicated on each of 3 d (6 observations/treatment). Concentrations of VFA and *in vitro* disappearance of DM (IVDMD) were measured. There was an interaction ($P < 0.01$) between pH and incubation time with respect to concentrations of acetate, propionate, valerate, total VFA, and A:P ratio. VFA concentrations were higher for pH 5.5 and 6 fermentations after 6 and 12 h, but were higher for pH 5 fermentations after 24 and 48 h. IVDMD increased with increasing pH (Lin, $P < 0.01$; Quad, $P < 0.01$) and incubation time. These results may help to explain decreases in cattle performance and diet digestibility when distiller's grains are substituted for steam-flaked grains.

Table 1. *In vitro* fermentation of a 50:50 dry rolled corn:DDG substrate by ruminal contents from cattle adapted to DDG

Item	Incubation time, h				Contrasts P-Values ^a			
	6	12	24	48	1	2	3	4
Total VFA, mM					0.55	0.01	<0.01	0.35
pH 5	49	103	167	170				
pH 5.5	91	115	154	158				
pH 6	93	123	152	136				
IVDMD,%					<0.01	<0.01	0.23	<0.01
pH 5	34	38	48	54				
pH 5.5	37	46	48	59				
pH 6	56	58	61	67				

^aContrasts are 1 = effect of pH; 2 = effect of incubation time; 3 = time \times pH interaction; and 4 = pH 5 vs average of pH 5.5 & 6

Key Words: Distiller's Grains, Ruminal pH, Digestibility

Small Ruminant: Goats and Sheep

345 ASAS Centennial Presentation: Impact of animal science research on U.S. goat production and predictions for the future. T. Sahlu*¹, L. J. Dawson^{1,2}, T. A. Gipson¹, S. P. Hart¹, R. C. Merkel¹, R. Puchala¹, Z. Wang¹, S. Zeng¹, and A. L. Goetsch¹, ¹American Institute for Goat Research, Langston University, Langston, OK, ²Oklahoma State University, Stillwater.

Goat research in the U.S. has increased but at a rate less than that in production. Research on goat meat includes nutritional quality, packaging, color, sensory characteristics, and preharvest management. Goat skins have value for leather, yet quality of goat leather has not been extensively studied. Research in the production, quality, antibiotic residues, and sensory characteristics of goat milk and its products has aided development of the U.S. dairy goat industry. Limited progress has been made in genetic improvement of milk or meat production. There is need to explore applications of genomics and proteomics and improve consistency in texture and functionality of goat cheeses. New goat meat and milk products are needed to increase demand and meet the diverse tastes of the American public. Despite research progress in control of mohair and cashmere growth, erratic prices and sale of raw materials have contributed to further declines in U.S. production. Innovative and cooperative ventures are needed for profit sharing up to the consumer level. Internal parasites pose the greatest challenge to goat production in humid areas largely because of anthelmintic resistance. Study of alternative controls is needed, including immunity enhancement via nutrition, vaccination, pasture management such as co-grazing with cattle, and genetic resistance. Similarly, the importance of health management is increasing related in part to a lack of effective vaccines for many diseases. Nutrition research should address requirements for vitamins and minerals, efficiencies of protein utilization, adjusting energy requirements for nutritional plane, acclimatization, and grazing conditions, feed intake prediction, and management practices for rapid-growth 'feedlot' production systems. Moreover, efficient technology transfer methods are needed to disseminate current knowledge and that gained in future research.

Key Words: Goats, Research

346 Effects of kidding season on performance of meat goat does in Kentucky. K. M. Andries* and E. Sherrow, *Kentucky State University, Frankfort.*

Price for meat goats are showing a seasonal trend with prices generally starting to rise in late fall and winter and peaking in spring with the lowest prices seen during late summer. Because of this many goat producers in Kentucky are moving their kidding season to late fall or winter with little information on the impact this may have on herd performance. A study was designed to evaluate doe performance using two kidding seasons. The objectives of this study were to evaluate doe performance by comparing total birth, 60 day and 90 day kid weight, doe productivity ratio, conception rate, and kid survival to weaning in two alternative kidding seasons. One hundred and twenty commercial meat type does were randomly assigned to either a fall (late October, November, and December) or spring (late March, April, and May) kidding season. Data collected during the first two years included birth weight, birth type, sex, 60 day weight, and 90 day weaning weight on the kids. Sixty day weight was adjusted for age and 90 day weights were

adjusted for sex, age, and age of dam. Doe weight and body condition score were taken at weaning (90 days) and the productivity ratio was calculated by dividing the total weight of kids at 90 days by the doe weight taken at weaning. Kidding season had a significant ($p < .01$) effect on doe weight, total weight at 60 days, conception rate, and number of kids born per doe. Season also had a slightly significant effect on total birth weight ($p = 0.0487$). Doe weight and total birth weight were higher in fall than spring, however total 60 day weight, conception rate, and number of kids born per doe were higher for spring kidding groups. Interaction between year and kidding season was significant ($p < .01$) for productivity ratio, number born, number at 60 days, and number at 90 days ($p = .022$). This indicates that kidding season does not have a strong influence on kid weight per doe. However, differences in conception rate and kids born per doe may decrease profitability of fall and early winter kidding programs.

Key Words: Meat Goats, Season of Birth, Efficiency

347 Use of electronic rumen boluses for the identification of different goat breeds in the U.S. S. Carné*¹, T. A. Gipson², M. Rovai^{1,2}, R. C. Merkel², and G. Caja¹, ¹Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain, ²E. (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.

With the aim of assessing the influence of breed on electronic bolus retention, 295 goats from 4 breeds were identified with 3 bolus types containing 32 mm HDX transponders. Ruminant pH was used as an indicator to evaluate feeding conditions. Bolus features were: **B1** (75 g, 68.2 × 21.0 mm, n = 100), **B2** (82 g, 69.1 × 21.2 mm, n = 100) and **B3** (20 g, 56.4 × 11.2 mm, n = 95). Distribution of boluses by breed and bolus type (B1, B2, B3) was: Alpine (25, 24, 25), Boer-cross (26, 24, 23), Angora (25, 26, 24) and Spanish (25, 25, 23). Goats were also identified with a standard flag-button plastic ear tag (4.6 g, 51 × 41 mm). Boluses were administered with a balling gun adapted to each bolus type. Time required for bolus administration was recorded as well as any incident observed. An ISO handheld reader was used to read the boluses. Retention rate (read/applied × 100) of boluses and ear tags was recorded at d 1, 7, 30, 60 and 120. Ruminant pH was measured with a portable pH meter, in random samples of 5 goats from each breed and feeding conditions, after bolus administration and at wk 1, 2, 3 and 4. Ruminant fluid was obtained at 2 h after feeding by using an oro-ruminal probe. Time required for bolus administration varied according to bolus type (B1, 24 ± 2 s; B2, 27 ± 2 s; B3, 14 ± 2 s; $P < 0.05$) and goat breed (Alpine, 34 ± 3 s; Boer-cross, 16 ± 1 s; Angora, 17 ± 2 s; Spanish, 19 ± 2 s; $P < 0.05$). No health or behavior disturbances were observed. Ruminant pH differed according to breed and feeding conditions (lactating Alpine, 6.50 ± 0.07; yearling Alpine, 6.73 ± 0.08; Boer-cross, 6.62 ± 0.04; Angora, 6.34 ± 0.06; Spanish, 6.32 ± 0.08; $P < 0.001$) but showed no influence on bolus retention. Only 1 goat regurgitated a B3 bolus when inverted on an operating table during laparoscopy surgery. At 120 d, bolus retention was greater than ear tag retention (99.7 vs. 97.6%; $P = 0.07$). In conclusion, medium-term bolus retention was not affected by breed and feeding conditions, and remained over the ICAR requirements for official livestock identification (>98%). Long-term bolus and ear tag retention is under study.

Key Words: Transponder, Ruminant Bolus, Goat

348 Comparison of pneumatic, needle-free vaccination to needle vaccination for sheep. M. R. Mousel^{*1}, T. D. Leeds¹, S. N. White², and L. M. Herrmann-Hoesing², ¹USDA-ARS U.S. Sheep Experiment Station, Dubois, ID, ²USDA-ARS Animal Disease Research Unit, Pullman, WA.

Administering vaccines using needle-free injection technology as opposed to traditional needles would likely reduce the lateral spread of infectious diseases in sheep flocks. In addition, needle-free technology could reduce the damage to carcasses caused by needle injections (i.e., lesions and broken needle fragments). Therefore, the objectives of this study were to determine whether a pneumatic, needle-free injector could inject s.c. and induce similar antibody responses as traditional needle vaccinations. To determine optimal pressure for s.c. vaccine delivery, 2 8-mo-old wethers received injections of Chinese ink in isotonic, sterile saline at pressures from 207 to 414 kPa in increments of 69 kPa. To evaluate antibody responses, 100 8-mo-old wethers were vaccinated at d 0 with ovalbumin, in an aluminum hydroxide adjuvant and isotonic, sterile saline, using either a needle-free injector or traditional needles. The wethers received a secondary injection of ovalbumin at d 28 using the same type of administration as d 0. Serum samples were collected before vaccination on d 0 and 28, as well as on d 14 and 42. An ELISA was used to determine serum anti ovalbumin antibody titers on d 0, 14, 28, and 42. An optimum pressure of 207 to 276 kPa was determined to deliver a safe and effective s.c. injection using the needle-free method. Serum anti ovalbumin titers at d 14, 28, and 42 were not different ($P > 0.12$) between traditional needle vaccination and pneumatic, needle-free injector. This indicates that needle-free vaccination and traditional needle vaccination produced an equivalent antibody response. Injecting 7 to 9 sheep with the needle-free method (mean 60.6 s) was faster ($P < 0.01$) than changing needles for every animal (mean 155.3 s). In addition, the needle-free injector will reduce biohazard waste, eliminate the possibility of accidental needle sticks for livestock handlers, and will likely reduce iatrogenic infection of sheep.

Key Words: Sheep, Methodology, Vaccination

349 Expected rank correlations for varying degrees of ultrasound accuracy. T. D. Leeds^{*1}, C. A. Moffet¹, D. R. Notter², and G. S. Lewis¹, ¹USDA, ARS, U.S. Sheep Experiment Station, Dubois, ID, ²Virginia Polytechnic Institute and State University, Blacksburg.

Live-animal ultrasound backfat thickness (BF) and loin muscle area (LMA) data must be accurate to correctly rank animals. The Beef Improvement Federation and National Swine Improvement Federation have established accuracy criteria for their respective species, but no such criteria have been established for sheep. We used Monte Carlo simulation to derive expected rank correlations for varying degrees of ultrasound accuracy (i.e., SE of prediction; SEP) for BF and LMA in cattle, pigs, and sheep. Normally-distributed carcass BF and LMA data were simulated ($n = 100 \text{ records} \cdot \text{trait}^{-1} \cdot \text{species}^{-1}$) using species-specific mean and SD estimates for each of 10,000 replications. Estimates used for cattle, pigs, and sheep, respectively, were: BF mean = 1.14, 1.74, and 0.571 cm; BF SD = 0.510, 0.500, and 0.225 cm; LMA mean = 80.6, 43.3, and 16.7 cm²; LMA SD = 9.10, 5.64, and 2.67 cm². For each replication, unbiased ultrasound data were generated as carcass data + variate ($N(0, \sigma = \text{SEP})$) for a range of ultrasound accuracy. Spearman rank correlations between the carcass and ultrasound data were

calculated for each replication. Means and SD of the rank correlation estimates were calculated across all replications within each degree of ultrasound accuracy. Means and SD of the rank correlations were described as a function of SEP using polynomial regression. As expected, rank correlations decreased, and SD of rank correlations increased, as SEP increased. The maximum SEP to achieve an expected rank correlation of 0.85 (arbitrary) between carcass and ultrasound measures for cattle, pigs, and sheep, respectively, were: BF = 0.290, 0.285, and 0.125 cm; LMA = 5.24, 3.25, and 1.53 cm². At these SEP, the SD of rank correlation estimates for all traits within all species was approximately 0.031. The SEP values reported here are based on an arbitrary rank correlation value, and are dependent upon trait variation within populations. However, this report describes an objective approach for establishing ultrasound accuracy criteria in sheep.

Key Words: Sheep, Ultrasound, Accuracy

350 Backfat thickness, LM area, and LM depth effects on carcass yield, composition, and value in sheep. T. D. Leeds^{*1}, M. R. Mousel¹, D. R. Notter², H. N. Zerby³, C. A. Moffet¹, and G. S. Lewis¹, ¹USDA, ARS, U.S. Sheep Experiment Station, Dubois, ID, ²Virginia Polytechnic Institute and State University, Blacksburg, ³The Ohio State University, Columbus.

Backfat thickness, LM area, and LM depth were measured on 172 wethers to determine relationships between these measures and carcass yield, composition, and value. Wethers were F₁ progeny from the mating of 4 terminal sire breeds to Rambouillet ewes and were finished on a concentrate diet to a mean BW of 62.9 kg (SD = 9.5 kg). Before transport to harvest, LM area, LM depth, and backfat thickness were measured from transverse ultrasound images taken between the 12th and 13th ribs. After harvest, these measures were taken on the carcasses. The SE of prediction, a measure of ultrasound accuracy, for the technician were 0.140 cm, 1.55 cm², and 0.263 cm for backfat thickness, LM area, and LM depth, respectively. Carcasses were fabricated into subprimal items, and weights were recorded. Carcass yield, composition, and value were described using linear models that included fixed effects of BW (or carcass weight), breed of sire, backfat thickness, and LM area (or LM depth). At a standardized BW and backfat thickness, wethers with larger LM area and LM depth yielded larger and more valuable carcasses, and these relationships were detectable with ultrasound. For each SD increase in carcass LM area, dressing percentage increased 1.57 percentage points, gross carcass value increased US\$5.12, and boxed carcass value increased US\$6.84 ($P < 0.001$). For each SD increase in ultrasound LM area, dressing percentage increased 0.95 percentage points, gross carcass value increased US\$3.15, and boxed carcass value increased US\$3.86 ($P < 0.001$). The response in boxed carcass value attributed to disproportionate increases in high-value subprimal item weights was small. Responses in dressing percentage and carcass value were significant ($P < 0.01$) for ultrasound and carcass LM depth, but were smaller in magnitude when compared with LM area. These data indicate biological and economical incentives for increasing LM area in wethers, and live-animal ultrasound can provide reliable estimates of carcass measures. These results are applicable to terminal sire breeders and producers who market sheep using carcass-merit pricing systems.

Key Words: Sheep, Ultrasound, Carcass yield

351 Phenotypic correlations among growth and carcass traits of Polypay and White Dorper × Polypay crossbred lambs. D. K. Aaron*, D. G. Ely, E. Fink, B. T. Burden, M. M. Simpson, and A. K. Lunsford, *University of Kentucky, Lexington*.

Wether lambs from two genetic types, Polypay (PP; n = 32) and White Dorper (WD) x PP crosses (WDX: 1/2 WD x 1/2 PP, n = 36; 3/4 WD x 1/4 PP, n = 34; 7/8 WD x 1/8 PP, n = 18; 15/16 WD x 1/16 PP, n = 12), were used to estimate phenotypic correlations among growth and carcass traits. Wethers were weaned at an average of 70 d of age and 26 kg, were managed postweaning on pasture and supplemented with grain at 2 to 3% BW, and were harvested at an average of 208 d of age and 55 kg. Partial correlations among growth and carcass traits, pooled within model fixed effects, were obtained separately for PP and WDX using multivariate procedures. Homogeneity of genetic type correlations were tested using Chi-square criteria. In general, correlations were homogenous between PP and WDX; thus, data were combined and pooled within genetic type correlations calculated. When heterogeneous correlations ($P < 0.05$)

were observed, they involved associations with live and carcass weights. Overall, weaning weight was positively correlated ($P < 0.05$) with final weight (0.48), hot carcass weight (0.40), leg (0.40), rack (0.20), and shoulder (0.20) weights but was negatively correlated with postweaning ADG (-0.50) and harvest age (-0.30). Postweaning ADG was positively associated with final weight (0.22; $P < 0.05$) but negatively associated with harvest age (-0.45; $P < 0.05$). Dressing percentage was positively correlated ($P < 0.05$) with hot carcass weight (0.57), rib fat (0.36), body wall thickness (0.37), yield grade (0.36) and leg, rack, and shoulder weights (0.36, 0.21, and 0.43). Positive correlations ($P < 0.05$) between longissimus muscle area and harvest weight, body wall thickness, and wholesale cut weights indicated moderate to strong relationships. Generally, correlations indicated weak to moderately strong relationships among all growth and carcass traits. Where heterogeneous correlations existed between PP and WDX, they indicated stronger associations among traits measured on WDX lambs.

Key Words: Growth, Carcass, Lambs

Swine Species

352 Multi-breed comparison of body composition in swine using dual energy X-ray absorptiometry (DXA) and magnetic resonance imaging (MRI) under special consideration of Cerdo Iberico. A. M. Scholz*, S. Schneider, and P. V. Kremer, *Ludwig Maximilians University Munich, Oberschleissheim, Bavaria, Germany.*

Swine breeders try to meet different consumer demands worldwide. Therefore in this study, totally 77 pigs were studied by dual energy X-ray absorptiometry and magnetic resonance imaging at an average age of the breeding groups between 144 and 160 days. The pigs originated from different extensive or conventional breeds or crossbreeds: Cerdo Iberico (Ib; n=5); Duroc (Du) x Ib (DuIb, n=15); German Landrace + German Large White = White Sow Lines (WSL; n=8), Hampshire (Ha) + Pietrain (Pi) x Ha + Pi x PiHa (Pi_Ha; n=6); Pi x Du + Pi x PiDu (Pi_Du; n=24); and Pi or PiDu x WSL (n=19). A whole body scan was performed by dual energy X-ray absorptiometry with a GE Lunar DPX IQ in order to measure the amount and percentage of fat tissue, lean tissue and bone mineral, while a Siemens Magnetom Open with a large body coil was used for magnetic resonance imaging in the thorax region between 13th and 14th vertebrae in order to measure longissimus muscle and above fat areas of both body sides. A mixed model procedure using SAS 8.2 was used to analyze the data. As expected, the extensive breed Ib followed by DuIb crossbreeds shows the highest body fat content combined with the smallest loin eye areas and a lower body weight at an average age of 154 days. The least amount of fat and largest muscles deposit pigs with pure Ha or Pi x Ha origin. The (white) sow lines and their terminal crossbreeds or crossbreeds with Pi x Du origin show an intermediate body composition. The highest body weights reached DuIb and Pi_Du combined with a completely diverse body composition (DuIb = fat; Pi_Du = lean). DuIb has the significantly highest DXA bone mineral density. Therefore, with exception of Cerdo Iberico itself, DuIb seems to be strongly suited for outdoor swine farming not alone in Spain.

Table 1. DXA and MRI results

Breeding Group	DXA Fat %	DXA BMD g/cm ²	MRI Loin cm ²	MRI Fat cm ²	Body Weight kg
Ib	27.2±1.6 ^a	1.00±.02 ^{ad}	46 ±5 ^a	38 ±3 ^a	47 ±4
DuIb	25.0±1.0 ^a	1.15±.01 ^b	74 ±3 ^{b*}	41 ±2 ^a	75 ±2
WSL	16.6±1.4 ^c	1.06±.02 ^c	82 ±4 ^{b*}	25 ±3 ^b	73 ±3
Pi_Ha	12.4±1.4 ^b	1.00±.02 ^{ad#}	99 ±4 ^c	21 ±3 ^b	64 ±3
Pi_Du	15.3±0.9 ^{bc}	1.04±.01 ^{ac#}	96 ±3 ^c	23 ±2 ^b	74 ±2
Pi or PiDu x WSL	15.4±1.0 ^{bc}	0.98±.01 ^d	93 ±3 ^c	23 ±2 ^b	72 ±2

All data were corrected for an age of 154 d. LSM with different superscripts differ significantly (P<.05). °[N], # P=0.054; * P=0.072

Key Words: Swine, Body Composition, Magnetic Resonance

353 Performance and carcass characteristics of pigs destined for natural label or commodity pork markets. A. F. Harper*¹, M. J. Estienne¹, T. D. Pringle², and K. A. Alberti¹, ¹Virginia Polytechnic Institute and State University, Blacksburg, ²University of Georgia, Athens.

Weanling pigs (n = 72) were used to assess diet and sire effects on pork produced for natural label or commodity markets. Natural label

diets contained no antimicrobial additives or animal slaughter by-products. Commodity diets contained antimicrobial additives (27 ppm carbadox followed by 33 ppm bacitracin methylene disalicylate) and animal slaughter by-products. Pigs were produced by AI of Yorkshire x Landrace sows using semen from a Berkshire boar or a terminal-line Hampshire boar. Treatments were: natural diets fed to Berkshire-sired pigs, natural diets fed to Hampshire-sired pigs, commodity diets fed to Berkshire-sired pigs and commodity diets fed to Hampshire-sired pigs. There were 6 replicate pens of 3 pigs each per treatment. Feed and water were available ad libitum. Two pigs per pen from 5 replications were selected on d 132 for harvest and carcass evaluation. During the nursery period (d 0 – 34), pigs fed the natural diet had lower ADG (431 vs. 458 ± 9 g, P = 0.06) than those fed the commodity diet; sire effects during the nursery period were not significant (P > 0.16). Thereafter there were no effects of diet or sire on performance during the growing-finishing period (d 35 – 132) or over the entire trial (P > 0.26). Carcass evaluation showed no fat or muscling differences due to diet (P > 0.15), but pigs sired by the Berkshire boar had greater tenth rib back fat thickness (27.2 vs. 21.7 ± 1.4 mm, P = 0.03) and smaller loin muscle area (41.2 vs. 54.5 ± 1.7 square cm, P = 0.001) than pigs sired by the Hampshire boar. Pigs fed the natural diet had greater loin shear force (3.04 vs. 2.56 ± 0.05 kg force, P = 0.05) than those fed the commodity diet. For pigs sired by the Berkshire boar, loin pH was greater (5.57 vs. 5.46 ± 0.03, P = 0.05) and Minolta a* (redness) value was lower (9.8 vs. 11.5 ± 0.4, P = 0.02) than in pigs sired by the Hampshire boar. No other differences in objective pork quality measures were observed (P > 0.37). For the 132 d trial pig performance was similar across feeding programs and sires. Pigs sired by the Berkshire boar produced more subcutaneous fat and less muscling, but differences in pork quality were minor.

Key Words: Pig, Diet, Sire

354 Effect of gender and slaughter age of heavy pigs on production of high quality dry-cured hams. M. A. Latorre*¹, L. Ariño², and B. Blanco³, ¹Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain, ²Integraciones Porcinas S.L., Teruel, Spain, ³Jamones y Embutidos Alto Mijares S.L., Teruel, Spain.

High quality dry-cured hams under the protection and designation of “Teruel hams” trademark are produced from heavy pigs in a specific area of Spain. Two aspects are required to consider finally a carcass suitable for Teruel ham; carcass weight and fat depth at Gluteus medius (GM) level should be at least 84 kg and 18 mm, respectively. A total of 120 (Landrace x Large White) x Duroc pigs, with an average age of 176 d, were used to study the effect of gender and slaughter age on growth performance and carcass quality of pigs destined to Teruel ham. There were three treatments; barrows slaughtered at 196 d of age (B; 130.8 kg BW), gilts slaughtered at 203 d of age (G1; 130.2 kg BW), and gilts slaughtered at 210 d of age (G2; 134.3 kg BW). Each treatment was replicated four times (ten pigs penned together). Animals fed commercial wheat, barley, and soybean meal diet, containing 2,360 kcal NE/kg and 0.68% total lysine. B ate more feed (P < 0.001), grew faster (P < 0.05), and showed worse feed conversion ratio (P < 0.01) than G1 or G2. No effect of treatment on carcass weight, and therefore on proportion of carcasses with 84 kg of minimum weight, was detected (P > 0.05). However, B had more fat at GM than G1, with G2 in an intermediate position (P < 0.05). In consequence, B and G2 showed similar percent-

age of carcasses with at least 18 mm of GM fat depth and both higher than G1 ($P < 0.001$). The weight of trimmed ham was not affected by treatment ($P > 0.05$), but the trimmed ham yield was lower in B or in G2 than in G1 ($P < 0.01$). At the end of the trial, B and G2 showed similar final percentage of suitable carcasses for Teruel ham, and both higher than G1 ($P < 0.001$). It is concluded that the production of suitable Teruel ham is optimum for barrows at 130 kg BW. However, an increase in slaughter age by two weeks in gilts, with regard to barrows, improves the production and the homogeneity of Teruel ham.

Key Words: Slaughter Age, Dry-Cured Ham, Pigs

355 Genetic opportunities for pork production without castration. J. W. M. Merks*, K. A. Engelsma, S. Bloemhof, and E. F. Knol, *IPG, Institute for Pig Genetics B.V., Beuningen, The Netherlands.*

Quality of food in terms of health and taste has high priority in our society and consumers do not accept off-flavor meat. Therefore, in most countries, male pigs are castrated shortly after birth to prevent the production of meat with the so called 'boar taint'. However, castration is a surgical intervention which is of growing concern in the society and becoming an animal welfare issue. In addition pork production with entire males is 5-12% more efficient than pork production with male castrates.

The main responsible compounds for boar taint are androstenone and skatole but these substances do not explain the perception of boar taint in taste panels completely. More compounds have recently been discussed in this respect, such as indole, and other steroids of the Δ -16-steroids group.

The genetic aspects of the 3 main boar taint components, androstenone, skatole and indole were investigated in purebred animals of a commercial sire line; more than 1300 fat samples from the neck were collected of pigs with an average live weight at slaughter of 125 kg and analyzed for these 3 compounds. Average values (minimum and maximum) were for androstenone; 1.59 $\mu\text{g/g}$ (0.01 - 10.15), for skatole 0.075 $\mu\text{g/g}$ (0.01 - 0.93) and for indole 0.05 $\mu\text{g/g}$ (0.01 - 0.68).

Heritabilities for the boar taint compounds ranged between 0.25 and 0.75, among others depending on estimated before or after log transformation or as a 0/1 trait with threshold values close to what is generally seen as accepted. The genetic correlations with production traits were close to zero or favorable like with backfat and lean meat%. For female reproduction traits only androstenone showed clearly negative genetic correlations with litter mortality (-0.59), interval weaning- 2nd insemination (-0.44), and with age at first insemination (-0.24). Genetic correlations with the male reproduction traits (volume, motility, longevity of semen) were also close to zero. These results clearly indicate the genetic opportunities to lower concentrations of the main compounds of boar taint, which on long term may enable production of entire male pigs without the problems of boar taint.

Key Words: Castration, Boar Taint, Selection

356 Lignocellulose as dietary fiber source in swine nutrition. A. Kroismayr*^{4,2}, J. Leibetseder¹, C. Plitzner², K. Neufeld³, and P. Affentranger⁴, ¹University of Veterinary Medicine, Vienna, Austria, ²University of Natural Resources and Applied Life Sciences, Vienna, Austria, ³Animal Nutrition Research Center, Austria, ⁴Agromed Austria, Kramsbrunn, Austria/EU, ⁵UFA AG, Switzerland.

Lignocellulose from fresh wood containing fermentable and non-fermentable fiber components is used in animal nutrition as fiber source because of its positive impact on digestion and for prevention of diarrhea. Fermentable and non-fermentable fiber components have different modes of action in the GI tract and seem to influence digestive process positively due to symbiotic activity.

In the presented piglet study, carried out by UFA AG, Switzerland, a combination of fermentable and non-fermentable lignocellulose components was investigated. For the 35 days lasting experiment 228 weaning piglets were split into 2 groups. Control group received a standard weaning diet including organic acids and feed enzymes. Treatment group received the control diet plus 1.5 % of the investigated lignocellulose product. The treatment effects were evaluated by analysis of variance (ANOVA). Means were compared with Bonferroni - Holmes test ($p < 0.05$).

Results show positive influence of lignocellulose on performance of piglets. Daily weight gain was significantly higher in the treated group (364 g per day) compared to the control group (342 g per day). Feed conversion rate was not influenced by the lignocellulose product (1.54 treatment vs. 1.57 control). In conclusion the combination of fermentable and non-fermentable lignocellulose components led to increased performance of piglets in this trial.

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Key Words: Dietary Fiber, Lignocellulose, Piglets

357 Effects of crystalline amino acids and sodium bicarbonate on physiological pH in swine. K. L. Dorton, L. N. Edwards*, T. E. Engle, R. M. Enns, and D. B. Anderson, *Colorado State University, Fort Collins.*

This experiment was conducted to determine the effects of dietary inclusion of crystalline amino acids and NaHCO_3 on urine and blood parameters indicative of physiological pH in swine. The experiment was a crossover design study divided into 6 periods consisting of the following: P1) 4 d acclimation phase; P2) 6 d baseline phase; P3) 4 d treatment; P4) 4 d treatment crossover; P5) 2 d sodium bicarbonate (NaHCO_3) addition; and P6: 2 d NaHCO_3 crossover. Barrows ($n = 8$) were stratified by urine pH collected during P2 and by initial body weight. During P3 and P4, treatments consisted of: 1) soybean meal (high protein diet; HP) or 2) crystalline amino acids (low protein diet; CAA). During P5 and P6, treatments consisted of the above diets with and without the addition of NaHCO_3 . Diets were formulated to meet or exceed NRC (1996) requirements for energy, protein, vitamins, and minerals. During P3 and P4, barrows that received HP had a greater stored urine pH (Mean \pm SEM, HP: 7.81 ± 0.08 , CAA: 7.66 ± 0.08 ; $P = 0.02$), blood pH (HP: 7.37 ± 0.008 , CAA: 7.32 ± 0.008 ; $P < 0.01$), blood urea nitrogen (BUN; HP: 10.24 ± 0.63 , CAA: 6.94 ± 0.63 ; $P < 0.01$), and ionized Ca (iCa; HP: 1.48 ± 0.02 , CAA: 1.43 ± 0.02 ; $P = 0.02$), and lower partial pressure carbon dioxide (HP: 55.61 ± 2.44 , CAA: 65.74 ± 2.44 , $P = 0.01$) and sodium concentration (HP: 141.33 ± 0.08 , CAA: 142.08 ± 0.08 , $P < 0.01$) than barrows that received CAA. During P5 and P6, barrows that were supplemented with NaHCO_3 had a greater stored urine pH ($P < 0.01$), base excess ($P < 0.01$), bicarbonate concentration ($P = 0.04$) and total carbon dioxide ($P = 0.05$) and tended to have a greater blood pH ($P = 0.08$). Sodium bicarbonate supplementation also resulted in lower BUN ($P = 0.03$), iCa ($P = 0.01$), potassium concentration (P

= 0.02), chloride concentration ($P = 0.02$), and glucose concentration ($P = 0.02$). These results indicate that the CAA diets were acidogenic and that the addition of 2.5% NaHCO_3 reversed this acidogenesis by affecting physiological indicators of pH.

Key Words: Acid Base Balance, Acidogenic, Dietary Electrolyte Balance

358 Effects of inclusion of fermentable carbohydrates on L-tryptophan metabolism by porcine fecal microbiota studied *in vitro*. C. Y. Li*, J. X. Liu, Y. Z. Wang, Y. M. Wu, and J. K. Wang, *Ministry of Education Key Laboratory of Molecular Animal Nutrition, Zhejiang University, Hangzhou, P.R. China.*

Sugar beet pulp (SBP), rye grass hay (RYE), alfalfa hay (ALF) and fructooligosaccharides (FOS) were used to investigate their effects on the metabolism of L-tryptophan to skatole and indole by a mixed bacterial population from the large intestines of pigs. Microbial suspensions were anaerobically incubated at 38°C, and indole compounds, pH value and volatile fatty acids were analyzed after 24 h fermentation. Effects of carbohydrate sources on the microbial diversity were analyzed using denaturing gradient gel electrophoresis (DGGE) of PCR amplicons of 16S rDNA, cloning and sequencing. Skatole contents and its relative rate of production were significantly decreased by SBP or FOS addition, but increased by addition of RYE or ALF. Rate of tryptophan degradation was reduced by ALF addition remarkably. Total and individual volatile fatty acids were significantly higher in all carbohydrate-added groups than in the none-added. Additions of SBP, RYE, ALF and FOS in pig fecal slurries with L-tryptophan markedly decreased the culture medium pH values. The DGGE profiles showed differences between cultures with different carbohydrate substrates. Fermentation with SBP showed a higher bacterial diversity than with others, with three distinct bands appeared. Sequences of the corresponding 16S rRNA of two bands were related to *Eubacterium rectale* (94%) and *Clostridium sp.* (96%), respectively. Three bands were present only in SBP, RYE and ALF samples. Two of them represented 93 and 98% similarity to *Lachnospira pectinoschiza* and *Clostridium disporicum* DSM 5521, respectively. These results suggest that the reduced contents of skatole observed in the presence of SBP and FOS may be caused by decreased tryptophan degradation to indolic compounds and by shifted microbial metabolism of tryptophan toward indole production at the expense of skatole, resultant from the changed microbial ecosystem and pH value. The bacteria *Clostridium disporicum* DSM 5521 may play a role in the production of skatole.

Key Words: Carbohydrate Sources, Pig Fecal Bacteria, Skatole

359 The impacts of vaccination and feeding a gel nutritional supplement on nursery pig performance. L. Layman*¹, W. Holt¹, L. Karriker¹, K. Stalder¹, B. de Rodas², D. Brown², and A. Johnson¹, ¹Iowa State University, Ames, ²Land O'Lakes Purina Feed, Gray Summit, MO.

An experiment involving 192 weanling pigs (4.2 kg BW) was conducted to determine if feeding a nutritional gel supplement when vaccinated improved pig performance. Pigs were sorted by size and sex and penned in groups of four (12 pens/treatment) in an off-site nursery. Dietary

treatments were applied to pens in a 2x2 factorial arrangement with one factor being with and without vaccination and another factor with and without the nutritional gel supplementation. Pigs in the vaccinated groups received a commercial single dose of *Mycoplasma hyopneumoniae* killed bacterin (2 cc vaccine/pig) on day 10 post-weaning and pigs on the gel group received the nutritional supplementation in a gel form (UltraCare®Gel) on d 9 to 11. All pigs were fed common Phase 1 (d 0 to 7), 2 (d 7 to 14), 3 (d 14 to 28) and 4 (d 28 to 42) diets. Pigs provided the gel weighed more ($P = 0.048$) than non gel pigs on d 14. Pigs not vaccinated tended ($P = 0.08$) to weigh more on d 14 when compared to vaccinated pigs. From d 7 to 14, pigs receiving the nutritional supplementation in the gel form had greater ($P = 0.048$) ADG than pigs not receiving gel and vaccinated pigs had lower ($P = 0.09$) ADG than non-vaccinated pigs. Pigs provided the gel had superior ($P < 0.01$) ADFI during d 9 to 11 when compared to pigs not receiving the gel. Pigs not vaccinated had improved ($P < 0.01$) ADFI on d 10 and d 7 to 14 when compared to vaccinated counterparts. Feed to gain (F/G) from d 7 to 14 was greater ($P = 0.004$) for pigs receiving the nutritional supplementation in a gel form versus those that did not. There were no ($P = 0.98$) vaccination effects for Feed: gain. During the overall 42-d experiment, no ($P > 0.05$) differences were observed in ADG, ADFI or F/G between vaccinated and non-vaccinated pigs or between pigs fed the nutritional supplementation in a gel form and non-gel fed pigs. In conclusion, using a gel-based product at vaccination time for nursery pigs offers some short term performance benefits.

Key Words: Gel, Pigs, Vaccination

360 Integrating benefits of organic apple and pork production: Evaluation of Plum curculio larva survival with ingestion and passage through the pigs' digestive tract. D. W. Rozeboom*, D. L. Epstein, J. M. B. Moore, and M. E. Whalon, *Michigan State University, East Lansing.*

The ability of the Plum curculio larvae to survive passage through the pigs' digestive tract was tested by feeding known numbers of live larvae and examining total fecal collections in a 5-day feeding study. Plum curculio, *Conotrachelus nemuphar*, is a pest management challenge faced by upper Midwest organic fruit growers. The overarching project goal was to develop a system that integrates swine grazing for control of the Plum curculio insect, while enhancing profit potential through sales of organic apples and pork. This experiment was conducted to understand the effectiveness of grazing pigs in consuming and killing the Plum curculio larvae residing in dropped apples on the orchard floor. Six barrows weighing 28.7 to 33.1 kg, were individually-housed in a 1.2 x 1.8 m pens equipped with low-pressure nipple drinkers. Flooring was perforated plastic to allow urine to pass uncollected through to concrete flooring and drains about 30 cm below. Fencing was solid plastic in order to prevent neighboring pigs from interfering with the collection of feces which was done using bags directly attached on the skin surrounding the anus. Each morning, pigs received 9 to 15 live Plum curculio larvae which had been gently mixed into 110 g of apple pulp. After consumption of the pulp-larvae mixture, pigs were given 340 g of a corn-soybean meal based diet. Two other meals of similar amounts of pulp and dry feed were provided in the afternoon and evening. Fecal bags were changed 3 times daily and feces were gently washed using flowing water, a soft spatula, and grain screens. A total of 264 Plum curculio larvae were fed in 26 meals which were followed by complete 24-h fecal collections. In 3 instances fecal bags had been detached prior to staff arrival and feces lost. No live Plum curculio larvae were found in any of the complete

fecal collections. The remains or carcass of one dead larva was found in the feces of one pig on d 2. This experiment demonstrated that ingestion by pigs was lethal to *Plum curculio* larvae.

Key Words: Pig, *Plum Curculio*, Organic

361 Effects of environment on non-ambulatory, injured and fatigued pigs and losses during transport and lairage at a commercial abattoir. R. Fitzgerald^{*1}, K. Stalder¹, N. Matthews², C. Schultz-Kaster², and A. Johnson¹, ¹*Iowa State University, Ames*, ²*Farmland Foods, Milan, MO*.

The objective of this retrospective study was to quantify the effects of harvest week, weather, and transport conditions that influence the frequency of non-ambulatory, injured and fatigued pigs and mortalities during transport and lairage. A total of 1,923,441 pigs were harvested at a commercial abattoir. Relative humidity, temperature, wind speed, and dew point were collected for trailer loads (n = 11,553) from of pigs May 2005 to April 2006. A temperature-humidity index was cal-

culated (NOAA,1976) and was used as a model covariate along with load time per pig, trailer density, and pig rest time. Week, pull nested within farm, split or normal load type, load crew, driver, trailer, wind direction, and wind speed were used as fixed effects in the model for the analysis of total defects (defects = fatigued + injured + dead pigs per trailer load) percentage per load using generalized linear models (GLIMMIX, SAS Inst. Inc.). The ILINK function was used to convert logarithmically-transformed trait means to their original units of measure. The frequency of fatigued, injured, and dead pigs occurred at 5.46 (n = 10510), 0.55 (n = 1061), and 2.32 (n = 4459) per thousand pigs transported, and 60.03% of the loads resulted in at least one defect. Pigs transported to the abattoir during summer months (June – August) resulted in fewer defects (P<0.001) than pigs transported during winter months (December – February) due to a higher incidence of fatigued and dead pigs. Contrarily, injured pigs increased in frequency during July through October. Percentage of defects increased (P<0.0001) with trailer density. The results of this study demonstrate that multiple factors influence and could be modified to reduce the percentage of defects per load of finishing pigs.

Key Words: Pigs, Transport, Environment

Symposium: Teaching/Undergraduate and Graduate Education: The Changing Student and Influence of Technology on Learning

362 ASAS Centennial Presentation: Animal science teaching: A century of excellence. D. S. Buchanan*¹ and L. C. Martin², ¹North Dakota State University, Fargo, ²The Ohio State University, Columbus.

Teaching has been central to the life of many members of ASAS since the organization's inception one hundred years ago. A high proportion of the scientists who publish research in the Journal of Animal Science or who present the results of research at the annual meetings also hold a teaching appointment. Virtually all members of ASAS are the product of animal science teaching programs and ASAS has, and continues to, play a central role in graduate student education. While ASAS recognizes an outstanding teacher with an award each year, those individuals recognized represent but a small sampling of the numerous excellent teachers who populate academic departments associated with ASAS. Teaching programs and symposia have been an area of growth at the annual meeting of ASAS during the last few decades as members gather to learn from one another about the latest techniques and innovations. Opportunities for enhancement of teaching programs abound and the student population continues to become more diverse in background, interests and career goals. Individual members of ASAS have been, and continue to be, interested in developing the next generations of animal scientists and leaders in the various industries we serve. Methods of delivery are expanding rapidly. This presentation will explore ways ASAS can build on its rich history and expand its contributions to the teaching of animal science and to the availability and delivery of information pertaining to all types of managed animals.

Key Words: Teaching, Animal Science, Students

363 How current students differ and what impact this has on learning in the classroom. L. C. Martin*, *The Ohio State University, Columbus.*

Effective teaching depends upon being able to connect with students. Because learning is contextual, a better understanding of student interests, values and perceptions serves to provide a stronger foundation for effective teaching within the discipline. Millennials (those born between 1982 and 2002) represent the second largest generation in history (second only to the baby boomers) and have unique characteristics that differentiate them from previous generations. Because they have different needs and expectations, educators have found it challenging to engage this new generation of learners. The millennial generation is the most diverse in history (only about 60% white), a growing number of students are delaying enrollment in college and fewer young men are choosing to pursue higher education. Millennials communicate via social networks, instant messaging, text messaging and occasional emails, read magazines rather than newspapers, watch less television, learn by trial and error, and are more consumer driven in their view of higher education. Multitasking is a way of life; they prefer to keep a flexible schedule and expect institutions to provide more educational choices, greater flexibility, and increased personalization and customization. They become frustrated by delays, seek immediate answers to their questions and resent what they perceive to be "busy work." These unique characteristics have challenged the effectiveness of traditional classroom teaching and are

forcing institutions to consider a new learning paradigm. As animal sciences programs prepare for the future, it will become increasingly more important to consider the unique characteristics of this millennial generation in course and curriculum development, classroom teaching, co-curricular engagement, and student development.

Key Words: Millennials, Teaching, Learning

364 Changes that have occurred in animal science teaching. J. A. Sterle*¹ and J. J. Parrish², ¹Texas A&M University, College Station, ²University of Wisconsin, Madison.

A centennial is a time to reflect on the journey that has taken us to the present point. It is a time to celebrate accomplishments, recall fond memories, and anticipate the future. The committees planning the centennial meeting of the American Society of Animal Science were charged with the task of selecting a "classic" paper and re-presenting it. While this approach works well for the committees representing disciplines (animal breeding, physiology, etc.), the Undergraduate and Graduate Teaching committee decided on a different approach. Finding it nearly impossible to select only one outstanding educator throughout Animal Science departments nationwide, the committee decided to create a video of multiple outstanding teachers. By capturing these individuals and their teaching philosophies on tape, this precious bit of history could be preserved. Short video segments were recorded at the home institutions of faculty members who were well-known for excellence in teaching. The segments were edited and produced into a short video segment for inclusion of the centennial celebration.

Key Words: Teaching, Centennial, History

365 The use of multimedia in the classroom. H. Khatib*, *University of Wisconsin, Madison.*

The use of multimedia in classroom is not new. It has been used for the last several decades in the form of overhead projectors, slide shows, filmstrips, among other tools. However, with the introduction of the computer and other electronic devices, multimedia is now being used in a number of ways including PowerPoint, digital videos, case studies, newsgroups, mailing lists, YouTube and more. Multimedia is motivating for most learners in that they enjoy working with it and the combination of pictures, text, audio and video provides a stimulating environment for students. I extensively utilize PowerPoint and elements of multimedia including videos, YouTube films, web sites, and other visual aids to make connections between genetics and real life. For example, in a lecture about African trypanosomiasis, a short video telling a story of an African woman affected with sleeping sickness was presented. In a different lecture about host pathogen interaction, a cartoon of Tom & Jerry was presented as an example of how pathogens escape the immune system of the host. In a lecture about the applications of DNA, I used music as an example. Music was composed algorithmically from the raw genetic data and protein sequences and is available as free downloads on the internet. Materials from web-sites about musical DNA were

presented. In a lecture about transgenics in animals, PowerPoint slides on transgenic plants were presented. Inspired by the presentation, the students were asked to draw figures on the power of genetic engineering in animals. Additional examples and feedback of the students will be further discussed. My conclusions are that the use of multimedia in classroom leads teachers to think about their students, classes, and lessons in new ways and that it moves instructors from the role of classroom authority into the role of learning coach or facilitator.

Key Words: Multimedia, Genetics, Undergraduate

366 The use of podcasts in the classroom. J. J. Parrish*, *University of Wisconsin, Madison.*

Podcasts are a method to deliver video, images and/or sound via the web. The effect of podcasts on student learning was investigated in an undergraduate reproduction course; 2-50 minute lectures and a 2 hour lab each week. The course is required for both Animal and Dairy Science majors. In year 1 (students=52), lectures were delivered in a traditional classroom setting using powerpoint slides. In year 2 (students=61), the instructor was gone due to sabbatical leave. Labs were given by a TA the same as in year 1. The lectures however were recorded via the commercial software, Profcast. The software allows recording of a powerpoint presentation's slides, complete with audio synchronized to each slide. The resulting file is posted to the web, can be downloaded and replayed in iTunes, a free digital media player application. Students could either take the course in year 2 or wait an additional year if they did not want to take a podcast only delivered lecture. It was unlikely that any pre-selection of students occurred. There was an improvement in exam scores of 10% in year 2 ($p < 0.05$) with a doubling of essay question scores. The same exams were given in year 1 and 2 and also in years 0 and -1. In years -1, 0, and 1, there were no differences in exam scores ($p > 0.05$). Exams in this class are not returned to students but they have access to on-line practice questions that were available in both year 1 and 2. Despite the improvement in learning, there was a trend toward less satisfaction on course evaluations. While many students liked the podcast format, some expressed an inability to ask questions as a problem. Improvement in learning outcomes may be due to allowing students to listen to the lecture at a time when they are better able to retain information. Normally, this class is offered from 8:50 – 9:40 AM and lecture attendance is around 80%. Students indicated they listened to podcasts in the afternoon or evening. Podcasts provide a method to deliver lectures or other course material where students select the viewing time. Podcast are particularly well suited for distance education and

increased student access but may require additional opportunities for student teacher interaction.

Key Words: Podcast, Web

367 Teaching and learning with an instructional web site. M. A. Wattiaux*, *University of Wisconsin, Madison.*

Web postings are now commonplace, but pedagogical use of websites remains a challenge. In the last four years, we have adopted a teaching strategy based on in-class discussions of pre-assigned web-postings (<http://dairynutrient.wisc.edu>) and used course evaluations to study students' perception of the class website. The eight classes presented here were taught from the fall (F) of 2005 to the spring (S) of 2007 and included: College Classroom: Teaching in Science and Engineering (F 06, n=14), Environmental Management of Livestock Operations (F 05-06, n=24), Ruminant Nutrition (S 05-06, n=43), Dairy Cattle Husbandry Practicum (S 07, n=18), and Agriculture in Emerging Economies: Dairying in Mexico (F 05-06, n=18). Respondents included 33 graduate and 84 undergraduate students ranging from freshmen to seniors. Scores were on a 1-to-10 Likert-type scale (1 = "not at all" and 10 = "a great deal"). For each of following statements, mean score (a measure of agreement: high score = high agreement) and mean standard deviation (a measure of consensus: high standard deviation = low consensus) were respectively: "I learned a lot", 8.0, 1.7; "The electronic material combined with in-class discussion was good", 8.7, 1.0; "The website was useful", 8.3, 1.9; "The website should be further developed for future classes", 7.0, 2.1; and "Additional class time for lecturing would be helpful", 5.3, 2.4. Students agreed with discussion of pre-assigned material as an alternative to lecture. However, they were divided on the value of additional class time in lecture. For some students the absence of lecture was a welcome departure from tradition. Others may have grown accustomed to lecture or felt less comfortable with an open-ended classroom environment. Scores for further reliance on the website in the future ranged from 4.2 to 8.2. Some students opined that the site "contained all the information that was really needed" or that it had to be maintained as-is because of the good "combination" with in-class material. Creating coherence between the out-of-class web-related components and the in-class components of these courses was a challenge that depended on learning objectives and perceived educational needs of each cohort.

Key Words: Pedagogy

Nonruminant Nutrition: Feed Additives I

368 Effects of mannan oligosaccharide and mannan rich fraction of *Saccharomyces cerevisiae* on production of cytokines by alveolar macrophages. M. T. Che*, R. W. Johnson, K. W. Kelley, and J. E. Pettigrew, *University of Illinois, Urbana*.

The study, consisting of 3 in vitro assays, was conducted to evaluate 1) inflammatory activity of alveolar macrophages (AM Φ) from pigs fed diets supplemented with mannan oligosaccharide (MOS); 2) cytokine production by AM Φ stimulated in vitro with MOS, mannan rich fraction (MRF) of *Saccharomyces cerevisiae* cell wall, Lipopolysaccharide (LPS), and Poly I:C (PLIC). In assay 1, pigs fed diets with 0%, 0.2%, and 0.4% MOS for 2 weeks post-weaning were slaughtered (1 pig/pen, 6 replicate pens) for collection of AM Φ which were stimulated in vitro with LPS or PLIC. In assays 2 & 3, replicates were donor pigs. In assay 2, AM Φ collected from 4 pigs were stimulated with 7 treatment doses of MOS, MRF, LPS, or PLIC. In assay 3a, AM Φ from 6 pigs were stimulated with MOS, LPS, PLIC, MOS plus LPS, and MOS plus PLIC. Assay 3b was identical to 3a but used MRF instead of MOS. AM Φ were cultured for 24 h, washed 3 times, and then stimulated for 24 h prior to collection of supernatants for measurement of pro-inflammatory (TNF- α) and anti-inflammatory (IL-10) cytokines by ELISA. In vitro LPS-stimulated AM Φ from pigs fed 0.2% or 0.4% MOS diets produced less TNF- α ($P < 0.01$) and more IL-10 ($P = 0.051$) than 0% MOS diet. However, no treatment effects on both cytokines were seen when AM Φ were stimulated with PLIC. TNF- α level peaked at stimulating concentrations of 500 $\mu\text{g/mL}$ MOS, 2500 $\mu\text{g/mL}$ MRF, 1 $\mu\text{g/mL}$ LPS, and 50 $\mu\text{g/mL}$ PLIC. Both MOS and MRF suppressed TNF- α response of LPS-stimulated AM Φ ($P < 0.01$), whereas TNF- α production by PLIC-stimulated AM Φ was decreased only by the presence of MRF ($P < 0.01$). IL-10 production by AM Φ stimulated with MOS or MRF was not affected by the presence of LPS or PLIC. In general, feeding MOS to weaned pigs for 2 weeks or in vitro stimulation of MOS reduced TNF- α production of LPS-stimulated AM Φ .

Key Words: MOS, Weaned Pigs, Cytokine Production

369 Effects of dietary yeast culture supplementation to gestation and lactation diets on performance of sows and litters. S. W. Kim*¹, M. Brandhem², B. Newton³, D. Cook³, and I. K. Yoon⁴, ¹*North Carolina State University, Raleigh*, ²*Hitch Pork Producers, Guymon, OK*, ³*Akey, Lewisburg, OH*, ⁴*Diamond V Mills, Cedar Rapids, IA*.

Four hundred ninety one sows at a commercial operation (Hitch Pork Producers, Guymon, OK) were used to determine dietary effects of yeast culture supplementation (XPC, Diamond V XPCTM Yeast Culture, Diamond V Mills, Cedar Rapids, IA) on litter performance. Sows were grouped by parity (primiparous vs. multiparous). Sows within a group were then allotted to 3 treatments consisting of: CON (no added yeast culture), YC5 (5 and 15 g/d XPC during gestation and lactation, respectively), and YC12 (12 and 15 g/d XPC during gestation and lactation, respectively). Sows were housed individually and fed their assigned gestation and lactation diets from d 35 of gestation to d 21 of lactation. Sows were fed 2.0-kg/d during gestation and *ad libitum* during lactation. Voluntary feed intake was measured daily during lactation. At farrowing, total numbers of pigs born and those born alive were measured. Litter weights were measured at birth and weaning on d 21 of lactation. Litter weight gain of multiparous sows in YC5 (47.4 kg) was 7.5% greater ($P <$

0.05) than CON (44.1 kg) but did not differ from sows in YC12 (45.0 kg). Litter weight gain of primiparous sows did not differ among treatment groups. Number of days from weaning to successful breeding of YC5 (5.75 d) and YC12 (6.80 d) was smaller ($P < 0.05$) than CON (8.74 d) for all sows. Voluntary feed intake of primiparous sows did not differ between CON (6.8 kg) and YC5 (6.6 kg); however, sows in YC12 (6.3 kg) had a smaller ($P < 0.05$) voluntary feed intake than CON. Production efficiency (litter weight gain per lactation feed intake of sow) of YC12 (3.19) was greater ($P < 0.05$) than CON (2.98) considering all sows and that of YC5 (3.09) was greater ($P < 0.05$) than CON (2.84) considering multiparous sows only. This study indicates that dietary yeast culture supplementation benefits productivity of multiparous sows by improving litter weight gain and reducing days from weaning to successful breeding. Improvement in litter weight gain may possibly be due to increasing milk nutrient output, which remains to be investigated.

Key Words: Litter Weight Gain, Sow, Yeast Culture

370 In vitro efficacy of yeast cell walls to bind pathogenic bacteria and to influence performance of broiler chickens. A. Ganner*, S. Nitsch, and G. Schatzmayr, *BioMin Research Center, Tulln, Lower Austria, Austria*.

Yeast cell wall products have been proposed to improve livestock health leading to increased performance. Amongst others this effect can be associated with the ability to bind enteropathogenic bacteria.

Aim of this study was to investigate different yeast cell wall products for their ability to bind *Salmonella*, *E. coli*-, *Campylobacter* and *Clostridium* strains. The products were examined with a quantitative microplate-based assay by measuring the optical density as growth parameter of adhering bacteria. 8 out of 10 *S. typhimurium* and *S. enteritidis* strains adhered to cell wall product MOS1 with an amount of up to 105 CFU/ml. 5 different *E. coli* strains (F4; O108 K; O139 K82; O149 K91; O141 K85ac) were tested for their ability to bind to MOS1. 4 of these strains showed an average binding capability (around 102 CFU/ml) whereas 105 *E. coli* F4 cells bound per ml. *C. jejuni* and *C. perfringens* did not bind to MOS1.

A feeding trial with broiler was conducted to evaluate the efficacy of MOS1 in comparison with commercially available MOS products (MOS2 and MOS3) on performance and health status in a 35 days study. 800 one day old mixed sexed broiler were distributed to 4 experimental groups with 8 replicates: control group A, group B (MOS1, 2kg/T), group C (MOS2, 2kg/T) and group D (MOS3, 2kg/T). In the course of the trial a positive influence could be observed by the addition of MOS1 and MOS2. Live weight (1649g MOS1, 1634g MOS2) and daily weight gain (46.07 g MOS1, 45.64 g MOS2) were improved and showed statistical differences ($P < 0.05$) compared to group A (1502g live weight, 41.84 g dwg) and MOS3 (1456 g live weight, 40.65 g dwg). Feed consumption was increased and feed conversion improved when compared to the control. Mortality rate was higher in group A ($> 6\%$), compared to the groups B, C, D (3,4 and 4,5%). Our results are in agreement with the literature that MOS is able to bind enteropathogenic bacteria, such as *E. coli* and *Salmonella*. This might have been one reason for the increase in performance in the broiler feeding trial.

Key Words: Yeast, *E. coli*, Broiler Performance

371 Effect of enzymatically hydrolyzed yeast supplementation on performance and in protecting broilers against a mild coccidiosis challenge. S. Jalukar^{*1}, J. Oppy¹, and S. Davis², ¹*Varied Industries Corporation, Mason City, IA*, ²*Colorado Quality Research Inc., Wellington, CO*.

This study evaluated the effect of enzymatically hydrolyzed yeast and yeast culture manufactured as a combined supplement called Celmanax[®] on broilers with a mild coccidiosis challenge with *Eimeria*. Celmanax[®] contains complex sugars like galactosamine, mannose and mannan oligosaccharide (MOS). Zero days old Cobb 500 chicks were assigned in 8 replications to 12 treatments with 10 birds/pen. The treatments included 1) Control non treated (NT), challenged 2) Celmanax[®] 2 kg/MT (Cel 2), challenged 3) Celmanax[®] 4 kg/MT (Cel 4), challenged 4) Control, NT non challenged (NC) 5) Cel 2 6) Cel 4 7) Salinomycin (Sal) 50 g/MT 8) Sal 50 g/MT, challenged. Chicks were on the treatment diets from day 0-21. The birds were infected at 15 days of age with 31,000 *E. tenella* (ET) oocysts/bird or with ~37,500 *E. acervulina* (EA) oocysts and ~25,000 *E. maxima* (EM) oocysts/bird. Treatments were assigned to brooding cages using a complete randomized block design. Efficacy

was evaluated by measuring body weight, feed intake and adjusted feed conversion (AFC), and intestinal lesion scores.

The non challenged treatments with Cel 2 and 4 performed well and had numerically improved weight gain (0.32 and 0.31 kg respectively) than the NT, NC control (0.3 kg). The 15-21 day data indicates that the Celmanax[®] treatments challenged with EA and EM did not prevent a significant impact on weight gain and AFC as the salinomycin. The lesion score data indicates that the EM and EA challenge was controlled significantly with Sal treatment (p=0.001) but not by Cel 2 and 4 treatments. The Sal, Cel 2 and Cel 4 treatments significantly decreased the ET lesion scores (0.93, 1.0 and 1.18 respectively p=0.001) compared to the un-treated *Eimeria* control (1.73). Both Cel 2 and Sal improved weight gain (0.306 and 0.31 kg respectively) but only Cel 2 improved AFC (1.389) in chicks challenged with ET compared to NT NC chicks (0.3 kg and 1.393). Overall, Celmanax[®] appeared to have performance improving properties when fed to non-challenged broilers, and showed significant efficacy against *E. tenella* but not against *E. maxima* and *E. acervulina* challenge.

Key Words: Coccidiosis, Poultry

Physiology and Endocrinology: Effects of Environment and Handling on Performance

372 Effects of female holding temperature and post-ovulatory oocyte ageing on egg survival in Pilot Peak Lahontan cutthroat trout, *Oncorhynchus clarki henshawi*. J. P. Bigelow*^{1,3}, M. M. Peacock², W. M. Rauw², and L. Gomez-Raya², ¹U.S. Fish and Wildlife Service, Gardnerville, NV, ²University of Nevada, Reno.

Twenty, 3-year-old females were held at 12.4 °C, and 20 females at 7.2°C from December 18 through the time of ovulation and hand spawning at the hatchery. Females were partially spawned one, four, and seven d post ovulation. Eggs were fertilized with milt from 3-year-old males held in 12.4°C water (one male per female) and then incubated at 12.4°C. All egg batches were enumerated by hand at the eyed-stage of development when dead eggs were removed. Normal appearing fry reaching the yolk sac resorption stage of development were counted 41 d post fertilization. Percent survival was calculated against the total number of eggs for each batch. Mean egg survival was 168% higher for females held at 7.2°C rather than 12.4°C when eggs were collected within one day of ovulation. The effect of water temperature on egg survival was highly significant ($P<0.001$) indicating that reproduction might be reduced in rivers and lakes affected by global warming. Two females in the 12.4°C group exhibited egg survivals higher than the mean survival in the 7.2°C group, suggesting a possible role for individual genetic variability in temperature tolerance. There was no significant effect of oocyte ageing up to one week post ovulation at either temperature. Relative fecundity was lower in the 12.4°C group, and was positively correlated to egg survival in that treatment, suggesting impeded ovulation at the higher temperature. Female length and weight were negatively correlated to egg survival at 12.4°C, indicating reduced heat tolerance for larger fish. These results have implications for management of the captive broodstock, and for reproductive temperature requirements of broodstock progeny spawning in the wild, especially in light of expected global temperature increases.

Key Words: Lahontan Trout, Reproduction, Temperature Tolerance

373 Differential effects of heat stress and reduced nutrient intake on production and metabolism in young growing beef cattle. M. D. O'Brien*, J. B. Wheelock, S. R. Sanders, G. C. Duff, R. P. Rhoads, and L. H. Baumgard, *University of Arizona, Tucson.*

To differentiate between heat stress (HS) and decreased DMI on physiological and metabolic indices in growing beef cattle, we conducted an experiment where a thermal-neutral control group ($n=6$) was pair-fed (PF) to match nutrient intake with heat-stressed Holstein bull calves ($n=6$). Bulls (4-5 mo, 110-160 kg) housed in climate-controlled chambers were fed an 86% concentrate, 14% protein diet and subjected to two experimental periods: 1) thermal-neutral (TN; 18-20°C) and ad libitum intake for 9 d and 2) HS (cyclical daily temps ranging from 29.4 to 40.0°C) and ad libitum intake or PF (TN conditions) for 9 d. During each period, blood was collected daily and all bulls received an iv insulin challenge on d 7 and a glucose tolerance test (GTT) on d 8. Rectal temperatures and respiration rates increased ($P<0.01$) during HS (39.02 to 40.57°C and 42 to 126 breaths/min). HS reduced (12%) DMI and by design, PF bulls had similar nutrient intake reductions. During period 1, body weight gain averaged 1.25 kg/d and both HS and PF reduced ($P<0.01$) ADG similarly (-0.09 kg/d). Compared to PF, HS decreased ($P<0.05$) basal circulating glucose levels (5%) and tended ($P<0.07$) to increase plasma insulin levels (0.60 vs 0.46 ng/mL), but neither

HS nor PF altered plasma NEFA concentrations (95 μ Eq/L). Although there were no treatment differences, both HS and PF increased ($P<0.05$) PUN levels (75%) compared to period 1. In contrast to TN ad libitum conditions, both HS and PF had increased (16%) glucose disposal, but compared to PF, HS had a larger (67%; $P<0.05$) insulin response to the GTT. Neither treatment altered the glucose response to an insulin challenge (area under the curve or fractional rate of glucose clearance). Independent of reduced nutrient intake, HS alters post-absorptive carbohydrate (basal and stimulated) metabolism, characterized primarily by increased insulin levels and insulin response to a GTT. However, HS-induced reduction in feed intake appears to fully explain reduced body weight gain in young Holstein bull calves.

Key Words: Heat Stress, Beef, Insulin

374 The influence of bovine temperament on rectal temperature and stress hormones in response to transportation. N. C. Burdick*¹, J. A. Carroll², R. D. Randel³, R. C. Vann⁴, S. T. Willard⁵, L. C. Caldwell¹, J. W. Dailey², L. E. Hulbert², and T. H. Welsh, Jr.¹, ¹AgriLife Research, Texas A&M System, College Station, TX, ²USDA-ARS Livestock Issues Research Unit, Lubbock, TX, ³AgriLife Research, Texas A&M System, Overton, TX, ⁴Mississippi State University, Raymond, ⁵Mississippi State University, Mississippi State.

This study was designed to determine the influence of bovine temperament on rectal temperature (RT), cortisol (CS) and epinephrine (EPI) secretion in response to transportation. Brahman bulls (10 months of age) were selected from the spring 2007 calf crop based on temperament score which was an average of exit velocity (EV; objective measure) and pen score (PS; subjective behavior score). The bulls with the lowest (C; $n=5$; 0.75 m/s EV and 1 PS), intermediate (I; $n=8$; 1.59 m/s EV and 2.25 PS), and highest (T; $n=4$; 3.59 m/s EV and 5 PS) scores were used for this study. Prior to transportation (departure) blood was collected and serum and plasma harvested. Bulls were also fitted with RT devices that recorded at 1-min intervals. Bulls were then loaded on a trailer and transported 770 km. Upon arrival similar blood samples were collected. Serum CS and plasma EPI concentrations were determined by RIA and EIA, respectively. RT data were summed into 10-min intervals prior to statistical analysis. Data were analyzed by ANOVA using Statview (SAS) and Pearson's correlation coefficients calculated. At departure there was no effect of temperament on CS concentrations ($P>0.05$). Concentrations of EPI were lower in C (110.21 \pm 20.52 pg/mL) and I (133.46 \pm 27.91 pg/mL) when compared to T bulls (359.85 \pm 112.50 pg/mL $P=0.01$). There was no difference due to temperament between departure and arrival concentrations of CS or EPI ($P>0.05$). During transport, RT peaked within 20 min (max RT) before decreasing to baseline values ($P<0.01$). C bulls (39.35 \pm 0.01°C) had lower RT when compared with I (39.61 \pm 0.02°C) and T bull (39.63 \pm 0.02°C; $P=0.06$). Moderate-to-high positive correlations were detected among: max RT and EV ($r=0.62$; $P<0.01$); EV and departure EPI ($r=0.64$; $P<0.01$); EV and arrival EPI ($r=0.58$; $P=0.01$); and EV and arrival CS ($r=0.55$; $P<0.01$). There was a tendency for a positive correlation between max RT and departure EPI ($r=0.46$; $P=0.06$). In conclusion, max RT was reached within 20 min of onset of transportation. Temperament and adrenal function were predictive of RT changes due to transportation.

Key Words: Bovine Temperament, Transportation, Rectal Temperature

375 Effects of acclimation on performance, physiologic responses, and puberty attainment of Brahman-crossbred heifers. R. F. Cooke*^{1,2}, B. R. Austin², J. V. Yelich², and J. D. Arthington¹, ¹University of Florida - IFAS, Range Cattle Research and Education Center, Ona, ²University of Florida - IFAS, Animal Sciences, Gainesville.

The objective of this study was to evaluate the effects of acclimation on growth, plasma concentrations of progesterone (P4) and cortisol, and puberty attainment of Brahman-crossbred heifers. Over 2 consecutive years, 80 heifers were initially evaluated for puberty status via trans-rectal ultrasonography (d 0 and 10) and for temperament by measurements of chute score, pen score, and exit velocity (d 10) within 30 d after weaning. On d 10, heifers were stratified by puberty status, temperament and BW, and randomly assigned to control or acclimation treatment. Heifers were maintained in bahiagrass (*Paspalum notatum*) pastures and received a blend of soybean hulls and cottonseed meal at a daily rate of 2.7 kg of DM per heifer throughout the experimental period (d 0 to 130). The acclimation process (d 11 to 40) consisted of bringing heifers to the cowpens 3 times weekly, where heifers were exposed to common handling practices and returned to pastures within 2 h. Heifer puberty status, evaluated via plasma P4 concentrations and trans-rectal ultrasonography, and BW were assessed on d 40 and 50, d 80 and 90, and d 120 and 130. Blood samples were also collected prior to (d 10) and at the end of the acclimation process (d 40) for determination of plasma P4 and cortisol concentrations. Heifer temperament was assessed again on d 40 of the study. No treatment x year interaction was detected. Acclimated heifers had decreased ($P < 0.05$) BW gain compared to control heifers (0.50 vs. 0.58 kg/d, respectively). Attainment of puberty, however, was increased ($P < 0.01$) for acclimated heifers. A treatment x day interaction was detected ($P < 0.05$) for plasma cortisol and P4 (within prepubertal heifers only) concentrations because heifers from both treatments had similar concentrations on d 10, but acclimated heifers had decreased concentrations of these hormones compared to control heifers on d 40 (3.6 vs. 5.2 ng/mL of cortisol, respectively; 0.50 vs. 0.91 ng/mL of P4, respectively). Results from this study indicated that although acclimation decreased BW gain, it enhanced the attainment of puberty of Brahman-crossbred heifers.

Key Words: Brahman-Crossbred Heifers, Acclimation, Puberty

376 Effects of acclimation on performance, physiologic responses, and pregnancy rates of Brahman-crossbred cows. R. F. Cooke*^{1,2}, D. B. Araujo^{1,2}, G. C. Lamb³, and J. D. Arthington¹, ¹University of Florida - IFAS, Range Cattle Research and Education Center, Ona, ²University of Florida - IFAS, Animal Sciences, Gainesville, ³University of Florida - IFAS, North Florida Research and Education Center, Marianna.

The objective of this study was to evaluate the effects of acclimation on performance, plasma concentrations of hormones and metabolites, and pregnancy rates of Brahman-crossbred cows. Approximately 30 d after weaning (August), 238 Brahman x British and 164 Braford cows were stratified, within breed, by temperament (measurements of chute score, pen score, and exit velocity), BW and BCS, and randomly allocated to 14 groups (Braford = 8; Brahman x British = 6). Groups were randomly assigned to control or acclimation treatment. Cows were maintained in bahiagrass (*Paspalum notatum*) pastures and received a blend of cane molasses and urea at a daily rate of 1.8 kg of DM per cow beginning in December. Cows were acclimated from August to February, and the acclimation process consisted of visiting groups twice weekly and hand-offering approximately 50 g of range cubes per cow. On February, cow temperament, BW and BCS was again assessed and cows were exposed to mature bulls for 90 d. Blood samples were collected at the beginning of the acclimation period and also breeding season for determination of cortisol, IGF-I, ceruloplasmin, and haptoglobin concentrations. Pregnancy was determined via trans-rectal ultrasonography 70 d after the end of breeding season. Within Braford cows, a treatment effect was detected ($P < 0.01$) for pregnancy rates because acclimated cows conceived earlier and at greater number compared to control cows. When data were combined between treatments and breeds, the probability of pregnancy increased linearly ($P < 0.05$) as temperament score and concentrations of ceruloplasmin, haptoglobin, and cortisol (Braford cows only) obtained at the beginning of the breeding season decreased. Probability of pregnancy was affected quadratically ($P < 0.05$) by BCS and IGF-I concentrations also assessed at the beginning of the breeding season. In conclusion, acclimation increased pregnancy rates of mature Braford cows, whereas measurements and physiologic responses associated with temperament and energy status appear to influence the probability of cows to conceive and maintain pregnancy during the breeding season.

Key Words: Brahman-Crossbred Cows, Acclimation, Pregnancy

Animal Behavior and Well-Being: Livestock: Swine and Sheep

377 ASAS Centennial Presentation: Animal behavior as a discipline within the American Society of Animal Science: One hundred years of change and promise. W. R. Stricklin*, *University of Maryland, College Park.*

Animal science emerged as a discipline from a tradition of using animals for human needs. One hundred years ago, the majority of Americans lived on farms in close association with animals. Animal husbandry programs emphasized good stockmanship which assumed students had a general knowledge of animal behavior. Today, 2% of Americans live on farms and husbandry systems differ greatly from earlier ones. Thus, the need for animal scientists to teach animal behavior is increasingly recognized. Within ASAS behavior research grew slowly and was influenced by other disciplines. The psychology-based American discipline of Behaviorism began 100 years ago but continues to have influence. Behaviorism contended that only what animals do (behavior) can be measured, and concepts such as motivation, feelings, pain, etc. were dismissed on the basis of parsimony. Concurrently, the European-based discipline of Ethology viewed behavior as genetically adaptive. American animal scientists Jay L. Lush et al. researched genetic aspects of behavior, but this work lessened as Animal Breeding faded. Ethology clashed with Behaviorism's view that behavior arises strictly from development and learning. The Ethologists' contention that suffering results when genetically-based behavioral drives are thwarted was included in the 1965 British Brambell report, a document that continues to influence animal welfare discussions. More recent USA public concern for welfare resulted in federal research funding. However, because the funds were labeled "animal well-being," behavior was typically researched only as a dependent variable. Consequently, the arguably sorely needed, stand-alone research-based subdiscipline of Applied Behavior within American animal sciences is yet to be attained.

Key Words: Applied Behavior, Animal Welfare, Animal Science

378 The effect of the autosort system on swine well-being. A. E. DeDecker*, J. M. Suchomel, and J. L. Salak-Johnson, *University of Illinois, Urbana.*

Limited data exist on the impact that autosort, a behavior-based production system, has on pig well-being. The objectives of this study were to evaluate a) how different autosort floor layouts affect wean-to-finish pig behavior and physiology (Exp1) and more specifically b) how different food court layouts affect pig well-being (Exp2). At weaning, pigs were randomly assigned to a water court (WC; 20% floor space, n = 633), food court (FC; 40% floor space, n = 617), fast lane (FL; 12.5% floor space per zone, n = 630) autosort layout, or conventional large pen (CV; control, n = 609). Physiological measures were evaluated via blood samples pre- and post-transportation. Live behavioral observations were registered during a 3-wk training period and at loading. Scan sampling was used to determine the total number of pigs performing specific behaviors at a given time. Data were analyzed using Proc GLM and MIXED with repeated measures and Chi-Square (SAS). In Exp1, cortisol levels were higher among CV pigs than among autosort pigs pre-transportation (P<0.001). Levels of IGF-1 were higher in the FC than all other treatments pre-transportation, while there was a differ-

ence pre- to post- transportation in the FC (P<0.04). White blood cell counts and neutrophil-to-lymphocyte ratio were greater (P ≤ 0.06) in CV pigs pre- and post- transportation than in certain autosort layouts. Floor layout influenced percent monocytes and eosinophils pre- and post- transportation (P ≤ 0.05). Number of pigs engaged in and time spent eating or drinking, as well as training and loading behaviors, were significantly affected by treatment (P ≤ 0.05). In Exp2, preliminary data indicate that pigs in a FC layout are less difficult and require less time to load than pigs from large and small CV pens (P<0.05). Number of rears and prod use were greater in pigs from small CV pens than all other treatments (P<0.05). During training, behaviors were different among treatments (P<0.05). Floor layout influenced white blood cell counts pre- and post-transportation. These data indicate that autosort layouts can affect ease of loading, various behaviors, and physiological measures throughout wean-to-finish.

Key Words: Autosort, Cortisol, Pig

379 The motivation of dominant and subordinate gestating sows for an enriched group pen. M. R. Pittman*¹, A. K. Johnson², J. P. Garner¹, R. D. Kirkden¹, B. T. Richert¹, and E. A. Pajor¹, ¹*Purdue University, West Lafayette, IN*, ²*Iowa State University, Ames.*

The swine industry is under pressure to consider alternatives to gestation stalls, including enriched group housing. The importance of these alternatives from the sows' perspective is unknown. The aim of this study was to compare the motivation of dominant (D) and subordinate (S) gestating sows for access to a group pen with feeding stalls and the following enrichments, a rubber mat, cotton cords, compost and straw. Groups of 3 Landrace x Yorkshire sows (42) were mixed post-breeding and test sows (D, n=7; S, n=7) were identified. Sows were trained to press an operant panel to gain access to the enriched group pen in which they spent 23 h. The fixed ratio schedule (the number of times that the sow was required to press) was increased daily. The highest schedule reached was the measure of motivational strength. The behavior of the sows was also recorded throughout the experiment. Data were analyzed with ANOVA using GLM and post-hoc Tukey tests. Upon entering the pen, sows, regardless of social status, spent 43.8 ± 3.64% of observations using the enrichments (rope 0.06 ± 0.02%, compost 21.4 ± 3.09%, and straw 22.3 ± 3.61%). The highest schedule pressed was not significantly different for D vs. S sows (41 ± 11.77 vs. 53 ± 11.74; P>0.10). However, previous work has shown that this level of pressing is roughly equivalent to the motivation of a sow working to gain access to a food reward after consuming 50% of her ad lib (4 kg) intake suggesting access to the enriched pen was important to sows. There were no statistical differences between D and S sows in drinking, straw use or compost use (all comparisons, P>0.10). D sows showed higher aggression compared to M sows (P<0.10) and S sows (P<0.05), while M vs. S sows was not significantly different (P>0.10). Locomotion was lower in D sows compared to S sows (P<0.10). In conclusion, D and S sows are equally motivated to gain access to an enriched group pen and behaved similarly within the space, spending almost half of their time in enrichment directed behavior.

Key Words: Gestating Sows, Motivation, Enriched Housing

380 Behavioral changes in young pigs infected with *Salmonella*. J. Higginson*¹, J. T. Gray², and S. T. Millman³, ¹University of Guelph, Guelph, ON, Canada, ²Des Moines University, Des Moines, IA, ³Iowa State University, Ames.

The objectives of this study were to determine if aggression, cleanliness, and exploratory behavior were altered when group-housed swine are infected with *Salmonella*. Twelve groups of 5 Landrace/Yorkshire weaned pigs (n=60 pigs) were housed in separate biosecure rooms. One pig per group was randomly selected as the seeder animal and given 10⁷-10⁸ CFU of *Salmonella typhimurium* orally on Day 0. All pigs were individually marked for identification and observers were blind to treatments. Fresh lesion scores and cleanliness scores were recorded daily on Day -1 through Day +6. Latency to approach a novel object was used as a measure of exploratory behavior, and was performed using 4 different objects on Days -1, +1, +3 and +6 with order of presentation balanced between groups. Preliminary analysis was performed using t-tests, comparing seeder animals to the mean of the undosed penmates. Infected pigs did not differ from their penmates for lesion scores (mean + S.E. was 0.25 ± 0.06 and 0.20 ± 0.04 for seeder and penmates respectively, P=0.54). Lesion scores did not differ relative to days. Similarly, seeder pigs did not differ from penmates for cleanliness scores (mean + S.E. 1.54 ± 0.19 and 1.60 ± 0.09 for seeders and penmates respectively, P=0.79). However, seeder pigs were significantly cleaner than penmates on Day +2 (1.03 ± 0.16 versus 1.54 ± 0.19, P<0.05). All pigs approached the novel object significantly faster on subsequent days (P<0.05), but there was no significant difference between seeders and non-seeders for this behavior. In conclusion, there was little evidence to support differences in behavior of animals infected with *Salmonella* relative to their healthy penmates for cleanliness, lesions scores or exploratory motivation.

Key Words: Sickness Behavior, Swine, *Salmonella*

381 The social behavior carried out by unacquainted sows on mixing may predict the likelihood of escalation into aggression. J. N. Marchant-Forde*¹, J. P. Garner², E. L. Schenck¹, A. K. Johnson³, and D. C. Lay Jr.¹, ¹USDA-ARS, West Lafayette, IN, ²Purdue University, West Lafayette, IN, ³Iowa State University, Ames.

Aggression is a major well-being challenge when housing sows in groups. Aggression can increase injuries and stress, whilst detrimentally affecting productivity and cost of production. The aim of this project was to determine the behavioral sequences associated with fight and non-fight interactions when two unacquainted sows are mixed. Twelve unacquainted multiparous sows were mixed in pairs immediately after weaning. Body weight, parity, litter of origin, and body length were measured 1 d prior to mixing. All sows were paired based on body weight and parity. Each pair was placed in a 6 m² pen, with 1.2m high solid walls to eliminate outside influences on behavior, for 1 hr during which behavior was video-recorded in real time. All social interactions were extracted from the video data by one experienced observer, using an ethogram containing 10 behaviors to describe each interaction. A new interaction was defined as ≥5 sec of non-contact from the end of the previous interaction. Aggressive interactions were defined as a bite to the body. To identify behaviors predictive of aggression, the first 20 behaviors in an observation, and the last 20 immediately preceding the first act of aggression were collated, to form non-aggressive and aggressive behavioral profiles respectively. Behavioral data were analyzed using a split-plot GLM, blocked by observation. Profiles

differed between the start of the observation and prior to the first fight (F_{9,95} = 4.89; P<0.0001). Bonferroni post hoc planned comparisons showed that 'nose-to-nose contact' decreased immediately before a fight (P=0.0001; alpha = 0.005), and 'no reaction to social behavior' was greater (P=0.0060; alpha = 0.005). In conclusion, nose-to-nose contact reduces the chance of aggression in sows, while a failure to respond to social behaviors increases it.

Key Words: Pigs, Aggression, Mixing

382 The effects of ractopamine, gender, and social rank on aggression and peripheral monoamine levels in finishing pigs. R. Poletto*^{1,2}, J. P. Garner¹, H. W. Cheng², B. T. Richert¹, and J. N. Marchant-Forde², ¹Purdue University, West Lafayette, IN, ²USDA-ARS-LBRU, West Lafayette, IN.

The aim of this study was to evaluate effects of a "step-up" ractopamine (RAC) feeding program on home pen aggression and peripheral levels of tryptophan (Trp), serotonin (5HT), dopamine (DA), norepinephrine (NE) and epinephrine (EP) in finishing pigs. Thirty-two pigs (16 barrows and 16 gilts) were assigned as either control (CTL) or RAC treatment (pen=4/gender). Treated animals were fed RAC at 5 ppm for 2 wk, then 10 ppm for additional 2 wk. The dominant and subordinate pigs in each pen were determined at assignment by the proportion of encounters won or lost over 36 h. Behavior in the home pen was continuously recorded once a wk (0800 h to 1100 h) for 5 wk to determine number of bites (B), head knocks (HK) and pursuits (P). Blood was collected from each animal once a wk for 5 wk, starting prior to dietary treatment and levels of Trp, 5HT, DA, NE and EP were measured using HPLC. A 2×2×2 factorial analysis was computed with repeated measures mixed models using individuals as units. Gilts showed more B (1.7±0.2 vs. 0.9±0.2, P<0.05) per interaction compared to barrows. Compared to baseline, RAC-fed gilts increased B while others decreased (P<0.05). CTL barrows showed the lowest number of HK (0.4±0.1), with others showing similar counts (0.7±0.1, treatment×gender, P<0.05). Pursuits increased greatly from baseline in RAC-fed gilts, but decreased for others (treatment ×gender, P<0.01). Overall, gilts showed more total actions per aggressive interaction than barrows (2.5±0.2 vs. 1.5±0.2, P<0.01) and RAC-fed gilts had an increase in the total number actions performed (P<0.01). RAC-fed gilts had lower 5HT compared to RAC-fed barrows (treatment×gender, P=0.08) and overall, Trp and 5HT levels increased up to d11 then plateaued (day, P<0.01). Dominant RAC pigs had highest concentrations of NE (P<0.05), and dominant barrows had higher EP levels than subordinate ones (P<0.05), but EP concentrations were similar in gilts regardless of social status. Gilts, especially RAC-fed gilts, showed more aggressive behavior which may be linked to lower 5HT availability, leading to increased production costs and impairment of welfare.

Key Words: Swine, Ractopamine, Aggression

383 Preference for foods by lambs conditioned with rumen distension and contraction. J. J. Villalba* and F. D. Provenza, Department of Wildland Resources, Utah State University, Logan.

Bloat is a major nonpathogenic cause of death and illness in livestock characterized by an accumulation of fermentation gas within the rumen which increases intraruminal pressure. We determined whether sheep

could associate ingestion of specific foods with the consequences of increased intraruminal pressure and its subsidence. In Experiment 1, 6 fistulated lambs (39 ± 2 Kg) were offered ground alfalfa, a familiar food, for 30 min after a rubber balloon was or was not inserted into the rumen of each animal. When present, the balloon was either not distended or distended with air to a volume of 1.8, 2.5 or 4.5 L. Food intake did not differ when the balloon was absent from the rumen or when it was present but not distended ($P > 0.05$). However, distension affected food intake ($P < 0.001$), which decreased linearly with an increase in distension ($r^2 = 0.7$). In Experiment 2, the 6 fistulated lambs were offered a novel food, Group 1 ($n = 3$) wheat bran and Group 2 ($n = 3$) beet pulp, after which a balloon in the rumen of each lamb was distended to a volume of 2.5 L for 30 min. The foods were then switched (Group 1: beet pulp; Group 2: wheat bran) and the balloons were deflated, relieving the intraruminal pressure. Lambs were then offered choices between the 2 novel foods and between the novel foods and alfalfa. All lambs strongly avoided the food ingested before the onset of ruminal distension, but preferred the novel food ingested when distension subsided ($P < 0.001$). A Control group of lambs that experienced the same conditioning protocol but without changes in ruminal pressure neither preferred nor avoided the novel foods ($P > 0.05$). Thus, sheep learned about the negative effects of increased intraruminal pressure and the positive effects of recovery from intraruminal pressure. These associations are likely to be critical in learning avoidances of bloat-inducing plants and preferences for plants and supplements that relieve the incidence of bloat.

Key Words: Bloat, Foraging, Sheep

384 Feeding behavior and rumen pH of lactating dairy sheep fed diets with different starch, NDF, and peNDF content. G. Molle¹, F. Boe², V. Giovanetti¹, M. Decandia¹, E. Zerbini³, and A. Cannas², ¹AGRIS Sardegna, Dipartimento Ricerca nelle Produzioni Animali, Olmedo, Italy, ²Dipartimento di Scienze Zootecniche, University of Sassari, Italy, ³Cargill Animal Nutrition, Spessa, Italy.

There is little information on the combined effects of dietary NDF, physical effective NDF (peNDF), and starch on feeding behavior and

rumen function in lactating dairy sheep. To address this gap, 40 Sarda ewes in mid-lactation were individually fed ad libitum 8 complete pelleted diets (5 ewes per diet), which differed in NDF and starch content and source. Based on their main ingredient, diets were denominated: corn meal (CM), wheat middlings (WM), corn flaked (CF), barley meal (BM), corn cobs (CC), beet pulp (BP), alfalfa (AA) and soybean hulls (SH). For each diet, peNDF was measured by dry sieving. Two hours after the morning feeding, rumen liquid was sampled with a stomach tube and its pH was measured. Sheep feeding behavior was observed for 24 h. Eating (ET), ruminating (RT), total chewing (CT = ET + RT) and idling times (IT) were measured by scan sampling each sheep every 2.5 min. Group average data were analysed using correlation and regression models.

Extreme peNDF were in diets CC and AA (25 to 27% DM) and WM and CF (6 to 9% DM), respectively. The RT was associated with peNDF intake ($r = 0.76$, $P = 0.03$), while it was not related to total NDF intake ($r = 0.54$, $P = 0.17$). In addition, the feeding behavior was strongly influenced by NDF particles larger than 2.36 mm ($r = 0.96$, $P < 0.001$, and $r = 0.93$, $P < 0.001$, for RT and CT, respectively) but not by those between 1.18 mm and 2.36 mm ($P > 0.1$ for both RT and CT), suggesting that the threshold of 1.18 mm used to define the peNDF might not be appropriate for sheep fed pelleted diets with small particle size.

Rumen pH was mostly influenced by the intake of starch ($r = -0.63$, $P = 0.09$) and NDF ($r = 0.69$, $P = 0.06$), while it was poorly associated with peNDF intake ($r = 0.53$, $P = 0.17$) and not associated at all with RT ($r = 0.13$, $P > 0.1$) or CT ($r = 0.1$, $P > 0.1$). This suggests that when sheep are fed diets characterized by small particle size, rumen pH is mainly influenced by NDF and starch intake rather than by peNDF content or RT.

Key Words: Feeding Behavior, peNDF, Rumen pH

Animal Health V

385 Advances in respiratory disease research. G. D. Snowden*, *National Center for Foreign Animal and Zoonotic Disease Defense, College Station, TX.*

Respiratory disease complex is the most costly livestock disease in the USA. Recent scientific advances in metaphylactic and therapeutic treatments, pathogenic mechanisms, immunological responses, inherent host resistance, management and preconditioning treatments, and several other areas to reduce the prevalence and economic impact of respiratory diseases have been reported. Innovative nutritional approaches for animals newly introduced to a feedlot suggest changes to vitamin and mineral content, and nutrient concentrations of initial diets to reduce respiratory disease morbidity. The effect of fear and stress in livestock on their immune system is being clarified. Research is also expanding our understanding of the pulmonary innate immune system regulating antimicrobial peptide/protein expression of the respiratory tract which may lead to novel prophylactic and therapeutic modalities to minimize mortality and morbidity. The method of infection by microbial pathogens is beginning to be understood as the role of pro-inflammatory chemokines and cytokines that recruit neutrophils, macrophages, and lymphocytes to the respiratory tract is elucidated. New vaccines administered by the mucosal route are being developed from research that manipulated the genome of various bacteria and viruses to identify the role of different proteins in the pathogenesis. Genetic selection to reduce respiratory disease may become more plausible as genetic factors influencing susceptibility to respiratory diseases are identified in many livestock species. A few quantitative trait loci associated with respiratory disease resistance have also been recently identified. Although complete control of respiratory disease may not be likely in the near future, new technologies and information will likely reduce the prevalence of respiratory disease in livestock.

Key Words: Immune Response, Shipping Fever, Livestock

386 An evaluation of tulathromycin treatment at post-weaning movement on the incidence of respiratory disease and on growth in commercial dairy calves. A. Stanton*¹, S. J. LeBlanc¹, R. T. Dingwell¹, D. Kelton¹, S. T. Millman¹, J. Wormuth¹, and K. E. Leslie¹, ¹*University of Guelph, Guelph, ON, Canada*, ²*CY Heifer Farm, Elba, NY.*

Bovine respiratory disease (BRD) is common following weaning and movement of calves from individual to group housing. The objective was to evaluate the effects of tulathromycin administered at the time of grouping post-weaning on the incidence of respiratory disease and on growth in dairy calves. The study was conducted at a custom heifer raising facility in New York State. 1,367 weaned dairy calves were randomly assigned to receive either tulathromycin (TUL) or oxytetracycline (TET), once SC at the time of movement. Weights and heights were measured on all calves at arrival at the farm (2-7 days of age), at enrolment (~56 days of age), and ~6 weeks post-enrolment (~97 days of age). All disease events were recorded by trained barn staff. The incidence of BRD was 8% and 13% in the TUL and TET groups, respectively. Controlling for source farm and enrolment cohort, calves treated with TET were 1.9 times more likely to be treated for BRD within 60 days post-enrollment than calves treated with TUL ($P < 0.001$).

Independent of experimental treatment, calves with non-specific fever in the 2 weeks before enrollment were 2.7 times more likely to have BRD than calves without fever ($P < 0.05$). In calves ($n = 1,207$) that were not diagnosed with non-specific fever by farm staff between birth and 5 weeks of age, animals treated with TUL had an ADG 0.11 kg/d greater than TET calves ($P < 0.001$). Accounting for treatment group, calves that had non-specific fever within 2 weeks before enrollment had a decrease in ADG of 0.11 kg/d ($P < 0.01$). Among calves diagnosed with non-specific fever between birth and 5 weeks of age ($n = 160$), treatment TUL or TET did not have a significant effect on ADG. Separate from the effect of experimental treatment, diagnosis of BRD within 60 days post-enrollment decreased ADG by 0.2 kg/d. Treatment did not affect mortality.

In this population of calves at risk of respiratory disease in the post-weaning period, treatment with TUL resulted in a lower incidence of BRD and increased weight gain than treatment with TET.

Key Words: Tulathromycin, Weaned Dairy Calves, Respiratory Disease

387 An evaluation of a Brix refractometer for measurement of colostrum quality and success of passive transfer. V. Biemann*, J. Garner, C. Throop, N. Perkins, and K. Leslie, *University of Guelph, Guelph, ON, Canada.*

New techniques to evaluate colostrum and passive transfer in dairy cattle are needed. These methods must be simple, rapid, accurate, inexpensive, and adaptable to farm conditions. The Brix refractometer was evaluated in colostrum samples from 231 Holstein cows from 3 dairy herds from May to August 2007. In addition, serum samples were collected from a subset of the newborn calves from these cows within 1 to 4 days of age. The immunoglobulin concentration of the colostrum samples was measured by a radial immunodiffusion (RID) assay. The correlation coefficient between the RID and the Brix scores for the 222 colostrum samples was $R^2 = 0.32$. Using a Brix score of 18%, the sensitivity and specificity for identifying colostrums samples with inadequate IgG concentrations (50g/L) was 34% and 94%, respectively. By these results, use of the Brix refractometer to identify and discard colostrum of inferior quality for first feeding in dairy calves would result in a large number of false negative colostrums being eliminated. Factors affecting these test characteristics were evaluated. Unlike the Colostrometer™, no significant difference was found between Brix scores taken at 3 different colostrum temperatures (5, 20 and 38°C). Interestingly, no substantial difference in colostrum quality was observed between primiparous and multiparous animals in this study. A total of 202 calf serum samples were evaluated using the Brix refractometer and a standard digital refractometer to measure serum total solids (TS). A correlation coefficient of 0.77 was determined between the Brix and digital refractometer results. These data indicate considerable utility of the Brix instrument for assessment of passive transfer in dairy calves. There is a need for further evaluation and refinement of the Brix refractometer for use as a tool for assessment of colostrum quality. Yet, having one instrument for both evaluations would make it a very useful farm management tool.

Key Words: Refractometer, Colostrum, Calves

388 Comparison of Brix (sugar) refractometer and colostrometer for evaluation of colostrum quality in dairy cows. P. Dinsmore^{*1} and A. Skidmore², ¹Colorado State University, Fort Collins, ²Schering-Plough Animal Health, Alexander, NY.

Measurement of colostrum Ig is an important on-farm procedure to ensure adequate transfer of Ig to the newborn calf. A colostrometer, which measures the specific gravity (SG) of colostrum, is currently available but not widely used. It has disadvantages: 1) colostrum SG is more strongly associated with protein than Ig, and 2) SG is affected by colostrum temperature. A Brix sugar refractometer (Brix) has been useful in estimating equine colostrum quality. It is simple and rapid to use. The study objective was to evaluate the Brix for measuring dairy cow colostrum quality and to compare it to the colostrometer. First-milking colostrum was obtained from 117 cows on a large Colorado dairy. Colostrometer measurements were made by farm personnel. Brix measurements were made in triplicate on fresh samples and were performed by the senior author. A subset of samples (17) was tested at 3°C, 20°C, and 38°C. The samples were submitted for radial immunodiffusion (RID) measurement of IgG, as well as fat and protein determination. No temperature effect was found, and the triplicate Brix measurements were statistically identical for a given sample. When reading the Brix values, a wide band of color transition was found in 25% of samples and was found to be strongly associated with fat level in the sample. The multiple linear regression model with the highest R² (0.623) included Brix value and lactation group. The correlation between colostrometer and RID was 0.36. At the minimum colostrum IgG concentration of 50mg/ml indicating adequate colostrum quality, the Brix value was 23 and 20 for lactation 1 and lactation 2+ cows, respectively. Using these cutoff values and RID=50 mg/ml as the gold standard, the specificity of the colostrometer, Brix for lactation 1, and Brix for lactation 2+ were 0.25, 0.56, and 0.37, respectively. Compared to the colostrometer, the Brix refractometer values were more highly correlated with colostrum IgG values, was simpler to use, and was unaffected by temperature of the colostrum.

Key Words: Colostrum, IgG, Refractometer

389 Thermal imaging of the bovine muzzle and the correlation to rectal temperature. S. M. Behrends*, T. B. Schmidt, P. Ryan, S. Willard, M. McGee, C. Welch, C. Trejo, J. O. Buntyn, and C. Huston, Mississippi State University, Mississippi State.

Crossbred calves (n=133) weighing an average of 228.82 ± 22.15 kg were evaluated upon arrival at a 10,000-head capacity backgrounding facility to evaluate an easily obtainable measurement taken at arrival as a prognostic tool for sorting incoming cattle. Standard protocol upon arrival was individual ID (ear tag), antiemetic application and vaccinations for respiratory disease (modified live vaccine) and clostridial pathogens. In addition to arrival protocol, heifers were weighed, rectal temperature determined, and a thermal image (FLIR ThermaCAM EX320) was captured. Thermal images were collected at a standard distance of 76.2 cm from the restraining chute. To determine the correlation between rectal temperature and thermal images; the image of Planum Nasolabiale Area (PNA) of the muzzle was highlighted and then bisected by one vertical line, one horizontal line, and two diagonal lines into quadrants that intersected at the geometric center of the PNA. Muzzle temperature was positively correlated with rectal temperature taken at the time of processing (P<0.01). The most highly correlated area on the muzzle was the convergence of lines in the geometric center

of the PNA (r=0.50; P<0.01) and the least correlated measure was the diagonal line bisecting the PNA (r=0.34; P<0.01). Factor 1 from principle component analysis (PCA) had high loadings for quadrants bisected by the vertical line (0.99 and 0.97; PCA). Thermal temperature measures of the bovine muzzle appear to hold promising correlations to rectal temperature and with further investigation possibly provide a tool for early detection of stress and susceptible cattle.

Key Words: Body Temperature, Cattle, Muzzle

390 Sorting heifers with high risk of bovine respiratory disease based on arrival serum haptoglobin concentration. B. P. Holland*, L. O. Burciaga-Robles, D. L. Step, and C. R. Krehbiel, Oklahoma State University, Stillwater.

Heifers (n=337; initial BW=241±17 kg) were assembled at a western Kentucky order buyer facility and shipped in two groups 957 km to Stillwater, OK. Upon arrival blood was collected and serum analyzed for haptoglobin (Hp) concentration. Heifers were sorted into 3 groups according to arrival Hp concentration. Groups were LOW (<1 µg/100 mL), MED (1 to 3 µg/100 mL), and HIGH (>3 µg/100 mL). Within 36 h after arrival, calves were penned according to groups and fed for a 63-d receiving/growing period. Body weight and blood for Hp analysis were collected on d 7, 14, 21, 42, and 63. Blood for Hp analysis was also collected at the time of antimicrobial treatment for bovine respiratory disease (BRD). Haptoglobin concentrations on arrival were 0.79, 1.93, and 7.60 µg/100 mL for LOW, MED, and HIGH, respectively (P<0.01). On d 7, Hp tended (P=0.08) to be greater for HIGH than LOW and MED. Similarly, Hp tended (P=0.09) to be least for LOW, intermediate for MED, and greatest for HIGH on d 21. Arrival BW was greater for LOW and HIGH than MED (P<0.01). However, BW did not differ throughout the remainder of the trial (P>0.27). Average daily gain was least (P=0.01) for HIGH from d 1 to 7, but no other differences (P>0.19) in ADG were observed. Overall DMI was not different (P=0.89) among treatments, but was greater (P=0.02) for LOW (6.26 kg/d) and MED (5.74 kg/d) than HIGH (5.18 kg/d) from d 1 to 21. Overall morbidity due to BRD was greater (P=0.01) for MED and HIGH (66.9 and 76.2%, respectively) than for LOW (50.8%). The number of heifers requiring three treatments was also greater (P=0.01) for MED and HIGH (28.2 and 28.5%, respectively) than for LOW (9.78%). However, heifers considered chronically ill was greatest (P=0.03) for MED (18.3%), intermediate for HIGH (9.6%), and least for LOW (5.2%). Total mortality and case fatality rate did not differ (P>0.68) among groups. Average daily gain and DMI early in the growing period, as well as overall morbidity, were affected by arrival Hp concentration. Arrival Hp concentration may be a beneficial tool for making management decisions for calves with high risk of BRD.

Key Words: Acute Phase Protein, Bovine Respiratory Disease, Calves

391 Effects of on-arrival vs. delayed clostridial or modified-live respiratory vaccinations on health, performance, bovine viral diarrhea titers, and physiological measures in high-risk, newly received beef calves. J. T. Richeson^{*1}, E. B. Kegley¹, M. S. Gadberry², P. A. Beck³, J. G. Powell¹, and C. Jones⁴, ¹University of Arkansas, Fayetteville, ²University of Arkansas, Little Rock, ³University of Arkansas, Hope, ⁴Boehringer-Ingelheim Vetmedica, Inc., St. Joseph, MO.

Stress commonly associated with weaning, marketing, and shipment of feeder cattle can compromise immune function, and vaccine administration during immunosuppression may reduce vaccine efficacy and calf growth. Four treatments were compared in a 2 × 2 factorial arrangement to evaluate the effect of on-arrival (d 0) vs. delayed (d 14) administration of 7-way clostridial (Alpha[®] 7, Boehringer-Ingelheim Vetmedica, Inc. [BIVI]; CLOS) and modified live viral respiratory (Express[®] 5, BIVI; RESP) vaccines. Crossbred calves (n = 263) were weighed (238 ± 1.2 kg), stratified by gender, and assigned randomly to vaccination treatment: 1) arrival CLOS, arrival RESP (ACAR), 2) arrival CLOS, delayed RESP (ACDR), 3) delayed CLOS, arrival RESP (DCAR), and 4) delayed CLOS, delayed RESP (DCDR). Gain did not differ ($P = 0.74$) averaging 0.98, 0.93, 0.95, and 0.91 kg/d for ACAR, ACDR, DCAR and DCDR, respectively for the entire 56-d trial. Vaccination timing did not affect morbidity ($P = 0.49$); however, there tended to be CLOS ($P = 0.07$) and RESP timing effects ($P = 0.09$) on d to initial bovine respiratory disease (BRD) treatment episode. Average d to initial BRD treatment were less for ACAR (6 ± 0.8 d) compared to DCDR (8 ± 0.8 d; $P = 0.01$). Serum cortisol concentrations were greater ($P \leq 0.01$) on d 0 than 14 or 28 but no treatment × day interaction ($P = 0.21$) was observed. RESP timing affected ($P = 0.001$) serum BVD titer levels, with greater ($P < 0.01$) levels in calves administered RESP vaccine on arrival. Delaying CLOS or RESP vaccination did not affect gain or morbidity in high risk, newly received stocker calves. Calves administered RESP vaccine on d 0 developed antibody titers to BVD earlier than delayed RESP treatments.

Key Words: Receiving Cattle, Vaccination, BRD

392 Effect of length of time between maternal separation and shipping on post-weaning performance of beef calves weaned during the fall. J. W. Bolte^{*1}, K. C. Olson¹, J. R. Jaeger¹, T. B. Schmidt², D. U. Thomson¹, B. J. White¹, R. L. Larson¹, A. Sproul¹, L. A. Pachenco¹, and M. D. Thomas¹, ¹Kansas State University, Manhattan, ²Mississippi State University, Starkville.

Ranch-of-origin weaning periods of between 30 and 60 d are recommended for preconditioning beef calves. Our objective was to test the validity of this recommendation for calves aged 160 to 220 d and weaned during the fall. Angus × calves (n=433) were stratified by age and assigned randomly to 1 of 5 weaning dates that corresponded to the length of time between separation from the dam and shipment to an auction market: 60, 45, 30, 15, or 0 days. Calves were vaccinated against common diseases 14 d before weaning and again on the day of weaning. On a common shipping date (d 0; November 7), calves were transported 3 h to an auction market and held for 12 h. Calves were then transported 1 h to a feedlot. All calves were fed common pre- and post-shipment diets ad libitum. Calf ADG during the 60 d preceding shipping tended to increase linearly ($P=0.09$) with longer weaning periods. Incidence of undifferentiated fever during the 14 d after maternal separation was greater ($P<0.01$) for calves weaned 60 d than those weaned 45, 30, or 15 d. Calf BW at shipping tended to increase linearly ($P=0.06$) with successively longer weaning periods. Calf BW 30 and 60 d after shipping

increased linearly ($P<0.01$) with successively longer weaning periods; however, ADG was similar ($P>0.6$) between treatments from d 1 to 30 and d 31 to 60 after feedlot arrival. Incidence of undifferentiated fever during the 60 d after shipping was greater ($P<0.01$) for calves weaned 0 d than those weaned 60, 45, 30, or 15 d. Under the conditions of our study, successively longer ranch-of-origin weaning periods improved calf ADG prior to shipping but did not affect ADG during the 60 d following feedlot arrival. Treatments retained their relative ranks in body size from shipping to the end of the study. Weaning management influenced when calves were most likely to become ill.

Key Words: Preconditioning, Weaning, Beef Calves

393 Effects of *Mannheimia haemolytica* challenge on blood gas, oxygen consumption and net splanchnic flux of volatile fatty acids in fed or fasted steers. L. O. Burciaga-Robles^{*}, C. R. Krehbiel, D. L. Step, J. W. Dillwith, R. Madden, M. Montelongo, A. W. Confer, J. N. Gilliam, B. P. Holland, and C. L. Goad, Oklahoma State University, Stillwater.

This experiment evaluated arterial blood gas concentration, net splanchnic flux of VFA and O₂ consumption during a bovine respiratory disease (BRD) challenge. Twenty-two steers (BW = 320±24 kg) with chronic catheters to measure blood flow and net flux across the portal-drained viscera (PDV) and liver were used. Arterial, portal, and hepatic blood samples were collected at 1.5-h intervals on d 0, 1, 2, and 3. Treatments (2×2 factorial arrangement) were: 1) ad libitum feeding and not challenged (FED/CON); 2) ad libitum feeding and challenged (d 0) with *M. haemolytica* via a tracheal tube (FED/CH); 3) 72-h fasting and not challenged (FAST/CON); 4) 72-h fasting and challenged (FAST/CH). All data were analyzed using repeated measures and first-order autoregressive correlation structure. FED or FAST did not affect blood gas variables, whereas CON steers had lower blood pH (7.45 vs 7.47; $P=0.01$), BeB (3.38 vs 4.25 mmol/L; $P=0.01$), base excess of extra cellular fluid (2.45 vs 3.51 mmol/L; $P=0.01$) and greater hematocrit (27.1 vs 24.5%; $P=0.03$) and O₂ concentration (2.69 vs 2.52 mM; $P=0.007$) compared with CH animals. FED steers had greater PDV (-190 vs -129 mmol/h; $P=0.03$), TST (-438 vs -269 mmol/h; $P=0.01$), and tended ($P=0.07$) to have lower (-194 vs -206 mmol/h) liver O₂ consumption than FAST steers. FED animals had greater (1.20 vs 0.79 mM; $P<0.001$) arterial acetate concentration compared with FAST; arterial propionate, butyrate, isobutyrate, isovalerate and valerate concentrations were not affected. FED steers had increased portal flux of propionate (67.3 vs 33.7 mmol/h; $P=0.022$), and hepatic removal of propionate (-61.6 vs -25 mmol/h; $P=0.001$), isobutyrate (-4.18 vs -1.43; $P<0.001$) and isovalerate (-7.46 vs -2.55 mmol/h; $P=0.006$). Our data confirms that BRD alters arterial blood gas profile, but generally did not affect O₂ consumption or VFA flux across splanchnic tissues. Fasting decreases O₂ consumption; however, energy demands by splanchnic tissues may not be altered during an acute challenge with BRD.

Key Words: Bovine Respiratory Disease, Net Flux, Oxygen Consumption

Symposium: ARPAS Symposium: Livestock Pharmaceuticals: The Past, The Present, The ...

394 Fifty years of pharmaceutical technology and its impact on the livestock we produce. R. L. Preston*, *Professor Emeritus, Bellingham, WA.*

Technology, including pharmaceutical technology, has contributed to improved animal efficiency and health over the past 50 years and will continue to do so in the future. Technology is utilized by the livestock industry because it improves efficiency and health thereby reducing the cost of production that in turn, reduces the cost of food for the consumer and helps to sustain the economic production of animals. However, there are well-funded anti-technology forces at work to limit the application of technology in beef, food animal and agricultural production in general. The mainstream media smothers consumers with confusing information that often transforms their ignorance into fear. This impacts their willingness to believe what they read and hear, and can result in misguided choices. All land-based industries are affected by these misguided choices, by legislation and by regulations that threaten their economic sustainability. This presentation details the impact of past and current technology on the efficiency of livestock production and demonstrates the potential impact that anti-technology forces could have not only on livestock production but also on this country's food production in the future. Technology must play a continuing role in agriculture. Although scientific research will continue, the eventual acceptance of technology will depend on getting consumers to better understand and value the role of scientific research in assuring them of a sufficient and affordable supply of safe, high-quality, nutritious food.

395 How are we making bacteria more resistant to antibiotics? Darwinian impacts. T. R. Callaway*¹, J. L. Rychlik², T. S. Edrington¹, R. C. Anderson¹, and D. J. Nisbet¹, ¹ARS, *Food and Feed Safety Research Unit, College Station, TX*, ²Rychlik and Associates, *Hillsboro, OR.*

This presentation will address the Darwinian selection of genes of antibiotic resistance in food animals. Darwin's concept of survival of the fittest is as critical when applied to bacteria as it is to animals. Bacteria live in a highly competitive environment that is similar to the microbiological world with its selective pressures. Neo-Darwinism views genes as selfish and as the ultimate unit of natural selection rather than the host organism. Bacteria carrying antibiotic resistance genes are merely vehicles for ensuring the reproduction and dissemination of these genes. Antibiotic resistance genes can be shared horizontally amongst bacteria of the same or different species through conjugation, transduction and transformation. Mobile genetic elements (DNA fragments, transposons, phage and plasmids) are wild cards in the evolution of bacteria and can introduce or combine new genes or groups of genes to bacteria, especially antibiotic resistance genes. The horizontal and vertical movement of these genes is critical to the further dissemination of the genes by ensuring the survival of the bacterial hosts. Addition of selective pressure via feeding antibiotics helps to select for new antibiotic resistance and provides an environmental niche opening for resistant strains to fill and proliferate. Strategies for using new or medically-important antibiotics must be developed and implemented that do not enhance Darwinian and neo-Darwinian selection for antibiotic resistance genes and their host organisms. The antibiotic resistance gene is as critical as the bacteria itself as related to the dissemination of antibiotic resistance throughout the food animal population.

Key Words: Darwinian Selection, Antibiotic Resistance, Genetic Transfer

396 Antibiotic resistance gene transfer in the intestinal tract – possible implications for agriculture? A. Slayers*, *University of Illinois, Urbana.*

Every day, many bacteria pass through the human intestinal tract. Many of these bacteria come from the food supply and may thus have become resistant to antibiotics if the farm where they originated uses antibiotics routinely. Since most of these bacteria do not cause disease, it may seem irrelevant to be concerned about whether or not they are resistant to antibiotics. They could become a human health problem, however, if they are able to pass their resistance genes to bacteria that normally reside in the colon, because members of the resident colonic microflora are common causes of post-surgical infections. To assess the likelihood of horizontal resistance gene transfer in the colon, we have determined whether the same resistance gene is found in bacteria from different species or genera. Our findings and those of others suggest that transfer of resistance genes across species and genus lines occurs fairly readily in the human colon.

Key Words: Antibiotic Resistance

397 Does ionophore resistance risk human health? J. B. Russell*, *ARS/USDA, Ithaca, NY.*

Since World War II livestock in the United States have been fed sub-therapeutic doses of antibiotics as "growth promotants." The mechanism of this action is still not entirely clear, but it appears that antibiotics by altering the natural gut flora inhibit bacteria that are detrimental to the host. This routine use of antibiotic in animal feed has led to concern and debate. With the general increase in antibiotic resistance, their effectiveness use to combat disease has diminished, and many common pathogenic bacteria to carry multiple antibiotic resistances. In January 2006, the European Union banned the use of all antibiotics as animal growth promotants, and this ban includes a special class of antibiotics called ionophores. Ionophores are fed to beef cattle and more recently dairy cattle, but their mode of action that is distinctly different from other commonly used antibiotics. Ionophores dissipate ion gradients across the cell membranes of sensitive bacteria. Ruminant bacteria that produce hydrogen, a precursor of methane or deaminate amino acids are inhibited, and these effects increase energy and amino acid availability to the animal. However, many ruminal bacteria are resistant to ionophores even if ionophores are not fed, and this resistance is due to the outside surface of their cells (glycocalyx). Adaptation experiments indicated that ionophore resistance did not confer an increased resistance to other classes of antibiotics, and there is no evidence suggesting that ionophore resistance can be spread from one bacterium to another. Because only some animals can be safely fed ionophores, and ionophores have never been used for human therapy, ionophore resistance is not apt to pose a significant threat to human health.

Key Words: Antibiotics, Ionophores, Resistance

Symposium: ASAS Graduate Student Symposium: Academia, Industry, Government, or None of the Above: Graduation is Coming, What Next?

398 Applying for an academic position. T. Etherton*, *Penn State University, University Park.*

Graduate students with an interest in pursuing an academic position in higher education are confronted with many challenges, as well as exciting opportunities. Getting positioned to be a strong candidate for a tenure-track faculty position begins with having the requisite abilities needed for success. These include “high intellect”, strong work ethic, great written and oral communication skills, being mentally tough, and understanding and putting the greater good of the team ahead of self-interests. In many beginning faculty positions, especially those that involve a basic science research component, a post-doctoral fellowship is a requirement. It is critically important that it be done in a strong program. This is not only a key period in a young career to learn new research techniques but also to grow one’s “brand name”. It is an expectation that several high-quality papers be published (in a timely manner) from the thesis and post-doctoral fellow experience.

With respect to the application process, there are a number of important considerations. A surprising number of letters of applications and resumes are not well written or organized. This is trouble. When you get the “big” interview prepare. It can be a pressure-packed situation. Not only is there is the seminar to prepare (and it has to be great) but you need to do a lot of homework. Learn about the faculty/staff and programs - be prepared for the “exit interview” with the Chair/Head. You might be asked about salary expectations, be ready. You will undoubtedly get questions for which you do not know the answer. Don’t guess. And, be precise. I have sat through more than a few exit interviews, and listened to a lot of talk but not much effective communication. If you get a job offer then you should get guidance about the salary and startup package- how the process works. Remember this is your point of greatest leverage. Be professional, seek a second visit to look at the program to better determine what your needs are for the startup package. When you sign the letter of offer you will have entered the “academy”. Enjoy the experience. It is a fabulous job filled with opportunity to do the greater good.

Key Words: Faculty Positions, Application, Interviews

399 How a career in animal science can help save endangered wildlife species. J. L. Brown*, *National Zoological Park, Conservation and Research Center, Front Royal, VA.*

This presentation highlights how techniques I learned as an Animal Sciences graduate student are being used to study and preserve endangered species. Wildlife populations all over the world are disappearing at an alarming rate, mostly due to destructive human activities. Reversing this trend will require protecting animals and their habitat. For many, it also will involve managing captive populations as hedges against extinction in the wild. Decades of experience have shown that successful animal management relies on a thorough knowledge of species biology through studies of nutrition, genetics, reproduction, behavior, immunology and health. While we are careful to maintain that “a cheetah is not a cow”, there are many aspects of domestic animal science that can be applied

to wildlife species. This especially is true for the reproductive sciences where much of our basic physiology knowledge and ability to develop assisted reproductive techniques (e.g., AI and IVF) stem from studies using domestic animals as research models. My area of expertise, endocrinology, has benefited tremendously by techniques developed for livestock. One major challenge is that, with rare exception, most wild animals are intractable. Thus, our laboratory has developed non-invasive approaches to monitoring hormones excreted in urine, feces and saliva. Many of the assays I used to study dairy cattle have proven applicable to a variety of endangered species. As assisted reproductive techniques become increasingly important for managing zoo species, endocrine tools are key to developing appropriate hormonal therapies. The ability to assess endocrine status of animals managed by different husbandry strategies also has profound implications for enhancing our limited understanding of how social and environmental cues modulate reproductive fitness and success. Thus, an Animal Sciences background can well prepare an individual for a career in wildlife research. Given that almost nothing is known about >90% of extant species, there is more than enough work to go around.

Key Words: Wildlife Species, Endocrinology, Conservation

400 Careers in government. R. D. Green*, *Pfizer Animal Genetics, Sutton, NE.*

The landscape for animal science careers has evolved substantially over the past decade and is likely to continue changing for the foreseeable future. With increasing regulatory demands related to animal agriculture, and a decrease in the number and general scope of animal science programs in academia, a higher proportion of those with graduate training in the animal sciences are finding their professional home in one of the several government agencies tied to animal agriculture. The principal federal agencies employing animal scientists are USDA’s Agricultural Research Service (ARS); Animal and Plant Health Inspection Service (APHIS); Food Safety Inspection Service (FSIS); and Agricultural Marketing Service (AMS); as well as the Food and Drug Administration (FDA) and to some degree the National Institutes of Health (NIH). Increasingly, these agencies are finding it more difficult to identify suitable candidates for positions who are well trained in the most up-to-date science (e.g. molecular biology, genomics, proteomics, synthetic biology, etc.) while also being conversant in and sufficiently knowledgeable of production animal agriculture and husbandry. As a result of this trend coupled with the need to better educate potential employees regarding the culture and nature of government service, more agency post-doctoral fellowship opportunities are being offered as a means of transitioning from graduate school to career civil service. Government careers bring the opportunity to be at the “front lines” of solving problems for animal agriculture and the public good with perhaps the most telling job satisfaction statistic being the very high percentage of civil service animal scientists spending their full careers in the government ranks.

Key Words: Animal Science, Careers, Government Agencies

401 Graduate student career opportunities in the animal science industry. J. F. Stika*, *Certified Angus Beef LLC, Wooster, OH.*

Globalization, consolidation, technological advancement, and a more vocal consumer have each contributed to dramatic changes within animal agriculture during the past decade. Concurrent with these changes has been an increase in the breadth of employment opportunities available to graduate students. Agriculture in the 21st Century is becoming more precision based, technology driven, and more focused on providing solutions to customer issues. Demand for technical service, research, and development positions has increased. Both masters and doctoral graduates are being sought for these positions as companies emphasize hiring more science-oriented, technical savvy specialists to replace or compliment bachelor level sales-oriented positions. As the complexity of our industry has increased, so has the expectation companies place on new graduates entering the workforce. While discipline specific technical expertise is the basis for many new positions in animal agriculture, the business environment requires that graduate students move beyond a specific discipline and into the realm of systems thinking and multi-disciplinary problem solving. Two types of graduate training programs are still needed. One focusing the student toward a career in basic research while another focuses on applied science. However, becoming an exceptional candidate for employment takes extra effort. Those most valued in the industry must be able to successfully merge biological, financial, public policy, and marketing awareness with an appreciation for the value of time and efficiency. Necessary skills beyond technical expertise include time management, effective communication, relationship building, goal setting and prioritizing, organization, and independent thinking. The opportunities for graduates of animal, dairy, and poultry science programs will continue to diversify as the issues facing animal agriculture become more challenging and the solutions more technical with broader implications across the entire industry.

Key Words: Graduate Education, Careers, Animal Science

402 Opportunities for graduate students in American Society of Animal Science. A. E. Radunz*, *The Ohio State University, Columbus.*

The American Society of Animal Science (ASAS) has a strong commitment to graduate students and providing opportunities for involvement in the organization. Several opportunities are available including serving on the board of directors and society committees and participating in graduate student activities. The ASAS membership annually elects one graduate student to the board of directors for a two-year term. Graduate student directors represent graduate students in the organization, develop networking contacts, and learn how ASAS operates. In 2007, the first graduate student symposium was incorporated in the national meeting program and a committee comprised of graduate students and professionals was appointed to organize this symposium. The organization encourages graduate students to serve on committees within the organization and students can be nominated for a committee by an ASAS member. Furthermore, graduate students presenting research at the meeting can apply for travel scholarships. Networking opportunities are offered to graduate students at the meetings including the graduate student mixer and job placement center, which is organized by graduate students. Involvement in the society can reap many rewards such as networking contacts, career opportunities, and knowledge of the society. More information on these opportunities can be found on the graduate student website at <http://www.asas.org/gradinfo/index.asp>.

Key Words: Graduate Students, ASAS

Breeding and Genetics: Applications of Genomic Analysis

403 Validation of multiple marker DNA profiles for carcass merit across multiple populations of beef cattle. J. D. Nkrumah* and B. W. Woodward, *Merial Limited, Duluth, GA.*

Genomic information can be employed in the management and selection of beef cattle to increase profitability and genetic progress. Advances in livestock genomics have resulted in the detection of numerous polymorphisms that putatively show associations with a range of economically relevant traits in beef cattle. The goal of DNA marker validation work is to re-evaluate and potentially confirm the proposed effects of genetic markers reported by the research community, usually in an experimental population, by utilizing information from commercial herds that are unrelated to the original herd(s) in which the initial discovery was made. Genetic markers discovered to date generally have small effects, which may not be economically relevant unless used in combination. Most reported associations are also based on markers that do not cause the phenotypic variation but are linked to, and therefore serve as surrogates for yet to be detected causal mutations. The significance and the sign of marker effect estimates, or which genotype combination is favorable may vary from population to population. To ensure broad applicability across the industry, DNA marker effects need to be tested across multiple populations and evaluated for the value in profile. Not all markers will provide statistically significant associations across all populations evaluated, but a profile could continue to remain instructive for determining differences among animals in as many herds and breeds as possible. As an example, we have created DNA profiles using a set of markers for beef carcass marbling score (effect = 96.0; $P = 10^{-12}$) and percent choice (effect = 43%; $P = 10^{-06}$), as well as multiple marker panels for carcass rib eye area (effect = 13.0 cm²; $P = 10^{-20}$), yield grade (effect = 1.20; $P = 10^{-27}$), and carcass backfat thickness (5.8 mm; $P = 10^{-18}$) based on assessments in multiple commercial populations with more than 6,000 steers and heifers. We have subsequently confirmed these profile associations using EPDs for similar traits and genotypes from a repository of about 2,000 beef bulls representing the major beef breeds used in North America.

Key Words: Beef Cattle, Carcass Merit, SNP Profile Validation

404 Genetic prediction of beef tenderness using a multi-marker SNP panel. S. P Miller*¹, M. J. Kelly¹, and D. J. Nkrumah², ¹*University of Guelph, Guelph, ON, Canada,* ²*Merial Limited, Duluth, GA.*

Beef tenderness is the most important quality attribute contributing to the consumer acceptance of beef. However improvement of beef tenderness has not been included in traditional beef breeding programs due to cost and difficulty of measuring this trait. The standard measurement used to assess tenderness of beef is the shear force, which is the force required to shear a standardized cooked meat sample. Recently commercial DNA tests have been developed that explain some of the variation in shear force. We have used the Merial/Igenity large SNP panel to screen for associations between SNP and beef tenderness in a multi-breed beef population that were assessed for shear force (n=648). This population consisted of progeny of mainly crossbred dams mated to terminal sires. The predominant breeds were Angus, Simmental, Limousin, Charolais

and Piedmontese. The effect of each marker was fit individually in a mixed model that included breed proportion, contemporary group and a polygenic effect. Markers that were significant in the single marker regressions were used to develop a multiple marker panel. Each of the markers that remained in the panel was explaining a significant proportion of the variation in shearforce ($P < 0.05$) and the marker effects ranged from 0.14kg to 0.49kg. The multi-marker panel explained 12% of the phenotypic variance. Given that the heritability of tenderness from this dataset is approximately 20% the current panel explains a large proportion of the genetic variance within this population. Selecting animals based on this panel will shift the mean tenderness from 4.92kg to 4.59kg which is slightly lower to that achieved selecting the best bulls based on their across breed expected progeny difference (4.47kg). These results indicate the growing power of SNP panels to explain significant genetic differences for beef tenderness and their practical application in the beef industries efforts to improve consumer demand.

Key Words: Beef, Tenderness, Genomics

405 Multiple marker DNA profiles for production, fertility, and functional traits in Holstein cattle. J. D. Nkrumah and B. W. Woodward*, *Merial Limited, Duluth, GA.*

Genetic marker-assisted selection is expected to significantly accelerate the rate of genetic progress through increased accuracy of selection, reduction of generation interval, and increasing selection differentials. A number of polymorphisms with moderate to large effects on economically relevant dairy traits have been reported, including the K232A polymorphism in the DGAT1 gene, the F279Y polymorphism in the growth hormone receptor (BGHR) gene, and the Y581S polymorphism in the ATP-binding cassette sub-family G2 (ABCG2) gene. Other polymorphisms have been reported to show small but economically significant associations on important traits in beef and dairy cattle, but most of these have not received further consideration in terms of validation and application in marker-assisted selection. In the present study, we have assembled a repository of over 2,000 dairy AI sires with high reliabilities for production, functional, and conformation traits, and attempted the validation of the effects of several markers on these traits in Holstein cattle. Current multiple marker association analyses using daughter yield deviations for milk, fat, and protein explain differences of about 700 kg ($P < 10^{-11}$), 30 kg ($P < 10^{-19}$), and 17 kg ($P < 10^{-12}$), respectively, among animals with extreme genotype combinations. We have also developed multiple marker panels using daughter deviations that explain up to 5.0 mo differences in dairy productive life ($P < 10^{-05}$), 2.5 percentage points in daughter pregnancy rates ($P < 10^{-04}$), and 1.8 genetic standard deviations in dairy form ($P < 10^{-15}$). These results show that significant increases in the predicted merit for dairy cattle can be obtained by evaluating models that allow the simultaneous computation of the effects of markers of small or moderate to large effects that are each independently associated with specific traits of economic importance.

Key Words: Dairy Cattle, Production and Functional Traits, SNPs Validation

406 Application of a Bayesian approach to identify candidate markers for marker assisted selection in pigs. M. A. Cleveland* and N. Deeb, *Genus plc, Hendersonville, TN.*

Genome-wide approaches to estimate genetic effects have proliferated due to increased availability and affordability of markers. These methods assume marker density is high and animals can be genotyped for all markers, which may not be feasible. This study investigated the ability of a Bayesian approach that fits all marker effects simultaneously to correctly identify markers in linkage disequilibrium (LD) with quantitative trait loci (QTL), at varying marker densities. A single chromosome of 200 cM containing five QTL was simulated, where effects were 0.2, 0.4, 0.6, 0.8 and 1.0 phenotypic standard deviations. Single nucleotide polymorphisms (SNPs) were assigned to the chromosome, based on gene drops from a small founder population, in five simulations where average SNP spacing was targeted at 0.1, 0.5, 1.0, 2.0 and 10.0 cM, respectively. Phenotypes were simulated for 2,600 animals selected from several generations of a closed population of pigs. The data were analyzed using single marker regression and a Bayesian multiple marker approach. The single marker regressions yielded many significant effects. The results from the Bayesian analysis showed clear signals at markers adjacent to the QTL, where most other markers had effect estimates at or near zero. In some cases there were multiple peaks near QTL where the effect was distributed between flanking markers. The decrease in marker density did not reduce the ability to identify markers adjacent to QTL, even at large distances where LD would be reduced. The Bayesian approach was also applied to a commercial dataset of 1,066 pigs with genotypes for 180 targeted SNPs across the genome. The analysis identified six markers with non-zero effects on a mortality trait. Results from these analyses indicated the Bayesian approach was suitable for identifying markers of moderate to large size for inclusion in marker-assisted genetic evaluation systems. This strategy can be used to identify marker associations when density is not optimal, in situations where genome-wide evaluation is not yet feasible.

Key Words: Pigs, Genome-Wide Association, Bayesian Analysis

407 Genomic selection of purebreds using data from admixed populations. A. Toosi*¹, R. Fernando¹, J. C. M. Dekkers¹, and R. L. Quaas², ¹*Iowa State University, Ames*, ²*Cornell University, Ithaca, NY.*

Genomic selection involves using marker genotype and phenotype data in a training population to estimate effects of all markers. These estimates are then used to predict the breeding value (BV) of selection candidates given their marker genotypes. In livestock, genomic selection has been investigated by computer simulation of purebred populations. Traits of interest are, however, often measured in crossbreds with uncertain breed composition. If such crossbreds are used as the training population without proper accounting of breed composition, estimates of marker effects may be biased due to population admixture. On the other hand, if the available markers are in high linkage disequilibrium with the trait loci (QTL), it may not be necessary to explicitly account for breed composition. To investigate this idea, a single chromosome of size 1.5 Morgans was simulated with 5000 evenly dispersed loci, of which 250 loci were assigned as QTL. After 1000 generations of random mating in a base population of effective size 500, two sub populations of effective

size 100 were isolated and random mating was continued for another 50 generations to create two breeds (A and B). These breeds were used to generate an F1, F2, and an admixed population. These populations and breed A were used as the training data set, with a total of 1000 individuals with phenotype for a trait controlled by 100 segregating QTL and heritability of 0.30. A Bayesian method (Bayes-B) was used to estimate the effects of 2000 segregating markers. Using these estimates and genotypes of selection candidates, the BVs of breed A animals eight generations away from the training population were estimated. The accuracy of the prediction was quantified by the correlation between the marker based predicted BV and the true BV. The accuracy was highest (0.85) when breed A was used as the training population. When the crossbreds were used as the training population, the accuracy ranged from 0.75 to 0.79. This demonstrates that, under the simulated conditions, purebreds can be accurately selected for crossbred performance using high-density marker data, without pedigree or breed information.

Key Words: Admixed Populations, Genomic Selection

408 A marker-assisted assessment of genotype by environment interaction: SNP-mortality association in broilers in two hygiene environments. N. Long¹, D. Gianola¹, G. J. M. Rosa*¹, K. A. Weigel¹, and S. Avendaño², ¹*University of Wisconsin, Madison*, ²*Aviagen Ltd., Newbridge, UK.*

An interplay between genetic and environmental factors, genotype by environment interaction ($G \times E$), determines phenotypes of complex traits, and implies that some genetic effects may be relevant only in certain environments. $G \times E$ was investigated here by detecting hygiene environment-specific SNP subsets associated with broiler chicken mortality at both early and late ages, followed by an examination of consistency between SNP subsets selected from different hygiene (low and high) environments. The trait was mean progeny mortality rate in 253 sire families, calculated after adjusting records for non-genetic and non-hygiene related environmental effects affecting mortality at the individual bird level. Over 5,000 whole genome SNPs were narrowed down via a machine learning (filter-wrapper) feature selection procedure applied to mortality rates in each of the low and high hygiene environments. For both early and late mortality, it was found that the SNP subsets selected were not consistent across hygiene environments, in terms of either across-environment predictive ability or extent of linkage disequilibrium (LD) between the subsets. Reduction in mortality predictive ability due to $G \times E$ was assessed by the ratio of two PRESS (predicted residual sum of squares) statistics, one associated with using SNPs selected from the same hygiene environment, and the other one associated with the SNP subset from a different environment. The reduction was 30% and 20% for early and late mortality, respectively. In addition, an extremely low level or absence of LD between SNP subsets selected under low and high hygiene also indicated $G \times E$. These findings suggest that there may not be a universally best SNP subset for predicting mortality, and that interactions between genomes and environmental factors need to be considered when attempting to associate genetic variants with complex traits.

Key Words: Genotype by Environment Interaction, SNP-Mortality Association, Hygiene Environments

409 Linkage disequilibrium and persistence of phase in Holstein Friesian, Jersey and Angus cattle. A. P. W. De Roos^{*1}, B. J. Hayes², R. J. Spelman³, and M. E. Goddard^{2,4}, ¹CRV, Arnhem, The Netherlands, ²Animal Genetics and Genomics, Primary Industries Research Victoria, Attwood, Australia, ³Livestock Improvement Corporation, Hamilton, New Zealand, ⁴University of Melbourne, Melbourne, Australia.

Genomic selection across multiple populations is complicated because linkage disequilibrium (LD) between markers and QTL may differ across populations. The objectives of this study were to compare the extent of LD and the persistence of LD phase across multiple cattle populations. LD measures r and r^2 were calculated for syntenic marker pairs using genome-wide single nucleotide polymorphisms (SNP) that were genotyped in Dutch and Australian Holstein Friesian (HF) bulls, Australian Angus cattle, and New Zealand Friesian and Jersey cows. Average r^2 was around 0.35, 0.25, 0.22, 0.14, and 0.06 at marker distance 10, 20, 40, 100 and 1000 kb, respectively, which indicates that genome-wide association studies or genomic selection within cattle breeds would require ~50,000 SNP. The correlation of r values between populations for the same marker pairs was close to 1 for pairs of very close markers (<10 kb) and decreased with increasing marker distance and the extent of divergence between the populations. The correlation of r values between Dutch and Australian HF, was still above 0.80 for marker distances of more than 1 Mb. Between Australian HF and New Zealand Friesian, or between New Zealand Friesian and New Zealand Jersey this correlation dropped below 0.80 for marker distances above ~50 kb, whereas between Australian Angus and New Zealand Jersey, the correlation dropped below 0.80 when the markers were more than 5 kb apart. To find markers in that are in LD with QTL across diverged breeds, such as HF, Jersey, and Angus, would require ~300,000 markers.

Key Words: Linkage Disequilibrium, Genetic Markers, Cattle

410 Estimated linkage disequilibrium in a multi-breed beef herd based on the Illumina BovineSNP50 BeadChip. M. J. Kelly^{*1}, M. Sargolzaei¹, Z. Wang², D. Kolbehdari², P. Stothard², F. Schenkel¹, S. S. Moore², and S. P. Miller¹, ¹University of Guelph, Guelph, ON, Canada, ²University of Alberta, Edmonton, AB, Canada.

Genomic breeding values may enable the beef industry to select genetically superior cattle for traits that are expensive or impossible to measure in conventional breeding programs. However, to estimate genomic breeding values with sufficient accuracy or fine mapping QTLs, a high degree of linkage disequilibrium (LD) between markers and the QTL is required. The average amount of LD between markers (SNPs) and QTLs across the bovine genome was assessed using the Illumina BovineSNP50 BeadChip within a multi-breed beef herd. A preliminary experiment comprised 374 multi-breed beef cattle (predominantly progeny of cross-bred cows mated to purebred terminal sires). Breeds represented included mostly Angus, Simmental, Limousin, Charolais and Piedmontese. Animals were genotyped for 56,947 SNPs. After exclusion of SNPs from the analysis when minor allele frequency was below 10% which included monomorphic SNPs (21%), due to a high proportion of uncalled genotypes (~0.1%), deviation from Hardy-Weinberg equilibrium (0.2%), located on chromosome X (1.6%), or unlocated (15%), 35,317 SNPs remained. The average distance between adjacent SNPs, once these edits were made, was 58 kb. Therefore, on average, the maximum distance between SNPs and QTLs should be half this (29 kb). The average r^2 based on 3428 marker pairs between markers 30 to 35 kb apart was calculated to be 0.21 (SD=0.26), this is somewhat lower

than that found in purebred populations. An approximation of the power to detect QTLs with this level of LD was examined (at $p < 0.01$). A QTL had to explain at least 8.5% of the phenotypic variance in order to be detected with a statistical power greater than 90% with a sample size of 1000. To detect smaller effects (2.5% of phenotypic variance) would require larger sample sizes (~3500) or higher levels of LD ($r^2 \sim 0.7$). Thus subsequent work will focus on genotyping a larger population and fine mapping regions of interest.

Key Words: Beef, Genomics, Linkage Disequilibrium

411 Linkage disequilibria of the SLA region loci with malignant melanoma in Sinclair swine. L. Gomez-Raya^{*1}, M. Miller¹, C. S. Ho², V. Kirchoff¹, D. M. Smith², W. M. Rauw¹, D. Thain¹, A. Rink¹, and C. W. Beattie³, ¹University of Nevada, Reno, ²University of Michigan, Ann Arbor, ³University of Illinois, Chicago.

The experimental design consisted of a boar mated to 11 sows to produce 70 offspring. A total of 20 DNA-markers within the Swine Leukocyte Antigen (SLA) region were typed (SW1856, SLAM62, SLA-1, SLA-3, SLA-2, SLAM037, SLAM055, SLAMA14, SLAMA13, SLAM046, SLAMS045, SLAMS044, SLAM043, SLAMA18, SLAM095, DRB, DQB, SLAMS092, SLAM047, SW0102). Linkage disequilibrium at each pair of loci was estimated by inferring the haplotypes contributed by the dams for all informative offspring. Linkage disequilibrium between each pair of loci was estimated using the normalized D' of Lewontin but allowing for more than two alleles. Strong linkage disequilibria were estimated for each pair of DNA-markers between SW1856 and DQB (ranging from 0.95 to 1). Testing of linkage disequilibrium within the boar family was performed while searching for 1) susceptibility to SSCM (at least one tumor during the first six weeks of life), and 2) number of tumors at birth (TB), at 6 weeks post-partum (T6), and the difference in tumor number between birth and six weeks (T6-B). Loci affecting melanoma susceptibility were not detected. However, we detected a QTL affecting T6-B in this region (P-value of 0.0028 in the permutation test). We tested for population-wide linkage disequilibrium for the number of tumors using the allele inherited from the dam. Our results showed that alleles are statistically associated with T6 and T6-B (up to 2.1 tumors at $P < 0.05$). However, the strong linkage disequilibria of loci in this region may limit finer mapping of a QTL.

Key Words: Swine, Malignant Melanoma, Swine Leukocyte Antigen

412 QTL with dominance effect affecting residual feed intake on BTA6. G. C. Márquez^{*1}, R. M. Enns¹, M. D. Grosz², and M. D. MacNeil³, ¹Colorado State University, Fort Collins, ²Monsanto Co., St. Louis, MO, ³USDA, Agricultural Research Service, Miles City, MT.

Residual feed intake (RFI) is a measure of feed efficiency and therefore an economically relevant trait. A genome-wide scan for quantitative trait loci (QTL) affecting RFI in beef cattle was conducted. Approximately equally spaced microsatellite markers ($n = 229$) spanned the 29 bovine autosomes. Two half-sib families of backcross progeny were produced by mating two F1 Line 1 Hereford (L1) \times composite gene combination (CGC) bulls to L1 and CGC cows. Progeny of the first sire were born in 1996 ($n=155$) and of the second sire were born in 1997 ($n=120$). Phenotypic data on feed intake and weight gain was collected in 1997

and 1998 for the two calf crops. Due to serial harvest for collection of carcass data, time on feed varied from 82 to 167 days. RFI was calculated as the residual after fitting the regression of daily feed intake on average daily gain, average weight, sex, and year of birth. Genotypes and phenotypes were collected from 218 animals. The backcross progenies from L1 and CGC females were analyzed separately using composite interval mapping. In the backcross to L1 cows, evidence for a QTL affecting RFI was found on BTA6 with a LOD score of 3.2 at 58 cM. Substitution of the L1 allele for the CGC allele reduced RFI by 0.9 kg/d. This QTL was absent in the backcross to CGC cows. Presence of an allele substitution effect in one backcross, but not the other, is consistent with the dominance model of inheritance. Thus, these results indicate a putative QTL with dominance effect on RFI located at approximately 58 cM on BTA6.

Key Words: Beef Cattle, Quantitative Trait Loci, Residual Feed Intake

413 Confirmation of quantitative trait loci for carcass and meat quality traits on pig chromosome 6 in a Duroc x Pietrain resource population. I. S. Choi*, R. O. Bates, N. E. Raney, D. B. Edwards, M. E. Doumit, and C. W. Ernst, *Michigan State University, East Lansing.*

We have previously reported quantitative trait loci (QTL) affecting carcass composition and pork quality on pig chromosome 6 (SSC6) in the Michigan State University Duroc x Pietrain F₂ resource population. The objective of the present study was to confirm these QTL by

incorporation of marker genotype data for an additional 452 F₂ pigs into the QTL analysis, thus improving the QTL detection power by nearly doubling the number of informative meioses. A total of 962 F₂ pigs were genotyped for the SSC6 markers S0087, SW122, SW1881 and SW322. Other SSC6 markers genotyped for the original genome scan (510 F₂ pigs) included S0099, SW2406, SW2525, S0220 and SW2419. Data were analyzed with line cross least squares regression interval mapping methods using sex and litter as fixed effects and carcass weight or harvest age as covariates. Carcass composition phenotypes included primal cut weights, skeletal characteristics, backfat thickness, muscle pH and carcass temperature. Meat quality data collected on boneless *longissimus* muscle chops included marbling, firmness, drip loss, and objective and subjective color. QTL significant at the 1% chromosome-wise level were found for first rib, tenth rib, last rib and last lumbar vertebra backfat, and for hot carcass weight, carcass length, loin muscle area, ham weight, loin weight and belly weight. QTL significant at the 5% chromosome-wise level were found for 24 h carcass temperature, Boston shoulder weight and marbling score. These results confirmed previously identified QTL and included four new QTL (carcass weight, first rib backfat, Boston shoulder weight and belly weight). In addition, F-ratios and LOD scores were increased for all traits except marbling score. However, three previously identified QTL failed to reach the 5% chromosome-wise level of significance (subjective color score, CIE a* and spareribs weight). The incorporation of additional F₂ animal genotypes into the QTL analysis helped to improve the power and precision of QTL detection and our results confirm QTL for carcass composition and pork quality on SSC6 in the MSU resource population.

Key Words: Pig, QTL, Carcass Composition

Symposium: Companion Animals: Perceptions and Implications of Companion Animals in Research and Teaching - Domestically and Globally

414 ASAS Centennial Presentation: Evolution of companion animals - A perception shift. L. P. Case*^{1,2}, ¹University of Illinois, Urbana, ²AutumnGold Consulting, Mahomet, IL.

We are a nation of dog and cat lovers. Never before in our history have we spent more time, money, and emotional energy on a group of animals that are kept solely for companionship. Pet food sales are a multi-billion dollar industry and pet owners are spending more than 11 billion dollars each year on veterinary care. This devotion is further illustrated by the exponential growth of the pet supply industry, including increasing numbers of pet “super-stores”, play-parks, training centers, and doggie day care centers. During the 1980’s, recognition of the “human-animal bond” led to serious study of the roles that pets play in our lives. These studies have shown that pets provide significant benefits to our emotional, physical and social well being. Unlike any other non-human species, dogs and cats have become fully integrated into our lives and our hearts. It is ironic then, that at a time when we recognize and appreciate our bonds with animal companions, dark elements of this relationship are equally pervasive. Animal shelters in the United States kill between 3 and 4 million dogs and cats annually. Dog fighting, although outlawed, has reached epidemic proportions in some areas of the country. Colonies of feral cats are so prevalent that organizations are devoted completely to their advocacy. Episodes of animal cruelty and neglect are reported with alarming frequency in the media; so frequently that discussions of the connection between animal cruelty and human violence have become daily parlance. How then did we come to have such paradoxical perceptions and treatment of our animal companions? Facts and myths about our pets’ ancestries and the cultural changes that led to domestication will be presented. Motivations for and results of selective breeding practices that created pets with wildly differing appearances and temperaments are discussed. A review of our working relationships with dogs and cats and the evolution of those relationships into bonds of companionship provides an understanding of pets today and a basis for continuing the evolution of our relationship with our two “best friends”.

Key Words: Companion Animals, Domestication, Human-Animal Bond

415 Past-present perceptions and research in companion animals – A domestic viewpoint. G. Czarnecki-Maulden*, Nestle Purina Research Center, St. Louis, MO.

The objective of this presentation is to review the evolution of research in companion animals in the United States over the past fifty years and how it relates to the perception of pets, trends in human nutrition and progression of the pet food industry. Nielsen reports on market data, pet food labels and literature reviews for specific time periods were evaluated. Much of the early canine and feline nutrition research focused on defining nutrient functions. Often this research focused on the use of dogs and cats as models for humans. This lack of research on dogs and cats was reflected in the type of pet foods on the market. Fifty years ago, most pet foods were “one size fits all”. As dogs and cats became more valued members of the human family, interest in companion animal nutrition blossomed. Increasingly, research has focused on functional ingredients and improving quality of life and longevity. Research areas

often parallel those in human nutrition. New non-invasive methodologies have allowed the study of body systems and metabolic pathways previously unattainable. Along with the changing focus of companion animal nutrition research came a shift in where the research is conducted. Industry scientists published few studies 30-50 years ago and there were only a handful of companion animal nutritionists in academia or industry. Now most pet food companies have several nutritionists. As a result, pet foods have become increasingly specialized and nutritionally focused.

Key Words: Nutrition, Dog, Cat

416 Past-present perceptions and research in companion animals – An international viewpoint. P. Nguyen*¹, L. Prola², R. C. Nap³, P. P. Mussa², and J. Nery¹, ¹National Veterinary School of Nantes, Nantes, France, ²Veterinary School of Turin, Turin, Italy, ³Uppertunity Consultants, Utrecht, The Netherlands.

In Europe animal experiments are subdued to the European convention ETS 123 and the EU directive 86/609 both adopted in 1986. The directive provides a minimum framework for housing and care of research animals. It also aims to promote the 3Rs. States may adopt more stringent regulation, and animal rights organizations (AROs; with different levels of “activism”: from those who aim to promote animal interests or influence public attitudes towards animals, to those who recommend strong-arm methods, to free research animals, and to carry out economical sabotage) have played a role in influencing the public opinion and politicians towards animal welfare and the use of animals in research. Sweden adopted an Animal Welfare Act. In the Netherlands the Party for the Animals has 2 seats in parliament. In Italy to get an authorization for dog research may need having each animal adopted by a family. Bull fighting is authorized here while displaying lobster on ice is fined there...

In EU, dogs and cats represent only $\pm 0.23\%$ (28000 in 2005) of total research animals. This use has been decreasing over the last 15 years. Some countries do not use any dog or cat while 3 account for 65% of dogs used in EU and 2 for 60% of cats. The EU directive is under revision and it could be influenced by a lobby engaged on banning research on primates. No doubt that pet animals are on the second line.

Using pets to study their physiology and diseases can still make scientific sense but using them to study human diseases or experimenting on healthy animals and deliberately making them sick has become unacceptable. Some AROs reject any animal experiment, even food testing, due to the use of “cruel and unethical” methods with the only objective of marketing edge. Some even publish lists of brands recommended or to boycott. More than direct effect on public opinion, this can strongly influence research definition and funding. Pet research has been reduced by improved access to information. Invasive protocols have been strongly restricted. Funding is driven by citation indexes, evidence of need, and optimal ratio between research benefit and disagreement for research animals.

Key Words: Companion Animals, Animal Research, Europe

417 Evolution of regulatory issues in companion animals. S. L. Traylor*, *Alltech, Inc., Nicholasville, KY.*

The evolution of food for companion animals is relatively short compared with the domestication of companion animals. Until commercial pet food grew in popularity, dogs ate whatever was available in their environment. This might have included meat scraps, raw milk, or eggs. In 1860, James Spratt developed the first processed dog biscuit and more than likely, sparked interest in regulatory and consumer related issues. During the early years, a small number of companies marketed pet food; however, they were not without their problems. Demand for these products was not high and the consumer often found the contents green with mold or rancid. Interestingly, it was about fifty years later that the first Federal Food Law was promulgated. The Pure Food and Drug Act of 1906 bill was rewritten in 1938, as amended, this is today's law and provides protection for man and animal. In parallel with Federal Law, the Association of American Feed Control Officials was formed and they quickly became the regulatory authority at the state level for labeling compliance. Although modern pet food formulations have become more complicated, the labels of the Depression Era have not changed much from those of today. Most regulatory authorities speculate that the information on the label is not likely to change significantly. However, at the date of submission, there are whole host of "safety" bills that have been introduced in Congress. These bills aim to provide the FDA, USDA and other agencies with new food safety authorities and responsibilities. One bill that was signed into law, the Food and Drug Administration Amendments Act (FDAAA), requires the FDA to promulgate rules in two years that will create ingredient standards, process control requirements, updated labeling and additional nutritional information for pet foods. The era of voluntary regulatory compliance is dated and the regulatory environment for the animal and pet food industry will require additional resources to implement the new feed safety regulations that are inevitable.

Key Words: Companion Animal, Regulatory, Feed Safety

418 Trends in pet food safety. R. Johnson*, *Private Pet Food Consultant.*

In the spring of 2007, the North American pet food industry experienced the most dramatic product recall in its history. Due to the number of pet food brands involved and intense media coverage, Congressional inquiries were generated as to the manner in which the safety of pet foods could be compromised. The basis for this massive recall was investigated by Federal and State agencies which determined that adulterated vegetable protein products coming from China contained melamine. Public and media attention to this recall exceeded anything that the Federal Drug Administration (FDA) had ever experienced. The result of these Congressional Hearings was a mandate for the implementation of a comprehensive feed safety program. The FDA has been directed by Congress, under the Federal Drug Administration Amendment Act (FDAAA), to develop a Food/Feed Safety Program. The FDAAA will create a reportable food registry for FDA regulated products. Within two years the FDA is to enact ingredient standards/definitions, processing standards, and a reportable food registry. The FDA and the American Association of Feed Control Officials (AAFCO) signed a Memorandum of Agreement to work together in development of the goals of FDAAA. In December 2007, the FDA signed a Memorandum of Understanding with China to exchange, investigate, and pursue feed safety issues. Congressional House Bills for 2008 are seeking required CGMP/

HACCP process control regulations for all foods and feed within two years. They would also increase civil monetary penalties and establish private rights of litigation. Items that can be expected for pet food safety will be the establishment of CGMP, where risk warrants; authorized increase in FDA inspections, based upon risk; FDA authorization of accredited third party inspections; expanded research and diagnostic laboratory activities related to improved food safety; modernization of computer systems for Federal Departments and Agencies for exchange of information on importers and shipments; authorization by the FDA for establishment of overseas inspection of high risk imports; and the utilization of third party inspectors.

Key Words: Pet Food, Food Safety, FDA

419 Alternatives to live animal models in companion animals: Research location shift. G. Kuhlman* and M. A. Tetrick, *Procter & Gamble Pet Care Research & Development, Lewisburg, OH.*

There are multiple options to consider for alternatives to current live companion animal testing methodologies. These options include refining the research environment, reducing the number of animals used or replacing the animal model. This presentation will focus on the refinement of the research setting as well as the shift from research environments into privately owned companion animals in the home. These refinements provide greater access to the five freedoms and are steps along the continuum to replacement alternative methods.

In considering housing refinements for felines, automated urine and fecal collection systems have been developed. These systems allow for social housing and interactions among groups of cats while still allowing individual feeding and individual identified collection of fecal and urine samples. Additionally, careful adaptation and acclimation of cats to research procedures such as blood sampling have been developed that allow for minimal restraint and greatly reduce stress for the cats and reduce the risk of injury for veterinary personnel. Similarly for dogs, implementation of paired housing allows conspecific species interaction but requires careful oversight and management as well as refinement of research procedures to be successful.

Shifting the location of dogs and cats participating in research studies to the home and veterinary clinic has been successfully accomplished. Clinical research in collaboration with veterinarians allows enrolling dogs or cats with preexisting clinical conditions to evaluate dietary interventions e.g. renal failure, diabetes, osteoarthritis, etc. Methods such as split plate preference studies typically run in the research setting can be adapted to be conducted by the pet owner in the home. While there are limitations that come with this location shift it also affords flexibility to recruit specific breeds, age groups, and health conditions and provides the ability to expand or contract capacity reducing overhead when not engaged in research. Application of these refinements has the potential to enhance welfare and facilitate research.

Key Words: Alternative Methods, Canine, Feline

420 Alternative systems for evaluating digestion in companion animals. D. L. Harmon* and M. R. C. de Godoy, *University of Kentucky, Lexington.*

To enable accurate diet formulation the ability to predict the behavior of individual feed ingredients is needed. This requires knowledge of

digestion and absorption of nutrients contained in these ingredients which is usually obtained in animal feeding studies. It is not possible to evaluate every ingredient source in animal studies, thus assays for comparing ingredients are widely used to estimate ingredient quality. This is particularly true in regards to amino acid and mineral bioavailability. Models that have been directly compared with the dog and cat include the cecectomized rooster, protein efficiency ratio in chicks, the blue fox, the mink and the rat. The rooster assay had very high correlations ($r = 0.87$ to 0.92) for individual amino acid digestibilities with values obtained in the dog indicating that it was a useful means of predicting nutrient availability in the dog. In vitro systems for determining digestibility have also been developed. These range from complex, multi-compartment, computer controlled systems to enzyme-test tube assays. Their application to pet foods has been limited; however, high correlations with in vivo digestion have been reported. One problem described when evaluating commercial pet foods is the narrow range of results obtained, thus making the development of an accurate prediction model difficult. Fermentation systems have been used based on fecal inoculum from both dogs and cats; however, the application has been limited to characterization of dietary fiber or other ingredient sources. Their application to complete diets is limited.

Key Words: Fermentation, In vitro, Digestion

421 Computer modeling: An alternative to live companion animal testing. R. M. Yamka* and N. Z. Frantz, *Hill's Pet Nutrition, Inc., Topeka, KS.*

In recent years, the pet food industry has been striving to refine, reduce and replace animal testing through alternative methods. Methods of alternative testing can include both in vitro and/or computer modeling. The aim of this review is to gain a fundamental understanding in how computer models are typically developed and the types of models available to the pet food industry today. The models discussed in this review will include urine pH, digestibility, metabolizable energy, stool quality and body composition. Since most of the models available today utilize the nutrient composition of the foods for prediction, this review will discuss how the incorporation of some of these models into food formulation can result in the reduction of time and costs associated with getting foods to market.

Key Words: Dog, Cat, Computer Modeling

422 ASAS Centennial Presentation: The future of teaching and research in companion animal biology in departments of animal sciences. J. McNamara*, *Washington State University, Pullman.*

Departments of Animal Sciences must be relevant to a society in which a small number of people can raise all the animal products needed. While involvement in animal agriculture has declined, lowering enrollments in many Departments, several of these adapted by seeking out and welcoming students from a diverse background. This is not a new trend, as research and teaching about pets dates to the 1940's. The adaptation was spotty and not without some 'discussion'. The future is now, and in most states, the undergraduate curriculum depends on having a number of students interested only in companion animals. A benefit is that we can often recruit 'new blood' into agriculture, and students have gone and will go on to excellent careers in agriculture. We have a new challenge: how to maintain and expand the efforts in both teaching and research. Departments wishing to expand in teaching have examples of successful courses and curricula from other departments that they can use. Some departments have, and others should, expand their teaching across their university to teach about pets to a wider audience than their own majors. In research, a small number of faculty have been able to establish extramurally funded projects on pets. Horses are included in this effort, and several departments have excellent equine programs. But it will be difficult for more than a handful of departments to have a serious research effort in dogs, cats, birds, fish or exotic animals. Departments will have to make a concerted effort to invest in such endeavors, joint ventures with other Universities and Colleges of Veterinary Medicine (or Medicine) will probably be required. Funding sources for traditional efforts in nutrition, reproduction, physiology, etc. are small and inconsistent; however, with the progress of the canine, and now feline, genome project, there should be opportunities from federal funding sources aimed at using animal models for human health. In addition, efforts in animal behavior and welfare can be expanded, perhaps with some funding from private foundations or animal-supportive organizations.

Key Words: Companion Animals, Research, Teaching

Symposium: Dairy Foods: Changes and Challenges of Probiotics in Dairy Products

423 Probiotics: From Metchnikoff to bioactives. N. P. Shah*, Victoria University, Melbourne, Victoria, Australia.

Nobel Laureate Ilya Metchnikoff suggested that human body was slowly poisoned by toxins present in the body produced by pathogens in the intestine and body's resistance steadily weakened by proliferation of enteric pathogens, all of which were successfully prevented by the consumption of fermented milk. Probiotics are live microorganisms which when administered in adequate amounts confer a health benefit on the host. Traditionally probiotics have been incorporated in yoghurt; however, a number of carriers for probiotic have been examined recently including mayonnaise, and spreads, in addition to other products of dairy origin i.e. cheese or cheese-based dips. It has been estimated that there are approximately 70 probiotic-containing products marketed in the world. Probiotic organisms are also available commercially in milk, sour milk, fruit juices, ice cream, single shots and oat-based products. Lunbest, Olifus, Bogarde, and Progurt are some of the commercial products. Probiotic products are very popular in Japan as reflected in more than 53 different types of probiotic containing products on the market. Commercial cultures used in these applications include mainly strains of *Lactobacillus* spp., *Bifidobacterium* spp. and *L. casei*. Since Metchnikoff's era, a number of health benefits has been contributed to products containing probiotic organisms. The strains *L. rhamnosus* GG (Valio), *Saccharomyces cerevisiae* Boulardii (Biocodex), *L. casei* Shirota (Yakult), and *B. animalis* Bb-12 (Chr. Hansen) are certainly the most investigated probiotic cultures with the established human health efficacy data against management of lactose malabsorption, rotaviral diarrhoea, antibiotic-associated diarrhoea, and *Clostridium difficile* diarrhoea. The functionality of dairy proteins may also be enhanced via liberation of bioactive peptides through proteolysis. Among bioactive peptides, angiotensin I-converting enzyme (ACE) inhibitors have been extensively studied due to their hypotensive role. Accordingly, several commercial products with highly proteolytic strains of *L. helveticus* have been developed and marketed to possess hypotensive activity including Calpis®, and Evolus®.

Key Words: Probiotics, ACE-I Peptides, Proteolytic System

424 Probiotics in natural cheese. B. Dias* and N. Mix, Kraft Foods Inc, Glenview, IL.

Significant increase in consumer awareness of probiotic cultures has boosted these cultures to becoming one of the top consumer trends in foods delivering health benefits. While probiotics have traditionally been found in yogurts, natural cheese has proven to be a good carrier for these cultures. Furthermore, studies have suggested that consuming probiotics in a cheese matrix is favorable for the viability of probiotics through the digestive tract. This has led to the marketing of several varieties of cheese containing added probiotic cultures. Natural cheeses are comprised of a complex microbial ecosystem which is in a constant state of flux as the cheese ages. Changes, including the addition of probiotic microorganisms, have the potential to significantly impact the chemical and microbiological properties of cheese. Hence, careful selection of strains is necessary to minimize alterations to the flavor and texture of cheese.

This presentation will review and discuss recent developments in relation to the production of probiotic cheese, the advantages and disadvantages

of cheese as a carrier, the stability of probiotic cultures in cheese, and the impact of processing on the viability of probiotics in natural cheese.

Key Words: Cheese, Probiotic

425 Development of yoghurt and specialty milks containing probiotics. C. P. Champagne*, Agriculture and Agri-food Canada, St. Hyacinthe, QC, Canada.

Yoghurt and fermented milks have been the most widely used food matrixes for the development of probiotic-containing functional foods. In this review-type presentation, the potential for innovation in this field will be examined. As opposed to starter cultures which are often prepared at the dairy plant, in yoghurt manufacture, probiotics are generally inoculated with direct-to-the-vat (DV) cultures. They are found in frozen or freeze-dried form. Examples will be given as to the effect the method of storage of the DV probiotic concentrate, its method of preparation (thawing or rehydration procedures) and the moment of addition in the yoghurt process on the viability of the probiotics in the product. Probiotic bacteria generally do not grow well in milk and are adversely affected by starters and storage conditions. Examples will be given on how strain selection, ingredients selection (flavours, enzymes, fruits or vegetables, prebiotics), strain microencapsulation and packaging can be used to innovate and develop new products while addressing these stability problems. Unfermented milks are now seen on the market. Data will be presented on the effect of strain viability of probiotics in such products is affected by strain and some technological processes (degassing, strain encapsulation). Fluid milk could be of great interest in promoting the survival of probiotics to the gastric environment, and some thoughts on the effect of the food matrix on probiotic functionality will be offered.

Key Words: Lactobacillus, Bifidobacterium, Functional Foods

426 Recent trends in the microencapsulation and delivery of probiotics in dairy foods. K. Kailaspathy*, University of Western Sydney, Hawkesbury, NSW, Australia.

Micro encapsulation has become the recent tool used for protecting and delivering bio-actives in the development of bio-functional foods. Probiotic foods are by far the largest functional food market. They provide several health benefits including immuno stimulation. Viability, physiological and metabolic activity of probiotic bacteria in a food product at the point of sale are important consideration for their efficacy, as they have to survive during shelf life of a food, transit through high acidic and alkaline conditions in the gastro-intestinal tract. It is essential that products sold with any health claims meet the recommended criterion of a minimum of 1 million CFU/g of probiotic bacteria at the expiry date and the minimum therapeutic dose per day is suggested to be 100 million cells. The reported health benefits of probiotic bacteria are: enhancement of immunity against intestinal infections, immune enhancement, prevention of diarrhoeal diseases, prevention of colon cancer, prevention of hypercholesterolemia, improvement in lactose utilization, prevention of upper gastro-intestinal tract diseases and stabilisation of the gut

mucosal barrier. Various studies have shown that probiotic organisms survive poorly in foods like yoghurt and fermented milks with cell numbers being much lower than the recommended levels at the expiry date. Therefore there is a need to protect the probiotic bacteria against adverse processing and storage conditions as well as during transit in the gastro-intestinal tract. Micro encapsulation is an inclusion technique for entrapping live cells such as probiotic bacteria, into a polymeric (gelled) matrix that may be coated by one or more semi-permeable polymers, by virtue of which the encapsulated substance become more stable than the free one. The aim of our investigation was to study the survival of micro encapsulated bacteria in fermented dairy products and their release in the gut and immune-stimulating effects; stability and release.

Key Words: Microencapsulation, Probiotics, Controlled Release

427 Identification of probiotic features in *Lactobacillus acidophilus* affected by dairy delivery. M. A. Azcarate-Peril*, R. Tallon, and T. R. Klaenhammer, *North Carolina State University, Raleigh.*

Historians generally agree that yogurt and other fermented milk products were born by accident when Neolithic people living in Central Asia, where the climate was appropriate, noticed that milk, which they carried in pouches made out of sheep's stomachs, had curdled. Today,

fermented milk products are often associated with good health and extended life, and some members of the lactic acid bacteria group are recognized as probiotics. In fact, *Lactobacillus acidophilus*, a member of this group, is commonly added to yogurt to promote health benefits. Approximately, 80% of the yogurt in the United States contains added *L. acidophilus*.

This study examined how growth or delivery in milk systems impacts the expression of traits that are important for probiotic activity, fermentative properties, and survival in a dairy environment or the human gastrointestinal tract. We employed microarray hybridization experiments to first, monitor gene expression of *L. acidophilus* cells propagated in milk during early, mid and late logarithmic phase, and stationary phase. Second, we characterized gene expression after exposure to specific milk components: casein, alpha-lactalbumin, beta-lactoglobulin, glycomacropeptide, and milkfat globule membrane fractions. Additionally, we investigated how mutations in genes differentially expressed during growth in milk affect acidification activity, survival under storage conditions, and adhesion to mucin and Caco-2 tissue culture cells. Whole genome transcriptional studies provided us with an overview of how probiotic organisms survive and function in both the dairy environment and the gastrointestinal tract. From this point on, a functional genomics approach is instrumental to elucidate the role of genes induced or repressed in the presence of compounds of interest, and how we can reprogram bacterial genetic systems to benefit the host.

Key Words: Probiotics, Gene Expression, Milk and Dairy Products

Symposium: Extension Education: From 40 Acres and a Mule to Today: Historical Perspective of Extension Programming

428 ASAS Centennial Presentation: History of extension. J. Paterson*, *Montana State University, Bozeman, MT.*

When President Wilson signed the Smith-Lever Act on May 8, 1914, he called it one of the most significant and far-reaching measures for the education of adults ever adopted by the government. Its purpose was to aid in diffusing among the people, useful and practical information on subjects related to agriculture and home economics. Even though most farm people at the turn of the 20th century were literate, many were not comfortable with the printed word and by tradition distrusted book farming. Seaman Knapp has often been referred to as the father of the Extension Service. Then 70 years old, Knapp had been a farmer, professor, and president of Iowa Agriculture College. He believed that the only way to change cotton-farming practices related to the boll weevil was to conduct research on the farmers own land. Starting in the 1980s, the Extension System shifted from a focus on audience to a focus on issues. A more recent Extension mission statement was to enable people to improve their lives and communities through learning partnerships that put knowledge to work. Why the changes? When Cooperative Extension was started in 1914, about 30% of US workers were employed in farming compared to today where approximately one percent of the hired workforce is in farming. Starting in the 1990s, Extension was charged to develop and implement a system based on issue-oriented goals which were: 1) an agricultural production system that is highly competitive in the global economy; 2) a safe, secure food and fiber system; 3) a healthy, well-nourished population; 4) a greater harmony between agriculture and the environment and 5) enhanced economic opportunity and quality of life. Today land use, obesity prevention, responsible use of pesticides, urban revitalization, non-agriculture commerce, and specific attention to the needs of underserved audiences are among the expanded Extension programs. Recently, some observers believe that the Extension Service has experienced mission creep and should return to a focus on agriculture while others argue that the Extension Service is a captive of agriculture interests and should serve a broader national purpose.

Key Words: Extension, History of CES, Cooperative extension

429 ASAS Centennial Presentation: Evolution of delivery methods. M. Hutjens*, *University of Illinois, Urbana, IL.*

One of extension's mission is to interpret and deliver research data and results to clientele. Early methods included on-farm demonstrations and field days to stakeholders. The traditional methods included face-to-face discussions and local meetings as travel was limited and on-farm validation important. As technology and transportation improved, delivery methods become more varied including local, regional, and national meetings using flip charts, overheads, slides (glass to plastic), and power points. The use of mass media including dairy magazines, local newspaper, mass media, radio, and television continue to be effective sources of information. Another method focused non-traditional on clientele with programs specifically for veterinarian (such AABP), dairy sanitarians, feed consultants, and A.I personnel. As extension funding becomes more limiting, more delivery systems are sponsored

and funded by industry groups (feed, seed, and A.I. organizations are examples) with extension educators presenting part of the program. Newer clientele groups include Hispanic program in Spanish and international conferences that are translated. The arrival of the Internet has expanded the methods to reach clientele including e-mail, webinars, on-line classes, and face-to-face discussions on-line. In the seminars, two new approaches will be discussed including the University of Illinois Dairy Certificate program (<http://online.ansci.uiuc.edu/>) and pod casts (<http://web.extension.uiuc.edu/podcasts/dairy/>). The dairy certificate program on the Internet was initiated in 1998 with the five classes (nutrition, reproduction, management, milk secretion, and principles of dairy science). Over 350 students have enrolled in classes with three certificates awarded while other students enroll for information and new knowledge, career enhancement, completion of a graduate advanced degree, and continuing education requirements.

Key Words: Extension, Internet, Delivery

430 ASAS Centennial Presentation: From 40 acres and a mule to today: Historical perspective of extension programming: Horse-Quest. E. A. Greene*, *University of Vermont, Burlington.*

eXtension (pronounced e-extension) is a web-based educational tool created by extension specialists, agents, and educators for the purpose of providing a complementary resource for use by extension personnel and clientele. This national extension initiative provides information divided by content areas (e.g. Horses, Dairy, Beef, Financial Planning, etc.). "Community of Practices" (CoP), made up of extension experts in each specific area of interest, develop the peer reviewed content for the site. The HorseQuest CoP, which has content contributed by more than 40 experts at over 30 institutions, was the first CoP to publicly launch their content in September 2006. The website (www.extension.org/horses) provides clientele a variety of methods and learning opportunities related to the care, management, and training of horses. Areas on the site include: Interactive Learning Lessons, Web Chats, Frequently Asked Questions, Basic Information, and News. Content is delivered through text, photos, videos, podcasts, flash applications, and interactive chats. The HorseQuest CoP has led the way in providing unique educational opportunities to reach their clientele. Through self guided Learning Lessons, horse enthusiasts can move at their own pace, or alternatively, research the topics through the "best of the best" articles available on the site. The "Ask the Expert" mechanism allows for individual questions to be addressed. Our experts also facilitate quarterly live chats on highly requested topics (e.g. Horse Care on Small Acreage, Feed Supplements, Exercise Physiology, etc.). Site usage statistics were evaluated by month from September 2006 through January 2008 using simple linear regression. Unique visitor traffic ($R^2 = .847$), Number of Visits ($R^2 = .836$), Pages Visited ($R^2 = .758$), and Page Hits ($R^2 = .753$) all significantly increased over time ($p < .001$). Finally, with eXtension site's recent conversion to Web 2.0 format, site users will be able to provide additional feedback through improved evaluation and ranking systems.

Key Words: Horse, eXtension, Internet

431 ASAS Centennial Presentation: DAIReXNET - Method of delivering extension programming for the dairy industry which transcends traditional methods of information delivery and state/regional borders. D. M. Amaral-Phillips* and L. McClanahan, *University of Kentucky, Lexington*.

DAIReXNET was launched in October 2007 at the World Dairy Expo in Madison, WI. This national, extension-driven web resource was developed using the latest in Web 2.0 technologies as a part of the eXtension effort and is designed to meet the educational and decision-making needs of dairy producers, allied industry partners, extension educators and consumers. Through collaboration amongst dairy professionals, relevant, cutting-edge information and learning opportunities are provided which are science-based and peer-reviewed in a format accessible 24/7. Informational resources include (1) **answers** to frequently asked questions, (2) **access** to information by top experts in their fields of expertise, (3) access to cutting-edge **content** currently in 13 subject areas, (4) **searchable** state and regional **newsletters**, (5) **consumer links** about the dairy industry and its products, and (6) news and lists of dairy events. Currently, resources are provided in the areas of business management and farm labor, calf and heifer management, facilities, food safety, genetics, health and diseases, mastitis and milking management, milk marketing, nutrient management, nutrition of milking and dry cows, organic dairy production, and reproduction. Several of these materials are available in Spanish for Spanish-speaking farm workers. Plans for 2008 are to continue to expand these resource areas and include pilot areas in the form of learning modules, hold webinar meetings for dairy producers and allied industry on cutting-edge, timely topics, and hold a webinar training session for county extension educators across the US. Leadership for this project is provided by 10 dairy extension professionals from across the United States. Additionally, our subject areas are led by 13 dairy experts from across the country. To date, 211 dairy professionals representing 35 universities and allied industries and the top 25 states for milk production have contributed to DAIReXNET. DAIReXNET can be accessed through the following web address: <http://www.extension.org/dairy+cattle>.

Key Words: Dairy, DAIReXNET, Extension programming

432 ASAS Centennial Presentation: Beef Cattle Clearinghouse: An eXtension Website. R. Rasby*¹, G. Selk², L. Anderson³, R. Weaber⁴, T. Marston⁵, C. Wright⁶, J. Paterson⁷, C. Mathis⁸, G. Lardy⁹, J. Whittier¹⁰, D. Strohhenn¹¹, T. McCollum¹², S. Paisley¹³, C. Lane¹⁴, D. Hamernik¹⁵, ¹*University of Nebraska, Lincoln*, ²*Oklahoma State University, Stillwater*, ³*University of Kentucky, Lexington*, ⁴*University of Missouri, Columbia*, ⁵*Kansas State University, Manhattan*, ⁶*South Dakota State University, Brookings*, ⁷*Montana State University, Bozeman*, ⁸*New Mexico State University, Las Cruces*, ⁹*North Dakota State University, Fargo*, ¹⁰*Colorado State University, Fort Collins*, ¹¹*Iowa State University, Ames*, ¹²*Texas A&M University, Amarillo*, ¹³*University of Wyoming, Laramie*, ¹⁴*University of Tennessee, Knoxville*, ¹⁵*USDA-CSREES, Washington, DC*.

A core Community of Practice (CoP) from Land Grant Universities organized to design a national website who's target audiences are producers, extension educators, and clientele with beef cattle interest. The goal of the CoP is to provide on-demand access to unbiased, research-based

information via the internet. This national effort allows for expertise to engage with clientele using the Beef Cattle Clearinghouse website. Beef cattle production systems vary tremendously across the United States due to the wide variety of resources available. Therefore, input into the Beef Cattle Clearinghouse website from a large number of faculty members from universities throughout the United States is imperative for the success of this educational effort. The Beef Cattle Clearinghouse website is database driven. All the material entered into the website is stored in a database that visitors can access via the online search engine. The website functionalities will consist of Cattle Questions (Frequently Asked Questions and Answers), Beef Pros (Ask the Expert), Beef Trains (Learning Modules) and Beef Tips (Timely Topics). Currently, there are 650 Cattle Questions and 200 Beef Tips in the data base. Our goal is to expand the CoP membership nationally to make the content more inclusive and to better serve the wide variety of clientele who access information through the Beef Cattle Clearinghouse eXtension website (<http://www.extension.org/beef+cattle>).

Key Words: Beef cattle, eXtension, Website

433 ASAS Centennial Presentation: Pork Information Gateway in eXtension. D. J. Meisinger*, *US Pork Center of Excellence, Iowa State University, Ames*.

Extension has always been about outreach. The goal is to interpret and convey research information and best management practices to users. The US Pork Center of Excellence (USPCE) is dedicated to this same goal through traditional means and using new technologies. This public/private partnership has a mission to add value to the pork industry by facilitating research and learning for U.S. pork producers through national collaboration. Indeed, the Pork Information Gateway (PIG) was initiated to serve pork producers with the latest information all in one place and to bring it to them with electronic technology. This web based interactive system is multi-disciplinary, multi-functional, and national in scope and utilizes all the best knowledge and interpretive abilities of extension specialists across the country. The goal was to utilize peer reviewed fact sheets, a question and answer format, and reference publications in a library format and add a glossary, images, and upcoming events to reach producers with all their needs. When the opportunity arose to link with eXtension to be part of a much bigger program, PIG became the community of practice for swine in eXtension. Most recently, a PIG Opportunities portal was added which provides students information on careers in the pork industry, a listing of swine science courses available, and a listing of internships which can be applied for throughout the country. Work is underway to add a weather and markets portal to encourage daily visits by pork producers. The current bank of knowledge on PIG is comprised of 232 peer reviewed fact sheets, over 2000 frequently asked questions and answers, and over 1500 reference documents including manuals, speeches, and swine day reports. The user friendly search function has been updated to provide users with the ability to find their answers immediately. A newly added feature allows partners to obtain impact reports which show the use of PIG in their state or by their co-branded site. This feature will be especially popular among extension specialists to demonstrate the use of their information in their states.

Key Words: Swine, Extension, Information

Forages and Pastures II

434 Effect of limiting hay access time on dry matter intake by beef cows. C. J. Fleenor*, R. P. Lemenager, M. C. Claeys, and S. L. Lake, *Purdue University, West Lafayette, IN.*

Sixty-three two and three year old mid-gestation Angus cross cows (BW=596.7 kg; BCS=5.15) were randomly assigned by BW, BCS and age to three treatments, with three replications per treatment, to determine the effects of limiting access time and forage quality on hay DMI. Treatments were limited access time (1, 2 or 4 h) to different qualities of hay per 24 h period. Daily, cows were fed large round bales (LRB) of low quality hay (50.65% TDN, CP 8.9%, 64.35% NDF) in rectangular hay feeders that provided adequate bunk space/cow; and were supplemented with soybean hulls and a vitamin-mineral mix to meet NRC requirements for maintenance. Average DMI/d for the 1, 2 and 4 h access times was 3.19, 5.18 and 7.31 ($P < 0.001$) kg and 0.53, 0.90 and 1.23 ($P < 0.001$) % of BW, respectively. To determine the effect of forage quality on DMI, small square bales differing in quality were fed one d/wk in lieu of LRB (9 estimates/hay quality/access time). High quality grass hay (HQ; 58.0% TDN, 15.4% CP, 51.28% NDF) was fed during wk 1-3, low quality grass hay (LQ; 44% TDN, 11.37% CP, 60.0% NDF) was fed during wk 4-6 and a mixed grass-legume hay (MX; 61.0% TDN, 14.81% CP, 52.08% NDF) was fed during wk 7-9. Average DMI was 7.32, 6.43 and 6.90 ($P < 0.05$) kg/d; 1.23, 1.07 and 1.16 ($P < 0.01$) % of BW/d; and 3.36, 2.96 and 3.27 ($P = 0.04$) kg consumption rate/hour for the HQ, LQ and MX hays, respectively. Estimated DMI/d was calculated from NDF as 2.34, 2.00 and 2.30% of BW and 13.96, 11.93 and 13.75 ($P < 0.001$) kg. Average DMI for 1, 2 and 4 h access time was, respectively, 3.72, 6.57 and 10.36 ($P < 0.001$) kg/d; 0.62, 1.10 and 1.74 ($P < 0.001$) % BW/d; and 3.72, 3.29 and 2.59 ($P < 0.01$) kg consumption rate/hour. Estimated DM savings compared to calculated ad libitum daily consumption was 71.9, 50.2 and 21.5% for the 1, 2 and 4 h access times. These data can be used by producers that need to extend limited forage supplies and provide a basis for creating diets using nutrient dense feeds that meet cow requirements.

Key Words: Cows, Hay Intake, Limited Access Time

435 Effect of ruminal fill on foraging behavior, intake rate, and plasma ghrelin, serum insulin and glucose levels of cattle grazing a vegetative micro-sward. P. Gregorini*¹, K. J. Soder¹, and R. S. Kensinger², ¹USDA-ARS Pasture Systems and Watershed Management Research Unit, University Park, PA, ²Pennsylvania State University, University Park.

The impact of ruminal fill (RF) on foraging behavior, intake rate and levels of circulating ghrelin, insulin and glucose was measured with four rumen-cannulated lactating dairy cows foraging micro-swards of vegetative orchardgrass. The treatments compared were removal of 1.00 (RF0), 0.66 (RF33), 0.33 (RF66) or 0 (RF100) of total ruminal content. Treatments were randomly applied in a 4 x 4 Latin-square design. Cows were evacuated and re-filled according to treatment at 1200 (treatment setting), then offered the micro-swards at 0200. Micro-swards were weighed before and after foraging sessions. Foraging sessions were time unlimited, but cows were allowed to take a maximum of 15 bites.

Herbage was analyzed by canopy strata for chemical composition, toughness and module of elasticity. Eating time, intake rate, total jaw movements, and bite parameters (mass, depth, area and rate) data were collected. Plasma was analyzed for ghrelin and serum for insulin and glucose. Short-term intake rate, bite mass and bite area decreased ($P < 0.05$) while bite depth increased as RF increased. The RF did not affect ($P > 0.05$) biting rate or total jaw movements. Increasing RF resulted in lower ($P < 0.05$) mean levels of circulating ghrelin, with no changes ($P > 0.05$) in mean levels of insulin and glucose. However, increasing RF decreased ($P < 0.05$) the incremental change in ghrelin, insulin and glucose levels from the time of treatment setting until the foraging sessions. Little was known regarding bite dimensions and instantaneous herbage intake rate adjustment as a function of RF, or if short-term temporal variations of RF reflect changes in the underlying endocrine physiology. The present study elucidates some of the underlying endocrine physiology under short-term temporal variations of RF and its effect on foraging behaviour.

Key Words: Appetite Regulating Hormones, Foraging Behavior, Ruminal Fill

436 Microclimate effects on temporal/spatial distribution of beef cows in cool-season grass pastures. D. Bear*, J. Russell, and M. Haan, *Iowa State University, Ames.*

Pastures on five southern Iowa cow/calf farms were used to evaluate the effects of microclimatic conditions on cattle grazing in cool-season grass pastures with streams and/or ponds. Pastures ranged from 14 to 129 ha and contained varying proportions of cool season grasses, legumes, sedge, weeds, brush, and bare ground. The percentage of shade ranged from 22 to 73% within pastures. Cows were Angus and Angus-cross on four of the farms, and Mexican Corriente on the remaining farm. In spring, summer, and fall of 2007, 2 to 3 cows per farm were fitted with Global Positioning System (GPS) collars to record position at 10 min intervals for periods of 5 to 14 d. Ambient temperature, black globe temperature, dew point, wind speed and wind direction were collected with HOBO data loggers at 10 min intervals over the grazing season on each farm. Streams, ponds, and fence lines were referenced on a geospatial map and used to establish zones in the pastures. Designated zones were: in the stream or pond, and <15.2, <30.5, <61.0, and >61.0 m from the stream or pond. Thirty-four data sets were obtained throughout the grazing season to determine cattle position. Mean proportions of observations when cattle were in the streams or ponds in summer (1.9%) did not differ from fall (1.3%), but were greater ($P < 0.10$) than spring (0.9%). Cattle distribution amongst other zones did not differ between seasons. Mean proportions of time cattle spent in any of the designated zones differed ($P < 0.05$) among farms. The proportion of time cattle were in and within 15.2 m of a stream or pond increased with increasing ambient temperature ($^{\circ}\text{C}$; $y = 3.8837 + -0.1249x + 0.0181x^2$, $r^2=0.37$) and black globe temperature ($^{\circ}\text{C}$; $y = 3.3538 + 0.0303x + 0.0068x^2$, $r^2=0.28$). The proportion of time cattle are in or near to surface water resources increases with increasing temperatures, but remains less than 24.0% at temperatures up to 37 $^{\circ}\text{C}$.

Key Words: Beef Cattle, Grazing, Temporal/Spatial Distribution

437 Grazing management and microclimatic effects on cattle distribution patterns in riparian pastures. M. Haan, J. Russell*, D. Bear, and D. Morrical, *Iowa State University, Ames.*

Cattle grazing in riparian areas may contribute to sediment and nutrient loading of surface waters. The objectives of the current study were to determine the impacts of grazing management and microclimate on cattle distribution patterns relative to a pasture stream. Six 12-ha cool-season grass pastures, each bisected by a 195-m stream segment, were assigned to one of three treatments using a randomized complete block design with two replicates: continuous stocking with unrestricted stream access (CSU), continuous stocking with stream access restricted to a stabilized crossing (CSR), and rotational stocking with stream access in a riparian paddock (RS). Pasture was considered the experimental unit. In 2005, 2006, and 2007 each pasture was stocked from mid-May through mid-October with 15 Angus cows, initial BW (mean±SE) 614±72, 577±53, and 621±56 kg, respectively. Cattle distribution patterns were monitored by visual observation and GPS collars monthly. Over three grazing seasons, cattle were in or within 34 m of the stream an average of 6 and 16% of the time, respectively, in CSU pastures, based on visual observations. Based on GPS collars, cattle were in or within 34 m of the stream an average of 1.2 and 10.6%, respectively, in CSU pastures. Based on visual observation and GPS collars the proportion of time cattle in CSR and RS pastures were present in and within 34 m of the stream were less ($P<0.05$) than CSU pastures. The presence of off-stream water decreased ($P<0.05$) the proportion of time cattle spent in the stream during the 2006 grazing season but not in 2005 or 2007. At greater ambient temperatures ($Y=112.9-4.4X+0.04X^2$, $r^2=0.85$) and heat load index ($Y=12.2-0.96X+0.02X^2$, $r^2=0.80$), the proportion of time cattle were within 34 m of the stream increased. Observed cattle distribution patterns were highly related ($r^2=0.99$) with defecation distribution patterns. The use of RS, CSR, and the presence of off-stream water may be effective management practices for altering cattle distribution patterns and reduce nutrient and pathogen loading of pasture streams.

Key Words: GPS, Water Quality, Heat Load Index

438 Morphological composition of marandu palisadegrass pasture managed under different herbage allowance grazed by dairy cattle in rotational stocking system. A. C. R. Ruggieri*, E. R. Januskiewicz¹, D. R. Casagrande^{1,3}, R. A. Reis^{1,2}, and M. A. Magalhães^{1,2}, ¹São Paulo State University, Jaboticabal, São Paulo, Brazil, ²Conselho Nacional de desenvolvimento Científico e Tecnológico, Brasília, DF, Brazil, ³Fundação de Amparo a Pesquisa do Estado de São Paulo, São Paulo, Brazil.

This study evaluated the effect of herbage allowance (HA) on sward morphological characteristics in a palisadegrass (*Brachiaria brizantha* cv. Marandu) pasture grazed by dairy cattle (BW= 450kg) in a rotational stocking system. The experiment was conducted at UNESP in Sao Paulo State, Brazil, from November 2005 to April 2006. Four HA (4, 7, 10 and 13% of BW) treatments were allocated in a complete randomized block design with three replications. Stocking density was calculated based on paddock occupation for eight hours in one day followed by 21 days rest. Hand-plucked samples and sward height of the paddock were collected and measurements were performed during the morning and afternoon of five grazing cycles. There was a tendency ($P=0.1507$) for animals to select the leaf fraction in the morning and stems in the afternoon for 4, 7 and 10% HA. The opposite was observed at 13% HA with greater ($P<0.05$) intake of stems in the morning and leaves the

afternoon. At 13%HA, sward height was taller ($P<0.01$) than that on other HA and had longer stem elongation. Thus when the grazing started the intake of stems may have increased. However, in the fifth cycle, there was a tendency ($P=0.25$) for more intake of stems in the morning on all HA. This may be associated with the transition from summer/winter growing conditions. In the afternoon the intake of leaves was greater. The greater intake of stems in the morning exposed leaves in the lower pasture strata, facilitating increased leaf intake. Among the HA studied the 7% HA presented highest leaf: stem ratio during the experimental period.

Key Words: *Brachiaria brizantha*, Pasture, Intake

439 Evaluation of forage sampling method and chemical composition of diet selection by cattle grazing subtropical forages during the summer. A. Hughes* and M. Hersom, *University of Florida, Gainesville.*

As with many tropical grasses, the nutritive value of bahiagrass (*Paspalum notatum*) has been reported to be relatively low, and the data that does exist consists of hand-harvested samples, which does not account for the ability of cattle to selectively graze pasture. The objective of this study was to characterize the chemical composition of forage selected by cattle and compare that to forage collected by hand sampling during the summer. Forage and masticate samples were collected monthly from pastures with estimated high and low forage availabilities (FA). Samples were collected at four locations from May 2007 to August 2007 and were analyzed to determine DM yield, height-adjusted DM yield, IVOMD, NDF, ADF, and selection index. Forage height was measured using a rising-disk meter to estimate forage quantity within the pasture. Forage samples were collected by hand-clipping the herbage to a height of 3.5 cm and dried at 55°C for 48 h. Masticate samples were collected using eight ruminally cannulated steers (2 steers/location) and then lyophilized. Mean DM yield across all 4 locations exhibited a FA x month interaction ($P<0.001$). Height-adjusted DM yield differed between months ($P<0.001$) and between FA ($P=0.05$). Concentration of IVOMD was greater ($P<0.001$) in masticate compared to hand-samples. Also, IVOMD concentration demonstrated a month x type interaction ($P=0.005$). Selection indices indicate that steers were able to select diets from May to August that were 20, 8, 19 and 28% greater in IVOMD concentrations than hand-samples. The ability to select for greater IVOMD differed ($P=0.05$) among months but not between FA ($P=0.06$). Concentrations of NDF and ADF differed among months ($P<0.05$) being lowest in May (67 and 32%) and increasing in August (73 and 42%). Concentrations of NDF and ADF were 3% less ($P<0.02$) for masticate samples compared to hand samples, indicating that steers were selecting a diet that was lower in cell wall concentrations. During the growing season, cattle will selectively graze bahiagrass forage that is greater in IVOMD and lower in NDF and ADF than what is estimated by hand-sampling.

Key Words: Forage, Grazing, Selection

440 Productivity and *in vitro* gas production of leaves and stems of Pennisetum purpureum cv Cuba CT-115 in Northern Mexico. E. Gutiérrez-Ornelas*, A. Cerrillo-Soto², A. S. Juárez-Reyes², H. Bernal-Barragán¹, H. Morales-Treviño¹, R. S. Herrera³, and R. Mejías³, ¹Facultad de Agronomía Universidad Autónoma de Nuevo León, Car-

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Pennisetum purpureum cv Cuba CT-115 (CT115) is a tropical tall grass introduced to subtropical regions in northern Mexico. The objective of this study was to evaluate DM production, in vitro gas production and chemical characteristics of leaves, stems and whole plant samples. Four plots (5 × 10 m) of CT115 were established with no fertilization in non-irrigated clay soil in February 2006. Productivity was assessed by harvesting by hand three random samples (5 m² each) at 30 cm height in two growing seasons (autumn 2006 and summer 2007). Forty plants were selected during the autumn of 2006 to establish the relationship between number of stems and DM production. Sub-samples from both years were separated into leaves and stems. Forage components above 1 m height from summer growing season were used for in vitro gas production and chemical analyses. Triplicate samples (200 mg DM each) were incubated in 100 ml calibrated glass syringes and gas production was registered at 3, 6, 9, 12, 24, 48, 72, and 96 h. Data were

fitted to the equation: $p=a+b(1-e^{-ct})$, where **p** represents gas volume (ml) at time **t**; **a** the intercept; **a+b** the potential gas production and, **c** is the constant rate. In vitro gas parameters were analyzed by ANOVA for a completely randomized design with 3 × 2 factorial arrangement of treatments (plant components and years). Dry matter production was 8.5 and 15.7 ton/ha during 2006 and 2007, respectively. In 2006, DM production increased linearly ($P<0.05$; $r^2=0.87$) with number of stems per plant. Rate of gas production was higher ($P<0.05$) for stems (5.6% h⁻¹) than leaves (3.8% h⁻¹) and whole plant (4.0% h⁻¹), with no year or interaction effect ($P>0.05$). The other in vitro gas parameters were not affected ($P>0.05$, **a** = -0.45 ml; **a+b** = 50.2 ml) by treatments. Leaf:stem ratio for the 2007 forage samples was 2.7, CP and NDF contents were respectively 8.0% and 74.2% for leaves, and 9.4% and 72.4% for stems. CT-115 is a good forage for livestock in northern Mexico; its leaves and stems had similar chemical composition but the higher constant rate of *in vitro* gas production for stems may imply better nutritive value of this plant component.

Key Words: *Pennisetum purpureum*, In Vitro Gas Production, Tropical Grass

Horse Species II

441 ASAS Centennial Presentation: Historical review and future outlook of equine nutrition. H. Hintz*, *Cornell University, Ithaca, NY.*

Although horses were still very important for farming in 1908 research on equine nutrition was not of high priority at most US agricultural colleges and experiment stations. The decline of the use of horses on farms, in the transportation industry and for hauling freight that started in the second decade of the twentieth century reinforced the low priority given to equine nutrition research. Nevertheless several members of the animal science community such as S. Brody (energy metabolism), P.B. Pearson (vitamin nutrition), W. D. Dawson (growth of foals) and A. L. Harvey (protein nutrition) provided valuable data in the 1930s and 1940s. In the 1960s the increased use of horses for recreation and the rapid growth of the horse population in the US stimulated interest in equine nutrition. University of Kentucky, Texas A&M, University of Florida and Cornell University started equine nutrition programs in the late 1960s. Many other universities developed equine nutrition programs in subsequent years. At the 2007 meeting of the Equine Science Society (ESS), papers related to equine nutrition were presented from 26 US universities and institutions. Most of the members of ESS are also members of ASAS. The improved knowledge of horse nutrition and hence better diets has been credited as a major factor in the improved health and increased longevity of horses. The horse industry continues to thrive and opportunities for valuable equine nutrition are endless. Examples include further studies on the microbiology of gut to help combat diseases such as founder, colic and metabolic syndrome, evaluation of nutraceuticals and other supplements, more defined studies on trace mineral requirements and metabolism, amelioration of the long existing problem of limited numbers of horses per treatment perhaps by developing regional cooperative studies or other more creative ideas. The relationship of nutrition and diseases in horses should be studied by teams consisting of researchers from several disciplines. There is much to be done.

Key Words: Horse, Nutrition, History

442 Glycemic and insulinemic responses differ in the morning versus the afternoon. L. M. Williamson¹, W. B. Staniar^{*2}, and R. J. Geor¹, ¹*Virginia Polytechnic Institute and State University, Blacksburg,* ²*Pennsylvania State University, State College.*

Glycemic and insulinemic responses influence equine health through change to metabolism. The objective of this study was to quantify the morning and afternoon glycemic and insulinemic responses to a meal. A post ANOVA multiple comparison procedure was used to examine potential differences, considered significant at a $P < 0.05$. On the 4 study days, blood plasma samples were taken from 8 Thoroughbred mares via a jugular vein catheter at 0, 15, 45, 75, 105, 135, 165, 225, 285, 345, 405, 435, 465, 495, 525, 585, 645, 705, and 765 minutes. A grain meal of 1.5 kg was fed immediately following the 15 (AM (0800)) and 405 (PM (1400)) min samples. Glucose (mg/dl) and insulin (mIU/L) were measured with a glucose oxidase and chemiluminescent assay, respectively. Dependent variables were peak values for glucose and insulin, area under the curve for glucose and insulin, and the time to peak, which represents the time from feeding the meal to when glucose or insulin reached peak values. There was no detectable difference in the starch intake of the AM diets 323 ± 133 g in comparison to the PM

330 ± 127 g, or the time taken to eat in the AM 22 ± 23 min versus that in the PM 24 ± 21 min. Baseline (mean of samples 0 and 15) glucose and insulin were 94 ± 5.3 mg/dl and 6.1 ± 2.9 mIU/L, respectively. The AM peak values for glucose and insulin (143 ± 17 mg/dl, 57 ± 31 mIU/L) were higher than the PM peak values (123 ± 8.6 mg/dl, 37 ± 20 mIU/L). No difference was detected in the time to peak values for AM versus PM for glucose (127 ± 49 , 118 ± 51 min) and insulin (137.4 ± 55.7 , 118.9 ± 43.5 min). The glucose and insulin area under the curve in the AM (8103 ± 2860 min*mg*dl⁻¹, 8468 ± 5050 min*mIU*L⁻¹) were higher than the PM values (4170 ± 1744 min*mg*dl⁻¹, 4358 ± 2091 min*mIU*L⁻¹). The horse shows a higher glycemic and insulinemic response to meal in the morning when compared to a similar afternoon meal. The specific mechanism may relate to circadian patterns of other metabolic regulatory hormones like melatonin or may simply be due to the fact that glucose and insulin values have only just returned to baseline when the afternoon meal is fed. Time of day is a factor when evaluating glycemic and insulinemic response.

Key Words: Glycemic, Equine

443 Effect of different ingredients or ingredient combinations on glycemic and insulinemic responses in horses. J. L. Shelton^{*1}, B. D. Nielsen², and C. I. O'Connor-Robison², ¹*Cargill Animal Nutrition, Minnetonka, MN,* ²*Michigan State University, East Lansing.*

The objective of this study was to determine the effect of different ingredients and ingredient combinations on glycemic and insulinemic responses in horses. A 12x12 Latin square design was used with mature Arabian horses (average age of 16 yr). Horses were maintained entirely on a roughage diet and subjected to a glycemic response test once weekly. The 12 treatments were: dextrose, EnergX (food grade identity preserved corn co-product), cracked corn, pelleted corn, steam pelleted corn, whole oats, steam rolled oats, steam crimped barley, COB (steam pelleted corn, steam rolled oats, steam crimped barley at a ratio of 1:1:1), COB+4% molasses, COB+8% molasses, EnergX+2% soy oil. The control treatment consisted of an oral dextrose drench given at the rate of 0.5 g dextrose/kg of BW. All remaining treatments were fed to provide 1 kcal DE/kg of BW. Once a week for 12 weeks, horses were jugular-catheterized after a 12-h fasting period. A fasting blood sample was taken 30 min later. Thirty min later, another baseline blood sample was taken and horses were fed their respective treatment. Blood samples were taken at 30, 60, 90, 120, 150, 180, 210 and 240 min after treatment. Samples were analyzed for glucose and insulin concentrations. Glucose and insulin area under the curve (AUC) were analyzed using the mixed model of SAS. When the individual ingredients were fed to horses, there were differences in glucose and insulin AUC ($P < 0.05$). For glucose AUC, EnergX had the lowest and steam processed corn had the highest. For insulin AUC, EnergX had the lowest and whole oats had the highest. As corn was further processed, differences between the corn treatments existed for glucose and insulin AUC ($P < 0.05$). Adding molasses to the COB product had a minimal effect on glycemic or insulinemic responses. These data indicate that glycemic and insulinemic responses can be affected by feeding different ingredients to the horse. Also, nutrients other than starch and sugar can play a role in reducing glycemic index in feeds for horses.

Key Words: Horse, Glycemic Response, Insulin

444 Glycemic response to meal length in equines. J. R. Bland^{*1}, E. L. Wagner¹, and W. H. McElhenney², ¹*Auburn University, Auburn, AL*, ²*Tuskegee University, Tuskegee, AL*.

Cereal grains are an ideal feedstuff for horses with high energy demands because of their high soluble carbohydrate content. However, consumption of a single meal high in soluble carbohydrates causes an immediate increase in blood glucose. This increase could be problematic for horses with certain health conditions such as insulin resistance or laminitis. Because some horses require additional energy for growth, performance, pregnancy or lactation, it becomes difficult to completely cut cereal grains out of their diet. Therefore, new feeding management strategies are needed to attenuate the blood glucose response to a soluble carbohydrate-rich meal. The objective of this study was to examine the relationship between time to consume a concentrate meal and the glycemic response to that meal as measured by peak plasma glucose, glucose area under the curve, time to peak plasma glucose, and insulin response. Eight mature horses were used in an experiment consisting of eight 7-d periods where treatment combinations were arranged in a 2x4 factorial. Horses were offered approximately 4 Mcal of oats or sweet feed twice daily starting at 0600 and 1800 hrs. Horses were offered their respective concentrate in 1, 2, 3 or 4 equal portions at 15 minute intervals, thereby restricting rate of intake of the concentrate. Blood was collected via jugular catheters at the evening feeding on d 7 of each period, with a baseline sample collected 30 min prior to feeding (1750 hrs), then every 30 min post-feeding until 2400 hrs. Plasma glucose and insulin concentrations were determined, and resulting data were analyzed by the GLM procedure in SAS. Time to peak plasma insulin was longer for horses consuming oats ($P < 0.05$), but there were no other significant differences for concentrate type, portions or treatment interactions for glucose and insulin. A period effect ($P < 0.05$) was noted for peak plasma glucose and time to peak plasma glucose. There was a trend toward a period effect ($P < 0.10$) for glucose area under the curve, but no period effects were observed for measures of insulin. Glucose and insulin responses to a concentrate meal were not altered by time to consume the meal in the present study.

Key Words: Glycemic Response, Meal Length, Horse

445 Aquacid alters markers of bone metabolism in yearling Arabians. B. D. Nielsen^{*}, R. E. Cate, C. I. O'Connor-Robison, and D. S. Rosenstein, *Michigan State University, East Lansing*.

The purpose of this study was to test whether a calcified seaweed mineral supplement (Aquacid), high in Ca and Mg, but low in P, can alter markers of bone metabolism and mineralization of the equine third metacarpus (MCIII). Prior to treatment assignment, 14 yearlings (four geldings and ten fillies) had dorsal-palmar and lateral-medial radiographs taken of their left MCIII. Radiographs were analyzed using a digital densitometer to determine the radiographic bone aluminum equivalence (RBAE) of each cortex as an estimate of mineral content. Blood samples were also taken at this time. Horses were stratified according to RBAE and gender, and then pair-matched and assigned to two treatment groups, which were housed in separate pastures. Horses were group-fed, with each horse receiving an average of 1.6 kg of oats divided into two equal feedings of 0.8 kg oats per feeding. Each group was supplemented with a mineral supplement in addition to their daily ration. The treated group (Aq) received 75 g Aquacid/horse/d mixed in with their oats. The 75 g

Aquacid provided an additional 15 g of Ca and a negligible amount of P (0.07 g). The control group (Co) received 39.5 g of limestone mixed in with their oats to provide a similar dose of Ca (15 g) and a negligible amount of P (0.008 g). Horses remained on the study for 112 d with blood samples being taken every 28 d. At d 56 and 112, another set of radiographs was taken for determination of changes in RBAE. Blood samples were analyzed for osteocalcin (OC: a marker of bone formation) and serum crosslaps (CTX-1: a marker of bone resorption) to help detect any alterations in bone metabolism. Using d 0 values as a covariate for bone markers, there was a trend ($P = 0.07$) for OC concentrations to be greater in the Aq horses than in Co. Likewise, CTX1 concentrations were greater ($P < 0.0001$) in Aq horses than in Co. There were no differences in RBAE values. These findings suggest Aquacid, while not altering bone mass, increases bone turnover and may aid in repairing damaged bone and preventing injuries.

Key Words: Horse, Bone, Calcium

446 Inflammation and vitamin E intake in horses during a CCI/CCI*** three-day event.** C. A. Williams^{*1}, E. D. Lamprecht¹, and A. O. Burk², ¹*Rutgers, The State University of New Jersey, New Brunswick*, ²*University of Maryland, College Park*.

The objective was to compare the vitamin E content in the total diet of horses competing in a three-day event to systemic inflammatory measures throughout competition. Competitors in the 2007 Jersey Fresh CCI**/CCI*** three-day event ($n = 35$) gave informed consent to participate in the study. A detailed nutritional management survey was completed by the investigators and all grain, hay and bran rations were weighed, plus pre-competition pasture intake was estimated. Calculations for daily intake of vitamin E at competition used manufacturer or NRC (2007) values, and recommended daily intakes used NRC (2007) equations. Blood samples, BW and body condition scores were taken before the competition (PRE), 20 to 30 min after cross country (XC), and 18 to 24 h of recovery (POST). Blood samples were evaluated for plasma nitric oxide (NO), tumor necrosis factor- α (TNF), creatine kinase (CK) and aspartate aminotransferase (AST). Data were analyzed using a mixed model ANOVA with repeated measures in SAS. Average intake of vitamin E from hay, grain and supplements was 1587.5 ± 230 IU/d (123.5 ± 22 IU/kg feed/d); the recommended intake was 1065.3 ± 16 IU/d (80.7 ± 0.5 IU/kg feed/d). There was a significant difference between sample times for NO ($P = 0.013$), TNF ($P = 0.013$) CK ($P < 0.0001$), and AST ($P = 0.0007$). Nitric oxide and TNF decreased ($P < 0.01$) between PRE and POST, yet was not different between XC and POST. However, CK increased between PRE and XC ($P < 0.0001$), but remained similar to XC at POST. Where AST decreased from PRE to XC ($P = 0.032$), and was higher than both PRE ($P = 0.059$) and XC ($P = 0.0002$) at POST. There was a correlation with BW and NO ($r = -0.32$, $P = 0.002$), and BW and TNF ($r = -0.41$, $P < 0.0001$). Vitamin E intake also correlated with NO ($r = -0.21$, $P = 0.04$) and TNF ($r = -0.31$, $P = 0.002$). However, there were no correlations with pasture intake and the blood chemistry measures. These results indicate that pro-inflammatory measures decrease, while muscle enzymes increased, in horses undergoing intense exercise during competition. These equine athletes are also consuming vitamin E in excess of current recommendations, which may have an impact on systemic inflammatory markers.

Key Words: Antioxidant, Equine, Exercise

447 Effect of high fat diets and fat source on immune function in yearling horses. K. R. Vineyard*, L. K. Warren, and J. Kivipelto, *University of Florida, Gainesville.*

Recent research suggests omega-3 (n-3) and omega-6 (n-6) fatty acids (FA) may affect immune function differently in humans. To determine if the fat source used in a high fat diet affects immune function in horses, 24 Quarter Horse and Thoroughbred yearlings were randomly assigned to one of three treatments for 42 d: a fish oil (1/3) and olive oil (2/3) blend (FISH, n=8), corn oil (CORN, n=8), and no supplemental fat (NON, n=8). All horses had free-choice access to bahiagrass pasture, and a grain mix top-dressed with 6% FISH or CORN to create a 10% fat concentrate was fed at 1.25% BW/d. NON grain mix was fed at a rate of 1.37% BW/d to make diets isocaloric. FISH contained 8.6 g linoleic acid (LA), 5.1 g eicosapentaenoic acid (EPA) and 2.4 g docosahexaenoic acid (DHA)/ 100 g fat, supplying 7.2 g n-3/100 kg BW/d. CORN contained 57.7 g LA/ 100 g fat, supplying 43.1 g n-6/100 kg BW/d. Blood samples were obtained at 0 and 42 d for determination of plasma and red blood cell membrane (RBC) FA composition, lymphocyte proliferation (LP), PGE₂ production by peripheral blood mononuclear cells (PBMC), and neutrophil phagocytic and oxidative burst activity. Horses were administered a tetanus booster on d 21, and titers were analyzed at d 42. Data were analyzed using the MIXED procedure of SAS, and contrasts were utilized to compare NON vs. fat-added treatments. Treatment did not affect weight gain, which averaged 0.7±0.1 kg/d. Horses fed FISH had higher (P<0.05) plasma and RBC EPA, DHA, and total n-3 and lower (P<0.05) plasma and RBC LA and total n-6 than CORN and NON. Plasma and RBC LA was higher (P<0.05) and arachidonic acid was lower (P<0.05) in horses fed CORN than NON. LP and neutrophil function were not affected by treatment. PGE₂ production was lower for FISH and CORN than NON (P<0.05). Using baseline titers as a covariate, horses fed fat-added diets had higher tetanus titers at d 42 than NON (P<0.05). Results indicate that fat source in a 10% total fat concentrate affects the FA profile of plasma and cell membranes, and fat supplementation may affect immune function. However, the immune response does not appear to differ between horses fed sources rich in n-6 or n-3 FA when fed at a rate to provide 12% of daily DE from fat.

Key Words: Omega-3, Omega-6, Immunity

448 Seasonal effects of diet on the omega-6 and omega-3 fatty acid composition of plasma and red blood cells in grazing horses. L. K. Warren* and J. Kivipelto, *University of Florida, Gainesville.*

Although low in total fat, research suggests forage may serve as a significant source of dietary α -linolenic acid. However, the fatty acid (FA) composition of pasture forage has been shown to be affected by season, which could alter the FA profile of cell membranes in grazing horses. To characterize the effect of season and diet on the FA composition of plasma and red blood cells (RBC), monthly blood samples were obtained for 24-mo from 5 mature geldings. Horses were maintained on an 8.1-ha, mixed-cultivar bahiagrass pasture. Pasture samples were collected at 1-mo intervals from areas on or near where there was recent evidence of grazing. Horses also had free-choice access to Coastal bermudagrass hay from Dec-Feb. The effect of season on plasma, RBC and forage FA composition were determined by the MIXED procedure of SAS (v 9.1), where spring=mean of Mar, Apr, May; summer=mean of Jun, Jul, Aug; fall=mean of Sept, Oct, Nov; and winter=mean of Dec, Jan, Feb. C18:2 was lowest in winter plasma (P<0.05) and tended to be lower in winter RBC (P<0.1). C20:4 was lower in winter and spring plasma (P<0.01) and tended to be lower in fall RBC (P<0.1). Plasma C18:3 was lowest in winter and spring (P<0.01) and C20:5 was lowest in spring (P<0.01). RBC C18:3 and C20:5 peaked in fall (P<0.01) and were lowest in spring (P<0.01). C22:5 and C22:6 were not affected by season in plasma, but were lowest in spring RBC (P<0.05). Total n-6 FA were higher in summer and fall in plasma (P<0.05) and tended to be higher in summer and fall in RBC (P<0.1). Total n-3 FA peaked in fall and were lowest in spring in plasma (P<0.01) and RBC (P<0.01). Pasture C18:2 was lower in winter (P<0.05) and C18:3 was higher in spring and winter. Hay C18:2 was higher (P<0.01) and C18:3 was lower (P<0.01) than pasture in all seasons, which altered FA intake during the winter. Collectively, these results indicate that plasma and RBC C18:2 and C18:3 composition mimic seasonal dietary intake in grazing horses. Longer-chain n-6 and n-3 FA in plasma and RBC appear to be dependent on the relative availability of C18:2 and C18:3 in the diet.

Key Words: Polyunsaturated Fatty Acids, Pasture, Warm-Season Forage

Lactation Biology I

449 The acute response to milk removal and the long-term response to frequent milking treatment involve distinct mechanisms.

E. H. Wall*, J. P. Bond, and T. B. McFadden, *University of Vermont, Burlington.*

Frequent milking during early lactation of dairy cows elicits a persistent increase in milk yield. We hypothesized that this response would be associated with increased mammary growth and altered expression of genes involved in the insulin-like growth factor (IGF) axis. Four multiparous cows were assigned at parturition to unilateral frequent milking (UFM; twice daily milking of the left udder half (2×; 0230 and 1430 h), four-times daily milking of the right udder half (4×; 0230, 0530, 1430 and 1730 h)). Mammary biopsies were obtained from both udder halves at 5 days in milk (DIM) at 0530 h (immediately after 4× glands were milked). Incorporation of [³H]-thymidine into DNA, mammary cell apoptosis, and expression of IGF-1, IGF-1 receptor, and IGF binding protein (IGFBP)-1 mRNA were not affected by UFM (P 's > 0.20), whereas expression of IGFBP-3 was lower in 4× glands (P ≤ 0.06). Using Affymetrix GeneChip® Bovine Genome Arrays, we identified 84 genes that were differentially expressed in 2X vs. 4X glands (P < 0.05). Because biopsies were obtained when glands were at different intervals since the previous milking, our results included both the acute mammary response to milk removal and the long-term response to UFM treatment. A second experiment was designed to distinguish the mechanisms involved in each of these responses. Mammary biopsies were obtained from UFM cows (n = 5) at 0500 h, when udder halves were at the same interval since the previous milking. Mammary cell apoptosis and expression of the genes listed above were not affected by UFM (P 's > 0.20). We identified an intersection of 13 genes that were differentially expressed in both experiments, consistent with their involvement in the persistent milk yield response. In contrast, the remaining 71 genes appear to be involved in the acute mammary response to milk removal. We conclude that frequent milking does not alter mammary growth or genes of the IGF axis at 5 DIM. Moreover, the acute mammary response to milk removal and the long-term response to frequent milking appear to involve separate mechanisms.

Key Words: Frequent Milking, Gene Expression

450 The effects of increased milking frequency during early lactation on metabolism and mammary cell proliferation in Holstein cows.

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Primiparous (n =30) and multiparous (n =30) cows were assigned randomly at calving to one of 2 treatments to evaluate metabolic and mammary cell responses to increased milking frequency (IMF). Controls were milked twice daily (2X) for 119 d and the IMF group was milked four times daily (4X) from d 2 until d 21 postpartum and 2× from d 22 until d 119. Early lactation IMF did not affect overall milk yield (42.0 vs. 40.6 kg/d; P > 0.10). An interaction of treatment by week (P < 0.01) indicated that IMF cows yielded 4.8 kg/d more milk than controls during wk 2 and 3 but yields were comparable thereafter. Although there was no interaction of treatment and parity (P = 0.31), a trend (P = 0.08) for an interaction of treatment, parity, and week suggested that overall responses were larger in primiparous cows. When cows subjected to

mammary biopsies were excluded, an overall interaction of treatment by parity existed (P < 0.01) such that milk yield was increased throughout the study period by IMF (40.1 vs. 34.2 kg/d) in primiparous but not multiparous cows (47.1 vs. 50.1 kg/d). Plasma nonesterified fatty acids were elevated in multiparous (679 vs. 468 μ Eq/L) but not primiparous (583 vs. 562 μ Eq/L) cows subjected to IMF (treatment by parity, P < 0.05). Plasma β -hydroxybutyrate was not affected by IMF. Mammary tissue was biopsied from a subset of cows (n =8 per parity group and treatment) at calving, 21 d postpartum, and 75 d postpartum and used for immunohistochemical localization of Ki-67. A treatment by day interaction (P = 0.03) indicated that IMF cows had fewer labeled epithelial cells than controls at d 21 (0.31 vs. 0.82%) but more labeled epithelial cells at d 75 (1.37 vs. 0.65%). Overall, results suggest that metabolic health may influence the milk yield response of cows to early lactation IMF. Further analysis of mammary cellular dynamics is needed to determine specific mechanisms for milk yield responses to early lactation IMF.

Key Words: Milking Frequency, Mammary Gland

451 Effects of serotonin receptor antagonists on milk protein gene expression in primary bovine mammary epithelial cells.

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Serotonin (5-HT) is proposed to be a feedback inhibitor of lactation (FIL) in the bovine specifically, decreasing α -lactalbumin and β -casein mRNA expression in primary bovine mammary epithelial cells (BMEC) and milk yield in lactating dairy cows. However, there are 7 5-HT receptor subtypes currently identified and it is critical to determine which one(s) is present in bovine mammary tissue. Therefore, we investigated effects of selective 5-HT receptor antagonists on milk protein mRNA expression in BMEC. Cells were cultured in collagen gels, proliferated for 7 d in a serum-free (SF) medium containing IGF-I, EGF, and insulin and then treated with a SF lactogenic medium containing IGF-1, hydrocortisone and PRL with gel release for 48 h. Treatments included 0.1, 1.0 and 10 μ M of the 5-HT receptor antagonists; SB-224289 (1b antagonist), ritanserin (2a antagonist), SB-204741 (2b antagonist), and pimoziide (7 antagonist), and 0.0001, 0.01 and 1.0 μ M of SB-204070 (4 antagonist). Lactogenic medium with gel release alone served as control (CTRL). Exogenous SB-224289, at a dose of 1.0 μ M and all doses of ritanserin up-regulated α -lactalbumin mRNA expression (P < 0.05) relative to the CTRL. The 1.0 μ M of ritanserin had the greatest effect on α -lactalbumin mRNA expression, causing a 16-fold increase relative to the CTRL (P < 0.001). All other treatments did not affect α -lactalbumin mRNA expression (P > 0.05). The 0.1 μ M doses of SB-224289, SB-204070 and pimoziide increased β -casein mRNA expression (P < 0.05) relative to the CTRL. The 1.0 μ M dose of ritanserin increased β -casein mRNA expression relative to the CTRL (P < 0.05). Antagonism of the 5-HT1b and 5-HT2a receptors increased α -lactalbumin mRNA expression. Furthermore, antagonism of the 5-HT1b, 5-HT4 and 5-HT7 increased β -casein mRNA levels. These results indicate there are multiple 5-HT receptor subtypes present in bovine mammary epithelial tissue and further support the involvement of the serotonergic system as a FIL in the bovine.

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Key Words: Serotonin, FIL, Serotonin Receptors

452 Effect of experimental tight junction opening on milk production. H. Ben Chedly^{*1}, M. Boutinaud¹, P. Lacasse³, R. Bounhamous², and P.-G. Marnet^{2,1}, ¹INRA, UMR 1080 Production du Lait, Saint Gilles, France, ²Agrocampus Rennes, Rennes, France, ³AAFC-Dairy and Swine R&D Centre, Sherbrooke, QC, Canada.

In situations where milk yield is decreasing rapidly, an opening of tight junctions between mammary epithelial cells (MEC) is often observed. The goal of this experiment was to determine if an experimental induction of tight junction opening by chelation of milk calcium by EGTA or citrate affects milk production, MEC activity and MEC apoptosis. Three hours after milking, 4 dairy goats received a 250 mL intra-mammary infusion of EGTA (115 mM) in the right gland and an equal volume of physiologic saline in the left gland. Similarly, 4 other goats received a 32 mL infusion of citrate (50 mM) in the right gland and lactose (300 mM) in the left gland. The procedure was repeated for 4 consecutive milkings. Mammary biopsies were performed before the milking following the 4th infusion. EGTA infusion induced a decrease in milk free calcium concentration (55%; $P < 0.01$) associated with an increase in milk serum albumin concentration (6 fold; $P < 0.01$), milk Na/K ratio ($P = 0.02$) and blood lactose ($P = 0.02$) indicating the opening of tight junctions. In contrast, the increase in milk serum albumin concentration caused by lactose infusion was larger than for citrate, ($P = 0.02$) suggesting that lactose caused tight junction opening. Tight junction opening in EGTA and lactose treated udder was associated to a decrease in milk yield (respectively 30%; $P = 0.03$ and 25%; $P = 0.01$). Gene expression of proteins involved in milk synthesis or cell apoptosis were quantified by qRT-PCR. Induction of tight junction opening was associated with lower α -lactalbumin ($P = 0.08$ and $P = 0.03$) and higher pro-apoptotic protein Bax ($P = 0.10$ and $P = 0.02$) mRNA levels for EGTA and lactose infusions, respectively. Higher TUNEL labeling were observed in EGTA ($P = 0.10$) and lactose ($P = 0.02$) infused glands which confirmed cell death induction. In conclusion, the lower MEC activity and higher MEC apoptosis were involved in the milk yield decrease consecutive of tight junction opening.

Key Words: Tight Junction, Mammary Gland, Apoptosis

453 Suppression of bovine α S1-casein gene expression during involution of the mammary gland is associated with increased DNA methylation at a STAT5-binding site in the α S1-casein promoter. K. Singh^{*1}, K. Swanson¹, C. Couldrey¹, H.-M. Seyfert², and K. Stelwagen¹, ¹AgResearch Ltd, Ruakura Research Centre, Hamilton, New Zealand, ²Research Institute for the Biology of Farm Animals (FBN), Dummerstorf, Germany.

Milk protein gene expression in the mammary gland is regulated in a tissue-specific and temporal manner. During lactation, the transcription factor STAT5 is activated in response to prolactin and stimulates expression of milk protein genes by binding to target sequences on the promoters. At the onset of mammary involution there is a rapid decline in milk protein gene expression. DNA methylation is an epigenetic event which results in the silencing of gene expression. The DNA methylation at a functional STAT5-binding site in the promoter of the bovine α S1-casein gene is associated with the shutdown of casein synthesis during acute mastitis. To elucidate the silencing mechanism of α S1-casein during bovine mammary gland involution, the DNA methylation

status across the promoter was examined in alveolar tissue obtained from non-pregnant cows in mid-lactation slaughtered at 0, 6, 12, 18, 24, 36, 72 and 192h ($n = 6$ per group) after the last milking. Quantitative real time RT-PCR analysis showed α S1-casein mRNA levels were down-regulated 6.6-fold ($P < 0.01$) by 24 h post milking, relative to 6 h and expression continued to decrease ($P < 0.001$) until 192 h after the last milking. A quantitative MassARRAY methylation analysis (www.sequenom.com) showed 2 of the 3 CpG sites at the STAT5-binding site approximately -10kbp upstream of the α S1-casein-encoding gene, had increased methylation levels. One site was increased ($P < 0.05$) from 21% to 44% at 36 h post milking compared to 18 h. The other site was increased ($P < 0.05$) from 34% to 60% by 192 h post milking compared to 18 h post milking. Results suggest that alterations in methylation status at CpG sites at the functional STAT5 binding site in the far upstream promoter are associated with the silencing of the α S1-casein gene during involution.

Key Words: DNA Methylation, Bovine α S1-Casein, Mammary Involution

454 Extending lactation in pasture-based dairy cows: Effect of genetic strain and diet on hormones and metabolites. J. Kay^{*}, P. Aspin, C. Phyn, J. Roche, D. Clark, and E. Kolver, DairyNZ, Hamilton, New Zealand.

The effect of genetic strain and diet on plasma hormone and metabolites was investigated in pasture-based dairy cows milked continuously for up to 670 d. Fifty-six genetically divergent New Zealand (NZ) and North American (NA) Holstein-Friesians (HF) grazed pasture and were offered 0, 3, or 6 kg concentrate DM/cow/d for 604 ± 8 DIM. Weekly blood samples collected from individual cows during wk 1-10 and wk 47-63 (extended lactation) were analyzed for NEFA, BHBA, insulin, glucose, leptin, growth hormone (GH) and IGF-I. Data were averaged for each period and analyzed by REML with genetic strain, diet and interactions as fixed effects and cow as random effect. In the first 10-wks postpartum there was no strain effects on BHBA, leptin, insulin or glucose, however NA HF had greater ($P < 0.05$) NEFA and GH and lower ($P < 0.05$) IGF-I compared with NZ HF. Plasma NEFA and GH were also greater ($P < 0.05$) in NA HF during the extended lactation period, but IGF-I was not affected by strain, and BHBA and glucose were greater ($P < 0.05$) in NZ HF. During the extended lactation period, leptin was greater ($P < 0.01$) and insulin tended to be greater ($P = 0.07$) in NZ HF. A strain by diet interaction ($P < 0.01$) revealed that this effect was due to a greater leptin and insulin content in NZ HF fed the highest concentrate level than either of the other 5 treatments that did not differ from each other. Supplementation during the first 10-wk postpartum linearly increased ($P < 0.01$) glucose and decreased GH, but did not alter BHBA, NEFA, leptin, insulin or IGF-I. During the extended lactation period, NEFA and IGF-I were unaltered and glucose and GH followed the same pattern with diet. However, BHBA increased linearly ($P < 0.01$) with increasing supplementation. These data are consistent with the previously reported greater milk production and BCS loss in NA HF compared to NZ HF and indicate potential strain differences in recoupling of the somatotrophic axis and energy partitioning. These results have implications for breeding and diet management during an extended lactation.

Key Words: Extended Lactation, Genetic Strain, Pasture-Based

455 Effect of the prolactin-release inhibitor Quinagolide on dairy cows. P. Lacasse^{*1}, V. Lollivier², R. M. Bruckmaier³, Y. R. Boisclair⁴, G. W. Wagner⁵, and M. Boutinaud², ¹*Dairy and Swine R&D centre, Sherbrooke, QC, Canada*, ²*INRA, Agrocampus Rennes, St-Gilles, France*, ³*University of Bern, Switzerland*, ⁴*Cornell University, Ithaca, NY*, ⁵*University of Western Ontario, London, ON, Canada*.

In most mammals, prolactin (PRL) is essential to maintain lactation. Nevertheless, short term suppression of PRL by bromocriptine has produced inconsistent effects on milk yield in cows and goats. To assess the effect of long term inhibition of PRL release in lactating dairy cows, five Holstein cows in early lactation received daily i.m. injection of 1 mg of Quinagolide for 9 weeks. Four control cows received the vehicle (water). During the last week of treatment, one half-gland was milked once (1X) and the other twice a day (2X). Blood samples were harvested at milking on wks -1, 1, 4 and 8 and mammary biopsies were taken at wks -1, 4 and 8. Daily injections of Quinagolide reduced milking-induced PRL release ($P<0.05$) but not basal PRL. Quinagolide induced a faster decline in milk production ($P<0.05$). During week 9, the inhibition of milk production by Quinagolide was maintained in half-gland milked 2X ($P<0.05$) but not in half-gland milked 1X. Milk production was significantly correlated with the quantity of PRL released at milking ($P<0.01$) but not with its basal level. Quinagolide did not affect the release of oxytocin at milking. The concentration of IGF-1 was not affected by treatment or correlated with milk production. Serum concentration of leptin and of the calcitropic hormone stanniocalcin were not affected by the treatment. Levels of κ -casein ($P<0.05$) and α -lactalbumin ($P=0.06$) mRNA determined by qRT-PCR were lower in mammary biopsies of Quinagolide-treated cows at wk 4. Western blotting and immunohistological determination of tissue harvested at wk 8 have shown that the protein PCNA was less abundant ($P<0.05$) and present in a lower number of cells ($P<0.05$) in Quinagolide-treated animals, suggesting a reduction in cell proliferation. In conclusion, chronic administration of the prolactin-release inhibitor Quinagolide reduces milk production in dairy cows.

Key Words: Leptin, Stanniocalcin, Persistency

456 Effect of estradiol cypionate injected at dry-off on lactose concentrations in bovine plasma. M. S. Gulay^{*1}, M. J. Hayen², H. H. Head², and K. C. Bachman², ¹*Mehmet Akif Ersoy University, Burdur, Turkey*, ²*University of Florida, Gainesville*.

Elevation of lactose in plasma of dairy cows because of mammary cell tight junction leakage serves as an indicator of the onset of mammary tissue involution. Therefore, objective of this study was to determine the effect of supplemental estradiol cypionate (ECP) at dry-off on concentrations of plasma lactose in Holstein cows. Thirty-two Holstein cows were assigned to four dry-off treatment groups ($n=8$ /group; 30 d dry, 30 d dry +ECP, 60 d dry, and 60 d dry +ECP). Single injections of ECP (15 mg) in cottonseed oil or equal quantities of cottonseed oil carrier were administered intramuscularly at dry-off to equal numbers of cows given 30 or 60 d dry periods. Blood samples were collected from the coccygeal vein 24 h prior to dry-off, at dry-off, and throughout the subsequent 48 h (12, 8, 4, 4, 4, 4, 4 and 8 h intervals) to monitor plasma lactose. Actual

dry period lengths for cows in 30d, 30d+ECP, 60d, and 60d+ECP were 26.8, 29.1, 54.2, and 59.1 d, respectively. No differences in mean milk yields at dry off for the four groups were observed (30d=16.1 \pm 4.3, 30d+ECP=14.3 \pm 4.3, 60d=14.0 \pm 4.2, 60d+ECP=14.4 \pm 4.4 kg/d; $P=0.47$). Similarly, no significant effect of ECP on overall concentrations of plasma lactose was detected (30d=282.7 \pm 52.1, 30d+ECP=189.5 \pm 48.9, 60d=191.0 \pm 51.6 and 60d+ECP=196.6 \pm 52.9 μ M; $P=0.62$). Lactose concentrations increased and were greatest in blood plasma at 20 h after the injection and final milk removal. At 40 h, concentrations approached those observed prior to dry-off. Plasma lactose concentrations at 20 h were positively correlated with milk yield at dry-off ($R^2=0.52$). The temporal profiles of lactose in blood plasma were similar across all treatments and indicated that supplementing 15 mg ECP at dry-off did not alter markedly the course of tight junction leakage that occurs in mammary epithelial tissue when milk removal is discontinued at dry-off.

Key Words: Dry Period, Estrogen, Plasma Lactose

457 Heat stress abatement for dry cows: Does cooling improve transition into lactation? B. C. do Amaral^{*1}, J. Hayen¹, E. E. Connor², S. Tao¹, and G. E. Dahl¹, ¹*University of Florida, Gainesville*, ²*USDA-ARS, Beltsville, MD*.

Environmental factors, especially temperature and photoperiod, influence health and productivity of dairy cows during lactation, possibly via similar physiological effects. For example, heat stress is a critical component of lowered milk yield during summer. Long days improve yield during lactation, while short days improve health and subsequent performance in dry cows. The objective of the study was to evaluate the effects of heat stress prepartum under controlled photoperiod on lactation performance and hepatic metabolic gene expression of periparturient Holstein cows ($n=16$). Cows were dried off 46 d before expected calving date and assigned to treatments by mature equivalent milk production. The treatments were: 1) Heat stress (HT) and 2) Cooling (CL). Both treatments had a photoperiod of (14L:10D). Rectal temperature was measured 2x daily during the dry period. After calving, cows were housed in a free stall barn with cooling, and milk yield was recorded daily up to 42 DIM. Daily DMI was measured from -35 to 42 d relative to calving. Liver biopsies were collected at dry off, -20, +2, and +20 d relative to calving for cows on HT ($n=5$) and CL ($n=4$) to measure mRNA expression of *prolactin receptor (PRL-R)*, *suppressors of cytokine signaling (SOCS1, 2, and 3)*, *CAV1*, *IGFII*, *IGFBP5*, a key transcription factor in lipid biosynthesis (*SREBP1-c*), and enzymes of lipid metabolism (*FASN*, *ACACA*, *ACADVL*, *LCAT*, *CPT1A*, and *ACOX*) by real-time qPCR. HT cows had greater afternoon rectal temperatures (39.2 vs. 38.8°C) and decreased DMI prepartum (12.0 vs. 14.1 kg/d) and milk yield postpartum (25.4 vs. 33.3 kg/d) compared with CL cows. Relative to CL cows, hepatic mRNA expression of *SOCS2* and *IGFBP5* was down-regulated in HT cows. Expression of *ACADVL* was up-regulated in CL cows at d +2 but down-regulated at d +20 relative to HT cows. These results suggest that heat stress abatement in the dry period improves subsequent lactation, possibly through *SOCS-2* and its regulation of hepatic lipid metabolism.

Key Words: Heat Stress, Dairy Cattle, Gene Expression

Meat Science and Muscle Biology: Beef Quality

458 National Market Cow and Bull Beef Quality Audit-2007: A survey of producer-related defects. J. D. W. Nicholson¹, R. J. Maddock², R. J. Delmore³, T. E. Lawrence⁴, W. R. Henning⁵, T. D. Pringle⁶, D. D. Johnson⁷, J. C. Paschal¹, R. J. Gill¹, J. J. Cleere¹, B. B. Carpenter¹, R. V. Machen¹, J. P. Banta¹, J. W. Savell¹, D. S. Hale^{*1}, and D. B. Griffin¹, ¹Texas A&M University, College Station, ²North Dakota State University, Fargo, ³California Poly Technical University, San Luis Obispo, ⁴West Texas A&M University, Canyon, ⁵Pennsylvania State University, University Park, ⁶University of Georgia, Athens, ⁷University of Florida, Gainesville.

Packing plants (n = 23) were audited for producer-related defects found in cull cows and bulls. Interviews, live animal and carcass evaluations, and subprimal evaluations were conducted during audits at each plant. Similar audits were conducted in 1994 and 1999. A drastic reduction in downer (non-ambulatory) incidence was found between 1999 and 2007. Fewer cattle had horns, brands, and mud/manure contamination on hides than in 1999. Predominant hide color for beef cows was black (44%). Fewer cattle displayed evidence of bovine ocular neoplasia than in 1994 and 1999. The frequency of injection site knots on live cattle was less in the round and more in the shoulder region than in 1999. Dairy cows were more frequently lame in 2007 than 1999, while beef cows were less lame. Carcass bruising was less evident during the 2007 audit than in previous audits. An increase in liver, tripe, heart, head, and tongue condemnation was found in 2007 than in 1999. Carcasses weighed more in 2007 (305 kg) than in 1999 (246 kg), as well as had less fat. The overall maturity score for cow and bull carcasses was D⁵⁴. The average fat color score was more yellow for beef cows (3.14) than dairy cows (2.42). The majority of all cattle (64%) were able to be traced back to their original owner. End-user audits revealed a higher incidence of injection site lesions in dairy rounds (48%) than in beef rounds (12%).

459 Expression of myosin heavy chain mRNA in skeletal muscle of zilpaterol-HCl fed steers. R. J. Rathmann^{*1}, T. J. Baxa², J. T. Vasconcelos¹, M. L. Galyean¹, B. J. Johnson², and M. F. Miller¹, ¹Texas Tech University, Lubbock, ²Kansas State University, Manhattan.

The objective of this experiment was to determine whether zilpaterol-HCl (ZH) influences protein turnover through the alteration of skeletal muscle gene expression. A 4 x 4 factorial arrangement of treatments in a completely random design was used with the feeding of ZH (8.33 mg/kg, DM basis) to 560 crossbred beef feedlot steers (112 pens; 7 pens/treatment) for durations of 0, 20, 30, and 40 d before slaughter with a 3-d withdrawal. The ZH duration treatments were applied to 4 slaughter groups (136, 157, 177 and 198 d on feed). Feedlot performance, carcass measurements, and the mRNA abundance of β -adrenergic receptors (β -AR), calpastatin (CAL), myosin heavy chain (MHC) isoform 2a, and insulin-like growth factor I (IGF-I) were determined. Within 10 min postmortem, samples were collected from the semimembranosus muscle for RNA isolation from 4 randomly selected steers from each treatment within the 157, 177, and 198 d slaughter groups. No ZH duration x slaughter group interactions were detected ($P > 0.10$) for feedlot or carcass data. Feeding ZH increased ADG, G:F, HCW, dressing percent, and LM area ($P < 0.01$); and decreased fat at the 12th rib, YG, marbling score ($P < 0.01$), and KPH ($P = 0.03$). Feeding ZH did not alter β 1-AR, β 2-AR, CAL, or IGF-I mRNA abundance ($P > 0.10$). There was ZH

duration x slaughter group interaction ($P < 0.01$) for the expression of MHC-2a, in which feeding ZH decreased MHC-2a mRNA abundance for every ZH duration within the 177 and 198 d slaughter groups ($P < 0.02$), but not for the 157 d group ($P > 0.10$). There was a tendency for a linear decrease in CAL mRNA abundance as ZH duration increased ($P = 0.07$), and there was a linear increase in β 2-AR ($P = 0.03$) and CAL ($P < 0.01$) mRNA abundance as days on feed increased. Collectively, the data indicate that ZH may influence net protein turnover by decreasing MHC-2a mRNA expression; however, further research is needed to confirm these results.

Key Words: Myosin, Skeletal Muscle, Zilpaterol

460 Zilpaterol-HCl feeding reduces myosin heavy chain mRNA abundance in skeletal muscle of finishing steers. T. J. Baxa^{*1}, J. P. Hutcheson², M. F. Miller³, W. T. Nichols², M. N. Streeter², D. A. Yates², and B. J. Johnson¹, ¹Kansas State University, Manhattan, ²Intervet Inc., Millsboro, DE, ³Texas Tech University, Lubbock.

This experiment investigated the effects of zilpaterol-HCl with and without the steroidal implant Revalor-S (Rev-S) on feedlot performance and mRNA expression of β -adrenergic receptors (β -AR), insulin-like growth factor I (IGF-I), and myosin heavy chain (MHC) isoforms 1, 2a, and 2x. A total of 2279 (426.2 kg) feedlot steers were administered Rev-S (0 vs. 120 mg trenbolone acetate and 24 mg estradiol) on day 0, and fed zilpaterol (0 vs. 8.3 mg/kg on a dry matter basis) during the last 30 days with a 3 day withdrawal. Treatments were randomly assigned to 24 pens. At slaughter, semimembranosus muscle tissue was excised for RNA isolation from four carcasses per pen. Zilpaterol administration increased ($P < 0.01$) ADG, G:F, HCW, and LM area; decreased ($P < 0.01$) 12th rib fat depth, and marbling; and improved ($P < 0.01$) yield grade. There was no effect ($P > 0.10$) for zilpaterol feeding on the expression of β 1-AR mRNA concentrations; however there was a tendency ($P = 0.09$) for Rev-S administration to decrease β 1-AR mRNA levels. All treatments had no effect ($P > 0.10$) on β 2-AR mRNA. Administration of Rev-S decreased ($P = 0.03$) β 3-AR mRNA, and zilpaterol feeding had a tendency ($P = 0.07$) to decrease β 3-AR mRNA. There was no effect ($P > 0.10$) on the expression of IGF-I mRNA for all treatments. For MHC-1 mRNA, there was a tendency ($P = 0.09$) for zilpaterol by implant interaction, with zilpaterol decreasing ($P = 0.03$) MHC-1 mRNA levels. We also observed a zilpaterol by Rev-S interaction ($P = 0.05$) for MHC-2x abundance. Zilpaterol administration decreased ($P = 0.01$) MHC-2a, and numerically decreased MHC-2x. These data indicate the combined use of zilpaterol and Rev-S additively contributes to total lean tissue accumulation in finishing feedlot steers. In addition, zilpaterol feeding reduced the abundance of myosin heavy chain mRNA in skeletal muscle which could be a consequence of altered protein synthesis and degradation.

Key Words: β -Adrenergic Receptors, Skeletal Muscle, Zilpaterol

461 Effects of ractopamine hydrochloride and zilpaterol hydrochloride fed to beef steers for the final 33 days of the finishing period on growth performance, carcass traits and Warner Bratzler shear force. W. J. Platter¹, R. A. Gomez¹, W. T. Choat^{*1}, S. M. Scramlin²,

and F. K. McKeith², ¹Elanco Animal Health, Greenfield, IN, ²University of Illinois, Urbana.

This study was conducted to evaluate the effects of ractopamine hydrochloride, (Optaflexx[®]) [RAC] and zilpaterol hydrochloride, (Zilmax[®]) [ZH] on performance, carcass characteristics and Warner Bratzler shear force (WBSF). Three hundred beef steers (516 ± 8 kg) were blocked by re-implant (Component TES[®] plus Tylan[®]) BW, breed make-up and condition score and randomly assigned to one of three treatments (10 steers per pen; 10 pens per treatment). Treatments were; control [C], RAC (200 mg RAC•hd⁻¹•day⁻¹ for 33 days), and ZH (7.5 ppm, ~75 mg•hd⁻¹•day⁻¹ ZH for 30 days plus a 3 day withdrawal). Both RAC and ZH improved (P < 0.05) daily gain (ADG), feed efficiency (FE), final BW and carcass wt (HCW) compared with C. Compared to RAC, ZH had (P < 0.05) lower ADG, feed intakes and final BW along with greater (P < 0.05) HCW and dressing percentages. RAC had no effect on carcass quality or yield in this experiment. However, ZH decreased (P < 0.05) backfat and KPH fat, increased (P < 0.05) ribeye area and improved (P < 0.05) yield grade when compared with C. Marbling score was not different between treatments. RAC steaks had higher (P < 0.05) WBSF values than C after 7 days of aging and did not differ from C after 14 days of aging. ZH steaks were tougher (P < 0.05) than C and RAC steaks even after 21 days of aging. This study indicates that both RAC and ZH are effective at improving feedlot performance during the final 33 days of the finishing period. Feeding ZH significantly increased WBSF, even with extended aging periods.

Table 1. Least squares means

Trait	Treatment			SEM
	Control	RAC	ZH	
Initial weight, kg	516	514	516	8.7
End weight, kg	547 ^c	555 ^a	550 ^b	1.5
ADG, kg	0.95 ^c	1.18 ^a	1.05 ^b	0.05
ADFI, kg•hd ⁻¹ •day ⁻¹	8.99 ^a	9.08 ^a	8.22 ^b	0.26
Feed:gain	9.6 ^a	7.8 ^b	8.0 ^b	0.38
HCW, kg	358 ^c	363 ^b	371 ^a	1.4
DP, %	65.49 ^b	65.52 ^b	67.42 ^a	0.18
Yield Grade	2.9 ^a	2.9 ^a	2.34 ^b	0.06
Marbling Score	SM ⁴⁵	SM ³³	SM ²⁴	8.66
14 d shear force, kg	3.55 ^a	3.78 ^a	5.28 ^b	0.20

^{a,b,c}Means lacking common superscripts differ (P < 0.05)

Key Words: Ractopamine Hydrochloride, Zilpaterol Hydrochloride, Shear Force

462 Sensory attributes of beef from steers finished with corn or high-tannin sorghum. R. E. Larrain^{*1,2}, D. M. Schaefer¹, and J. D. Reed¹, ¹University of Wisconsin, Madison, ²Pontificia Universidad Católica de Chile, Santiago, RM, Chile.

The objective of this study was to test if finishing steers with diets containing high-tannin sorghum (HTS) affects sensory attributes of beef. Steers (n = 31) were randomly allocated to 3 diets containing: 132 g/kg supplement, 100 g/kg corn silage and 768 g/kg grain. Grains were corn (control), HTS and a 1:1 mix of both. Animals were individually penned and harvested in 2 groups after 102 and 123 d. Strip loins were removed from each carcass 48 h post-mortem. Samples were aged in vacuum packages at 2°C for 14 d. Steaks (2.54 cm thick) were cooked in

an electric broiler to an internal temperature of 71°C. A seven-member trained panel evaluated samples from all animals. Loins were evaluated for juiciness, tenderness, beef flavor intensity, grass-fed beef flavor intensity, off-flavor intensity and degree of cooking-doneness. A continuous 15 cm line scale with anchors at both sides was used. The model used for analysis was a completely randomized design with diet as variable, harvest group and panelist as blocks and degree of cooking-doneness as covariate. There was no difference among treatments in juiciness and intensity of beef flavor, grass-fed beef flavor and off flavors (Table 1). Main effect of diet in tenderness tended to be significant but none of the treatments was different from the control (Table 1). We concluded that replacement of corn by HTS in finishing diets for steers did not affect beef sensory attributes when evaluated by a trained panel.

Table 1. Trained-panel sensory attributes of beef from steers finished with corn (C) or high-tannin sorghum (HTS)

	C	HTS	1:1 mix C:HTS	P diet effect
Juiciness	7.27 ± 0.24	6.57 ± 0.24	7.12 ± 0.22	0.094
Tenderness	7.84 ± 0.25	7.22 ± 0.26	8.06 ± 0.24	0.055
Beef flavor intensity	8.37 ± 0.19	8.07 ± 0.19	7.99 ± 0.18	0.307
Grass-fed beef flavor intensity	2.86 ± 0.17	3.00 ± 0.17	2.78 ± 0.16	0.646
Off flavor intensity	1.88 ± 0.17	1.78 ± 0.17	1.63 ± 0.16	0.548

Scale of attributes: 0 = absent, 15 = present strongly or at high degree

Key Words: Sensory Attributes, Sorghum, Beef

463 Development of a natural beef production and marketing program for Holstein bull calves. M. J. Baker^{*1}, D. G. Fox¹, W. R. Henning², L. O. Tedeschi³, and D. J. Ketchen¹, ¹Cornell University, Ithaca, NY, ²Pennsylvania State University, University Park, ³Texas A&M University, College Station.

The effects of diet and sex condition on feedlot performance, carcass quality, and taste panel acceptability were evaluated for Holstein bulls (n=36), implanted steers (n=36), and non-implanted steers (n=36). During Phase 1 (84 d), cattle were fed a high grain (HG) or high forage (HF) diets, and then fed a common high grain diet (Phase 2) until they reached the USDA low Choice quality grade. During Phase 1, bulls and implanted steers were not different (P > 0.05) in ADG, DMI, or F:G. The HG cattle gained faster, consumed more DM, and were more efficient than HF (P < 0.01). During Phase 2 there was no difference (P > 0.01) between bulls and implanted steers in days on feed (DOF), ADG, or DMI. For steers, implants decreased DOF (P < 0.05) and increased (P < 0.01) ADG and DMI. There was no difference (P > 0.05) in F:G due to sex or implant. Cattle that had previously been on the HF diet had a higher ADG (P < 0.05), but were not different (P > 0.05) in all other performance traits. Over the entire feeding period there was no difference (P > 0.05) between bulls and implanted steers in ADG, DMI, or F:G. In steers, implants increased ADG and DMI (P > 0.05). Compared to implanted steers, bulls tended to have less backfat (P = 0.05) and marbling (P = 0.06) but were similar in ribeye area (REA; P = 0.15), and had numerically lower yield grades, darker lean and lower USDA quality grade. No differences were found in carcass traits due to previous diet, other than HG increased REA. The consumer taste panel favored bull beef over that from implanted steers in juiciness

and tenderness but found both sources of beef to be equally acceptable. Juiciness and tenderness were improved in HF treatment ($P > 0.05$). We conclude that young Holstein bulls grow and convert feed to weight gain as efficiently as implanted steers and produce beef that is of equal or better eating quality.

Key Words: Holstein Beef, Implants, Natural Market

464 Fatty acid composition of beef finished on various forage species or concentrates. S. K. Duckett^{*1}, J. P. S. Neel², J. P. Fontenot³, W. Clapham², and W. S. Swecker, Jr.³, ¹Clemson University, Clemson, SC, ²USDA-ARS, Beaver, WV, ³Virginia Tech University, Blacksburg.

Angus-crossbred steers ($n = 128$) were used to determine the effects of forage species grazed in the last 41 d or high concentrate finishing on the fatty acid composition of beef. Steers grazed mixed pastures (bluegrass/white clover) for 93 d and then grazed alfalfa (AL; $n = 36$), pearl millet (PM; $n = 24$), or mixed (MP; $n = 36$) pastures for the final 44 d of finishing. Due to drought conditions in year 3, steers did not graze PM pastures. Steers were also finished on traditional high concentrate diets (C; $n = 32$) for 134 d. Total lipid content of LM was 60% lower ($P < 0.01$) for forage-finished than C with no differences among forage species. Saturated fatty acid percentage was higher ($P < 0.05$) for AL, PM, and MP than C due to greater ($P < 0.05$) concentrations of stearic acid. Monounsaturated fatty acid (MUFA) percentage was higher ($P < 0.05$) for C than all forage-finished treatments. MUFA was also higher ($P < 0.05$) in PM than AL. Omega-6 fatty acid concentration was higher ($P < 0.05$) for AL than PM and C with MP intermediate. Linolenic acid and total omega-3 fatty acid concentrations were higher ($P < 0.05$) for AL than MP and PM, which were also greater ($P < 0.05$) than C. The ratio of omega-6 to omega-3 fatty acids was lower ($P < 0.05$), hence more desirable from a human health standpoint, for forage-finished (1.3) than C (6.1). Trans-11 vaccenic acid (TVA) concentration was greater ($P < 0.05$) for forage-finished than C; whereas, trans-10 octadecenoic acid concentration was greater ($P < 0.05$) for C than forage-finished. The cis-9 trans-11 isomer of conjugated linoleic acid (CLA) concentration was greater ($P < 0.05$) for PM than AL and MP. CLA percentages were higher ($P < 0.05$) for all forage species compared to C. Forage species grazed during the final 44 d of finishing altered the concentrations of CLA, MUFA, omega-6 and omega-3 fatty acids. Forage finished beef

was leaner and contained greater concentrations of CLA, TVA, and omega-3 fatty acids than concentrate finished.

Key Words: Beef, Forages, Fatty Acids

465 Effect of finishing steers on different forages or high concentrate diet on rib composition, color, and palatability. S. K. Duckett^{*1}, J. P. S. Neel², J. P. Fontenot³, W. Clapham², and W. S. Swecker, Jr.³, ¹Clemson University, Clemson, SC, ²USDA-ARS, Beaver, WV, ³Virginia Tech University, Blacksburg.

Angus-crossbred steers ($n = 128$) were used to determine the effects of forage species grazed in the last 41 d or high concentrate finishing on rib composition, color, and palatability of beef. Steers grazed mixed pastures (bluegrass/white clover) for 93 d and then grazed alfalfa (AL; $n = 36$), pearl millet (PM; $n = 24$), or mixed (MP; $n = 36$) pastures for the final 44 d of finishing. Due to drought conditions in year 3, steers did not graze PM pastures. Steers were also finished on traditional high concentrate diets (C; $n = 32$) for 134 d. Hot carcass weight (HCW) was on average 97 kg heavier ($P < 0.01$) for C than MP, AL, and PM for the three year period. Percentage total fat was 45% greater ($P < 0.05$) and percent fat-free lean was 27% lower for C than forage-finished in the 9-10-11th rib section. No differences were detected in lean, fat and bone composition among forage species. Lightness (L^*) of LM was higher ($P < 0.01$) for C than AL, MP and PM. Lightness values were also higher ($P < 0.05$) for AL than MP. Redness (a^*) of LM was higher ($P < 0.05$) for C than MP and PM in year 1 and higher ($P < 0.05$) than all forage-finished treatments in year 2. In year 3, redness of LM did not differ ($P > 0.05$) among treatments. Yellowness (b^*) of s.c. fat was higher ($P < 0.01$) for AL, MP, and PM than C in all three years. Ultimate LM pH was lower ($P < 0.05$) for C than PM, MP, or AL. Warner-Bratzler shear force did not differ ($P = 0.90$) among finishing treatments and averaged 2.6 kg. Descriptive flavor panel evaluation found that C had higher ($P < 0.05$) beef flavor identification and less ($P < 0.05$) off-notes than AL or MP. Steaks from MP had higher ($P < 0.05$) organ meat (livery) flavor than AL, C, or MP. Finishing steers on forages versus concentrates to an equal animal age endpoint lowered carcass weight and fat content with no change in tenderness. Forage species utilized during the final 44 d of finishing did not alter rib composition or tenderness and had only minor influences on color and palatability.

Key Words: Beef, Forages, Tenderness

Symposium: Nonruminant Nutrition: Oxidative Stress and the Use of Antioxidants for Nonruminant Animals

466 Oxidative stress during the lifecycle of animals. W. P. Weiss* and D. C. Mahan, *The Ohio State University, Wooster and Columbus.*

Reactive oxygen species (ROS) are chemical compounds that contain oxygen and are highly reactive because they have, or can be easily converted to compounds that have, unpaired electrons. Common ROS in biological systems include superoxide, hydroxyl radical, hydrogen peroxide, and fatty acid peroxides. ROS are produced via normal oxidative metabolism and certain ROS are absolutely essential for cell signaling and other functions. However, because of their reactive properties, concentrations of ROS must be controlled, and sophisticated antioxidant systems have been developed to keep ROS in check. Oxidative stress occurs when the antioxidant system is overwhelmed by the production of ROS which can lead to increased prevalence of infectious disease via impaired immune cell function, longer term health disorders such as atherosclerosis, and perhaps various sudden death syndromes. For example mortality of weanling pigs was greatly reduced when they were injected with Se and/or vitamin E (two important components of antioxidant systems). Oxidative stress commonly occurs during an infection or other challenge to the immune system. Indeed, the massive production of ROS is essential to kill invading bacteria and trigger various immune responses. These ROS can also cause tissue damage and prolong the disease state; therefore, antioxidants are extremely important to certain types of immune cells. Oxidative stress is also associated with partition. The concentrations of serum antioxidants (e.g., ascorbic acid, glutathione peroxidase, Se, and vitamin E) in sows decline starting 80 d post coitum. Numerous studies have shown that serum concentrations of several antioxidants decrease markedly during the peripartum period and in some animals changes in antioxidant status has been associated with the immunosuppression that occurs during that period. Profitable swine and poultry production requires rapid production of lean tissue, larger litter sizes, and greater milk production and egg production. These requirements place increasing demands on the metabolic system of these animals which can lead to increased oxidative stress unless antioxidant systems are enhanced most likely via nutrition.

Key Words: Reactive Oxygen Species, Oxidative Stress

467 Roles in animals of the antioxidant micronutrients vitamin E, vitamin C, and selenium. R. F. Burk*, *Vanderbilt University, Nashville, TN.*

Three essential micronutrients have major antioxidant properties in animals: vitamin E is a lipid soluble free radical scavenger that protects membranes; vitamin C is a reducing substance in the aqueous phase; and selenium forms the active sites of the glutathione peroxidases and the thioredoxin reductases. These micronutrients interact with one another at a molecular level. Radical scavenging by vitamin E converts it to a free radical form, which is converted back to the active vitamin E by reaction with vitamin C at the membrane-aqueous interface. The resulting vitamin C free radical is converted back to the active vitamin C by the selenoenzyme thioredoxin reductase at the expense of NADPH. Nutritional deficiencies of each micronutrient occur and have been characterized.

Severe vitamin C deficiency causes scurvy in most susceptible species, but the manifestations of severe vitamin E and selenium deficiencies vary from species to species. We have carried out studies in guinea pigs to assess the effects of mild deficiencies in two of these micronutrients that occur simultaneously. Combined mild deficiencies of vitamin E and selenium, each of which was too mild to affect the animal, caused massive skeletal muscle necrosis that was fatal. It was associated with mitochondrial abnormalities in the muscle. Combined mild deficiencies of vitamin E and vitamin C caused infarcts in the spinal cord and brainstem leading to death. These results demonstrate that combined mild deficiencies of antioxidant micronutrients can have serious effects on animal health and indicate the need to ensure adequate intake of all three antioxidant micronutrients. Supported by NIH ES02497.

Key Words: Oxidative Stress, Antioxidant Micronutrients, Central Nervous System Injury

468 Bioavailability of natural and synthetic vitamin E in sows and their progeny. C. Lauridsen*, *University of Aarhus, Tjele, Denmark.*

Two of the critical stages for dietary vitamin E as a nutrient for growth and health status in pigs are immediately after birth and after weaning. Supplemental vitamin E is usually added to animal feed in the form of all-rac- α -tocopheryl acetate, which is an equimolar mixture of all eight possible stereoisomers of which only the RRR stereoisomer possesses the natural configuration. Relatively little information is available in pigs concerning vitamin E delivery to the fetus during gestation or to the suckling progeny from milk. In addition, little is known regarding the effect of supplementing vitamin E to sow diets on the subsequent effect on the vitamin E status of the progeny after weaning. By feeding sows capsules with labelled vitamin E forms it was found (Lauridsen et al., 2002) that swine discriminate between RRR- and all-rac- α -tocopherol with a preference for RRR- α -tocopherol; thus, the official bioequivalence factor of 1.36:1 RRR- to all-rac- α -tocopherol is underestimated. The increased bioavailability the RRR- α -tocopherol resulted in a 2:1 ratio of the natural and synthetic vitamin E forms in milk and in the suckling progeny. In a subsequent experiment it was shown (Lauridsen & Jensen, 2005) that increasing dietary all-rac- α -tocopheryl acetate (70, 150, and 250 IU/kg) during lactation increased the concentration of α -tocopherol in milk and plasma of sows, and in tissues of the pigs at weaning (day 28 after birth). However, after weaning (from day 35 to 49 of age) a decrease in α -tocopherol concentration in most tissues was seen irrespective provision of a dietary level of all-rac- α -tocopheryl acetate at 70 IU/kg feed. In recent studies different nutritional strategies have been investigated to overcome the decrease in vitamin E status following weaning, e.g. by investigating different forms of natural and synthetic vitamin E (Lauridsen & Jensen, 2006), and vitamin C supplement (Lauridsen & Jensen, 2005).

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Key Words: Vitamin E, Sows, Pigs

469 Synthetic antioxidant applications in nonruminants. R. J. Harrell*, J. Andrews, V. Robinson, M. Vazquez-Anon, and S. Carter, *Novus International Inc., St Charles, MO.*

Synthetic antioxidants are used to preserve feed quality by preventing the oxidation of lipids, which can lead to improved animal performance. Oxidation begins in feed and feed ingredients and can have a negative impact on the gastrointestinal tract and performance of animals fed oxidized fats. In the presence of oxygen and a catalyst, such as trace minerals, unsaturated fatty acids are oxidized forming free radicals. Generally, synthetic antioxidants control oxidation of lipids by acting as free radical scavengers. Examples include tert-butylhydroquinone, ethoxyquin, butylated hydroxytoluene, and butylated hydroxyanisole. Oxidation occurs in body tissues as a normal process and tissues have a complement of antioxidant compounds and enzymes to prevent oxidative damage including superoxide dismutase, catalase, glutathione, and vitamins E and C. Poor quality feed ingredients, disease, environmental conditions, and level of production can lead to oxidative stress. Oxi-

dativ stress occurs when the endogenous antioxidant capacity of the animal is not enough to control free radical formation. Accumulation of free radicals in the body would lead to tissue damage and reduced performance. A prime target for oxidative stress is the gastrointestinal tract and liver where studies have shown that feeding oxidized fat not only reduces the feed energy value, but also increases epithelial cell turnover, reduced immune function and hepatic function. Synthetic antioxidants are very effective at stabilizing dietary fat sources at the site of oxidation and the choice is dependent on the fat source. Certain antioxidants are more effective against animal based fats, whereas other antioxidants are more effective in preventing oxidation of vegetable oils. Synthetic antioxidants can partially ameliorate the negative effects of feeding oxidized fats by preventing further oxidation through control of peroxides leading to reduced damage to intestinal structure and function, preserving tissue antioxidant activity to reduce oxidative stress and improve performance.

Key Words: Antioxidants, Nonruminants, Synthetic

Physiology and Endocrinology: The Physiology of Gestation and the Post-partum Interval

470 Fibroblast growth factor 2-induced expression of interferon-tau is mediated by protein kinase C in bovine trophectoderm. Q. Yang*, S. E. Johnson, and A. D. Ealy, *University of Florida, Gainesville.*

Interferon-tau (IFNT) serves as the maternal recognition of pregnancy signal in cattle and sheep. Pre- and peri-attachment conceptus production of IFNT is controlled in part by members of the fibroblast growth factor (FGF) family. FGF2 supplementation stimulates IFNT mRNA and protein concentrations in bovine blastocysts and trophectoderm. The objective of this work was to identify the intracellular signaling modules invoked by FGF2 in bovine trophectoderm cells (CT1). CT1 cells were treated for 2 h with chemical inhibitors for either protein kinase C (PKC) isoforms (0.5 μ M Calphostin), extracellular signal-regulated kinases (ERK)1/2 (50 μ M PD98059), p38 mitogen-activated protein kinase (MAPK) (25 μ M SB203580) or vehicle-only prior to FGF2 supplementation for 24 h. After cell lysis and RNA extraction, quantitative RT-PCR revealed a 10.70 ± 1.93 fold increase ($P=0.001$) in IFNT mRNA abundance in response to FGF2. Suppression of ERK1/2 or p38 activity did not alter the FGF2 response. However, exposure to the pan-PKC inhibitor limited ($P=0.01$) the ability of FGF2 to increase in IFNT mRNA abundance (2.42 ± 1.13 fold induction above control). Media supplementation with 100 nM phorbol 12-myristate 13-acetate (PMA), a PKC activator, mimicked the FGF2 response in CT1 cells. Selectivity of the PKC response was examined in the presence of chemical antagonists to PKC- $\alpha/\beta/\gamma$ (5 μ M Gö6976) or PKC- δ/θ (5 μ M rottlerin). Treatment of CT1 cells with Gö6976 did not affect FGF2- or PMA-mediated increases in IFNT mRNA abundance. By contrast, inhibition of PKC- δ/θ attenuated ($P<0.01$) the PMA and FGF2 responses. Thus, PKC- δ or - θ likely is required for FGF2-mediated IFNT expression. Further studies are forthcoming to confirm this and other roles for PKC- δ/θ during bovine conceptus development. Project supported by National Research Initiative Competitive Grant #2003-35203-13345 and 2003-35203-15382 from the USDA Cooperative State Research, Education, and Extension Service.

Key Words: Pregnancy, Placenta, Gene Expression

471 Expression of fibroblast growth factors and their receptors during pre- and peri-attachment development in bovine conceptuses. F. N. T. Cooke* and A. D. Ealy, *The University of Florida, Gainesville.*

For pregnancy to continue beyond the length of a normal estrous cycle, the bovine conceptus must secrete copious quantities of interferon-tau (IFNT) to interrupt the luteolytic process and maintain pregnancy. This laboratory discovered that fibroblast growth factor 2 (FGF2) increases IFNT production in cultured bovine trophectoderm and blastocysts. Several genes encode FGFs and some of these FGFs possess receptor subtype binding affinities similar to FGF2. To better understand the functional roles of FGFs during bovine conceptus development, studies were completed to: 1) identify the FGF receptor (FGFR) subtypes expressed by pre- and peri-attachment bovine conceptuses, and 2) identify conceptus-derived FGFs that may interact with these receptors. RT-PCR was completed using total RNA extracted from in vitro-derived bovine

blastocysts and in vivo-derived elongated conceptuses (3 pools/stage) and primers specific for bovine FGFR1, 2, 3 or 4. Sequencing of the amplified products revealed expression of receptor subtypes FGFR1IIIc, 2IIIb, 3IIIc, and 4 at both stages of development. Since FGFR2IIIb is crucial for trophectoderm development in other species, expression of ligands that act through this receptor subtype was explored. Transcripts for FGF1, 2, and 10 but not FGF7 were detected in elongated bovine conceptuses. In blastocysts, FGF1 and 2 mRNA abundance was low and FGF10 transcripts were not amplified. FGF7 transcript abundance was not analyzed at the blastocysts stage. In summary, at least four FGFRs reside in pre- and peri-attachment bovine conceptuses. Moreover, conceptuses express at least three candidate FGFs during elongation, the time of peak IFNT expression. Further studies are required to examine how some or all of these ligands interact with their receptors to regulate IFNT expression and conceptus development in cattle and other ruminants. Project supported by National Research Initiative Competitive Grant #2003-35203-13345 and 2003-35203-15382 from the USDA Cooperative State Research, Education, and Extension Service.

Key Words: Embryo, Pregnancy, Placenta

472 Reduced angiogenic factor expression in cotyledonary (COT) arteries of overnourished, obese ewes at midgestation. Y. Ma*¹, M. J. Zhu¹, P. W. Nathanielsz^{1,2}, and S. P. Ford¹, ¹*University of Wyoming, Laramie,* ²*University of Texas, San Antonio.*

In the sheep, maternal:fetal exchange takes place in placentomes, which are comprised of maternal caruncular and fetal COT tissues. We have demonstrated previously that COT vascularity in obese ewes was decreased ~50% by 75 d gestational age (dGA). This study investigated the role of selected angiogenic factors in reducing COT vascularity in pregnant obese ewes. Multiparous ewes carrying twin fetuses were assigned to a control (C, 100% of NRC recommendations; n = 10) or obesogenic (OB, 150% of NRC; n = 10) diet from 60 d before conception to 75 dGA, at which time COT arteries were collected from 5 ewes/group and snap frozen on liquid nitrogen. The remaining ewes in each group were maintained on their respective diets and allowed to lamb. At 75 dGA, OB ewes and their fetuses were ~50% and ~25% heavier, respectively, than C ewes and fetuses. Lambs from both dietary groups exhibited similar birth weights. COT artery mRNA levels of vascular endothelial growth factor (VEGF) and its receptors FLT-1 and KDR, angiopoietin-1 (ANG-1) and -2 (ANG-2), and their receptor Tie-2, basic fibroblast growth factor (FGF-2), and placenta growth factor (PLGF) were quantified via Real-time PCR. VEGF, ANG-1, ANG-2, FGF-2 and PLGF mRNA level were reduced ($P<0.05$) 2 fold or more in COT arteries of OB vs. C ewes, while no treatment differences were observed in FLT-1, KDR, or Tie-2 expression. COT arterial protein levels of VEGF, PLGF and FGF-2 were then quantified by Western-blot, and were reduced ($P<0.05$) 41%, 32% and 50%, respectively in OB ewes when compared to C ewes. This decrease in COT artery angiogenic factor expression in OB ewes would be expected to decrease vascularity and thus nutrient delivery to the fetus, slowing fetal growth, and reducing lamb birth weight. NIH INBRE 1P20RR16474.

Key Words: Angiogenic Factors, COT Vascularity, Obese Ewe

473 Increased circulating progesterone (P₄) levels during the estrous cycle in offspring of nutrient restricted ewes. L. A. George*¹, P. W. Nathanielsz^{1,2}, and S. P. Ford¹, ¹University of Wyoming, Laramie, ²University of Texas, San Antonio.

We have reported that fetuses of ewes nutrient restricted from 28-78 d of gestation (dGA) exhibited increased oxidative base lesions within DNA of day 78 fetal oogonia compared to controls (Murdoch et al., 2003, *Reprod. Biol. Endocrinol.* 1:6). Such lesions in fetal oogonia could affect oocyte/follicular/corpora lutea (CL) function later in life. P₄ secretion by the CL is vital for initiation and maintenance of cyclicity and pregnancy. This study examined the impact of maternal nutrient restriction during early gestation on P₄ secretion during an estrous cycle of female offspring. Dams were fed either a nutrient restricted (NR: 50% NRC recommendations) or control (C: 100% NRC) diet from 28 to 78 dGA and then both groups were fed 100% of requirements to lambing. Female lambs from NR and C dams were commingled in a single group and fed 100% NRC from weaning through testing. During October and November, yearlings born from NR (n=7) and C (n=7) dams were monitored daily for estrus and blood sampled every three days from standing estrus (d 0) to the subsequent estrus. This procedure was repeated at 3 yrs of age. NR and C ewes were of similar BW both at 1 (62.4 ± 3.1 kg) and 3 (75.8 ± 2.6 kg) yrs of age. Estrous cycle lengths were similar across treatment groups (19.1 ± 0.2 d). P₄ area under the curve was 20% higher in NR vs. C offspring at 1 yr of age (P = 0.05), and 23% higher at 3 yrs of age (P = 0.08). Maternal diet-induced increases in systemic P₄ in female offspring of NR vs. C ewes could indicate differences in either CL P₄ secretion, incidence of multiple ovulations and/or P₄ clearance. Regardless of mechanism, these data provide evidence for the persistent in utero programming of progesterone levels in offspring induced by differences in early gestational maternal nutrition.

Key Words: Fetal Programming, Estrous Cycle, Progesterone

474 Increased macrophage migration inhibitory factor (MIF) in the pancreas of fetuses gestated by overnourished, obese ewes. L. Zhang*¹, M. J. Zhu¹, P. W. Nathanielsz^{1,2}, and S. P. Ford¹, ¹University of Wyoming, Laramie, ²University of Texas Health Sciences Center, San Antonio, TX.

MIF is an integral component of the stress response and has been shown to be released by the pituitary, macrophage, and the T-lymphocyte in response to inflammation, infection and stress. More recently MIF was identified as a glucose-dependent pancreatic beta cell product, which increases insulin secretion in an autocrine fashion, and thus may play an important role in carbohydrate metabolism (Waeber et al. 1997. *Proc. Natl. Acad. Sci.* 94:4782-4787). In a recently developed sheep model of maternal obesity, we have reported that blood glucose and insulin concentrations were markedly elevated at midgestation in fetuses from obese mothers. This study investigated the potential role of MIF in the regulation of fetal pancreatic insulin secretion in our obese model. Multiparous ewes carrying twin fetuses were assigned to a control (C, 100% of NRC recommendations; n=5) or obesogenic (OB, 150% of NRC; n=5) diet from 60 d before conception to 75 days of gestation (dGA), at which time fetal pancreatic tissue were collected and snap frozen on liquid nitrogen or fixed in paraformaldehyde and paraffin embedded. At 75 dGA, OB ewes and their fetuses were ~50% and ~25% heavier

(P<0.05), respectively, than C ewes and fetuses. Fetal pancreatic tissue sections were incubated with guinea pig anti-porcine insulin or rabbit anti-MIF antibodies at 4° C overnight, then with fluorescent labeled 2° antibodies: Rhodamine labeled goat anti-guinea pig or AlexaFluor 488 labeled goat anti-rabbit for 60 min at 22° C. By evaluating immunostaining of both insulin positive cells and MIF positive cells, we determined that MIF is largely expressed within the cytoplasm of insulin positive beta cells. The protein level of MIF in pancreatic tissue was quantified via Western blot using a specific polyclonal antibody to MIF. The pancreatic MIF protein level was increased (P<0.05) in fetuses of OB ewes compared with fetuses from C ewes. The increased pancreatic MIF expression in fetuses from OB ewes would be expected to potentiate insulin release and thus glucose uptake by fetal body tissues. NIH INBRE 1P20RR16474.

Key Words: Pancreatic Beta Cell MIF, Maternal Obesity, Sheep

475 Effects of soy-derived phytoestrogen and estradiol exposure on reproductive development in male neonatal pigs. K. Necaie*¹, K. Moulton¹, D. Christiansen¹, K. Walters¹, M. Crenshaw¹, C. Scanes², and P. Ryan¹, ¹Mississippi State University, Starkville, ²University of Wisconsin, Milwaukee.

While dietary phytoestrogens are known to mimic estrogenic effects on adult mammalian reproductive systems, there is little information on the effects of these compounds on fetal or neonatal reproductive development. The objective of this study was to evaluate the effects of soy-derived isoflavones on normal reproductive development in neonatal pigs. Yorkshire-Landrace crossbred sows (100 d gestation) were randomly assigned to a lactating diet (2.3 kg/sow/d) supplemented with either Novasoy 70, an isoflavone extract, (NOV, n=8) or without (CON, n=8). Mean BW for CON and NOV sows was 275.8 ± 7.0 kg and 278.8 ± 13 kg, respectively. Feed was top-dressed 2 x d with the NOV from d 100 of gestation to farrowing. Male neonatal pigs (NPs) were weighed on post natal day (PND) six then randomly assigned to one of four treatments (n=10 to 12/treatment): 1) control (vehicle), 2) estradiol (50 µg/kg BW/d) as a positive control, 3) low genistein dose (3 mg/kg BW/d) and 4) high genistein dose (9 mg/kg BW/d). NPs were dosed by oral gavage 2 x d for 7 d commencing on PND 7. Doses were adjusted daily according to BW change. On PND 14, NPs were euthanized and the testes, epididymi and seminal vesicles were recovered, grossly examined, and wet tissue weights recorded. Wet tissue weights were analyzed using GLM mixed model procedures. At PND 14 body weights did not differ (P > 0.05) between assigned NP treatments. Novasoy treatment of sows had no effect on testes, epididymal or seminal vesicles weights. However, estradiol treatment of NP increased seminal vesicle wet weight as a % of BW (P=0.075), but there was no observed effects of estradiol or either genistein treatments on NP testes and epididymal weights. While no detrimental effects of estrogen exposure were observed in testes or epididymis, changes in seminal vesicle tissue weights demonstrates that oral exposure to estradiol but not genistein may alter reproductive development in male neonatal pigs. Thus, the neonatal pig may provide a useful model for assessing effects of dietary phytoestrogens on reproductive development in infants on soy-based formulas.

Key Words: Pigs, Phytoestrogens, Reproductive Development

476 Meta-analysis of progesterone supplementation during early pregnancy in cattle. G. E. Mann*, *University of Nottingham, Sutton Bonington Campus, Loughborough, UK.*

Progesterone is a critical hormone during early pregnancy in the cow. As a result a number of studies have investigated the effects of progesterone supplementation on pregnancy rate. An earlier meta-analysis of some of these studies revealed an overall improvement in pregnancy rate and marked effects of factors such as time of treatment (Mann and Lamming, 1999, *Reproduction in Domestic Animals* 34, 269-274). In this study an updated meta-analysis was carried out on 30 studies involving a total of 5262 control cows and 4726 progesterone treated cows. Treatment was by a variety of routes including intravaginal insert, subcutaneous implant and im injection. Data was analyzed by Chi square test with Yates correction. While the results of individual studies showed wide variations (range of 28.5% decrease to 34.4% increase), progesterone treatment did result in an overall increase ($P < 0.05$) in pregnancy rate of 2.4%. Treatment following natural or synchronized estrus resulted in an overall increase ($P < 0.001$) of 4.9% while treatment following synchronized ovulation did not result in any increase. In cows treated following unsynchronized ovulation, very early (d 0 to 2) or late (after d 10) initiation of treatment had no significant effect on pregnancy rate, while initiation of treatment between d 3 to 9 resulted in an overall 8.5% increase ($P < 0.001$) in pregnancy rate. This analysis demonstrates that progesterone supplementation is of no benefit following synchronized ovulation. However, if ovulation has not been synchronized, treatment results in improvements in pregnancy rate that are highly dependant on time of treatment.

Key Words: Cow, Progesterone, Pregnancy

477 Effect of endocannabinoid (EC) agonists on cow corpus luteum (CL) function in vitro. C. W. Weems^{*1}, Y. S. Weems¹, A. W. Lewis², D. A. Neuendorf², and R. D. Randel², ¹*University of Hawaii, Honolulu*, ²*Texas A&M University, Overton.*

Thirty to 40 % of pregnancies are lost during the first 3rd of pregnancy due to inadequate progesterone (P4) secretion. Loss of CL P4 secretion during the estrous cycle is via uterine secretion of PGF2 α . Cow CL secretion of PGE and PGF2 α , which are derived from arachidonic acid (AA) in phospholipids, increased linearly with time in culture with the PGE:PGF2 α ratio being 1:1. PGE1 or PGE2 are luteotropic and antiluteolytic in vitro and in vivo (C Weems et al. *The Vet J* 171:206, 2006; Y Weems et al. *Prostaglandins* 55:28, 55:359, 1988). EC are also derived from phospholipids and are associated with infertility, which could be via negative effects on implantation or CL function (Wang et al. *J Clin Invest* 116:2122, 2006; *Endo Rev* 27:427, 2006). The objective was to elucidate effects of EC1 or EC2 receptor agonists, antagonists or a fatty acid amide hydrolase (FAAH) inhibitor of EC catabolism on cow CL P4, PGE and PGF2 α secretion. Day-15 CL slices were weighed, randomized to treatments (100 ng/mL; n = 8) within cow, and incubated at 39.5 C in M199 1 hr without treatment and 4 and 8 hr with treatments. Treatments were: Vehicle (VEH), PGE1, PGF2 α , AM 251 (EC1 antagonist), AM 630 (EC2 antagonist), ACPA (EC2 agonist), IMMA (EC2 agonist), MAFP (inhibits FAAH catabolism of EC), MAFP+ACPA or MAFP+IMMA. Media collected at 4 and 8 h were analyzed for P4, PGE and PGF2 α by RIA. Data were analyzed by a 2X10 Factorial Design for ANOVA. P4 was increased by PGE1 ($P < 0.05$) and reduced ($P < 0.05$) by PGF2 α , ACPA, IMMA, MAFP, MAFP+ACPA, and MAFP+IMMA. PGE and

PGF2 α increased ($P < 0.05$) with time in VEH controls. PGE1 increased PGE and PGF2 α increased PGF2 α at 4 and 8 h ($P < 0.05$). ACPA, IMMA, MAFP, MAFP+ACPA and MAFP+IMMA lowered ($P < 0.05$) PGE secretion at 4 and 8 h and by AM251, AM 630 and PGF2 α at 8 h. AM 251, AM 630, MAFP+IMMA, ACPA, IMMA or MAFP+ACPA decreased ($P < 0.05$) PGF2 α at 4 and 8 h and by PGE1 at 8 h. Overall EC negatively affect cow CL function, The CL may be one site for EC decreased fertility.

Key Words: Cow, Corpus Luteum, Endocannabinoids

478 Peripheral concentrations of insulin are negativity correlated with cytochrome P450 3A activity and mRNA expression in dairy cows. C. O. Lemley*, L. R. Tager, K. M. Krause, and M. E. Wilson, *West Virginia University, Morgantown.*

Current dairy cow pregnancy rates to first service are very low, dramatically decreasing the potential profits to the industry. Dairy cow pregnancy rates have been improved with progesterone supplementation. Low peripheral concentrations of progesterone may be due to deficiencies in luteal secretion and/or excessive hepatic catabolism via cytochrome P450 enzymes. The objectives of the current experiment were to determine any association between plasma insulin concentrations and hepatic cytochrome P450 activity and/or mRNA expression. Six lactating Holstein dairy cows (123 \pm 38 DIM) were fed one of three diets (14 d experimental period) utilizing a Latin rectangle design. Diets were formulated to be isocaloric and isonitrogenous, while causing differential insulin secretion (2% propylene glycol diet, 15.1% corn starch diet or a high fiber diet). Energy balance and DMI on d 10-14 were similar among cows fed the three different diets. On d 12 a jugular blood sample was collected prior to the morning feeding at 0 hr, and then at 1, 2, 3, 4, 5, 6, 8, and 10 hr post-feeding for determination of insulin concentrations. On d 14 a liver biopsy was collected 3 hr post-feeding and used for determining cytochrome P450 2C and 3A activity and mRNA expression. Insulin response for each cow over the 10 hr blood sampling period was used to generate area under the curve (AUC) values. A correlation analysis revealed a significant negative correlation between cytochrome P450 3A activity and insulin AUC ($r = -0.49$, $P < 0.05$), as well as cytochrome P450 3A mRNA expression and insulin AUC ($r = -0.50$, $P < 0.05$). However, neither cytochrome P450 2C activity nor mRNA expression were correlated with insulin AUC. In conclusion we have demonstrated a significant negative correlation between cytochrome P450 3A activity and mRNA expression with insulin AUC, supporting the notion that feedstuffs that stimulate insulin secretion may be useful in decreasing excessive progesterone catabolism.

Key Words: Insulin, Cytochrome P450, Progesterone Catabolism

479 Biostimulatory effect of bulls alters characteristics of cortisol concentration patterns before resumption of ovulatory activity in postpartum, anovular, suckled beef cows. S. A. Tauck*, J. R. Olsen, J. R. C. Wilkinson, and J. G. Berardinelli, *Montana State University, Bozeman.*

The objective was to determine if bulls alter temporal patterns of cortisol concentrations in postpartum, suckled beef cows before resumption of ovulatory activity (ROA). The null hypotheses were that interval to

ROA and characteristics of cortisol patterns do not differ between cows exposed or not exposed to bulls. At 72 ± 3.5 d (\pm SE) postpartum, anovular cows were assigned randomly to be exposed (BE; n=8) or not exposed (NE; n=5) to bulls for 33 d in separate pen areas. Day 0 was designated as the start of bull exposure and BE cows had been exposed to bulls for 6 d before the initiation of the intensive sampling period. Blood samples were collected daily via an indwelling jugular catheter from each cow at 15-min intervals between 1000 to 1400 h over a 10-d interval (d 7 to 16) for assay of cortisol. Interval from d 0 to ROA, mean cortisol, and pulse frequency, amplitude, and duration, and inter-pulse interval were analyzed by ANOVA. Interval to ROA was shorter ($P < 0.05$) for BE (11.4 d) than NE (21 d) cows. Mean cortisol and characteristics of cortisol patterns did not differ ($P > 0.10$) between BE and NE cows from D 7 to 16. However, characteristics of cortisol patterns in BE cows differed ($P < 0.05$) before and after ROA. Five BE cows and only one NE cow began to cycle before or during the sampling period. Before the initiation of cycling activity cortisol pulse frequency was lower ($P < 0.05$) in BE cows than NE cows. Mean cortisol and cortisol pulse duration were correlated positively ($P < 0.05$) with interval to ROA in BE cows, while only mean cortisol was correlated positively ($P < 0.05$) with interval to ROA in NE cows. In conclusion, bull exposure decreased cortisol pulse frequency and lengthened cortisol pulse duration before ROA. The results indicate that changes in characteristics of cortisol concentrations precede the biostimulatory effect of bulls to induce resumption of ovulatory activity in postpartum, anovular, suckled beef cows.

Key Words: Bull Biostimulation, Cortisol, Postpartum

480 Effects of oro-nasal administration of androstadienone on characteristics of cortisol concentrations in postpartum, suckled beef cows. J. R. C. Wilkinson*, S. A. Tauck, J. R. Olsen, and J. G. Berardinelli, *Montana State University, Bozeman.*

The objective was to determine if oro-nasal administration of androstadienone changes characteristics of cortisol concentration patterns in postpartum, anovulatory beef cows. The hypotheses were that characteristics of cortisol concentration patterns do not change before, during, or after exposure to androstadienone in anovular cows. To test these hypotheses, three primiparous, crossbred cows were fitted with indwelling jugular catheters 2 d before the start of the experiment (92 ± 5.9 d after calving). Treatments were: oro-nasal administration of 0.9% saline on day 1 (S1); androstadienone (Andro; 10 mg/mL 0.9% saline) on day 2 (Andro); and 0.9% saline on day 3 (S2) for 4 h over 3 consecutive days. Oro-nasal exposure consisted of three vigorous sprays: one in each nostril and one on the top of the nose, given each h over a 4-h period each d. Samples were collected at 15-min intervals for 4 h from 1000 to 1400 h each day. Characteristics of cortisol patterns (mean, baseline, pulse frequency, amplitude, and duration) were analyzed by ANOVA. Mean, baseline, and pulse amplitude in cows did not differ ($P > 0.10$) among treatments. Pulse frequency was greater ($P < 0.05$) in cows during the S1 (1 pulse/h) and S2 (1 pulse/h) treatments than in cows during the Andro treatment (0.5 pulses/h). Pulse duration did not differ ($P > 0.10$) among cows treated with S1 and S2 or S2 and Andro. However, pulse duration was longer ($P < 0.05$) when cows were given Andro (75 min) than when given S1 (46.8 min). Androstadienone, administered oro-nasally to postpartum cows did not alter mean, baseline, and pulse amplitude of cortisol. However, androstadienone exposure appeared to decrease pulse frequency and increase the duration of pulses of cortisol. These preliminary results indicate that androstadienone may be a putative pheromone involved with the biostimulatory effect of bulls on resumption of ovulatory activity in postpartum, suckled beef cows.

Key Words: Bull Biostimulation, Postpartum, Pheromone

Production, Management and the Environment: Disease, Management and Environment

481 Milking procedures and prevalence of contagious mastitis pathogens on U. S. dairy operations. J. E. Lombard^{1*}, C. A. Kopral¹, T. Van Slyke², F. Welcome², and Y. Schukken², ¹USDA:APHIS:VS:Centers for Epidemiology and Animal Health, Fort Collins, CO, ²Quality Milk Production Services, Ithaca, NY.

The National Animal Health Monitoring System's Dairy 2007 study collected milking procedures and other management practice data from 582 operations in 17 of the top dairy states. In addition, a single bulk tank milk sample was collected from 534 operations to estimate the prevalence of the contagious mastitis pathogens - *Staphylococcus aureus*, *Streptococcus agalactiae* and *Mycoplasma*. Milk was cultured according to NMC protocols. After adjusting for the study design, an estimated 43.3% of U.S. dairy operations were infected with *S. aureus*, while *S. agalactiae* and *Mycoplasma* prevalences were 2.7 and 3.2%, respectively. Only *Mycoplasma* had herd size differences where prevalence increased as herd size increased ($P=0.005$). The presence of *S. aureus* was positively associated with use of a backflush system, milking mastitis cows in a separate string and culturing milk from fresh cows and high SCC cows ($p<0.05$). Operations infected with *S. agalactiae* were more likely to have purchased cattle in 2006, applied a nonlabeled predip using a cup, or had a BTSCC greater than 400,000 ($p<0.05$). The use of a labeled predip using a sprayer, a postdip or a backflush system were associated with decreased odds of being infected with *S. agalactiae* ($p<0.05$). Operations who had cultured *Mycoplasma* in the 12 months prior to the interview, applied a labeled predip using a sprayer, provided vitamin ADE or selenium supplementation, purchased cattle, had a BTSCC greater than 400,000 or had concurrent infection with *S. aureus* were at increased odds of being infected with *Mycoplasma* ($P<0.05$). Operations that used a water hose with disinfectant, or applied labeled predip using a cup or single use towels were less likely to be infected with *Mycoplasma* ($P<0.05$). Although some of the associations found in this analysis are likely effects of infection, rather than causes, not purchasing cattle and following recommended milking procedures appears to decrease the prevalence of contagious mastitis pathogens and improve milk quality.

Key Words: Mastitis, Milk Quality, Pathogens

482 Reliability of a standardized environmental sampling protocol to quantify *Mycobacterium avium* ssp. *paratuberculosis* in free-stall dairies. S. S. Aly^{1*}, R. J. Anderson², I. A. Gardner¹, R. H. Whitlock³, T. Fyock³, J. M. Adaska⁴, and J. Jiang¹, ¹University of California, Davis, ²California Department of Food and Agriculture, Animal Health Branch, Sacramento, CA, ³University of Pennsylvania, Kennett Square, ⁴California Animal Health and Food Safety Laboratory, Tulare Branch, Tulare, CA.

Mycobacterium avium ssp. *paratuberculosis* (MAP) is the cause of Johne's disease in dairy cattle and can be detected in fecal slurry in pens housing infected cows. The extent to which environmental samples are comparable across collectors and time affects the reliability of a sampling protocol. High reliability is important if such samples are to be used as part of a diagnostic strategy to detect MAP super-shedder cows and monitor temporal changes in environmental MAP load. The objective of this longitudinal study was to quantify MAP in environmental samples collected using a standardized sampling protocol from free-stall pens

using culture on Herrold's egg yolk medium (HEYM) and quantitative real-time PCR (qrt-PCR), and estimate the variability in results due to dairy, pen, collector and time.

A standardized sampling protocol was used to collect environmental samples from unflushed cross-over alleys in 31 cow pens in 4 California free-stall dairies (803, 1024, 1300 and 3577 cows). Samples were collected simultaneously by two veterinarians on each of days 1, 3 and 5 after scraping alley surfaces while keeping pen populations stable. Results were analyzed using variance components models and variability due to dairy, pen, collector and time were estimated and used to compute intraclass correlation coefficients (ICC). Among-pen variation was the largest source of sample variation. The ICC for similarity in samples collected by different collectors from the same location on the same day was 80% for qrt-PCR and 82% for HEYM. The ICC for samples collected by the same collector from the same location on different days was 82% for qrt-PCR and 65% for HEYM.

Environmental sampling of free-stall pens using a standardized sampling protocol can be reliable and yield comparable results with minimal variation due to collector or time. As part of a diagnostic plan, environmental samples can be used to identify pen populations with high MAP loads that are likely to include super-shedders thus reduce testing costs compared to whole herd tests and encourage more owners to enroll in Johne's disease control programs.

Key Words: Johne's, Environmental Sampling Reliability

483 Prevalence of bovine viral diarrhoea virus in bulk tank milk and associations with herd characteristics on U.S. dairy operations. J. E. Lombard^{1*}, E. J. Dubovi², and C. A. Kopral¹, ¹USDA:APHIS:VS:Centers for Epidemiology and Animal Health, Fort Collins, CO, ²Cornell University, Ithaca, NY.

Bulk tank milk was collected and tested for BVD antigen during the National Animal Health Monitoring System's Dairy 2007 study. Information regarding BVD-related management practices and dairy cow health and productivity was also collected. One objective of the study was to estimate the prevalence of persistent infection with BVD and associated herd level factors. Samples were collected from 527 operations during the months of March through August 2007. After adjusting for study design and incorporating weighting procedures, 1.7% of dairy operations had PCR evidence of BVD infection. BVD virus was detected in bulk tank milk on 1.0% of operations with less than 500 cows and 12.9% of operations with 500 or more cows. A larger percentage of operations in the West (7.8%) were BVD-infected compared to the East (1.1%). The mean number of cows represented in the bulk tank samples were 125 for noninfected and 677 for infected operations. Vaccination for both heifers and cows was more commonly performed on infected compared to noninfected operations. Operations that brought in new additions during 2006 were more likely to have BVD virus in their bulk tank than operations that did not purchase cattle. Infertility problems, defined as percent of cows >150 days open, were higher for infected operations compared to noninfected (18.2% of cows versus 14.3%). Although there were no differences in the percentage of removals, noninfected operations sold a higher percentage of removal as dairy replacements compared to infected operations (6.2% and 1.9%, respectively). Rolling herd average milk production was higher for infected operations (10,201 kg) compared to noninfected operations (9,254

kg). Results suggest that large operations and those that purchase new additions are more likely to have animals with persistent BVD infection compared to small closed herds.

Key Words: BVD, Bulk Milk, Prevalence

484 Prevalence of *Mycobacterium avium* subspecies *paratuberculosis* and associations with herd characteristics on U.S. dairy operations. J. E. Lombard*¹, R. T. Capel², B. A. Wagner¹, J. B. Payeur², and C. P. Fossler¹, ¹USDA:APHIS:VS:Centers for Epidemiology and Animal Health, Fort Collins, CO, ²USDA:APHIS:VS:National Veterinary Services Laboratories, Ames, IA.

During the National Animal Health Monitoring System's Dairy 2007 study, in addition to information collected on management practices and health, 6 environmental samples were collected from 524 operations for culture of *Mycobacterium avium* subspecies *paratuberculosis*, the causative agent of Johne's disease. One objective of the study was to estimate the prevalence of *M. paratuberculosis* and associated herd level factors. Samples were collected during the months of March through August 2007. Samples were cultured on Herrolds egg yolk in both tubes and flasks and confirmed as positive with PCR. After adjusting for study design and incorporating weighting procedures, 45.8% of samples were positive and 68.1% of operations had at least one sample that was culture positive for *M. paratuberculosis*. The largest percentage of samples that tested positive were from flush water (64.6%) and lagoons (61.2%) while the lowest percent positive were from gutter cleaners (32.1%). The herd-level prevalence of *M. paratuberculosis* increased as herd size increased with 95.0% of large operations (500 or more cows) being infected. No regional or month of collection differences were observed at the operation level. Operations that brought in herd additions during 2006 were at increased risk of being infected. The overall percentages of removals or deaths were not different between infected and noninfected operations. However, differences were observed in the percentage of cows removed for poor production (8.8% for noninfected operations compared with 14.8% for infected operations). In addition, noninfected operations had a higher percentage of removals sold as replacements (12.5%) compared with infected operations (4.5%). There were no significant differences in RHA milk production. The prevalence of *M. paratuberculosis*-infected dairy operations in the U.S is higher than previously reported.

Key Words: Paratuberculosis, Prevalence, Johne's Disease

485 Puncture force resistance of hoof horn from New Zealand (NZ) Friesian and Jersey cross NZ Friesian dairy. L. A. Lethbridge, J. K. Margerison*, G. W. Reynolds, R. Laven, and C. S. Brennan, Massey University.

The aim was to assess the resistance to puncture of the hoof horn from differing claws and regions of claws in prepartum New Zealand (NZ) Friesian and Jersey cross NZ Friesian dairy breeds. At 14 weeks of age all four hooves from 9 (5 Jersey × NZ Friesian (JXNZF); 4 NZ Friesian (NZF)) male dairy cattle had their hooves held and the distal Imm surface of the sole horn removed. All 8 claws were scored for the

presence of lesions and hoof samples were collected from the weight bearing regions 1 to 5 (according to the International foot map (IFM) and tested for puncture force (PF) using a texture analyser. PF of regions 1 and 2, corresponding to the white line, was consistently significantly lower compared with regions 4 and 5, which correspond with the sole, for both NZF and JXNZF (NZF: 1; 0.62^c, 2; 0.57^c, 3; 0.74^b, 4; 0.80^{ab}, 5; 0.86^a (SEM 0.013) P<0.001; JXNZF: 1; 0.76^b, 2; 0.64^c, 3; 0.86^{ab}, 4; 0.94^a, 5; 0.93^a (SEM: 0.019) P<0.001). Horn PF of JXNZF was consistently higher for both sole and white line regions compared with Friesian (IFM 1: NZFR; 0.67^b, JXNZF; 0.85^a (SEM 0.021) P< 0.001; IFM 2: NZFR; 0.60^b, JXNZF; 0.70^a (SEM 0.022) P< 0.001; IFM 3: NZF; 0.73^b, JXNZF 0.85^a (SEM 0.023) P< 0.001; IFM 4: NZF 0.78^b, JXNZF 0.91^a (SEM 0.020) P<0.001; IFM 5: NZF; 0.84^b, JXNZF; 0.90^a (SEM 0.021) P< 0.001). In conclusion hoof taken from Jersey cross Friesian cattle required a significantly higher maximum force to puncture than that from Friesian cattle, making claws less susceptible to puncture and wear. PF for white line tissue (1 and 2) was significantly lower than that from the sole (4 and 5) in both breed types.

Key Words: Dairy Breed, Hoof Horn Strength, Lameness

486 Incidence of peripartum health related problems in Argentine dairy herds. C. Corbellini¹, F. Busso¹, F. Bargo², B. Suarez², J. Grigera*², M. Podetti², and G. Tuñon³, ¹INTA, Argentina, ²ELANCO, Argentina, ³AACREA, Argentina.

Claves is a program conducted by INTA, AACREA and ELANCO to monitor the incidence of peripartum health problems. A data set of 15165 multiparous and 7607 primiparous dairy cows was used to determine body condition score (BCS=1 to 5 scale) and to calculate the incidence of health problems in the first 90 DIM. BCS was measured at dry off, prepartum, calving and postpartum (46 DIM). Case definition incidences (cases/100 animals) of assisted parturition (API), retained placenta (RPI), clinical hypocalcaemia (HCI), metritis (MI), clinical mastitis (CMI), lameness (LI), sub-clinical ketosis (SCKI= milk BHBA concentration ≥ than 2 mg/100 ml, Ketotest®) and death rates (DR) were standardized and calculated. Incidences were compared between primiparous and multiparous cows using Chi-square test (PROC FREQ of SAS) and t Student test was used for BCS (PROC TTEST). Multiparous cows were dried off with BCS=3.2. At prepartum, BCS was similar for multiparous (3.3) and primiparous cows (3.3), but at calving and postpartum it was lower (P<0.01) for multiparous cows (3.2 and 2.8) than for primiparous cows (3.4 and 2.9), respectively. At 55 DIM, multiparous and primiparous cows reached milk production peak (27.6 and 24.2 kg/d), with a BCS decrease of 0.4 and 0.5 points, respectively. RPI, HCI, CMI and DR were greater (P<0.01) in multiparous (8.1, 5.9, 25.6, 5.6) than in primiparous cows (4.3, 0.8, 13.7, 3.0), while API and LI were greater (P<0.01) in primiparous (28.2, 13.9) than in multiparous cows (13.1, 11.1). There were no differences between MI and SCKI for multiparous (4.3, 4.5) and primiparous cows (2.5, 2.4), respectively. SCKI ranged from 2 to 24 %, with a higher incidence in multiparous cows (BCS ≥ 3.8) or when BCS reduction at 46 DIM was ≥ 1. The mayor causes of death were traumatic calving, hypocalcaemia, endotoxic and mastitis and mostly occurred in the first week of lactation (44 and 34.1% for multiparous and primiparous cows, respectively).

Key Words: Peripartum, Health Problems, Incidence

487 Relationships between production measurements and sow longevity in a university research herd. M. S. Hicks* and W. F. Owsley, *Auburn University, Auburn, AL.*

Sow production data were collected by the Auburn University Swine Nutrition Unit from 1996-2003 to determine the relationship of performance measurements (weaning, breeding and farrowing dates, lactation feed intake, number born alive (NBA), number weaned, litter birth weight, litter weaning weight), indicators of sow longevity (sow weight pre-farrowing, sow backfat pre-farrowing, sow weight at weaning, sow backfat at weaning, lactation weight change and backfat change) and longevity (parity). The data were analyzed using the GLM procedure of SAS. Maximum R^2 for sow weight loss and backfat loss was calculated using the STEPWISE procedure, MAXR option, of SAS. Parity had an effect on both number born alive and number weaned ($P < .05$) but not litter weaning weight. As parity increased, number born and weaned also increased. Parity also affected lactation weight change ($P < .05$), measured as kg per parity or percent weight change. Weight change decreased with increased parity, as total kg and percentage of pre-farrowing weight.

The same was found for changes in backfat measured in mm change ($P < .05$), but not when measured as a percentage of pre-farrowing backfat. Sow weight loss and backfat loss decreased as feed intake increased ($P < .05$). Weight loss increased as the number of pigs weaned per litter increased ($P < .05$). Lactational fat loss increased as the litter weaning weight increased ($P < .05$). For lactation weight loss, a maximum R^2 was reached with a 6 variable model including pre-farrowing weight and fat, parity, intake, weaning weight and number weaned ($R^2 = .3308$, $P < .05$). For lactation fat loss, a maximum R^2 was reached with a 7 variable model including pre-farrowing weight and fat, parity, intake, number born alive, weaning weight and number weaned ($R^2 = .3245$, $P < .05$). Using this study and the available literature, the variables of lactation feed intake, number born alive, number weaned, litter weaning weight, sow weight pre-farrowing, sow backfat pre-farrowing and parity should account for approximately 30 percent of the variation in longevity, and should in part help understand what is required to keep a female productive longer.

Key Words: Sow Productivity, Performance, Longevity

Symposium: Ruminant Nutrition: Glycerin as a Feed for Ruminants

488 Glycerin as a feed ingredient, official definition(s) and approvals. R. S. Sellers*, *American Feed Industry Association, Arlington, VA.*

Glycerin is generally recognized as safe (GRAS) animal food ingredient as provided for in Title 21, Code of Federal Regulations, Section 582.1320. The glycerin defined in this regulation is refined glycerin and has historically been from the soap making industry. Crude glycerin from biodiesel production can contain contaminants, of which, methanol is the most common one of concern. The U.S. Food and Drug Administration (FDA) has issued an industry letter stating that glycerin from biodiesel should meet the U.S. Pharmacopeia (U.S.P.) standards for glycerin, which includes a limit of 150 mg/kg of methanol, and FDA would consider such glycerin with higher methanol limits as unsafe for feeding to animals, unless it were otherwise demonstrated to be safe. The government of the Federal Republic of Germany has stated that levels of 5,000 mg/kg of methanol in glycerin are safe for animal food. An industry coalition is collecting data and meeting with FDA to determine what information is needed to demonstrate crude glycerin safety for use in animal food with levels higher than 150 mg/kg.

489 Ruminal and physiological metabolism of glycerin. C. R. Krehbiel*, *Oklahoma State University, Stillwater.*

Glycerin, or glycerol ($\text{HOCH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$), is a 3 carbon compound that forms the backbone of triacylglycerols and phospholipids in animals and plants. The demand for biodiesel from fats and oils has increased the availability of glycerol as a potential feed ingredient for ruminants. Three fates of glycerol in the rumen have been estimated, and include passage (13%), fermentation (44%) and absorption (43%). Early reports on glycerol suggested rapid fermentation to propionate by ruminal bacteria. In vitro fermentation studies suggested that species of *Selenomonas* were the major fermenters of glycerol, with the main products being propionate, lactate, succinate and acetate. However, other end products from glycerol fermentation have been reported. The most consistent response from both in vitro and in vivo experiments appears to be a slight increase in proportion of propionate and a greater increase in butyrate. When butyrate has increased, a concomitant increase in β -hydroxybutyrate concentrations in plasma has been observed. Differences most likely result from varied experimental conditions, but might suggest changes or interactions among microbial species. It has also been suggested that microorganisms adapt to glycerol feeding, as rates of disappearance increase with increased days of feeding glycerol. The fate of absorbed glycerol across the ruminal epithelium would most likely be conversion to glucose in the liver. Glycerol kinase converts glycerol and ATP to glycerol-3-phosphate and ADP at the triose phosphate level, directing glycerol towards gluconeogenesis. Net portal appearance of glycerol has been shown to account for only 10% and liver removal 8% of an intraruminal glycerol dose. Arterial concentration of glycerol increased, whereas glucose concentration was not affected. Others have observed that concentrations of blood glucose increased when dairy cows were intraruminally dosed with glycerol. Rates of glycerol absorption across the ruminal epithelium relative to the amount that is fermented may determine the gluconeogenicity of glycerol in ruminant animals. Metabolic fates of glycerol associated with glycerol fermentation in the rumen and metabolism in liver will be discussed.

Key Words: Glycerol, Metabolism, Ruminant

490 Glycerin as a feed for ruminants: Using glycerin in high-concentrate diets. J. S. Drouillard*, *Kansas State University, Manhattan.*

The availability of glycerin as a feedstock for cattle and other livestock species is increasing due to rapid expansion of the biodiesel industry. Glycerin is a viscous, sweet liquid, is effective in controlling dust, and can aid in preventing segregation of diet components in a total mixed diet. Published literature pertaining to utilization of glycerin in concentrate-fed animals is scarce, but studies currently are underway at several U.S. institutions. German researchers reported that glycerol can readily replace up to 10% of readily fermentable starches, but its energetic value when fed in conjunction with a starch-based diet (60% concentrate) was approximately 85% of its value when fed with a forage-based diet. Feeding glycerol has been reported to shift VFA production in favor of propionate at the expense of acetate both in vitro and in vivo. Since propionate production typically is greater for concentrate fed animals, there may be less opportunity to improve energetic efficiency when glycerol is combined with concentrates compared to feeding with forages. Crude glycerin has been reported to decrease DMI when included at 10% of diets that contain combinations of dry-rolled corn and grain co-products, but ADG increased, resulting in efficiency improvements of 16 to 23% compared to diets without glycerin. Efficiency improvements were greatest when diets contained more starch, which is in contrast to observations of German researchers. In flaked-corn diets, feeding glycerin has been reported to have a quadratic effect on efficiency ($P < 0.05$), with the greatest improvements associated with low levels of feeding. Efficiency changes were 11, 10, 8, 3, and -3% for diets containing 2, 4, 8, 12, and 16% glycerin, respectively. Adding glycerin to flaked corn diets yielded a linear increase in longissimus muscle area ($P < 0.05$) and linear decreases in subcutaneous fat and marbling deposition ($P < 0.05$). Crude glycerin is promising as a feed for finishing cattle, though much remains to be learned about optimal levels of feeding and implications for carcass quality, composition, and sensory attributes.

Key Words: Glycerin, Cattle, Feedlot

491 Using glycerin as a supplement for forage-fed ruminants. B. W. Hess*¹, S. L. Lake², and S. A. Gunter³, ¹University of Wyoming, Laramie, ²Purdue University, West Lafayette, IN, ³University of Arkansas, Hope.

The utility of crude glycerin as a feed additive for forage-fed ruminants depends largely on how well the animals are able to utilize the glycerol and other dietary components when crude glycerin is added to the diet. Several studies have demonstrated that ruminal fermentation of pure glycerol results in the production of VFA, with propionate and butyrate being most prominent. No effect of up to 1% pure glycerol on the growth, adhesion, and cellulolytic activity of 2 rumen cellulolytic bacterial species has been observed in a pure culture in vitro system. However, growth and cellulolytic activity of the 2 bacterial species were greatly inhibited at a concentration of 5% pure glycerol. It has been reported that pure glycerol can comprise 13.3% of the diet without affecting diet digestibility when the in vitro system was inoculated with ruminal microorganisms, and OM fermentation increased if microbes were adapted to glycerol. With the exception of annual cool-season grasses, our in vitro experiments indicate that up to 15% crude glycerin may be

added to various feedstuffs without affecting DM or fiber digestibility. Although lag time for NDF disappearance tended to decrease linearly ($P = 0.07$) as crude glycerin increased to 30% of the in vitro substrate, rate and extent of DM, N, and NDF disappearance were largely unaffected by inclusion of crude glycerin in the substrate. Other researchers observed either no effect or a positive effect on nutrient digestibility with up to 20% crude glycerin in diets containing a low-starch concentrate. Preliminary results from a study with prepuberal beef heifers indicate that ADG is comparable between diets with 25% crude glycerin and a soybean hull-based supplement. Furthermore, substituting wheat grain with crude glycerin of different purities to provide glycerin at about 9% of the dietary DM did not influence nutrient disappearance from the total tract of steers. Thus, crude glycerin is a viable feed additive for ruminants consuming roughage-based diets.

Key Words: Glycerol Supplementation, Forage Diets, Ruminants

492 Use of glycerin in dairy diets. S. S. Donkin*, *Purdue University, West Lafayette, IN.*

Glycerin, also known as glycerol, is a colorless, odorless, hygroscopic, and sweet-tasting viscous liquid. It is a sugar alcohol with high solubility index in water and has a wide range of applications in the food, pharmaceutical, and cosmetic industries. The use of glycerin in diets for dairy cattle is not novel; however, this interest has been renewed

due to the increased availability and favorable pricing of glycerin as a consequence of recent growth in the biofuels industry. Experimental evidence supports the use of glycerin as a transition cow therapy but feeding rates are low, ranging from 5 to 8 % of the diet DM. There is a paucity of research that examines the use of glycerin as a macro-ingredient in rations for lactating dairy cows. Most reports indicate a lack of effect of addition of glycerin to the diet when it replaces corn or corn starch. Recent feeding experiments with lactating dairy cows indicate replacing corn with glycerin to a level of 15% of the ration DM does not adversely effect milk production or composition. Glycerin fed to dairy cattle is fermented to volatile fatty acids (VFA) in the rumen and early reports indicated that glycerin is almost entirely fermented to propionate. In vitro data indicates glycerin fermentation increases the production of propionate and butyrate at the expense of acetate. Rumen microbes appear to adapt to glycerin feeding and consequently, cows fed glycerin also require an adaptation period to glycerin inclusion. Debate exists regarding the fate of glycerin in the rumen and although most reports suggest that glycerin is largely fermented in the rumen, the extent of rumen digestion may depend on level of inclusion in the diet. Data are lacking regarding the rates of rumen fermentation of glycerin at intake levels for high producing dairy cattle. Although recent data indicates that glycerin can be included in diets fed to dairy cattle at macro ingredient levels data which would permit a full appreciation of the feeding value of glycerin and the resulting impact on cow health and productivity, is lacking.

Key Words: Glycerin, Glycerol, Dairy

Small Ruminant: Sheep

493 ASAS Centennial Presentation: Impacts of animal science research on U.S. sheep production and predictions for the future. C. J. Lupton*, *Texas AgriLife Research, San Angelo, TX.*

A 100 yr ago, there were over 48 million sheep in the U.S. In 1910, they were valued at \$4/hd with 43% of income from sale of sheep, lambs, and meat and 57% from wool. Great fluctuations in this ratio over the years have challenged breeder and researcher alike. By 2007, sheep numbers had declined to 6.2 million with the average sheep shearing 3.4 kg of wool (< 10% of income), 0.2 kg more than in 1909 but 0.5 kg less than fleeces in the mid 1950s. Sheep operations have declined by more than 170,000 in the past 40 yr. A cursory examination of this information might lead one to conclude that animal science research has made little impact on sheep production in the U.S. On the contrary, lamb crops in the new millennium (range = 109 to 115%) are greater than those recorded in the 1920s (85 to 89%) and dressed lamb weights increased from 18 to 32 kg from 1940 to present. In the past century, researchers conducted thousands of investigations with progress reported in new, existing and cross breed evaluations, quantitative and molecular genetics, selection, nutrition, fiber, meat, hides, milk, growth, physiology, reproduction, endocrinology, management, behavior, the environment, disease, pharmacology, toxicology, and range, pasture, and forage utilization such that a vast amount of new information was accrued. Our understanding of sheep has benefited also from research conducted on other species, and vice versa. Many factors that have contributed to decline in the sheep industry are not easily influenced by academic research (e.g., low per capita consumption of lamb meat, predation, reluctance to adopt new technology, cost and availability of labor with sheep-related skills, and fewer young people pursuing careers in agriculture). The size of the U.S. sheep industry is expected to remain stable with possible slow growth in the foreseeable future. To remain profitable, producers will take advantage of new (or previously unused) technology, the public's desire for things natural, domestic niche and international fiber markets, and the sheep's ability to control noxious weeds and thrive in sub-optimal ecosystems.

Key Words: Impact, Research, Sheep

494 Impact of grazing systems on management of gastrointestinal nematodes in weaned lambs in Arkansas. J. M. Burke*¹, J. E. Miller², and T. H. Terrill³, ¹USDA, ARS, Booneville, AR, ²Louisiana State University, Baton Rouge, ³Fort Valley State University, Fort Valley, GA.

Gastrointestinal nematode (GIN) control for 'natural' or organic lamb production is needed, especially where *Haemonchus contortus* is prevalent. Objective was to determine the impact of grazing systems on GIN infection of weaned lambs. Naturally infected Katahdin lambs (120 d of age) were randomly assigned to graze 1) continuous bermudagrass (CB; n = 14), 2) rotationally grazed bermudagrass, moved every 3.5 d and returned to original plot 35 d later (RB; n = 14), 3) continuous tall fescue (TF; n = 7), or 4) continuous sericea lespedeza (SL; n = 19). In late summer, all lambs were supplemented with 500 g corn/SBM because of declining body condition. Fecal egg counts (FEC) and packed cell

volume (PCV) were determined weekly and BW monthly. Individuals were dewormed with 0.5 g copper oxide wire particles when FAMACHA score increased to ≥ 3 . FEC peaked on first d of grazing (D 0) and was lowest in SL lambs by D 28 (grazing system \times day, $P < 0.001$). TF lambs became the most anemic by D 21 (grazing system \times day, $P < 0.001$). Between 0 and 3 dewormings/lamb were necessary and there tended to be fewer SL lambs and more TF and CB lambs dewormed by D 105 (CB, 1.69; RB, 1.27; TF, 1.66; SL, 0.85 ± 0.26 ; $P < 0.10$). Worm free tracer lambs were introduced to CB (n = 6) and RB (n = 8) plots following the last rotation to determine worm burdens after 20 d grazing. Abomasal worm burden was greater in RB than CB tracer lambs ($P < 0.05$), but intestinal worm numbers were similar. Greater number of abomasal worms may occur because RB lambs required less deworming than CB lambs leading to more eggs on the RB plots. TF lambs gained no BW while grazing TF and BW never reached that of other lambs (grazing system \times day, $P < 0.001$). BW of SL lambs was lower on D 28 than CB and RB lambs. In summary, the TF grazing system was unacceptable for GIN control or weight gain. The SL grazing system was best for GIN control, but did not persist during drought. Weight gains were similar between CB and RB groups of lambs, but CB lambs required more deworming. This research was funded by CSREES, IOP Grant #2005-51300-02392.

Key Words: Gastrointestinal Nematodes, Grazing Systems, Lambs

495 Nutrient digestibility of straw-based diets by sheep. C. Anderson Alexander-Huerta, A. S. Juárez-Reyes*, M. Murillo-Ortiz, R. Montoya-Escalante, G. Nevárez-Carrasco, and M. A. Cerrillo-Soto, *Universidad Juárez del Estado de Durango, Durango, Dgo. México.*

A study was conducted to estimate the effect of oat and bean straw-based diets on nutrient digestibility in sheep. Five criollo sheep (45 ± 4.5 kg BW) fitted with ruminal and duodenal cannulae were fed the experimental diets consisting of 70% oat straw (T1); 40% oat straw (T2), 70% bean straw (T3); 40% bean straw (T4); and a control with 20% oat straw and 20% bean straw (T5). Other ingredients were alfalfa hay, ground corn and cotton seed meal. Diets were isonitrogenous (11% CP). Each period of the trial consisted of a 14-day adjustment and a 5-day collection phases. Mordanted fiber was used as internal marker, it was dosed through the rumen cannula, whereas purines were utilized for estimation of microbial efficiency. Data were analyzed using PROC GLM for a 5 \times 5 Latin Square experimental design. Intakes of OM were similar ($P > 0.05$) across diets. However, sheep fed T3 consumed higher amounts ($P < 0.05$) of NDF and ADF. Apparent OM ruminal digestion was different across diets ($P < 0.05$). Sheep fed T2 registered higher OM rumen digestibilities. Feeding T3 and T5 to sheep, however, resulted in lower OM digestibilities. No differences ($P > 0.05$) in apparent ruminal NDF and ADF digestibilities were registered. Total tract digestibilities of OM, NDF or ADF were not affected by diets. Similarly, no effect was observed in N intakes. Nonetheless, differences were registered in microbial efficiency. Sheep fed T5 registered the highest efficiencies. Data evidenced the potential of diets based on bean and oat straw when other sources of food are scarce.

Table 1.

Item	T1	T2	T3	T4	T5	Mean	SEM	P
Intake, g/d								
OM	894	982	1029	1032	1000	987	105	0.28
NDF	468	450	563	498	481	492	52	0.04
ADF	288	244	385	308	301	305	33	0.001
Apparent ruminal digestion,								
OM	54	60	49	56	49	54	5.9	0.05
NDF	53	57	44	49	45	50	8.2	0.15
ADF	44	42	28	31	30	35	10.1	0.09
Apparent total tract digestion, %								
OM	73	77	70	76	73	74	4.7	0.22
NDF	62	62	56	63	58	60	6.4	0.38
ADF	51	45	50	50	46	48	7.7	0.74
N Intake, g/d	14	16	16	17	17	16	1.7	0.16
Microbial efficiency*	14	12	16	17	19	15	3.0	0.03

* g bacterial-N/kg OM trully digested in the rumen

Key Words: Digestibility, Straw, Sheep

496 WITHDRAWN

497 Ability of ewes to rebreed while lactating in spring. K. M. Jordan*, J. W. Knight, and D. R. Notter, *Virginia Polytechnic Institute and State University, Blacksburg.*

These studies were conducted to investigate the ability of a sheep population genetically selected since 1988 to lamb in fall and containing 50% Dorset, 25% Rambouillet, and 25% Finnsheep breeding to breed while lactating during anestrus. Raddled rams were introduced to lactating ewes, and percentages of ewes marked, diagnosed pregnant by ultrasonography, and lambing were recorded. In April 2006, January-lambing ewes of the selected line were compared to St. Croix ewes, a hair sheep breed often considered to be lowly seasonal. Rams were introduced at an average of 61 d (range 46-79 d) postpartum. By 21 and 42 d after ram introduction, more ewes in the selected population than St. Croix ewes were marked by rams (42 vs 0% and 71 vs 35%, respectively, $P < 0.05$). However, the overall percentage of ewes exposed to rams for 42 d that subsequently lambled (41%) did not differ between breeds even though ewes in the selected line had been marked earlier and in greater numbers than St. Croix ewes. Thus, significant fetal loss appears to have occurred in ewes in the selected line. A second study in May 2007 used ewes that lambled in March and averaged 43 d (range 33-52 d) postpartum to study fetal loss in 35 ewes in the selected line that were bred while lactating during what is generally believed to be the deepest part of anestrus. Of the 18 ewes that were marked, 13 were diagnosed pregnant 120 d after ram introduction. Ten ewes maintained their pregnancy through September but only seven produced lambs of normal birth weight while three produced underweight, premature lambs that did not survive. Therefore, even though more than 51% of ewes were marked, only 20% of ewes gave birth to viable lambs. These studies indicate that ewes in the selected line are able to become pregnant while lactating during anestrus, but are often unable to carry the lambs to term. Although the selected ewes appear to be well suited to accelerated lambing systems involving 7 to 8-mo lambing intervals,

reduction of lambing intervals to 6 to 7-mo appears to have detrimental effects on fetal survival.

Key Words: Sheep, Fertility, Season

498 Lactational and reproductive effects of melatonin in lactating dairy ewes mated during spring. G. Caja*, A. A. K. Salama, S. Carné, E. Albanell, X. Such, and R. Casals, *Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.*

A total of 110 dairy ewes of 2 breeds differing in milk yield and milk composition (Manchega, $n = 57$; Lacaune, $n = 53$) were used to evaluate the lactational and reproductive effects of using s.c. implants of 18 mg melatonin (Melovine, Ceva Salud Animal, Barcelona, Spain) for improving fertility at ram mating during lactation in spring. Ewes were switched from a seasonal lambing system (December) to an out-of-season lambing system (September) to obtain greater lamb and milk market prices under Spanish conditions. Lambs were weaned from their mothers in January (35 d of age), and the ewes were machine milked thereafter (wk 5 to 30 of lactation). At spring (April 21) lactating ewes were assigned to 4 balanced groups according to breed to which the experimental treatments were randomly applied: Control (untreated; $n = 55$) and MEL (melatonin implanted 42 d before mating; $n = 55$). Intensive management and feeding (ad libitum forage and 0.4 to 0.8 kg concentrate according to requirements) was maintained throughout lactation and ewes improved BCS during matting. Rams of each breed were also treated with 3 implants of MEL at d 60 before mating and were joined to ewes (1 ram/12 to 15 ewes) for 90 d (June 2 to August 31). Milking was maintained throughout the matting period and ewes were dried off during July. Milk yield was recorded weekly and sampling for milk composition was done fortnightly. Results showed no effects of MEL on milk yield ($P > 0.05$) and milk fat and protein contents ($P > 0.05$) for both breeds. Both MEL and control ewes showed good ability for out-of-season breeding during milking, and lambing was concentrated in 21 and 25 d, respectively. On average, fertility ($P < 0.05$) and prolificacy ($P = 0.12$) increased as a result of the MEL treatment (Table 1). Lamb birth weight (3.72 kg BW, on average) and mortality rate (4.2%, on average) did not vary. In conclusion, use of melatonin in dairy ewes was effective to improve reproductive performance in out-of-season conditions, without effects on milk yield and milk composition.

Table 1. Performance of dairy ewes according to breed and treatment during lactation

Item	Manchega		Lacaune	
	Control	Melatonin	Control	Melatonin
Ewes, No	28	29	27	26
Fertility, %	85.7 ^c	100 ^a	92.6 ^b	100 ^a
Prolificacy, lamb/ewe	1.75	1.83	1.92	2.00
Milk yield, L ¹	117 ± 13	120 ± 12	237 ± 15	227 ± 13
Milk fat, %	8.67 ± 0.21	8.90 ± 0.19	7.01 ± 0.13	7.22 ± 0.11
Milk protein, %	5.61 ± 0.08	5.71 ± 0.07	5.08 ± 0.05	5.13 ± 0.06

¹For 147 d of milking excluding lamb sucked milk; ^{a,b,c} $P < 0.05$

Key Words: Melatonin, Breeding, Dairy Sheep

499 Effect of protein degradability on milk production of dairy ewes. C. M. Mikolayunas*, L. E. Armentano, and D. L. Thomas, *University of Wisconsin, Madison*.

To study the effect of protein degradability on milk yield and milk urea N (MUN) concentration in dairy ewes, three diets were formulated of similar energy density but varying dietary concentrations of rumen-degradable protein (RDP) and rumen-undegradable protein (RUP): 12% RDP and 6% RUP (12-6), 14% RDP and 4% RUP (14-4), 12% RDP and 4% RUP (12-4) (% of dry matter). Eighteen multiparous dairy ewes in mid-lactation were assigned to 2 blocks of 9 ewes each according to milk yield and randomly assigned within block to 6 pens of 3 ewes each. Dietary treatments sequences were balanced for carryover in two 3×3 Latin Squares and applied to pens for 2 wk. Milk yield was measured during the final 8 milkings (4 d) and milk composition (% fat, % protein and MUN) was determined on compiled samples (morning and evening milking) from the final 2 d of each period. Pen dry matter intake was measured on the final 4 d of each period. Pen data were analyzed using the PROC MIXED model of SAS. The model included square, treatment, period \times square and treatment \times square, and the random effect was pen (square). There was an interaction ($P < 0.01$) of block by diet for dry matter intake and milk, fat, and protein yield. Across both squares, milk yield was greater ($P < 0.01$) for the 12-6 treatment compared to the 14-4 and 12-4 treatments (2.02 vs. 1.79 and 1.79 kg/d, respectively). Milk fat yield was greater ($P < 0.05$) for the 12-6 treatment compared to the 14-4 and 12-4 treatments (122.1 vs. 110.7 and 108.0 g/d, respectively), and milk protein yield was greater ($P < 0.05$) for the 12-6 treatment compared to the 14-4 and 12-4 treatments (94.9 vs. 85.6 and 85.0 g/d, respectively). Milk urea N concentration was greater ($P < 0.05$) for the 12-6 and 14-4 treatments compared to the 12-4 treatment (26.33 and 27.39 vs. 23.43 mg/dL, respectively). There was no effect of dietary treatment on dry matter intake. The results indicate a positive effect of RUP on milk yield. Higher dietary crude protein concentration resulted in higher milk urea excretion, regardless of protein degradability.

Key Words: Dairy Sheep, Protein Degradability, Milk Urea Nitrogen

500 Implementing electronic identification for milk recording in dairy sheep. A. Ait-Saidi, A. A. K. Salama, S. Carné*, and G. Caja, *Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain*.

Dairy ewes ($n = 48$) were used to compare manual (**M**) vs. semi-automated (**SA**) systems for identification (**ID**) and milk recording (MEC Project AGL-2007-64541). Ewes were grouped according to milking frequency (once daily, 0.98 ± 0.05 L/d; twice daily, 1.45 ± 0.06 L/d). The M system used visual ID, on-paper data recording, and manual data uploading to a computer. The SA system used e-ID (20 g ceramic boluses, containing 32 mm HDX transponders) by a hand-held reader and manual data recording by reader keyboard (milk yield and observations), and data was automatically uploaded to a computer by Blue-tooth connection. Data were collected for groups of 2×12 ewes for 10 test-days of each system and milking frequency over a period of 70 d. Time data was converted to a decimal scale. Dynamic reading efficiency measured at the milking parlor entrance (speed, 1 ewe/s) using a stationary transceiver with a frame antenna was 100%. Milk recording time varied according to milking frequency and milk recording system, being greater in M (0.49 to 0.56 min/ewe; $P < 0.001$) than in SA (0.40 to 0.47 min/ewe; $P < 0.001$), and correlated with ewe milk yield during the experiment ($R^2=0.62$). Average data transfer time per batch of 24 ewes was greater for M (0.13 ± 0.01 min/ewe) than SA (0.03 ± 0.01 min/ewe). Total milk recording time was greater in M (0.62 to 0.70 min/ewe; $P < 0.001$) than in SA (0.43 to 0.50 min/ewe; $P < 0.001$). Time for transferring data to the computer of groups of 24 ewes, was 3.27 ± 0.09 and 0.78 ± 0.03 min for M and SA, respectively. Increase for the next additional 24 ewes in SA was only 0.19 ± 0.01 min. Data errors were only found for the M system (3.6%). Differences in labor time between M and SA increased with number of ewes processed on the same test-day (4.6 to 218.6 min for 24 to 1,008 ewes, respectively) and reduction in milk recording cost ranged from \$US 1.0 to 49.3 (0.8 to 36.5 Euros), being able to pay for the extra costs of e-ID. In conclusion, both labor cost and data errors showed the benefits of using electronic identification for milk recording in sheep, the benefit being greater with complete (am and pm) milk recording and in larger flocks.

Key Words: Transponder, Milk Recording, Dairy Sheep

Teaching/Undergraduate and Graduate Education: Teaching in the Animal Sciences

501 The Academic Roadmap: A web-based tool for improving student recruitment, retention and success in the agricultural sciences. K. H. Petersson*, D. Grossman-Garber, C. English, T. P. Husband, D. P. Murray, and A. I. Veeger, *University of Rhode Island, Kingston.*

Today's students are frequently unaware of the diversity of career trajectories and opportunities available to them in the field of agriculture. The scientific challenges that will be faced in the coming decades are daunting, making it imperative that talented young minds are attracted into the field of agriculture. The Academic Roadmap (AR) is a web-based tool developed at the University of Rhode Island to improve student recruitment, retention, and overall student success in higher education in general and agricultural-related fields in particular. The AR is a 'one-stop' portal to an academic discipline, its associated course(s) of study, and related career tracks. In a sense, it is a 'user-friendly' way for students to access information on careers and relevant majors from one source. The AR contains general information on the field, as well as detailed information on curriculum, learning outcomes, experiential learning opportunities, careers, and graduate programs for each academic discipline. Each of these sections of the AR is linked, showing the student how courses taken relate to learning outcomes which then relate to career options down the road. Also contained in the AR are 'hot topics' in the field so students can learn about the real-world applications of their studies and on-going research efforts. Past and present student biographies and links to virtual labs and field trips bring the site to life. Currently AR's have been developed for four disciplines, one of which is Animal & Veterinary Science. Efforts are currently underway to personalize the roadmaps for students through a 'My Academic Roadmap' module that is linked to the university's student records database. Student response to the AR, obtained through an online survey, was overwhelmingly positive. Ninety-eight percent of students surveyed (n=328) found the website to be valuable/very valuable. The long-term goal of this project is to disseminate the completed AR to land-grant institutions nationwide via a multi-state, integrated USDA project to help improve training and retention of students in agricultural-related fields.

Key Words: Education, Recruitment, Advising

502 Capstone experiences in animal and poultry sciences: Opportunity and challenge. C. M. Wood*, W. E. Beal, E. A. Dunnington, D. E. Eversole, H. Jiang, A. P. McElroy, R. K. Splan, and M. L. Wahlberg, *Virginia Tech, Blacksburg.*

The Department of Animal and Poultry Sciences (APSC) at Virginia Tech recently revised the undergraduate curriculum using a holistic and comprehensive process. The most significant new requirement is a two-credit capstone experience that every student must complete within 45 credits (three terms) of graduation. Specific learning objectives include: 1) employing critical thinking skills to acquire, analyze, interpret, and integrate information from a variety of sources; 2) solving problems in authentic or realistic situations in the animal sciences; 3) planning and completing a project pertaining to each student's discipline and field; 4) demonstrating verbal, visual, and written communication skills;

5) contributing to a team effort; 6) assessing and describing potential contributions to society; and 7) effectively competing for career and/or post-baccalaureate opportunities. By its nature, each capstone experience will be unique to the student who designs it in consultation with his/her advisor. To aid students in that process, a new sophomore-level seminar course was developed that includes drafting a capstone experience proposal. The capstone proposal must clearly outline how the learning objectives listed above will be achieved and how student attainment of the objectives will be assessed. Proposals must be submitted to a faculty committee for approval no later than the term prior to undertaking the capstone experience. Potential capstone experiences in the animal sciences could include, but are not limited to, Study Abroad, Field Studies, Internships, Undergraduate Research, Independent Studies, and formal coursework at the senior or masters level. With more than 450 APSC majors, the challenges presented by this new requirement are many but are outweighed by the tremendous opportunities.

Key Words: Undergraduate Education, Experiential Learning, Capstone Experience

503 The Graduate Experience Program. J. A. Atkins*¹, D. L. McNamara², and G. W. Jesse¹, ¹*University of Missouri, Columbia*, ²*University of Wisconsin, Platteville.*

The objective of the Graduate Experience Program is to offer undergraduates insight into graduate education and career opportunities within animal science. This is a one credit problems course that is taught and organized by graduate students. The class meets every other week to discuss topics concerning graduate school aimed at helping students decide whether graduate education is the right decision for them. These topics include exercises in developing career goals and what degree they need to meet those goals, applying to graduate schools, writing résumés, graduate education expectations and philosophies, reading and discussing scientific articles, and presenting research at professional meetings. Each undergraduate student has a primary graduate student mentor who meets with them individually and ensures the undergraduate's scientific interests are being met. During these meetings, undergraduates gain first-hand experience with collecting samples, performing lab work, attending seminars, participating in journal clubs, attending scientific meetings, and many other activities important in graduate training. Undergraduate students are required to meet with at least two other graduate students in the department in order to experience a broad range of research opportunities within the division. At the end of the semester the undergraduates present their experiences from this course, and report on three graduate programs, professional schools, or job postings that appeal to them and what steps they need to take in order to be good candidates. Graduate students involved in the course learn to be effective mentors by attending to the needs of the undergraduate students and developing the course material taught which improves their scholarship of teaching. To date, 22 undergraduate students have enrolled in the graduate experience program and more than 30 graduate students have been actively involved in mentoring and teaching this class.

Key Words: Undergraduate and Graduate, Teaching, Mentoring

504 A holistic approach to undergraduate curriculum review and revision in animal and poultry sciences: Process and results. C. M. Wood*, W. E. Beal, E. A. Dunnington, D. E. Eversole, A. P. McElroy, and R. K. Splan, *Virginia Tech, Blacksburg*.

With more than 450 majors and nine degree combinations, the undergraduate program in the Department of Animal and Poultry Sciences (APSC) at Virginia Tech is large and complex. The department recently conducted a holistic review of the undergraduate curriculum that involved all faculty in APSC and collaboration with colleagues in other departments. This effort resulted in a complete revision that yielded 29 new and updated courses, a new option, and two revised minors. Changes included dropping public speaking and adding statistics; an increased emphasis on life skills, guidance in curriculum choices and career planning through a series of courses in the freshman, sophomore and senior years; dropping one senior production course from the requirements, and adding animal handling laboratories, an animal products course and a capstone experience requirement. The Production-Business Option was strengthened with the addition of an advanced livestock enterprise analysis course, and an additional companion animal course was added to the elective list, along with several other courses. The review and revision effort was led by the department's Undergraduate Education Committee (UEC). Eight discipline and species committees, chaired by UEC members, reviewed the entire curriculum from their particular perspectives. Departmental outcomes assessment information, demographic trends of APSC students, university requirements, and peer department programs were studied to project the needs of students entering college in the next five to ten years and to formulate draft recommendations. Two faculty workshops yielded a framework that was 95% complete, and course proposal writing groups were formed. A complete set of recommendations was subsequently submitted to university governance. Implementation of the revised curriculum began in Fall 2007 and will be phased in over the next two years as those freshmen proceed through their undergraduate careers.

Key Words: Undergraduate Education, Curriculum Revision, Capstone Experience

505 The challenges and opportunities of teaching a virtual introduction to animal science course. M. Latour*, *Purdue University, West Lafayette, IN*.

In 2000, a virtual version of introduction to animal sciences was created and over the past eight years, the course has reached more than 350 students in over 20 countries and has paved the way for significant funding into the university to support ongoing programs. Like the on-campus course it is designed to teach the fundamentals of animal agriculture but through a series of course modules (n=20). Through the eight year period, studies have been conducted using these students to examine the following: a) impact of virtual teaching assistants vs. the professor and b) the acceptance of course modules and what makes some more appealing to students. Our studies show that online teaching assistances are significantly ($P \leq 0.005$) preferred vs. the professor in the online course, but the reverse if true on campus; that is, on campus students significantly ($P \leq 0.003$) choose to communicate the professor vs. the on campus teaching assistance. In the online course, students ranked one module significantly lower ($P \leq 0.03$) when compared to the other 19 modules with two modules being intermediate to both. The nature of the low ranking module was somewhat expected, but the other two modules that were intermediate to the top ranking and low rankings,

were found to be significantly ($P \leq 0.01$) beneficial to the students and incorporated some face-to-face interaction. In addition to these studies, there are many different challenges imposed on the professor teaching to an audience covering the world; that is, the instructor must be sensitive to natural disasters, military and homeland security, foreign governments, aiming the course to hit specified objectives, internet challenges, and ability to work with students to secure creditable information regardless of learning resources. Hence, the purpose of this work is to show the importance of virtual teaching assistants, course module development and the challenges an instructor might face in teaching students across the world. Lastly demonstrate how funding through distance learning courses can significantly impact ongoing programs.

Key Words: Distance, Learning, Instructor

506 Engaging students with service learning within an animal science curriculum at Texas Tech University: A ten year perspective. H. Brady*, *Texas Tech University, Lubbock*.

The pedagogy of active and service learning can be effectively used in any discipline within higher education to increase student engagement and retention. In this presentation, the evolution of a service learning curriculum in the Department of Animal and Food Sciences will be discussed with an emphasis on practical applications and suggestions for other disciplines/ courses. An overview of Animal Science 3309, Principles of Hippotherapy, offered since 1998, will be discussed including evolution of the class, development of a service program, and active involvement of the class. This class has developed from working with 4 disabled children and borrowed horses to now being an integral part of a full time Premier Accredited Program serving over 60 riders per week. Hippotherapy is the use of the horse and its movement to augment therapy goals and improve the quality of life in individuals with cognitive and physical disabilities. Students become actively engaged as they are assigned to the same children each week and actively plot their progress through lab reports and reflections. Group projects used in the course will be covered, including the development of creative teaching lessons which are taught to the children by the students. This program was chosen as one of 13 Exemplary Courses in the National Case Study for Learner-Centered Approaches in Agriculture, Food and Natural Resources. As part of this presentation, video clips will demonstrate the class in action, the students teaching the sessions to riders with disabilities and, and interviews of participants. Over these years, data have been collected and we have published that in addition to dramatic improvements in the riders, we have seen significant changes in the Texas Tech undergraduate students who take this course. It was determined that students who have taken the course had a greater understanding of disabilities and of the hardships that families of children with disabilities face. In conclusion, the active engagement of students by a service learning curriculum is a powerful tool for use in higher education.

Key Words: Service Learning, Hippotherapy

507 Use of eID to monitor classroom attendance. L. D. Luqué* and D. A. Nichols, *Kansas State University, Manhattan*.

Kansas State University (KSU) offers an introductory animal science course to give students, primarily freshman, of all backgrounds an

overview of the animal production industry. The objective of this study was to develop a model to effectively and efficiently record attendance. Records will then be used to manage attendance, encourage attendance, and identify students with poor attendance in a large class. To accomplish these objectives, KSU created a program using Microsoft Excel. The program records student attendance by day and provides an output of total attendance, identifying those students with poor classroom attendance. This study was conducted over 18 wks during the fall 2007 semester at KSU. Unique Destron full duplex button tags (eID) were assigned to electronically identify students and record attendance. Students were asked to pass their eIDs past an Allflex stick reader (Allflex USA, Inc.) as they entered the classroom. Total attendance was recorded and summarized prior to the start of each class. Two sections of the course were offered: Tuesday and Thursday at 8:05AM (A; n = 118), and Monday, Wednesday, and Friday at 11:30AM (B; n = 171). Results showed a correlation between student attendance and course grade ($P < 0.0001$; n = 287; r = 0.59). Students with a higher classroom attendance had a higher final grade. When comparing student gender (male, female), year in school (freshman, sophomore, junior, senior), section (A, B), and declared major (animal science (ASI), non-animal science (NON)) to percent of classroom attendance, student gender and declared major were important factors. Females had a higher percentage of attendance compared to males ($P < 0.05$) and ASI majors tended to have a higher percentage of attendance compared to NON majors ($P = 0.10$). To conclude, this model of using eID to monitor classroom attendance is an efficient, easy, and quick means of recording attendance.

Key Words: Classroom Attendance, Electronic Identification

508 'A Postcard Home' provides opportunity for first-year students to gain writing experience. J. M. Mapes*, G. M. Hill, M. W. Orth, and J. E. Link, *Michigan State University, East Lansing.*

A misconception of writing is that it should be learned outside of science courses. However, writing assignments are valuable tools to engage students in course concepts and are critical for developing writing skills. A short writing assignment, entitled 'A Postcard Home', was adapted from an assignment created by Dr. William Beal, professor at Virginia Polytechnic Institute and State University. Students in the Introductory Animal Agriculture course were given a specially designed postcard and instructed to write a letter home to someone that they considered as a family member or supporter. In their letter, students described an experience from class and what they learned. They addressed the postcards, which were then mailed by the instructor. Objectives were to engage students in course material, provide an opportunity to develop writing skills, and involve family in students' education. Students could earn up to 10 points, and were evaluated on four criteria: spelling, grammar, sentence structure, and ability to follow directions. Within each criterion individual errors were valued at 0.5 points. If the same error was made multiple times, such as misspelling the same word, half a point was deducted for the first instance only, so as not to discourage students in their writing. Spelling and punctuation errors were the most common. For evaluation purposes, grades were based on a 4.0 scale, with divisions at 9, 8, 7, 6, and 5 points. Out of 142 students, 64% had a 4.0, 19% had a 3.0, 12% had a 2.0, 2% had a 1.0, and 1% had a 0.0. Overall, students performed well, with over 50% of the class scoring 9 points or more. Students seemed to enjoy the assignment; many included humorous explanations of what they were learning in class. Connecting to class material through personal experience engages students in what they are learning. Short writing assignments provide students the opportunity to develop or improve writing skills, while minimizing the amount of work for instructors. Writing is a critical skill in the sciences and should be fostered in all levels of coursework.

Key Words: Writing, Education, Animal Science

Thursday, July 10, 2008

POSTER PRESENTATIONS

Animal Behavior and Well-Being: Methodology

TH1 Functional test of the hypothalamic-pituitary-adrenal axis of sows which perform various abnormal behaviors. D. C. Lay Jr.*, *Livestock Behavior Research Unit, Agricultural Research Service - USDA, West Lafayette IN.*

The objective of this study was to assess the function of the hypothalamic-pituitary-adrenal (HPA) axis of sows which perform differing abnormal behaviors to determine if regulation of their HPA axis had been altered. When dexamethasone is injected i.v., in normal individuals plasma cortisol is suppressed. Individuals with an altered regulation of their HPA are resistant to this suppression. Sows (n = 27) were housed in traditional gestation stalls and fed once daily in the morning. Behavioral data were collected weekly on 3 separate days (-7, 0, 7 d): 7 d prior to treatment, on the day of treatment, and 7 d after treatment. At 0830, 1 h after sows were fed, behavioral assessments were conducted to determine the incidence and type of stereotypic behavior that each sow performed. On d 0, a 10 mL blood sample was collected from all sows at approximately 2000 h. Immediately following blood collection, all sows received 2 mg of dexamethasone administered i.v. The following morning, 12 h later, a second blood sample was collected from each sow. Dexamethasone suppressed plasma cortisol in 23 sows who exhibited base concentrations of 38.8 ± 3.2 ng/mL which were decreased to 9.0 ± 0.9 ng/mL by 12 h later. Four sows proved to be resistant to the dexamethasone. These sows exhibited base concentrations of 40.7 ± 11.1 ng/mL which increased to 53.7 ± 9.5 ng/mL by 12 h later. Fourteen sows performed oral stereotypic behaviors during more than 50 % of the observations. These sows tended to ($P < 0.08$) have greater base cortisol concentrations and they also had greater ($P < 0.04$) post-dexamethasone plasma cortisol than sows performing stereotypic behavior during less than 50 % of the observations. These data indicate that sows which perform oral stereotypic behavior may have altered regulation of their hypothalamic-pituitary-adrenal axis.

Key Words: Stress, Swine, Hypothalamic-Pituitary-Adrenal Axis

TH2 Validation of a water HOBO and the Noldus Observer for drinking behavior in the nursery pig. A. M. Meiszberg*¹, A. K. Johnson¹, J. W. Dailey², J. A. Carroll², L. J. Sadler¹, J. R. Garvey¹, and N. Krebs³, ¹*Animal Science, Iowa State University, Ames*, ²*USDA-ARS, Livestock Issues Research Unit, Lubbock, TX*, ³*Pork Industry Institute, Texas Tech University, Lubbock.*

Collecting accurate behavioral events for extended periods can be time consuming. If a device could accurately record duration and frequency for a behavioral event, this would provide a useful research tool. The objectives of this study were to determine the accuracy of an automatic water meter compared to a human observer for drinking duration (s) and the frequency of visits to the waterer by nursery pigs. Eleven PIC USA gilts (22 ± 2 d of age; 6.5 ± 1.4 kg BW) were used to compare 2 methods; Observer software (OBS) and water meter Hobos (WMHOB) affixed to the water line. For our study, the WMHOB was defined as the control for drinking duration and visits. All gilts were housed individually in stainless steel pens and had ad libitum access to a corn-based diet and one water nipple. Drinking behavior was collected on d 0, 7, and 14 of the trial using one color camera positioned over 4 attached pens that recorded onto a RECO-204 DVR for 24 h at 1 fps. Drinking was defined as head over the water nipple. Behavioral measures were collected continuously from DVD by 2 experienced observers. Data were transformed prior to statistical analysis, and the duration and frequency were analyzed using the general linear model (GLM) and regression procedures in SAS. The GLM model included the method of observation and pig nested within method for the error term. The method of observation affected ($P = 0.001$) the duration (13.88 ± 1.43 s for WMHOB vs. 22.58 ± 1.46 s for OBS) and visits ($P = 0.005$) for drinking behavior (4.94 ± 0.33 visits for WMHOB vs. 3.48 ± 0.33 visits for OBS). For duration and frequency of visits to the drinker, R^2 was 0.563 and 0.687 respectively. In conclusion, the relationship between methods was weak. Also, OBS method underestimated the number of visits and overestimated the total duration of drinking for the nursery pig compared to the WMHOB.

Key Words: Drinking, Pig, Water

TH3 Temporary glycosuria alters molasses consumption in Holstein calves. C. S. Wilcox^{*1}, M. M. Schutz¹, S. S. Donkin¹, and S. D. Eicher², ¹*Purdue University, West Lafayette, IN*, ²*USDA- ARS, West Lafayette, IN*.

Cognitive activities and stress increase hippocampal glucose demand. Elevated circulating cortisol improves glucose conservation and neogenesis. Chronic activation of the adrenal cortex causes adrenal fatigue and lowers cortisol production causing hypoglycemia. In chronic stress rat models, sucrose intake is altered. This study was conducted, as a preliminary study of stress in dairy calves, to determine the effect of phlorizin-induced glucose demand on molasses consumption. Phlorizin temporarily blocks renal absorption of glucose from the urine causing glycosuria. This increases the demand for glucose in order to maintain normal physiologic blood glucose concentrations. To ensure preruminant status, all calves were maintained on milk replacer (fed at 10% of body weight) and given free access to water. In a completely randomized design with 2 treatments, 3-wk-old calves ($n = 6/\text{treatment}$) received 0.365g of phlorizin by s.c. injection (3 ml) or 3 ml of s.c. of saline. During a 7-d adjustment period and 24 h after treatment, all calves were allowed free access to molasses. Hourly urinary output, urinary glucose concentration, and molasses consumption were measured. Data were analyzed using GLM procedure in SAS. Mean molasses consumption for 24 h after treatment was 0.72g (± 0.07) for the control group and 1.42g (± 0.01) for the phlorizin-treated group ($P = 0.02$). Urinary output for the 8-h test period was 1.13 kg (± 0.06) for the control group and 1.67 kg (± 0.08) for the phlorizin-treated calves ($P = 0.026$). Mean urinary glucose peaked at 60 mg/dL 4 h after treatment for calves given phlorizin while the concentration for the control group fluctuated between 0 and 5 mg/dL ($P = 0.001$). Phlorizin treatment significantly increased urinary excretion, urinary glucose concentration and molasses consumption in 3-wk-old Holstein calves. Results of our study showed that alterations in glucose metabolism, specifically increased urinary glucose losses, and increased voluntary sucrose intake. Additional investigations are needed to confirm the relationship of stress with voluntary sucrose intake and to extend the utility of this feeding behavior response as an experimental model.

Key Words: Dairy Calf, Glucose, Phlorizin

TH4 Effect of alternative models for increasing stocking density on the lying behavior, hygiene, and short-term productivity of lactating Holstein dairy cattle. P. D. Krawczel^{*1,2}, C. S. Mooney¹, H. M. Dann¹, M. P. Carter¹, R. E. Butzler¹, C. S. Ballard¹, and R. J. Grant¹, ¹*William H. Miner Agricultural Research Institute, Chazy, NY*, ²*Department of Animal Science, The University of Vermont, Burlington*.

Spatial requirements of dairy cows may be assessed using several experimental models that attempt to simulate on-farm conditions. The objective of this study was to determine the differences in lying behavior, hygiene, and milk production of Holstein dairy cows when housed at a stocking density of 100 (1 cow per stall and headlock) or 142% imposed by either 1) the denial of access to freestalls and headlocks, 2) the denial of freestalls, headlocks, and 26.6 m² of alley space to simulate adding cows to the pen, or 3) adding 14 cows to increase group size. Cows ($n = 136$) were assigned to 1 of 4 pens in a 4-row freestall barn and treatments were allocated using a 4 \times 4 Latin square with 14-d periods. Lying time (h) and number of bouts per d for 12 focal cows per pen were determined using dataloggers recording at 1-min intervals during the final 5 d of each period. Hygiene of focal cows was assessed from the difference in the scores observed after the legs and udder were cleaned on d 2 of each period and those observed on d 14. Milk yield and dry matter intake were established from the pen mean over the final 4 d of each period. Milk composition was evaluated from samples collected during all milkings on d 12 of each period. Data were analyzed using MIXED procedure of SAS. Lying time was greater (13.0 h/d; $P < 0.002$) for 100% stocking density than 142% stocking density treatments, which did not differ (11.8 h/d; $P > 0.10$). Lying bouts (12.3 per d) did not differ among treatments ($P > 0.10$). The changes in udder (0.6) and leg (1.3) hygiene score per period were not affected by treatment ($P > 0.10$). Milk fat (3.6%), true protein (3.19), somatic cell score (4.5), milk yield (43.8 kg/d), and dry matter intake (24.6 kg/d) did not differ ($P > 0.10$) by treatment. The three stocking density models evaluated in this short-term study appear to be equally valid based on the lack of response in lying behavior and lactation performance. Additionally, all 3 models resulted in 1.2 h/d less lying time than the 100% stocking density control.

Key Words: Dairy Cattle, Stocking Density, Behavior

Animal Health: General

TH5 Hard water preservative effect of Birjand Quanats to reduce lead acetate toxicity on *Capoeta fusca*. A. Omid^{*} and H. Farhangfar, *Birjand University, Birjand, Iran.*

This study was conducted in order to determine the acute toxicity of lead acetate on *Capoeta fusca*. For this purpose 580 fishes with mean length of $12/28 \pm 0/14$ and mean weight of $16/64 \pm 0/52$ were divided into 15 control and treatment groups of fishes. The fishes kept in 20 L aquariums and the procedure designed in static condition according to Organization Economic Cooperation and Development (OECD) method. Mortality rate was recorded in 96 h and lead acetate LC50 was calculated by standard statistical method. LC50 of 10/992, 10/594, 9/338 and 7/575 ppm were determined at 24, 48, 72 and 96 hours post exposing respectively. Also minimum and maximum lethal concentrations of lead were determined as 4 and 12/5 ppm and MAC was 0/7575. Lead acetate in soft water (Hardness 10 mg/L) was highly toxic for fish but in hard water (Hardness: 310 mg/L) had a little toxicity. High trend of lead for interaction with minerals such as calcium and carbonates is the major reason of this phenomenon. Lead toxicity is decreased with increase of water hardness and this is the cause of fish tolerance against some heavy metals pollution in natural environment.

Key Words: *Capoeta fusca*, Water Hardness, Lead Acetate

TH6 Less common complication of traumatic reticulitis in cattle: Abscess on left thoracic wall. A. Omid^{*}, *Birjand University, Birjand, Iran.*

Little accurate information is available on the prevalence or incidence of thoracic abscess as a complication of traumatic reticulitis. During two years among 75 cases confirmed suffering from traumatic reticulitis five cows with thoracic abscesses were examined clinically, radiography and ultrasonographically. There was a wide range of clinical signs include anorexia, abdominal pain, recurrent tympany and/or weight loss. All of the cases had a big abscess in back portion of left humerus on thoracic wall. In every case, the diagnosis was confirmed by centesis and aspiration of the abscess. In all cows, radiographic findings revealed a metal foreign body in the reticulum penetrating it. Ultrasonography revealed a large reticular abscess with a well developed capsule appeared as echogenic deposits that sometimes accompanied by hypoechogenic fluid. Abscesses had an echogenic capsule with a hypoechogenic center. The abscess was elongated toward left thoracic wall and appeared in posterior portion of left humerus. In one case, the tip of wire was detected on abscess surface but in others the skin was intact. The abscess was incised and drained from body surface and reticulum during a rumenotomy. All the cows after abscess drainage and treatment with antibiotics recovered their health. Clinical findings, laboratory testing, ultrasonography and radiography when combined each other, could have a large practical application in diagnosis and treatment of traumatic reticulitis complications. Foreign bodies should be considered in the differential diagnosis of localised swelling on thoracic wall. Ultrasound was a useful diagnostic tool, to help retrieve a fluid sample for culture and sensitivity, monitor the progression of the lesion and to guide surgical debridement

Key Words: Traumatic Reticulitis, Abscess, Cow

TH7 Comparison of attachment to feed ingredients of whole *E. coli* K88 cells and purified F4/K88 fimbriae. P. M. Becker¹, S. Galetti², J. Van der Meulen¹, A. Bannink^{*1}, and H. C. A. Widjaja¹, ¹*Wageningen University Research Centre, Lelystad, The Netherlands,* ²*University of Milan, Milan, Italy.*

F4(K88) fimbriae-producing ETEC are an important cause of diarrhea in young pigs. Alternative adhesion matrices that interfere with the attachment of *E. coli* K88 to pig intestinal receptors are promising antidotes. In this study, live *E. coli* K88 cells (O149 F4(K88)ac, K91, LT, STb) were compared with purified F4(K88ac) fimbriae in terms of their binding capacity for feed-related plant materials. For determination of whole cell attachment, microtitration plates were coated with suspensions of powdered plant materials in PBS buffer, employing BSA as blocking reagent and reference. *E. coli* K88 cells were allowed to adhere to the coating at RT for 30 min. Then, the wells were washed to remove non-adherent bacteria. After addition of Minca-IsoVitaleX medium, plates were incubated in the reading chamber of a photometer at 37°C. The OD was automatically read at 650 nm in 15 min intervals. The test principle was based on an inverse relationship between adhering cell numbers and detection times of growth. For determination of F4 fimbrial binding, microtitration plates were coated with 0.1 µg fimbriae/well. Suspensions of powdered plant materials were pipetted into the wells and plant materials were allowed to bind to F4 fimbriae during incubation at room temperature for 1 h. Then, the plates were washed to remove non-binding material. F4-fimbriae that were not masked by bound plant material were quantified by means of HRP-conjugated Mab AC5 antibodies. For three plant materials, namely tempeh (fermented soybeans), pumpkin fruit, and tomato fruit, the high binding affinity of whole *E. coli* K88 cells was supported by the results obtained with purified F4 fimbriae. In other cases, such as for a yeast cell-wall preparation, sunflower meal, and sesame seed meal, additional factors to F4 on the cell surface of *E. coli* K88 might have contributed to the binding of intact cells.

Key Words: Anti-Adhesion, *E. coli* K88, Plant Materials

TH8 Effects of spray-dried porcine plasma on nasal associated lymphoid tissue in a lung inflammation model in mice. A. Pérez-Bosque^{1,2}, M. Maijó¹, L. Miró¹, J. Polo², L. Russell³, J. Campbell³, E. Weaver³, J. Crenshaw³, and M. Moretó^{*1}, ¹*Universitat de Barcelona, Barcelona, Spain,* ²*APC Europe, Granollers, Barcelona, Spain,* ³*APC Inc., Ankeny, IA.*

Spray-dried porcine plasma (SDPP) is a complex mixture of proteins and other biologically important compounds that is used as a dietary supplement for farm animals. Dietary supplementation with animal plasma can ameliorate the inflammatory response in an experimental model of intestinal inflammation induced by *S. aureus* enterotoxin B. Since the common mucosal immune system connects the inductive sites (Peyer's patches and Nasal Associated Lymphoid Tissue; NALT) with the effector sites (lamina propria of the intestinal and respiratory tracts) we have now studied the effect of dietary plasma proteins on pulmonary inflammation. C57BL/6 Hsd mice were fed diets supplemented with 8% SDPP (SDPP group), 1.5% IgC (porcine immunoglobulin concentrate; IgC group) or milk proteins (Control group) from day 19 (weaning) until day 33. On day 32, mice were given an intranasal dose of 500 µg LPS/kg

b.w. (groups LPS, LPS-SDPP and LPS-IgC), or PBS (groups Control, SDPP and IgC), and killed 24h later. The percentages of subpopulations of lymphocytes and polymorphonuclear cells (PMN) in bronchoalveolar lavage fluid (BALF) and in lung tissue were measured. In BALF, LPS administration increased 27-fold the number of leucocytes. LPS also modified the profile of the cells in BALF (In Control group, 3% were lymphocytes and 97% PMN; in LPS group they were 40% and 60%, respectively; $P < 0.001$). Diets supplemented with either SDPP or IgC did not modify the LPS response, but SDPP reduced the LPS-induced activation of monocytes ($P < 0.05$). In lung tissue, LPS increased the percentage of neutrophils and monocytes, resulting in a 50% increase in infiltrated granulocytes ($P < 0.05$). The supplemented diets did not modify the LPS effects. However, both SDPP and IgC diets reduced the percentage of resident neutrophils and monocytes ($P < 0.05$) as well as the degree of activation of lung neutrophils ($P < 0.05$). These results indicate that plasma protein supplementation reduces innate immune cells from NALT without affecting the pulmonary immune response to LPS, although the degree of activation of infiltrated monocytes may be reduced by SDPP.

Key Words: Acute Lung Inflammation, Plasma Protein Supplements

TH9 Endophyte infected fescue seed causes vasoconstriction in horses as measured by Doppler ultrasonography. E. S. Moore*, A. G. Parks, L. M. Lawrence, and K. J. McDowell, *University of Kentucky, Lexington.*

Pregnant mares grazing endophyte infected (E+) tall fescue frequently incur problems in late pregnancy such as extended gestation, thickened placenta, dystocia,agalactia, and potentially death of the foal and/or mare. This experiment was designed to test the hypothesis that consumption of E+ tall fescue seed by horses causes vasoconstriction that can be measured by Doppler and real-time ultrasonography. Eleven horses were randomly assigned to receive either E+ whole fescue seed (E+W; n=3), E+ ground fescue seed (E+G, n=4), or E- ground fescue seed (E-G; n=4). The experiment was divided into two periods (P). P1 was an adjustment period during which a sweet feed ration and alfalfa cubes were fed, and varied from 7-14 days as horses established a consistent feed intake. P2 was a 15-day treatment period during which fescue seed was mixed into the feed rations. Seed was mixed with the daily grain ration in twice/day feedings, in increasing amounts such that each day horses received seed at 0.16% body weight (BW) on days 4-9 (averaging 327 ppb ergovaline and 227 ppb ergovalinine) and 0.22% BW on days 10-15 (averaging 416 ppb ergovaline and 288 ppb ergovalinine). The medial palmar artery of the left foreleg of each horse was scanned using real-time B-mode, color Doppler and Doppler spectral traces on 3 or 4 days during P1, and on 4 days during P2 (days 3, 8, 10 and 15 relative to seed being offered). Five replicate scans were taken on each horse on each day and 14 measurements were taken during each scan. The sonograms were performed by the same 2 people throughout and sonographers were blinded to treatment. When P2 was compared to P1, animals fed E+G fescue seed had reduced ($p < 0.05$) cross sectional vessel diameter (long axis, short axis and mean diameter), circumference and area, whether examined within individual animals or across animals by treatment group. Consumption of E+G fescue seed caused vasoconstriction which could be measured by Doppler ultrasonography.

Key Words: Horse, Fescue, Doppler Ultrasonography

TH10 Survey of *Clostridium perfringens* Type A prevalence and genotypes in calves and *in vitro* development of Omni-Bos CB™, a calf specific, *Bacillus*-based direct fed microbial. C. Wehnes*, V. Patskevich, K. Mertz, and T. G. Rehberger, *Agtech Products, Inc., Waukesha, WI.*

Clostridium perfringens Type A has been associated with diarrhea (scours) in calves; however, there is a lack of data characterizing *C. perfringens* genotypes in calves. Therapies and prophylaxes are available for *C. perfringens* A; however, these products typically were either not designed specifically for reducing *C. perfringens* or were designed against only a few toxinotypes of *C. perfringens*. Therefore, a survey of *C. perfringens* in calves was performed with the objectives of assessing *C. perfringens* prevalence and genotypes. Genotyping results were utilized to develop a *Bacillus*-based direct fed microbial (DFM) which inhibited a broad range of *C. perfringens* genotypes. From March 2005 to January 2006, 705 fecal swabs and 108 gastrointestinal tract samples were collected from scouring calves in California, Iowa, Ohio, Pennsylvania, Washington, and Wisconsin. Randomly Amplified Polymorphic DNA Polymerase Chain Reaction and BioNumerics software (Applied Maths Inc. Austin, TX) were utilized to create genetic fingerprints and to assess *C. perfringens* genotypic diversity respectively. *C. perfringens* were detected in 239 of 813 samples (29%) and 917 *C. perfringens* colonies were isolated. All isolates were *C. perfringens* A. The results of the *C. perfringens* genotypic survey indicate that there were 149 genotypes at 75% similarity using the Dice similarity coefficient with the unweighted pair group method using arithmetic averages. Representatives of all 149 genotypes were utilized in an inhibition assay to determine percent inhibition of *C. perfringens* by the filtrates of six *Bacillus* strains. A multistrain product (Omni-Bos CB™) was formulated using three *Bacillus* strains. BS1 inhibited 88%, BS3 inhibited 85%, and BS8 inhibited 82% of the *C. perfringens*; together these strains inhibited 89%. Future research should focus on testing the effects of this novel DFM *in vivo* as well as comparing inhibition of *C. perfringens* by the therapies and prophylaxes available for use in calves with this DFM.

Key Words: Probiotic, RAPD PCR, Microbiota

TH11 The effects of feeding tall fescue seed on daily feed intakes of horses. A. G. Parks* and L. M. Lawrence, *University of Kentucky, Lexington.*

Twelve horses (3 mature geldings, 6 mature, non-pregnant mares, and 3 two-year-old fillies) were studied in a randomized complete block design. Each horse's daily feed intake was monitored through an adaptation period and a 14-d treatment period. Horses were maintained throughout the adaptation and treatment periods on a diet of alfalfa cubes (fed ad libitum) and sweet feed (0.4% BW daily, as fed). During the adaptation period, horses were offered increasing amounts of alfalfa cubes daily until the amount of cubes offered exceeded the amount of cubes consumed. The length of the adaptation period varied (7-14 d) depending on the length of time required to establish a consistent cube intake for all horses in the group. After the adaptation period, horses were randomly assigned to one of three treatments: endophyte-free ground tall fescue (TF) seed (E-G), endophyte-infected ground TF seed (E+G), or endophyte-infected whole TF seed (E+W). Seed was topdressed on the sweet feed in increasing amounts during d 0-4. Horses were then offered seed at 0.16% body weight on d 4-9 and at 0.22% BW on d 10-14. For d 4-9, E+ diets averaged 327 ppb ergovaline and 227 ppb ergovalinine. Ergovaline and ergovalinine concentrations in the E+ diets on d 10-14

averaged 416 ppb and 288 ppb, respectively. Two horses in the E+G group refused portions of the sweet feed and seed mixture on several days, suggesting a palatability issue with this treatment. However, inclusion of E- or E+ seed in the diet did not affect mean daily alfalfa cube intakes for the final three days of the study compared to the final three days of the adaptation period for E-G horses (10.3 ± 1.1 kg vs. 10.8 ± 0.8 kg, $P = 0.371$), E+W horses (10.9 ± 0.4 kg vs. 11.0 ± 0.2 kg, $P = 0.681$), or E+G horses (10.3 ± 0.6 kg vs. 10.2 ± 0.5 kg, $P = 0.882$). While tall fescue seed consumption did not appear to affect daily feed intake, all observations were made in the fall when environmental temperatures were mild. Further studies should be conducted in hot weather.

Key Words: Fescue Toxicosis, Horses, Intake

TH12 Hemodynamics in the caudal artery of beef heifers fed different ergot alkaloid concentrations. G. E. Aiken^{*1}, J. R. Strickland¹, M. L. Looper², and F. N. Schrick³, ¹USDA-ARS-Forage-Animal Production Research Unit, Lexington, KY, ²USDA-ARS-Dale Bumpers Small Farms Research Center, Booneville, AR, ³University of Tennessee, Knoxville.

Doppler ultrasonography was used to compare hemodynamics in the caudal artery of heifers fed diets with either endophyte (*Neotyphodium coenophialum*) infected (E+; $1.14 \mu\text{g}$ ergovaline/g DM), endophyte free (E-; $0 \mu\text{g}$ ergovaline/g DM), or a mixture of E+ and E- (E+E-; $0.38 \mu\text{g}$ ergovaline/g DM) tall fescue seed in a base ration of chopped alfalfa hay plus concentrate. Eighteen endophyte-naïve, Angus x Brangus heifers were stratified by BW into individual pens and fed the E- diet for a 7-d adjustment period. A 9-d experimental period followed with the 3 diets. Doppler ultrasound measurements (caudal artery area, heart rate, and flow rate) and blood samples for determination of serum prolactin were collected during the adjustment period (d 4, 5, and 7) to determine baseline measures, and during the experimental period at 3, 27, 51, 75, 100, 171, and 195 h from initial feeding of the diets. Statistical analyses compared proportionate differences between baseline and responses during the experimental period. Prolactin concentrations for the E- diet during the experimental period were similar to baseline concentrations, and Doppler measures were sporadic. Prolactin concentrations for the E+ and E+E- diets were less ($P < 0.05$) by 27 h and 51 h, respectively, and remained decreased until 195 h after initial feeding. Caudal artery area for the E+ diet was less ($P < 0.01$) between 27 and 171, and caudal artery area for the E+E- diet was less ($P < 0.01$) between 51 and 99 h. Reductions in heart rate with the E+ diet were only detected ($P < 0.05$) at 27, 99, and 171 h; no changes in heart rate were observed the E+E- diet. Blood flow rates for E+ and E+E- diets declined after 51 h, but increased to the baseline by 99 h for the E+E- diet and by 171 h for the E+ diet. Results indicated that reductions in blood flow rate through the caudal artery occur by 51 h after consumption of either low or high ergot alkaloid concentrations, even though vasoconstriction and heart rate responses were more sensitive to the higher alkaloid concentration. Doppler ultrasonography is a method to potentially establish threshold toxicity levels for the ergot alkaloids.

Key Words: Bovine, Fescue Toxicosis, Ergot Alkaloids

TH13 Analysis of locomotion scores with altered periparturient management. S. Eicher^{*1}, M. M. Schutz², J. Townsend², K. Daniels², S. Donkin², and A. Parkhurst³, ¹USDA-ARS, West Lafayette, IN, ²Purdue University, West Lafayette, IN, ³University of Nebraska, Lincoln.

The objective of this study was to evaluate locomotion scoring as a predictor of lameness in heifers and multiparous cows subjected to periparturient management change. Heifers were either milked 3 wk prior to expected calving or not milked until after calving. The multiparous cows were fed hyper alimentation, hypo alimentation, or control diets beginning on d -15 prior to expected calving until calving. Locomotion scores and lameness incidence were collapsed into pre- and post-calving scores for comparison because of infrequent incidence of lameness. The greatest factor tending ($P = 0.10$) to predict lameness was parity. Although speed was greater ($P < 0.05$) for control heifers, it did not predict lameness. However, persistence of lameness was correlated ($P < 0.05$) with speed following calving. Overfed cows had greater ($P = 0.001$) back arch scores than other treatments, suggesting that they may be experiencing pain associated with walking; but it was not a significant factor in predicting lameness. Odds Ratio analysis supported the ANOVA analysis. Discriminant analysis of 13 treatment-lameness categories indicated that hyper alimentation cows had greater incidence of lameness than the others. Control heifers were again found to have fewer incidence of lameness than control cows. The first canonical function, essentially a weighted average of all 5 treatments, correlated most strongly with back arch ($r = 0.914$, $P = 0.0285$) and speed ($r = 0.735$, $P = 0.001$). The second canonical discriminant function was primarily the difference between speed ($r = 0.507$, $P = 0.001$) and back arch ($r = 0.370$, $P = 0.007$). The third canonical discriminant function represented extremes of the significant correlations; head bob ($r = 0.835$, $P = 0.001$) and foot rotation ($r = 0.287$, $P = 0.039$). Prepartum milking did not affect lameness in heifers and feeding routine of cows only mildly affected incidence of lameness. Results accentuate the complexity of lameness and reinforce that it develops with time.

Key Words: Dairy Cattle, Lameness, Locomotion Score

TH14 Experimental haemonchosis in resistant and susceptible Creole kids. J. C. Bambou^{*}, E. González-García, C. de la Chevrotière, R. Arquet, N. Vachiéry, and N. Mandonet, INRA UR143 Unité de Recherches Zootechniques (URZ), Centre Antilles Guyane, Domain Duclos, 97170 Petit Bourg, Guadeloupe (French West Indies).

This study was developed to characterize the peripheral immune response during haemonchosis in goats by comparing genetically resistant and susceptible animals. We analysed the changes of circulating lymphocytes populations after experimental infection with *Haemonchus contortus* in sixteen nematode resistant ($n = 8$) and susceptible ($n = 8$) Creole kids (BW = 18.23 ± 4.56 kg) which were kept under confinement receiving an *ad libitum* diet based on a mix of tropical hay. Kinetics of faecal eggs count (FEC), packed cell volume (PCV), eosinophilia, as well as body weight (BW) changes, were weekly monitored. Flow cytometry was used to follow changes in peripheral blood mononuclear cell (PBMC) populations at early stage, 0, 3 and 35 days post-infection (d.p.i.). Data of FEC, PCV, eosinophilia and BW were analyzed by non-orthogonal contrast of SAS, while relative proportion of T lymphocyte (LT) sub-populations was compared across time by using GLIMMIX

(SAS, 2000). Main significant differences in eosinophils counts were detectable from the beginning until 7 d.p.i., afterwards, no differences were found. At the beginning, PCV values were lower in susceptible animals compared to resistant but at physiological level (31.5 and 28.9 respectively, $P=0.051$). These differences became higher from 21 d.p.i. onwards. Interestingly, from 21 to 35 d.p.i. FEC in resistant animals were significantly lower than in susceptible. Thus, at the end of the infection susceptible animals showed a FEC 11 folds higher than resistant ($P=0.031$). However, no evolution across time and no difference between resistant and susceptible kids were evidenced in circulating LTCD8+ and LTCD4+ sub-populations. Surprisingly, a significant decrease in CD4+ sub-populations was evidenced throughout the experiment in both groups, probably due to a mucosal localization of activated cells. The analysis of the local immune response in the abomasal mucosa could help to verify this hypothesis.

Key Words: Gastrointestinal Parasitism, *Haemonchus contortus*, Creole Goats

TH15 JDIP – Phase II. K. E. Olson*, *KEO Consulting, Schaumburg, IL.*

The Johne's Disease Integrated Program (JDIP) is a comprehensive consortium of academic, agency and industry researchers focused on

developing real-world solutions that will help producers deal more effectively with Johne's disease and mitigate potential losses. Currently in the third year of the original project, it is the first Coordinated Agricultural Project (CAP) proposal to receive approval for a second round of funding by the USDA-CSREES-NRI. Phase 2 funding will allow findings from the initial round of funding to be used to expand understanding of the transmission of the disease as well as potential new diagnostics, therapeutics and management tools that will allow producers to deal more effectively with the disease. Proposals approved for year four funding in the JDIP Core areas 1) Epidemiology and Biostatistics; 2) Diagnostics and Strain Differentiation; 3) Genomics, Antibodies and Proteomics and 4) Animal Models and Facilities as well as the Project areas of: 1) Epidemiology and Transmission; 2) Diagnostics and Strain Differentiation; 3) Map Biology and Pathogenesis; 4) Map Immunology and Vaccine Development and 5) Extension and Communication will be highlighted. Additional funding, made available by USDA APHIS VS, will fund projects over the next three years that are focused on identifying and validating potential Johne's vaccine candidates with the greatest likelihood of success in the field. An overview of work in this area will be included.

Key Words: Johne's, MAP, JDIP

Contemporary and Emerging Issues

TH16 Best practices for the conduct of animal studies to evaluate crops genetically modified for input and output traits. G. L. Cromwell*, G. F. Hartnell, A. J. Lewis, G. R. Dana, D. H. Baker, M. R. Bedford, K. C. Klasing, F. N. Owens, J. Wiseman, L. K. Kurtyka, and M. J. Levine, *International Life Sciences Institute and Federation of Animal Science Societies, Washington, DC and Savoy, IL.*

The International Life Sciences Institute (ILSI) in collaboration with the Federation of Animal Science Societies (FASS) appointed two task forces consisting of scientists with expertise in animal nutrition, animal health, feed chemistry, food science, statistics, and other relevant disciplines to develop two documents that would assist researchers in the evaluation of crops genetically modified (GM) for input and output traits. The rationale was to provide a platform for the scientific evaluation of crops containing input traits (e.g., herbicide tolerance, insect protection; composition of crops unchanged) and output traits (composition of crops intentionally changed) when fed to food-producing animals and to promote international harmonization of experimental methods. Both documents provide best practices on how to produce, handle, store, and process GM crops containing the genetically enhanced trait(s), sample and analyze the harvested and processed crop, and analyze and interpret the results. In addition, the input document describes experiments for assessing cereal grains, oilseeds, and forages for lactating and growing ruminants, swine, and poultry. The output document also provides information on the types of studies to consider in evaluating specific GM traits, such as modification of protein, amino acids, lipids, carbohydrates, minerals, vitamins, antioxidants, enzymes, and antinutrients in specific crops when fed to target animal species; and how to design and conduct livestock, poultry, and aquaculture studies including proper comparator selection, animal-product processing effects, and sensory evaluation of the end-product. The input and output documents were subjected to peer review by 38 domestic and international experts and were published by ILSI in 2003 and 2007, respectively.

Key Words: Genetically Modified Traits

TH17 Animal biotechnology: The movie. A. L. Van Eenennaam* and W. E. Pohlmeier, *University of California, Davis.*

The public experience with animal biotechnology often starts and ends with Dolly the sheep, the first mammal ever cloned from an adult cell. The hype that surrounded Dolly rapidly became entangled with the debate over human cloning, and the ensuing discussion failed to elaborate on, or even differentiate between, the broad range of technologies encompassed by the ill-defined term “animal biotechnology”. In the absence of information, animal biotechnologies tend to evoke a negative reaction. To address this knowledge deficit and the fact that few general audience educational resources about this topic have been developed by publicly-funded animal scientists, a 30-minute educational movie entitled **Animal Biotechnology** was produced. The movie begins with a brief historical description of the development of various animal biotechnologies and places the most controversial of these technologies, cloning and genetic engineering, within that framework. Both biomedical and agricultural applications of animal biotechnology are discussed, in addition to some of the science-based and ethical concerns that are engendered by certain applications. Excerpts from interviews with leading academic and industry scientists conducted at the UC Davis Transgenic Animal Conference in 2007 scientists in the field are interspersed throughout the movie. The script and visuals underwent anonymous scientific peer-review prior to release. The target audience for the movie includes college and high school students and interested members of the general public. To make the movie widely available to the general public, it will be posted on YouTube, the UC Davis Animal Biotechnology website, and DVD copies will be made available to educators and other interested parties at scientific and educational meetings. Funding for this project was provided by USDA NRI Grant 2005-01655.

Key Words: Biotechnology, Cloning, Education

Dairy Foods: Dairy Products and Processing I

TH18 Stability of a long life drinking yoghurt. M. M. Macchione and W. H. Viotto*, *State University of Campinas, Campinas, SP, Brazil.*

Heat treatment of yoghurt after fermentation may extend its shelf-life, but proteins may become instable because of the heating in low pH. This work studied the effect of 2 different post-fermentation heat treatments (72°C/15s and 110°C/15s) and 2 storage temperatures (5–7°C and 25–30°C) on the physicochemical and microbiological properties of drinking yoghurt stabilized by pectin. Skim milk with 12% sugar was heated at 80°C/30min and 2% EPS producing starter culture (mix of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*: Yo-Mix™ 601 Lyo from Danisco™ Brazil) was added at 45°C, until reaching pH 4.0. Pectin (0.45% of Grindsted™ Pectin AMD 382, from Danisco™ Brazil) was added with 2% sugar and the yoghurt was treated in a tubular heat-exchanger followed by aseptic homogenization. The product stability was evaluated during 95 days, by following analyses: pH and titratable acidity; sedimentation and syneresis (by centrifugation); apparent viscosity (Brookfield rheometer), standard plate count (PCA), lactic acid bacteria (MRS) and yeasts and moulds (PDA plus antibiotics). Heat treatment intensities and storage conditions did not affect the products stability, and no physical changes occurred during all the storage time. The only parameter affected was the viscosity, which was lower for the most intensive treatment (25cp x 35cp) and increased under refrigerated conditions (3–5cp) for both treatments. There were no changes in acidity (1.1% lactic acid), pH (3.9), sedimentation (2–3%) and syneresis (none) due to the type of heat treatments and storage temperature and time. All the heat treatments resulted in stable products, with no microbiological growth during the 95 days of storage. Maximum standard plate count was 25 CFU/ml and no detectable amounts of yeasts and moulds were found.

Key Words: Drinking Yoghurt, Long Life, Stability

TH19 Thirty-four percent whey (WPC) and serum protein (SPC) concentrate and 65% serum protein (SP) reduced micellar casein: production and composition. J. Zulewska*¹, D. M. Barbano², M. W. Newbold², M. A. Drake³, E. A. Foegeding³, and C. Moraru², ¹*University of Warmia and Mazury, Olsztyn, Poland*, ²*Cornell University, Ithaca, NY*, ³*North Carolina State University, Raleigh.*

Raw whole milk (ca. 1200 kg) was split into two portions. One portion was pasteurized and made into Cheddar cheese and whey and the other was cold separated into skim milk (SM) and cream. The SM was pasteurized and microfiltered (MF) at 50°C with a 0.1 micron ceramic uniform transmembrane pressure system to produce a 65% SP reduced micellar casein concentrate (MCC) and MF permeate. The separated whey and MF permeate were ultrafiltered (UF) to produce liquid 34% WPC and SPC. This was replicated 3 times. No difference in UF flux when processing whey or MF permeate from skim milk using a spiral wound 10 kDa polyethersulfone membrane was detected after 60 min of processing, 15.7 vs. 14.6 kg/m²/h. The liquid WPC was opaque while the SPC was clear and the pH of the liquid WPC was lower than the WPC, 6.44 vs. 6.74. Half of the MCC, WPC, and SPC was spray dried, moisture 3.8, 3.0, and 4.1%, respectively and the other half was freeze dried, moisture 3.3, 2.5 and 3.1%, respectively. The protein content of

WPC and SPC powders (total nitrogen × 6.38) were 34.5 and 35.3% on a dry basis, respectively. Spray dried WPC contained more fat on a dry basis than SPC, 1.94 vs. 0.25%, and this may cause flavor or flavor stability differences. The WPC contained more glycomacropeptide than SPC (4.1 vs. 0% of protein) and this may cause differences in functionality. The WPC and SPC contained phosphorus, calcium, magnesium, potassium, sulfur, and sodium at the following percentages on a dry basis: 0.63 and 0.56, 0.57 and 0.44, 0.12 and 0.11, 1.91 and 1.88, 0.52 and 0.57, and 0.45 and 0.43, respectively. WPC contained significantly higher content of calcium and phosphorus than SPC, which may influence functionality. No differences in L, a, b color values were detected for the spray dried WPC and SPC at 90.25 and 90.05, -0.42 and -0.50, and 6.40 and 5.90, respectively. The spray dried 65% SP reduced MCC contained 2.3% fat and 57.9% protein on a dry basis.

Key Words: Whey and Serum Protein Concentrate, Production, Composition

TH20 Comparison of sensory and functional properties of 34% serum (SPC) and 34% whey protein concentrates (WPC). J. P. Evans*¹, P. J. Luck¹, E. A. Foegeding¹, J. Zulewska³, D. M. Barbano², and M. A. Drake¹, ¹*North Carolina State University, Raleigh*, ²*Cornell University, Ithaca, NY*, ³*University of Warmia and Mazury, Olsztyn, Poland.*

Serum proteins (SP) are primarily α -lactalbumin and β -lactoglobulin removed directly from skim milk while these same proteins for WPC manufacture are typically harvested from whey after cheese making. Since SP are not exposed to the cheese make-process, enzymatic and/or chemical reactions that can lead to off-flavors, or a reduction in functionality, are reduced. Research today has not compared flavor and functionality of SPC and traditional WPC. SPC and WPC (34%) were manufactured in triplicate from the same lot of milk. At each replication, liquid SPC and WPC were collected and spray-dried (SD) and freeze-dried (FD). Solubility, heat stability, gelation and foaming properties were measured. A trained sensory panel documented the sensory profiles of liquid retentate and rehydrated spray or freeze-dried powders. Volatile components were extracted by solid phase micro-extraction (SPME) followed by gas chromatography-mass spectrometry. Both SPC and WPC were characterized by low intensities of sweet aromatic and cardboard flavors, but these intensities were lower in SPC compared to WPC. Diacetyl flavor was absent in SPC. SD increased flavor intensities compared to FD, but the types of flavors documented were not different. Volatile compound results were consistent with sensory results. All SPC treatments were more soluble and had generally lower turbidity than their corresponding WPC treatment. In addition, all SPC treatments exhibited greater foaming properties than corresponding WPC treatments. No stable foams were generated from liquid or freeze-dried WPC treatments, and spray-dried WPC produced foams low in yield stress, overrun and stability. SPC treatments were also more heat stable and produced stronger gels than similar WPC treatments. These results indicate that 34% SPC has distinct differences in functional and flavor characteristics from WPC.

Key Words: Whey Protein, Serum Protein, Flavor

TH21 The effect of crosslinked β -cyclodextrin treatment on the rheological and sensory properties of ice cream. H. J. Ha* and H. S. Kwak, *Sejong University, Seoul, Korea.*

This study was designed to examine the effect of crosslinked β -cyclodextrin (β -CD) treatment on cholesterol removal, and the rheological and sensory properties of ice cream when stored at 4, -12, -18 and -28°C. Cholesterol-reduced milk and cream were made by crosslinked β -CD. Ice cream mixes were formulated with 15% milk fat, 8% nonfat milk solids, 1.3% sugar and 0.3% stabilizer. Then it was pasteurized at 65°C for 30 min, homogenized in a single-stage homogenizer at 10.4 MPa and cooled to 4°C before tests were performed. The cholesterol removal reached 90.3% when crosslinked β -CD was treated. Ice crystal size was greater in the control at 4 and -28°C storage temperature, however, it was smaller at -12 and -18°C storage temperature. The viscosity of the cholesterol-reduced ice cream was significantly lower at all temperatures than that in the control. In addition, the viscosities in both groups were significantly higher at -18°C storage temperature compared with other temperatures. The meltdown stability appeared to be lowered with the crosslinked β -CD treatment in all storage temperatures. Most of color values were different between the control and the cholesterol-reduced ice cream. The L-value was increased in the melted state than in the frozen state in all temperatures, whereas a-value was decreased. Appearance of the cholesterol-reduced ice cream was similar to the control, however, it was decreased at -28°C storage temperature. In addition, the overall acceptability was lower in both groups at -28°C storage temperature. The present study indicated that the crosslinked β -CD treatment showed the lower viscosity and meltdown stability, however, sensory characteristics were not significantly lowered compared with the control.

Key Words: Ice Cream, Viscosity, Meltdown Stability

TH22 Rapid determination of emulsifier and stabilizer concentration in ice cream. S. L. Cropper*, N. A. Kocaoglu-Vurma, L. E. Rodriguez-Saona, and W. J. Harper, *The Ohio State University, Columbus.*

Ice cream is a complex foam structure consisting of fat, sweeteners, flavorings and air incorporated during the freezing process. Emulsifiers and stabilizers are used to help stabilize the air within the fat matrix producing a better quality product. Fourier Transform Infrared Spectroscopy (FTIR) has shown to be a rapid and effective method for analyzing and determining ingredient concentrations in ice cream.

The objective for this research was to generate a multivariate calibration model using infrared spectroscopy to quantify stabilizer and emulsifier concentrations in ice cream.

Ice creams were made with 10% fat, 11% milk solids non-fat, 18% sugar and varying concentrations of mono and diglycerides (MDG) and carboxy methyl cellulose (CMC) ranging from 0.0-0.15 % for MDG and 0.0 to 0.20 % for CMC. All ingredients were blended and the mix was homogenized, pasteurized, and aged at 4°C for two days. Following aging, the mixes were frozen using a scraped surface heat exchanger at -4°C and then stored at -40°C. Each ice cream was thawed and 0.5 μ L was placed directly onto the ZnSe-ATR crystal, vacuum dried to produce a thin film, and the spectra, which was collected in the mid-IR region (4000-700 cm⁻¹), was analyzed using partial least squares regression (PLSR) analysis.

Multivariate models (PLSR) for emulsifier (MDG) and stabilizer (CMC) were developed from infrared spectra (770-1800 and 2800-3005 cm⁻¹),

resulting in a correlation coefficient of validation (r_{Val}) \geq 0.92 and a standard error of validation (SEV) of 0.01% for estimation of emulsifier and stabilizer levels.

Infrared spectroscopy can estimate MDG and CMC in the ice cream individually and in combination within the complete ice cream matrix. This method provides an efficient way to analyze emulsifier and stabilizer concentrations in ice cream and offers a faster means of quantification of ingredients. Infrared spectroscopy can be used to better understand the combined roles of emulsifiers and stabilizers in the ice cream system. Overall, this technique allows for easier monitoring of ice cream quality during processing and will enable the manufacturer to minimize production cost while ensuring the highest quality.

Key Words: FTIR, Ice Cream

TH23 Addition of rice extract improves the quality characteristics and consumer acceptability of banana flavored yogurt. T. Bor*, D. Song, C. W. Seo, and S. A. Ibrahim, *North Carolina A&T State University, Greensboro.*

Manufacturing dairy products with consistent and desirable textures continue to be a concern to the industry. Different approaches have been studied recently to improve texture ranging from using different process techniques to different ingredients. Rice possesses some unique properties that may be of interest to the dairy industry. Rice is rich in oligosaccharides, hydrocolloids compounds that could be used to improve the texture of dairy products. The objective of this study was to evaluate the effects of rice extract on the quality characteristics and consumer acceptability of banana flavored yogurt. Rice flour (10% wt/vol) was cooked with tap water for 45 min and stored at 4 C for 2 days to allow for gel formation. Plain yogurt was purchased from a local store and mixed with rice extract at 5% (wt/wt, rice extract/ yogurt). Sliced fresh banana (2% wt/wt) was then mixed with the yogurt mix. The finished product was stored in the refrigerator for 12 h before conducting the sensory evaluation. A consumer panel recruited from the university campus (n= 90) rated the acceptability and sensory characteristics of the products. In addition, pH values, apparent viscosity, color and water holding capacity of the yogurt samples were recorded. Results showed that panelists gave high acceptability scores for yogurt with rice flour samples in term of texture, appearance and overall acceptability. The addition of rice flour did not change the pH value of the yogurt. The viscosity, color and water holding capacity measurements were slightly changed with the addition of rice flour. These findings suggest that rice extract can be added to improve the quality characteristics and consumer acceptability of banana flavored yogurt. Moreover, since rice and banana flavored products are popular among ethnic groups including Asians and Hispanics, the use of this food combination of has promising market potential.

Key Words: Yogurt, Rice

TH24 Functional properties of 65% serum protein reduced micellar casein concentrates obtained by microfiltration. C. M. Belicium¹, J. Zulewska², M. Newbold¹, C. I. Moraru*¹, and D. M. Barbano¹, ¹*Cornel University, Ithaca, NY*, ²*University of Warmia and Mazury, Olsztyn, Poland.*

The objective of this work was to characterize the functional properties of micellar casein concentrates (MCC) obtained by microfiltration

(MF). 65% serum protein (SP) reduced MCC was obtained by MF of skim milk in a uniform transmembrane pressure system equipped with a 0.1 micron ceramic membrane. The MF retentate (MCC) was both spray dried (3.8% m.c.) and freeze dried (3.3% m.c.). The spray dried 65% SP reduced MCC contained 57.9% protein (d.b.) and 2.3% fat. Solubility, emulsification and foaming properties of the MCC powders were determined. The rheological properties of the MCC liquid retentate and of reconstituted MCC powders were also measured. The powder solubility was the property mostly affected by the drying method. The sediment for freeze dried MCC ranged between 0.25±0.00 mL and 1.58±0.14 mL among 3 replicates, and for spray dried MCC between 5.83±0.58 mL and 8.67±0.29 mL. The foam expansion was higher for spray dried (212.9%) as compared to freeze dried MCC (151.1%); foam stability was poor for all samples. No significant differences in emulsification properties between spray and freeze dried MCC were observed, with emulsification stability values of 69.73±2.17% and 65.98±1.09%, respectively. Low amplitude rheological measurements of reconstituted MCC of 7.5% to 15% concentration showed slightly higher values of the storage modulus (G') for spray dried as compared to freeze dried MCC. The fresh retentates had lower G' and G'' than the reconstituted samples, at the same concentration, due to denaturation of residual SP in the dried samples. No significant differences in apparent viscosity, yield stress and flow index were observed between different batches or drying methods. Viscosity and yield stress increased with concentration. At the same concentration, fresh retentates were more viscous than reconstituted samples, due to the denaturation of SP in the MCC powders. Flow indices decreased with increasing concentration, indicating a tendency towards shear thinning behavior of the concentrated MCC. Fresh retentates had a flow behavior closer to Newtonian than reconstituted MCC, due to the native state of proteins.

Key Words: Micellar Casein, Functionality

TH25 Surface hydrophobicity of co-extruded and milled corn starch with whey protein concentrate as a function of pH. S. L. Amaya-Llano*^{1,2}, E. Castano-Tostado², F. Martinez-Bustos¹, and L. Ozimek³, ¹*Ciencia de Materiales, CINVESTAV Queretaro, Queretaro, Mexico*, ²*PROPAC, Universidad Autonoma de Queretaro, Queretaro, Queretaro, Mexico*, ³*University of Alberta, Edmonton, AB, Canada*.

The aim of this work was to study the effect of co-extrusion over blends of corn starch and WPC measuring surface hydrophobicity. Surface hydrophobicity (SH) was used to define the potential interaction between starch and protein at varied technological parameters of extrusion such as temperature, moisture and hydrogen ion concentration. The extrusion factors were: barrel temperature (70-180°C), feed moisture (18-30%), pH (3-8), different proportions of corn starch (75-95%), and whey protein concentrate (WPC, 80% protein concentration) (25-5%). The extrusion process was carried out using a single screw extruder, designed and manufactured by Cinvestav-IPN, Mexico. The screw compression ratio was 1:1 with a 5.0-mm die-nozzle. The co-extruded product was milled to particle size below 250 µm. This milled product can be used as a new food ingredient as source of protein, as stabilizer or emulsifier. In order to define suitable food applications of the new ingredient, functional properties must be determined. Surface hydrophobicity is a good indicator of the ingredient hydrophobic sides available for interaction in food systems. Also, the SH was used in this study to probe interaction between corn starch and WPC during extrusion process. Results showed

that SH is affected by processing parameters of extrusion and it can be used to monitor the interaction between proteins and carbohydrates.

Key Words: Surface Hydrophobicity, Extrusion, Whey Protein Concentrate

TH26 Effect of ultrasound treatment on microbial load in milk. S. Gokavi, T. Silk, and M. Guo*, *University of Vermont, Burlington*.

Non-thermal technologies such as ultrasound are emerging as promising alternatives to heat treatment for food processing. Ultrasound is defined as sound waves with a frequency greater than 20 kHz that are able to travel through gas, liquid and solid materials with proven bactericidal effects, especially when combined with mild heat treatments. The objective of the present study was to determine the effect of ultrasound treatment on standard plate count levels (SPC) present in raw milk and non-pathogenic *Escherichia coli* and *Listeria innocua* inoculated in ultra-high temperature (UHT) milk. An ultrasonic processor (VCF 1500HV, Sonics & Materials, Inc., CT) consisting of a continuous flow cell and a 10" titanium alloy probe (Frequency 20 kHz, 100% power level, 650 W acoustic power, 132 W/cm² acoustic intensity) with a 370 ml sample processing chamber was used. Samples were subjected to two treatments: batch and continuous flow (420 ml/min) at two temperatures 25±2° and 55±2°C with treatment times of 6, 12, 18 and 24 min. Both batch and continuous treatment at 25±2°C for 24 min yielded a 3-log reduction of SPC, a 3-log reduction of *E. coli* and 1 to 2-log reduction of *L. innocua*. Ultrasound treatment with mild heat (55±2°C) was effective at reducing SPC in raw milk. Reductions were also noted in *E. coli* and *L. innocua* levels inoculated in UHT milk. Batch ultrasound treatment combined with mild heat for 24 min yielded a 5-log reduction of SPC, a 4-log reduction of *E. coli* and 3-log reduction of *L. innocua*. Continuous flow ultrasound treatment combined with mild heat for 24 min resulted in a 6-log reduction of SPC, a 6-log reduction in *E. coli* and *L. innocua*. Inactivation regressions were second-order polynomials, showing an initial period of rapid inactivation, eventually tailing off. Results indicate that ultrasound technology is a promising processing alternative for the reduction of microbial load in milk and other liquid foods.

Key Words: Milk, Ultrasound Treatment, Microbial Load

TH27 Effects of high pressure homogenization on milk. C. A. Boeneke*, A. Pastorek, and K. J. Aryana, *Louisiana State University Agricultural Center, Baton Rouge*.

Homogenization is a process of forcing milk through tiny orifices. The resulting pressure causes the fat globules to become smaller limiting their separation in the emulsion. Although effective, some separation of the fat can still occur over time. As demand for dairy products with longer shelf lives i.e., products processed using Ultra High Temperature and Ultra Temperature pasteurization grows, separation of the fat is a concern. In this experiment, milk was standardized to 2% and 3.25% fat before homogenization at 50, 125, and 200 MPa using an APV 2000 two stage homogenizer (APV Systems Albertslund, Denmark) to determine effects of increased homogenization pressure on the finished product. Milk was collected and stored at 7 °C for 3 weeks. Milks were analyzed for fat content, rate of creaming, viscosity and color. Milk was evaluated for flavor, body/texture, and appearance/color at the end of 1, 2, and 3

weeks of storage by a 5 member trained panel. Trained panelists were unable to detect differences in flavor, appearance/color, or mouth-feel over a three week period. Homogenization was affected by pressure, inlet temperature, and fat content of the milk. No creaming was observed over a two week storage period. Changing milk inlet temperature and homogenization pressures influenced results.

Key Words: Milk, High Pressure Homogenization

TH28 Classification of cream butter by infrared spectroscopy and multivariate analysis. S. Herringshaw*, N. Kocaoglu-Vurma, and L. Rodriguez-Saona, *The Ohio State University, Columbus.*

Food authenticity has become a focal point attracting the attention of producers, consumers, and policy makers. Major authenticity issues concern the true labeling of food whereby substitution of high value raw materials with cheaper materials is common practice. Factors such as milk sources and production methods result in a wide range of butter types, some of which command a premium price. There is a need for rapid and reliable analytical tools for determination of authenticity since traditional methods often involve time-consuming and laborious processes. Our objective was to evaluate the application of infrared spectroscopy combined with pattern recognition techniques to discriminate among butter samples in relation to quality and authenticity. Butter produced by different manufacturers from different production lots were purchased from a local market (Columbus, OH). Samples were filtered at 65°C and the collected fat samples were directly applied onto a temperature-controlled single bounce ZnSe crystal for attenuated total reflectance measurements. The ZnSe crystal was heated at 65°C and spectra analyzed using soft independent modeling of class analogy (SIMCA), a multivariate classification technique. This simple protocol generated unique mid-infrared signature profiles that permitted the chemically-based classification of butter samples based on manufacturer. By using the spectral region from 1200-900 cm⁻¹, multivariate (SIMCA) modeling showed well-separated clusters that discriminated among butter samples, due to -HC=CH- trans bending out of plane vibration modes (968 cm⁻¹) presumably attributed to conjugated fatty acids. Infrared spectroscopy combined with multivariate analysis provides a simple and efficient tool for classification of butter with minimal sample preparation. This rapid protocol can provide both the industry and regulatory agencies with markers by which butter can be classified and whereby uniform quality can be established thus providing a tool for determining butter authenticity.

Key Words: Butter, Authenticity, Infrared Spectroscopy

TH29 Effect of various antioxidants on the characteristics of plain yogurt. B. Brignac¹ and K. Aryana*², ¹*Louisiana State University, Baton Rouge*, ²*Louisiana State University Agricultural Center, Baton Rouge.*

Free radicals have a significant influence on ageing and age-related conditions. Optimal intake of antioxidant nutrients may contribute to enhanced quality of life and may delay / slow the onset of ageing. The objective was to study the effect of vitamin C, vitamin E, beta carotene and a combination of these three antioxidants on the characteristics of plain yogurt. The antioxidants Vitamin C, vitamin E and beta carotene

and a combination of Vitamin C + vitamin E + beta carotene were incorporated at 100% of their respective recommended dietary allowance of 60 mg, 10 mg and 3 mg and 60 + 10 + 3 mgs respectively in an 8 oz cup of yogurt. Product manufacture was replicated three times. Flavor scores for yogurts with vit E and yogurts with beta carotene were high and not significantly ($p < 0.05$) different from each other. Flavor scores for yogurts with vit E were significantly ($p < 0.05$) higher than the control. Yogurts with vit C + vit E + beta carotene had flavor scores that were not different from control but were significantly ($p < 0.05$) lower than yogurts with vit E and beta carotene. Control yogurts and yogurts with vit C and yogurts with vit E had significantly ($p < 0.05$) high appearance scores which were not significantly ($p < 0.05$) different from each other but were significantly ($p < 0.05$) higher than yogurts with vit C + vit E + beta carotene. Yogurts with vit C + vit E + beta carotene had the lowest appearance scores. Yogurt with vit E had higher body and texture scores compared to the control while yogurts with vit C has lower scores compared to the control. The remaining yogurts had body and texture scores not significantly ($p < 0.05$) different compared to the control. Yogurts with vit C + vit E + beta carotene had the highest a* values compared to the remaining yogurts which were not significantly ($p < 0.05$) different from each other. Compared to control there were no significant ($p < 0.05$) differences in pH, apparent viscosity, lactobacilli counts, L* and b* values of yogurts with antioxidants. Use of antioxidants influenced some characteristics of plain yogurt.

Key Words: Yogurt, Antioxidant, Quality

TH30 Effect of stabilizer and emulsifier concentrations on particle size and melting rate of ice cream. S. L. Cropper*, N. A. Kocaoglu-Vurma, and W. J. Harper, *The Ohio State University, Columbus.*

Stabilizers and emulsifiers are used in ice cream to improve texture and maintain structure. Emulsifiers help to minimize the coalescence of fat and destabilize the fat globule in the matrix. Stabilizers are commonly utilized for their ability to bind water in ice cream, but also have been found to play a part in enhancing fat aggregation. Determining how particle size and melting rate is influenced by stabilizer and emulsifier concentration is beneficial to see what the maximum quantities of these ingredients are required to provide the best texture.

The objective for this research was to determine the influence of varying emulsifier and stabilizer concentrations on particle size and melt rate of ice cream.

Ice cream mixes were prepared with 10% fat, 11% milk solids non-fat, 18% sugar and varying concentrations of mono and diglycerides (MDG) and carboxy methyl cellulose (CMC) ranging from 0.0-0.15 % for MDG and 0.0 to 0.20 % for CMC. All ingredients were blended and the mix was homogenized, pasteurized, and aged at 4°C for two days. After aging, the mixes were frozen using a scraped surface heat exchanger to -4°C and then stored at -40°C. Each type of ice cream was evaluated for particle size, d [4, 3] (volume-surface weight diameter), using a particle size analyzer and the melting rate by a melt test, which determined sample weight loss at ambient temperatures over time.

Particle size analysis showed, for samples containing MDG only, d [4, 3] values to be significantly higher at concentrations $\geq 0.09\%$. The d [4, 3] values for samples containing 0.05% and 0.10% CMC were significantly higher than the control when CMC concentrations were varied at set MDG concentrations of 0.075% or 0.15%. The melting rates were not significantly different at any of the tested concentrations.

The results show that the effect of stabilizers and emulsifiers on particle

size is concentration dependent. Using the proper amounts of stabilizers and emulsifiers in ice cream is important in order to produce a higher quality product that is more desirable to consumers.

Key Words: Melt Test, Particle Size, Ice Cream

TH31 Fluctuation on composition and insoluble aggregates in a WPC manufacturing line: Implications for quality and function. M. Costa^{2,1}, M. Gigante², P. Tong¹, and R. Jimenez-Flores*¹, ¹California Polytechnic State University, San Luis Obispo, ²UNICAMP, Campinas-Sao Paulo, Brazil.

In response to quality demands of users and producers of whey protein powders, we have investigated the basic influence that composition has upon processing of liquid whey into WPC in a commercial plant. Several researchers indicate either the formation of 'aggregates' or the difference in particle size in the whey concentrates, as the main causative agents of quality and functionality variation. However, very few studies have thoroughly analyzed the fundamental origin or causes for the variability of whey powders in a systematic and holistic way. This work is an initial step to gather base-line information on the range of variability in particle size and composition of the liquid whey protein concentrate (LWPC) and the resulting powder (WPC80) in a commercial plant. Our study was carried out for a period of 8 weeks in a plant that process in excess of 10 million pounds of milk per day. Due to security and sanitation aspects, employees of the plant did the sampling. Upon receipt each sample was divided and 15ml of the LWPC sample were frozen for later composition analyses (protein, fat, lactose, ash, total solids). For each set of sample, we prepared 5% protein solutions with the WPC and LWPC, which were stirred for 1 hour and analyzed in the same (LWPC) or in the following day (WPC). Particle size and Solubility were measured for each sample. All samples were analyzed for total composition. The results indicate that while protein concentrations are maintained within a narrow range, lactose and residual fat have the highest ranges of variation. During our study the liquid concentrate had an average of 20.22 (± 0.97) % protein, while lactose was 1.06 (± 0.58) and residual fat 1.35 (± 0.19); for the WPC protein was 78.78 (± 0.72), lactose 7.94 (± 1.12) and residual fat 5.66 (± 0.53). Particle size analysis resulted in Volume %: liquid concentrate solutions had no particle larger than 20 μ m (the LWPC were stored in a cooler until be analyzed; results could varied when heated), while the WPC solutions in average had around 27% of the particles in the over 20 μ m range, so mean and mode parameters had higher values in the WPC solutions. Our analysis of the proteins by SDS-PAGE indicates that the aggregates have a very complex composition that is not correlated with only insoluble b-LG. Our results seem to point towards differences in minerals and residual fat, as primary causative agents of particle size fluctuations in WPC manufacture. As for processing, Ca, pH and temperature along processing are major aggregate-inducing factors.

Key Words: Whey Protein Concentrate, Protein, Insoluble Aggregates

TH32 Influence of pulsed electric field processing on protease activity of *Lactobacillus acidophilus* LA-K in skim milk. O. Cueva¹ and K. Aryana*², ¹Louisiana State University, Baton Rouge, ²Louisiana State University Agricultural Center, Baton Rouge.

The objective was to study the effect of square waveform bipolar pulse widths on protease activity of *Lactobacillus acidophilus* LA-K. Freshly thawed *Lactobacillus acidophilus* LA-K was suspended at 1% wt/v in 0.1% wt/v peptone and was treated in an OSU-4 pilot plant pulsed electric field (PEF) processor. The processing conditions that remained constant were field strength of 25 Kv/cm, pulse period of 10000 us, delay time of 20 μ s and processing temperature of 21°C. The treatments were square waveform bipolar pulse widths of 0, 3, 6 and 9 μ s. Immediately after passing through the PEF processor the *Lactobacillus acidophilus* LA-K cell suspension was used to inoculate skim milk followed by incubation at 40°C. After 0, 12 and 24 h of incubation, protease activity in control and all treatments was evaluated by the *o*-phthalaldehyde (OPA) assay followed by absorbance measurements using a spectrophotometer set at 340 nm. The pulse width x incubation time interaction effect was significant ($P < 0.0001$). The maximum absorbance values were recorded for samples treated for 6 μ s and incubated for 24 hours (mean \pm SD) (0.45 ± 0.003) followed by 9 μ s for 24 h (0.43 ± 0.004), followed by 3 μ s for 24 h (0.35 ± 0.002) followed by the control (0.35 ± 0.006 absorbance units). A different trend was seen for the samples incubated for 12 h. Samples treated for 9 μ s showed maximum absorbance values (0.32 ± 0.006) followed by 6 μ s (0.25 ± 0.003) followed by 3 μ s (0.240 ± 0.000) followed by the control (0.213 ± 0.000 absorbance units). For a 24 h incubation, samples processed at 6 μ s pulse width gave the maximum protease activity, while for a 12 h incubation, samples processed at 9 μ s pulse width showed maximum protease activity.

Key Words: Pulse Width, Non Thermal, Processing

TH33 Production of native whey from whole milk. I. Jarto*¹, J. A. Lucey¹, D. Zhu¹, and K. E. Smith², ¹University of Wisconsin, Madison, ²Wisconsin Center for Dairy Research, Madison, WI.

The objective of the study was to investigate the viability of using whole milk (WM) as a starting material to produce native whey protein by spiral-wound microfiltration (MF). A single commercial scale 0.3 μ m polyvinylidene fluoride spiral-wound element was used. Pasteurized skim milk (SM) or pasteurized non-homogenized WM with an initial volume of 230 kg was microfiltered at either 4 or 13°C with inlet and outlet pressures of 120-135 kPa and 42-75 kPa, respectively. The milk was microfiltered to a volume concentration factor (VCF) of 3 with an hour of batch recirculation at VCF of 1, 2, and 3. Operating conditions and flux were recorded over time. Permeate and retentate samples were collected for compositional analysis. A Malvern Mastersizer was utilized to evaluate the fat globule size distribution before and after MF processing. MF performance was evaluated as a function of permeate flux rate and whey protein transmission over VCF of 1 to 3. At 4°C, lower MF flux was observed for WM compared to SM, particularly at higher VCF (probably due to increased viscosity of WM). During MF at 4°C, the average ratios of WM permeate flux to SM permeate flux at VCF 1, 2, and 3 were 0.98, 0.87, and 0.31, respectively. However, at 13°C the flux in WM was more comparable to SM, with average ratios of WM permeate flux to SM permeate flux at VCF 1, 2, and 3 of 1.00, 0.98, and 0.74, respectively. Fat globule size distribution was not altered by the MF processing in any trial. During MF at 4°C, the whey protein concentration in permeates at VCF 1, 2, and 3 were 0.09%, 0.13%, and 0.23% for SM and 0.09%, 0.16%, and 0.35% for WM, respectively. During MF at 13°C, the whey protein concentration in permeates at VCF 1, 2, and 3 were 0.06%, 0.12%, and 0.21% for SM and 0.05%, 0.11%, and 0.25% for WM, respectively. Our study concluded that native whey proteins can be separated successfully at low temperatures from WM

using spiral-wound MF membranes at rates comparable with the whey protein permeation rate in SM.

Key Words: Whole Milk, Microfiltration, Native Whey Protein

TH34 Flavor assessments of heated sweet cream butter. E. L. Harvey*, A. M. Renaud, and S. A. Rankin, *University of Wisconsin, Madison*.

Butter contains numerous compounds capable of reacting during the course of extended heat treatment such as baking or frying. The objective of this work was to determine the effect of heat treatment on the volatile character of unsalted sweet cream butter using instrumental and sensory methods. This work reports the qualitative presence of volatile compounds generated by extended heat treatment of butter. Pasteurized (87.2°C, 19s) 37% milkfat cream was churned to invert the emulsion. After draining the buttermilk, the fresh butter was analyzed for the presence of volatile compounds using GC/MS with SPME (DVD/

Carboxen/PDMS fiber). The butter was placed in a glass vial with Teflon-lined closure and rapidly heated to by immersion in a mineral oil bath. The heated samples were analyzed using GC/MS and SPME as above, and the results were compared with those of the fresh butter. The fresh sample contained numerous volatiles including short chain free fatty acids (butanoic acid, hexanoic acid, octanoic acid, nonanoic acid, and decanoic acid). Aldehydes and ketones were also found including hexanal, nonanal, 2-heptanone, and nonanone. The lactones δ -hexanolactone, δ -octalactone, and δ -decalactone, and one sulfur compound dimethyl sulfone occurred in both samples. The heated samples contained increases in the number of volatile compounds including lipid oxidation and Maillard reaction products. Partially trained descriptive panel assessments demonstrated relationships between heating and several sensory descriptors. This work provides a rapid method for the assessment of heated butter volatiles as well as describing the influence of thermal treatment on sensory character. Applications of this work may be used by processors to optimize flavor contributions resulting from heat treatment of butter.

Key Words: Heated Butter, Solid-Phase Microextraction, Sensory Analysis

Forages and Pastures III

TH35 Grazing management effects on physical and nutritional characteristics of pastures. M. Haan, J. Russell*, and D. Morrical, *Iowa State University, Ames.*

Cattle grazing in riparian areas may contribute to sediment and nutrient loading of surface waters. A study was conducted to evaluate the effects of cattle grazing on physical characteristics and the nutrient composition of cool-season grass pastures. Six 12-ha cool-season grass pastures, each bisected by a 195-m stream segment, were assigned to one of three treatments: continuous stocking with unrestricted stream access (CSU), continuous stocking with stream access restricted to a stabilized crossing (CSR), and rotational stocking with stream access in a riparian paddock (RS). In 2005, 2006, and 2007 each pasture was stocked from mid-May through mid-October with 15 Angus cows, initial BW (mean±SE) 614±72, 577±53, and 621±56 kg, respectively. Forage sward height and mass, and the proportions of bare and manure-covered ground were measured monthly from open and congregation sites on the stream banks and at distances of 0 to 34 m, 34 to 68 m, and greater than 68 m from the stream bank. Forage samples were analyzed for IVDMD, CP, and phosphorus (P). Occurrence of bare and fecal-covered ground were greater ($P<0.05$) in congregation than open areas of pastures across all grazing treatments during most months. Forage mass on stream banks did not differ between grazing treatments, but was lesser ($P<0.05$) within the 34 m zone of CSU pastures than in CSR pastures. Sward height was inversely related to forage mass. Proportion of bare ground on stream banks did not differ between grazing treatments. Proportions of bare ground within 34 m of the stream in CSU pastures were greater ($P<0.05$) than the CSR or RS pastures in late summer of 2005 and 2006. Fecal cover was greater ($P<0.05$) on the banks and within 34 m of the stream in CSU pastures than CSR pastures in most months. Crude protein and P concentration and IVDMD of forage did not differ between treatments. Forage characteristics and ground cover in the riparian area of a rotationally stocked pasture were similar to an ungrazed riparian buffer indicating that improved grazing management practices may be able to reduce negative impacts of cattle on surface water quality while still allowing use of riparian areas for cattle production.

Key Words: Water Quality, Forage Quality

TH36 Grazing management effects on selected stream bank characteristics and erosion. M. Haan¹, J. Russell*¹, and J. Kovar², ¹*Iowa State University, Ames*, ²*USDA-ARS, Ames, IA.*

Cattle grazing in riparian areas may contribute to sediment and nutrient loading of surface waters. A study was conducted to establish the effects of cattle grazing on stream bank erosion. Six 12-ha cool-season grass pastures, each bisected by a 195-m stream segment, were assigned to one of three treatments: continuous stocking with unrestricted stream access (CSU), continuous stocking with stream access restricted to a stabilized crossing (CSR), and rotational stocking with stream access in a riparian paddock (RS). In 2005, 2006, and 2007 each pasture was stocked from mid-May through mid-October with 15 Angus cows, initial BW (mean±SE) 614±72, 577±53, and 621±56 kg, respectively. Stream bank erosion susceptibility score (0 = low susceptibility, 60 = high susceptibility) and stream channel morphology (based on image analysis at 10 transects per pasture) were determined pre-, mid-, and post-grazing in all years. Stream bank erosion was measured at ten transects per pasture using erosion pins. Exposed pin length was measured monthly

during the grazing season, and one month post-grazing in all years. At one location per pasture, bank erosion was also measured with ground-based LiDAR (Light Detection and Ranging) pre- and post-grazing in 2006 and 2007. Stream banks in CSU pastures had a greater ($P<0.05$) erosion susceptibility score than did CSR or RS pastures. Stream cross-sectional area decreased at a rate of 13.0 cm² per day, with no difference ($P>0.05$) between grazing treatments. Annual net erosion, as determined by erosion pins, averaged -5.3 (erosion), 0.1 (deposition), and -6.6 (erosion) cm in 2005, 2006, and 2007, respectively, and did not differ ($P>0.05$) between treatments in any year. Over the entire study period (May, 2005 through December, 2007) the rate of net soil erosion from stream banks averaged -0.01 cm of soil per day and did not differ ($P>0.05$) between treatments. Similar to erosion pins, no differences ($P>0.05$) in soil erosion between treatments when measured by LiDAR. Grazing management had little effect on stream bank erosion during three years of the study.

Key Words: Water Quality

TH37 Ingestive behavior of dairy cattle during the different grazing down process of palisadegrass subjected to rotational stocking. A. C. Ruggieri*¹, E. R. Januskiewicz¹, D. R. Casagrande^{1,2}, A. G. Pascoa¹, R. A. Reis^{1,3}, and M. J. R. Paranhos da Costa^{1,3}, ¹*São Paulo State University, Jaboticabal, São Paulo, Brazil*, ²*Fundação de Amparo a Pesquisa do Estado de São Paulo, São Paulo, Brazil*, ³*Conselho Nacional de Desenvolvimento Científico Tecnológico, Brasília, Distrito Federal, Brazil.*

This study aimed evaluate the effect of different herbage allowance (HA) in a rotational stocking on animal behavior and the relationship between time of grazing and sward height and patterns of herbage ingestion of dairy cattle on palisadegrass (*Brachiaria brizantha* cv. Marandu). The experiment was carried out at UNESP in São Paulo State, Brazil, from November 2005 to April 2006. Treatments were four HA (4, 7, 10 and 13% of LW) allocated in a complete randomized block design with three replications. Measurements were performed in five grazing cycles and the stocking density was calculated aiming at a paddocks occupation of the eight hours in one day, and 21 days of resting period. The response variables analyzed were: vertical height of the plants in each feeding station, animal behavior and patterns of animal movement and search for herbage. The method of analysis was the focal behavior. The bite rates were different due to differences on HA. The bite rate was highest at the third grazing cycle due to the increase in the sward height. On the second grazing cycle the animals concentrated the grazing in the stratum above 15 cm in the 4 and 10% HA. In the 13% HA the animals grazed a highest layer of plants, due to great available herbage mass. In the forth grazing cycle the grazing stratum increased with the increment of the sward height. In highest heights, the animals reduced the grazing time. In all the HA the animals grazed stratum superior to 15 cm above the soil. In the fifth cycle, with 4% of HA the animals concentrated the grazing in the stratum height above 20 cm and above 10 cm in the 7% and 13% HA. When the herbage mass is abundant, the competition among the animals is smaller providing a selective grazing. In superior sward heights the animals dedicate less time in the grazing activities as a consequence of the highest herbage mass.

Key Words: Animal Behavior, Herbage Allowance, Sward Structure

TH38 Behavior of steers grazing novel endophyte tall fescues in southern Arkansas. B. Stewart*¹, P. Beck¹, D. Singh², and S. Gunter¹, ¹University of Arkansas, Hope, AR, ²Barenbrug USA, Tangent, OR.

Calves grazing Kentucky-31 (KY-31) tall fescue often exhibit signs of fescue toxicosis caused by ergot alkaloids produced by fungal endophytes. These fungal ergot alkaloids enable the tall fescue to be highly persistent in harsh conditions. Performance of calves grazing Endophyte-free (EF) tall fescue is improved but plant persistence is reduced. Novel endophyte (NE) tall fescues combine the advantages of plant persistence with the increased animal performance of fescues not containing the endophytes. Eleven 0.81-ha pastures (Una silty clay loam) were sprayed with 4.7 L glyphosate/ha and no-till seeded with EF (Barcel, Barenbrug USA, Tangent, OR), NE (Jessup AR542, Pennington Seed, Madison, GA; and BAR FA BE 9301A, Barenbrug USA), and KY-31 tall fescues in the fall of 2005. Calves (n=33, BW= 227 ± 6.7 kg, n=3/ pasture) were used to evaluate animal grazing behavior once/hour from daylight to dark on one day per month. Due to a treatment x time x month interaction ($P < 0.01$), data were separated by month and reanalyzed. In January and March grazing was affected ($P < 0.01$) by time of day across treatments. Calves were observed grazing for 94.5% of the observations prior to 11:30 and 84.9% of the observations thereafter in January. In March calves were observed grazing for 87.2% of the observations prior to 11:30 and for 77.8% of the observations between 11:30 and 16:30. Calves grazed for 96% of the observations after 16:30 with the exception of 17:30 where there was a tendency ($P = 0.09$) for KY-31 calves to graze less than the others (72 vs. 97%). In 2007 calves were removed from EF (lack of forage) and KY-31 (heat stress). In May 2006, there was a treatment x time interaction ($P = 0.08$). At 6:30, KY-31 tended ($P = 0.09$) to graze less (75 vs. 100%) than the EF and NE calves. Calves in EF pastures grazed more ($P < 0.01$) than the others (100 vs. 89%) at 8:30. At 9:30, 100% of all calves were cooling. At 11:30, NE grazed less ($P < 0.01$) than the others (54 vs. 100%). At 16:30, EF grazed more ($P < 0.01$) than the others (100 vs. 52%). The results of this experiment indicate that calves on NE pastures grazed more frequently during the heat of the day and stayed on pasture longer into the summer when compared to KY-31 and EF fescue.

Key Words: Tall Fescue, Grazing, Behavior

TH39 Giving beef calves a choice of pasture-type influences behavior and weight gain. H. T. Boland*¹, G. Scaglia², and W. S. Swecker, Jr.³, ¹Virginia Polytechnic Institute and State University, Blacksburg, ²Iberia Research Station, LSU Agricultural Center, Jeanerette, LA, ³Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, VA.

A 38-d backgrounding study was conducted to determine the response of spring born Angus cross-bred steer calves (n=54, initial BW=228±1 kg) when grazing endophyte-free tall fescue (*Festuca arundinacea* Shreb.) or alfalfa (*Medicago sativa* L.) as single monocultures or paddocks of 50% fescue and 50% alfalfa (by area) as adjacent monocultures (F: A). Fescue and alfalfa paddocks were rotationally stocked at a rate of 3.1 steers/ha while F: A stocking rate was 4.5 steers/ha. Calves were fitted with pedometers that recorded percentage of time spent standing, lying, or active (walking), and the number of steps taken per day. The experiment was a randomized complete block design and the MIXED procedure was used to analyze the data with block as a random effect, paddock as the experimental unit, and day as the repeated measure.

Alfalfa paddocks were of higher CP ($P < 0.0001$) than tall fescue paddocks (24 vs 12 %, respectively). Alfalfa paddocks also had lower ($P < 0.0001$) NDF (36%) and ADF (24%) than tall fescue paddocks (62 and 33%, respectively). Calves grazing alfalfa were more ($P = 0.03$) active (5.0%) than F: A calves (4.1%) while those grazing tall fescue did not differ in activity level from other treatments (4.8%). Similarly, calves grazing alfalfa took more ($P = 0.02$) steps/d (3072) than F: A calves (2411), with calves grazing tall fescue taking an intermediate number of steps/d (2927). Calves grazing tall fescue spent less ($P = 0.003$) time standing and more ($P = 0.003$) time lying (48.0 and 47.3%, respectively) than calves grazing alfalfa (49.2 and 45.8%, respectively) or the F: A calves (50.7 and 45.2%, respectively). Calves grazing alfalfa had lower ($P < 0.02$) ADG (0.57 kg) than calves grazing tall fescue (0.79 kg) or F: A (0.83 kg). Providing calves with a choice of forages improved their performance over grazing alfalfa alone. Calves could be maintained at a higher stocking rate with numerically greater ADG when given a choice of forages compared to tall fescue alone.

Key Words: Grazing Behavior, Adjacent Monocultures, Pedometers

TH40 Tall fescue based forage systems supplemented with winter annuals for stocker cattle. B. T. Campbell*¹, A. E. Fisher¹, G. E. Bates¹, J. C. Riggins², F. N. Schrick¹, and J. C. Waller¹, ¹University of Tennessee, Knoxville, ²University of Tennessee, Springfield.

A four year study (2004-2007) was conducted at Highland Rim Research and Education Center near Springfield, TN to compare tall fescue (*Lolium arundinaceum* Schreb.) forage systems in which rye (*Secale cereale* L.)/ryegrass (*Lolium multiflorum* Lam.) was used to supply additional high quality forage to stocker cattle. Twelve 1.2-ha pastures were assigned to two cool-season forages and two forage systems with three replicate pastures each. Cool-season forage treatments were: (1) endophyte-infected (*Neotyphodium coenophialum*) Ky-31 tall fescue and (2) Jessup MaxQ™ tall fescue. The two forage systems were: (1) stockpiled tall fescue, supplemental feed (a blend of byproduct feeds formulated to provide energy and protein equivalent to tall fescue hay) during winter, spring growth tall fescue and (2) stockpiled tall fescue, rye/ryegrass during winter when available, spring growth tall fescue and rye/ryegrass. Forage systems containing rye/ryegrass were established by drilling 38 kg of rye and 6.8 kg ryegrass in a prepared seedbed in 0.4 ha of the allotted 1.2 ha pasture area. All pastures were clipped in late spring to assure vegetative growth. In late-November, four weaned beef steers were randomly allotted to each pasture based on age, weight, and breed and remained on pastures until mid to late June. Steers grazed rye/ryegrass when it reached average height of 20 cm and were removed at an average height of 8 to 10 cm. Forage heights before and after grazing of rye/ryegrass and the number of days grazing were recorded. When forage was unavailable or insufficient, cattle were fed a byproduct-based supplement. Animal weights were collected on two consecutive days at the beginning and end of the trial. Data collected at 14-d intervals included: steer weight, forage availability by clipping strips (2 per 0.4-ha pasture), and blood serum for prolactin. Data were analyzed using the MIXED procedure of SAS and differences determined at $P < 0.05$. Steers grazing Jessup MaxQ™ pastures gained more ($P < 0.05$) weight and had higher ($P < 0.05$) serum prolactin levels than those grazing Ky-31 regardless of presence of rye/ryegrass.

Key Words: Tall Fescue, Beef Cattle, Stockers

TH41 Efficacy of EndoFighter™ for steers grazing endophyte-infected tall fescue pastures during summer. R. Norman^{*1}, C. D. Lane, Jr.¹, S. S. Block², A. E. Fisher¹, B. T. Campbell¹, F. N. Schrick¹, and J. C. Waller¹, ¹University of Tennessee, Knoxville, ²ADM Animal Nutrition Research, Decatur, IL.

An 84-d grazing trial was conducted (Jun 14-Sep 7) near Spring Hill, TN to determine the efficacy of EndoFighter™, an ADM Alliance Nutrition, Inc. product designed to be fed to cattle grazing or fed endophyte-infected fescue. Jesup tall fescue pastures grazed in this trial were >90% infested with *Neotyphodium coenophialum* (E+). Sixty weaned crossbred steers (267 kg) were used in a completely randomized design and randomly allotted to pastures with four animals per 1.2-ha paddocks and five replications per treatment. Treatments were ADM Alliance Nutrition, Inc. mineral products: 1) Mastergain® mineral = Control; 2) EndoFighter™ mineral; and 3) Prototype mineral. Steers had free choice access to E+ grass, water and shade. Steers were weighed on d 0, 1, 21, 42, 63, 83, and 84. Initial and final weights were an average of the two beginning and ending weights, respectively. Data collected were initial, d 21, d 42, d 63, and final weights, and ADG (period 1 = d 1 to 21; period 2 = d 22 to 42; period 3 = d 43 to 63; period 4 = d 64 to 84; total = d 1 to 84). Blood serum was collected at d 0, 21, 42, 63, and 84 for prolactin analysis. Mineral consumption and animal grazing behavior were determined at 14-d intervals. Data were analyzed using the MIXED procedure of SAS and differences determined at $P < 0.05$. For all variables except behavior, contrasts were performed to compare Control to mineral supplements containing EndoFighter™ or Prototype. This trial was conducted during extreme heat (d 1-42 had $30 \text{ d} \geq 32^\circ \text{C}$; d 43-84 had $31 \text{ d} \geq 35^\circ \text{C}$ with $19 \text{ d} \geq 39^\circ \text{C}$) and drought conditions, thus forage was limited during the last 42 d of the trial and E+ hay was provided. Total ADG (kg) and average daily mineral consumption (g) were: 0.50, 134; 0.54, 147; 0.44, 116; for Control, EndoFighter™ and Prototype, respectively. Serum prolactin was not different ($P > .05$) among treatments for the entire trial. However, serum prolactin levels for EndoFighter™ were higher ($P < 0.05$) than Control at d 21 (26.0 vs. 10.1 ppb, respectively) and d 42 (58.9 vs. 30.8 ppb, respectively).

Key Words: Beef Heifers, Tall Fescue, EndoFighter™

TH42 Two year study on finishing beef cattle performance and forage characteristics of ryegrass (*Lolium perenne*), rye (*Secale cereale*) and oats (*Avena sativa*). A. C. Pereira^{*}, E. J. Bungenstab, J. C. Lin, B. Gamble, S. P. Schmidt, C. R. Kerth, and R. B. Muntiferung, Auburn University, Auburn, AL.

A 2-yr grazing trial was conducted with ryegrass (RG; *Lolium perenne*), rye (R; *Secale cereale*) and oats (O; *Avena sativa*) as winter pasture for forage-finished beef. Replicate 1.42-ha paddocks (2 per forage) were established and stocked initially with 3 Angus × Continental crossbred steers per paddock (374 ± 5.5 kg initial BW in year 1 and 410 ± 7.0 kg in year 2). All steers had free-choice access to salt-mineral mix and water. Grazing was initiated on Jan 19 (84 d grazing season in year 1) and on Nov 27 (145 d grazing season in year 2) when average forage DM availability reached 1000 kg/ha. Forage mass and nutrient composition were determined by clipping 0.25-m² quadrats (n=8 per paddock) prior to the beginning of grazing and every 2 wk during the trial. Stocking rates were adjusted using put-and-take steers to maintain forage in the vegetative stage. Evaluation of animal performance was discontinued when steers reached 530 kg. Average daily gain differed ($P < 0.05$) between years, but there was no animal × year interaction. In year 1, seasonal-

mean ADG (1.81 ± 0.03 kg/d) did not differ among treatments. In year 2, RG produced higher ($P < 0.05$) ADG (1.18 ± 0.06 kg/d) than did R (0.94 ± 0.06 kg/d), but ADG did not differ between RG and O (1.03 ± 0.06 kg/d). There was no year effect or year × treatment interaction for forage concentrations of CP and NDF. Rye contained more CP ($19.8 \pm 0.8\%$) than did RG ($17.4 \pm 0.8\%$), but %CP did not differ between R and O ($17.9 \pm 0.8\%$). Ryegrass had lower ($P < 0.05$) concentration of NDF ($40.0 \pm 1.4\%$) than did O ($46.3 \pm 1.4\%$) and R ($45.1 \pm 1.4\%$). Total gain/ha differed ($P < 0.05$) between years, but there was no year × treatment interaction. Year 1 had lower ($P < 0.05$) gain/ha (371 ± 17.0 kg) than did year 2 (556 ± 17.0 kg/ha). There were no differences in total gain/ha among forage sources in either year, however RG was superior than R but did not differ from O in year 2 in supporting ADG.

Key Words: Grazing, Finishing, Pasture

TH43 Effect of forage species during finishing on growth rate, final weight and carcass parameters from pasture finished cattle. J. P. S. Neel^{*1}, J. P. Fontenot², W. M. Clapham¹, S. K. Duckett³, E. E. D. Felton⁴, and W. S. Swecker, Jr.², ¹USDA-ARS-AFRC, Beaver, WV, ²Virginia Polytechnic Institute and State University, Blacksburg, ³Clemson University, Clemson, SC, ⁴West Virginia University, Morgantown.

In 2005 and 2006, Angus-crossbred steers (n = 72; 431 ± 40 kg initial BW) were used to compare growth rate, final weight and carcass parameters from pasture-finished cattle grazing cool-season mixed (MP), alfalfa (AL), or pearl millet (PM) pastures during the final 44 d of finishing. Mixed pasture consisted primarily of bluegrass (*Poa pratensis* L.), orchardgrass (*Dactylis glomerata* L.), fescue (*Festuca* L.) and white clover (*Trifolium repens* L.). Steers were harvested on the same dates, across treatments, at a commercial meat plant. Forage species did not influence final weight (FW), marbling score (MS), quality grade (QG), rib fat (RF), kidney, pelvic and heart fat (KPH) or yield grade (YG). Forage species influenced ($P < 0.05$) ribeye area (REA) with PM being greater ($P < 0.05$) than MP and AL. There was a trend ($P = 0.06$) for forage species to impact carcass weight (CW) with PM tending ($P < 0.06$) to be greater than MP and AL. Year influenced REA and KPH with REA being greater ($P < 0.05$) in 2006 and KPH being greater ($P < 0.05$) in 2005. The interaction between finishing treatment and year was significant ($P < 0.05$) for finishing period ADG (ADG) and dressing percentage (DP). Year did not influence ADG for MP or PM while ADG was greater ($P < 0.001$) in 2005 than 2006 for AL. Pearl millet produced greater ($P < 0.05$) ADG than MP. In 2005, AL had equivalent ADG to PM but lower ($P < 0.05$) ADG than PM and MP in 2006. Year influenced ($P < 0.05$) DP in AL and PM, being greater in 2006 than 2005. Dressing percentage was greater ($P < 0.05$) for AL and PM than MP in 2006. Pearl millet and MP produced consistent ADG across years. Animal performance was improved with PM versus MP during both years and was greater than AL in 2006.

Key Words: Finishing, Pasture, Forage

TH44 Performance and carcass characteristics of the supplemented or not beef heifers grazing palisade grass (*Brachiaria brizantha*) on the rainy season. D. R. Casagrande^{1,2}, R. A. Reis^{*1,3}, A. C. Ruggieri¹, T. T. Berchielli^{1,3}, M. H. Moretti^{1,2}, J. F. de Mattos^{1,2}, and M. A. A. Balsalobre⁴, ¹São Paulo State University, Jaboticabal, São

Paulo, Brazil, ²Fundação de Amparo Pesquisa do Estado de São Paulo, São Paulo, São Paulo, Brazil, ³Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brasília, Distrito Federal, Brazil, ⁴Bellman Nutrição Animal, Mirassol, São Paulo, Brazil.

This research evaluated performance (kg/d and kg/ha) and carcass characteristics of beef heifers (initial BW = 200 kg; 1/4 Saint Gertrudis × 1/4 Nelore × 1/2 Braunvieh) grazing palisade grass pastures from December 2006 to April 2007. Treatments were the factorial arrangement of three forage allowances (FA; 2.0, 2.5, 3.0 kg DM/kg BW) and two levels of supplementation (none, C; 0.3%BW/d, PS), distributed in a randomized complete block design with two replications. The PS ingredients were: cotton seed meal, citrus pulp, urea, Megalac[®], and mineral (26.0% CP, 81.0%TDN). Six tester heifers were stocked continuously in each experimental unit (1.0 ha). Desired FA was maintained using put-and-take heifers (BW = 230 kg). Average daily gain was 0.49 and 0.66 kg/d for C and PS (P<0.05), respectively; response to PS was greater (P<0.05) at the end of experimental period. Supplementation increased (P<0.05) gain per unit of land from 523 to 627 kg/ha. Forage allowance did not affect (P>0.05) ADG (0.48, 0.53, 0.60 kg/d for 2.0, 2.5, and 3.0 kg DM/kg LW, respectively). Gain per unit of land increased (P<0.05) from 502 to 647 kg/ha as FA increased from 2.0 to 3.0 kg DM/kg LW. Heifers supplemented with PS had larger (P<0.05) *longissimus dorsi* muscle area but fat thickness over the loin and rump were not affected. We conclude that supplementation increased ADG, gain per unit of land, and *longissimus dorsi* muscle area of beef heifers grazing palisade grass pastures in different forage allowances.

Key Words: Forage Allowance, Supplementation, Tropical Grass

TH45 Productivity, utilization and nutritive quality of dallisgrass (*Paspalum dilatatum*) as influenced by stocking density under continuous or rotational grazing. E. J. Bungenstab*, A. C. Pereira, J. C. Lin, J. L. Holliman, and R. B. Muntifering, Auburn University, Auburn, AL.

Information on dallisgrass (*Paspalum dilatatum*) under intensive grazing is limited. Therefore, we conducted a trial in which replicate 0.40-ha paddocks in a dallisgrass pasture were continuously grazed (CG), or replicate 0.40-ha paddocks were subdivided into either two 0.20-ha, three 0.13-ha or four 0.10-ha cells and rotationally grazed (RG). Within RG treatments, 0.20-, 0.13- and 0.10-ha cells were grazed for 7 d followed by 7, 14 or 21 d rest, respectively. Three Angus × Continental crossbred steers (initial BW, 354 ± 6 kg) were assigned randomly to each paddock initially, and cattle were weighed at 28-d intervals. Post-grazing residual forage DM and pre-grazing forage DM availability and quality were measured weekly in RG cells, concurrently with measurement of forage DM availability and quality in CG paddocks. One steer was removed from each paddock after 28 d because of persistent drought. Data were analyzed by the GLM/Least Squares Means procedure of SAS. Over the 84-d trial, total liveweight gain from the 0.10-ha cells (143 kg/ha) was greater (P = 0.08) than from 0.13-ha cells (63 kg/ha), but was not different from 0.20-ha cells (111 kg/ha) or CG paddocks (108 kg/ha). Similarly, ADG was greater (P = 0.08) for RG steers from 0.10-ha (1.03 kg/d) than 0.13-ha (0.45 kg/d) cells, but was not different between steers from 0.20-ha cells (0.80 kg/d) or CG paddocks (0.78 kg/d). Mean forage concentration of CP was greater (P = 0.09) for 0.10-ha and 0.13-ha than 0.20-ha cells and CG paddocks. Forage concentration of NDF was lower (P = 0.03) for 0.13-ha cells than CG paddocks, and ADF concentration was lower (P = 0.07) for CG paddocks, 0.10-ha and 0.13-ha cells than

0.20-ha cells. Mean forage DM availability was greater (P = 0.03) for the 0.20-ha, 0.13-ha and 0.10-ha cells (2819, 2587 and 2462 kg/ha, respectively) than CG paddocks (1793 kg/ha), and mean residual forage DM following grazing in the RG cells (2,172 kg DM/ha) was not different from the CG paddocks. Results indicate that intensive RG management of dallisgrass has potential for increasing forage productivity while maintaining nutritive quality compared with CG.

Key Words: Dallisgrass, Rotational Grazing, Stocking Density

TH46 Supplementation with different levels and sources of energy for steers on *Panicum maximum* Jacq cv Tanzânia pasture: forage availability, morphological composition and nutritive value. M. C. Ar. Santana*¹, V. P. B. Euclides², and A. B. Mancio³, ¹Universidade Estadual Paulista, Jaboticabal, São Paulo, Brazil, ²Empresa Brasileira de Pesquisa Agropecuária - Embrapa, Campo Grande, Mato Grosso do Sul, Brazil, ³Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.

Tropical forages are the primary base of the bovine production system and supplementation strategies contribute to improved utilization. This experiment was carried out to evaluate the forage mass, morphological composition, and nutritional value of *Panicum maximum* Jacq. cv Tanzânia, and the influence of supplementation with different levels and energy sources on animal performance. The experiment was conducted from July 22 to October 21, 2005, on guineagrass pasture fertilized with two levels of N (150 and 300 kg of N/ha/yr). Forty-eight crossbred steers, average age = 12 mo, were used in a completely randomized design of a 2×3 factorial treatment arrangement (2 N levels and 3 supplements), with four replications. The supplements were: a) mineral salt, and supplementation at 1% of LW with the following supplements, b) 41.1% corn, 49.5% soybean meal, 2.5% calcium carbonate, 0.6% mineral salt, 6% NaCl and 0.06% of rumensin; c) 24.3% soybean meal, 24.3% soybean hulls, 48% soybean seed, 2.5% calcium carbonate, 0.6% of mineral salt, 6% NaCl and 0.06% of rumensin. There were no treatment interactions (P>.63) for forage variables of that were evaluated. The supplements did not influence the morphological composition (P>.43), mass (P>.45) or nutritional value (P>.06) of the forage. The steers supplemented with 1% LW performed better (P<.01) than those supplemented with mineral salt. However there was no effect (P>.14) of energy source, being on average, 500, 960 and 1,000 g/steer/d for supplement a, b and c, respectively. The fertilizer N level influenced the CP (P<.05), in vitro organic matter digestibility (P<.05) and mass (P<.02) of forage which were higher for the highest level of fertilization. In spite of variation in its composition and available forage, the guineagrass pasture was able to maintain, throughout the dry season, a reasonable nutritional value.

Table 1. Least square means for forage mass (FM), crude protein (CP), in vitro organic matter digestibility (IOMD) of guineagrass fertilized with 150 (N150) and 300 (N300) kg/ha.

	N150	N300	Pr>F
FM (kg/ha of DM)	2320 (190)	3017 (222)	0.02
CP (%)	7.1 b (0.27)	9.0 a (0.32)	0.05
IOMD (%)	51.0 b (1.13)	57.4 a (1.35)	0.05

Means followed by different letters in the same row are different by Tukey's Test (P<0.05). Values between parentheses represent the standard means error.

Key Words: Levels of Nitrogen, Feed Supplementation, Forage Mass

TH47 Monensin and *Saccharomyces cerevisiae* as additive for beef heifers grazing *Brachiaria brizantha* cv. Marandu. L. M. Abaker Bertipaglia^{1,3}, G. M. Peruca de Melo¹, A. Prates e Oliveira^{1,3}, R. Andrade Reis^{*1,2}, T. T. Berchielli^{1,2}, A. S. Ferraudo^{1,2}, E. Braga Malheiros^{1,2}, and L. Abaker Bertipaglia¹, ¹São Paulo State University, Jaboticabal, São Paulo, Brazil, ²Conselho Nacional de Desenvolvimento e Tecnológico, Brasília, Distrito Federal, Brazil, ³Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Brasília, Distrito Federal, Brazil, ⁴Fundação de Amparo à Pesquisa do Estado de São Paulo, São Paulo, São Paulo, Brazil.

This trial was conducted to evaluate protein supplementation with additives on performance of heifers (Santa Gertrudez, Brahman, Nelore) maintained in palisade grass pasture. The experiment was performed during the transition from rainy to dry season (P1-March to June) and in the dry period (P2-July to September). The supplements were: mineral (M); protein supplement (PS); PS plus monensin (PSM, 137mg/kgDM); PS plus yeast (PSY, 43×10⁶CF/kgDM); and PS plus monensin and yeast (PSMY). Supplementation levels were 0.4% BW in P1, and 0.5% BW in P2. Forage quantity and quality were evaluated in addition to total DM, intake and total animal weight gain (TWG). The data were analyzed as a randomized block design with repeated measures. Pasture total herbage mass, green dry matter mass, and leaf proportion decreased after June (beginning of P2). Forage quality (cell wall, N and in vitro organic matter digestibility) in extrusa samples changed little during the periods. During P1, SPM heifers had the lowest forage intake (1.8%BW); the other treatments averaged 2.0%BW. However, in P2 all supplement groups had lower forage intake (average 1.5%BW) than M (2.0%BW). The additives PSM, PSY and PSMY increased supplement intake (0.5%BW) compared to PS (0.4%BW). Protein supplementation increased TWG (37.1 and 47.0kg/period, P1 and P2), compared to the animals of the M supplementation (24.0 vs 22.7 kg/period, P1 and P2). The PSM group gained more TWG (40.7kg) than PSY (30.9kg) in P1; however in P2 the additives did not affect the TWG. Animal performance was associated with forage green DM mass, green and died proportions. Extrusa sampling methodology was not a good approach to evaluate the supplementation effects in this trial.

Key Words: Intake, Supplementation, Tropical Grass

TH48 Effects of rumen degradable protein supplementation on forage intake and digestibility of early weaned beef calves consuming stargrass hay and receiving soybean hull supplementation. T. Saraiva¹, J. M. B. Vendramini^{*1}, L. E. Sollenberger², U. Inyang¹, R. Farias¹, and J. D. Arthington¹, ¹University of Florida, Ona, ²University of Florida, Gainesville.

The objective of this study was to evaluate the effects of different levels of rumen degradable protein supplementation, on forage intake and digestibility of early weaned calves consuming stargrass (*Cynodon nlemfuensis*) hay and receiving 0.85% BW soybean hulls supplementation. The experiment was conducted at the Range Cattle Research and Education Center, Ona, FL from 4 June 2007 to 7 July 2007. Calves were weaned on 6 Jan 2007 at an average age of 84 d. They grazed annual ryegrass (*Lolium multiflorum*) pastures and were moved to a stargrass pasture on 5 May 2007. The treatments were three levels of rumen degradable protein supplementation, soybean meal (SBM, 35% RUP 65% RDP), a 50:50 mixture of SBM-soyplus[®] (modified expeller soybean meal, 60% RUP 40% RDP), or soyplus[®], supplemented at

0.15% BW. Three early weaned steers (160±18 kg BW) were used. The statistical design was a latin square 3 x 3, 3 treatments and 3 periods (10 d adaptation, and 7 d data collection). Ground stargrass hay (11% CP, 51% IVOMD) was offered daily and adjusted to allow 10% refusals. Daily offered forage and refusals were weighed, and subsampled for DM determination. Total feces production was collected, placed in aluminum pans, and dried at 60°C for diet apparent digestibility determination. There was no difference (P>0.10) in forage DM and total DM intake among treatments. Forage DM and total DM intake were 2.2±0.1 and 2.9±0.1 % BW respectively. In addition, there was no effect of different levels on rumen degradable protein supplementation on diet apparent digestibility, 57.5±2.5 %. In conclusion, it is unlikely that rumen degradable protein supplementation at the levels tested in this study will improve performance of early weaned calves that are being fed soybean hulls while grazing warm-season grasses pastures during the summer in Florida.

Key Words: Early Weaned Calves, Forage Intake, Stargrass

TH49 Effect of urea inclusion and cooking time on intake of blocks containing greasy cottonseed meal by beef cows. T. A. Wickersham^{*1}, F. M. Rouquette², J. E. Sawyer¹, and R. O. Dittmar, III¹, ¹Texas A&M University, College Station, ²Texas AgriLife Research, Overton, TX.

One hundred pregnant, spring-calving beef cows (body condition score (BCS) = 5.2 and BW = 574 kg) were used to evaluate intake of cooked molasses protein supplements. Cows were stratified by BCS and BW, and randomly assigned to 1 of 12 dormant Tifton 85 bermudagrass pastures from October 1 through November 2. Pastures were randomly assigned to receive a block type (3 pastures per block type). All blocks contained 25% greasy cottonseed meal (a byproduct of the biodiesel industry, 30% CP), but differed in urea content and length of cooking. Blocks contained 0 (N) or 20 equivalents of CP from urea (U) and were cooked for a standard time to achieve regular hardness (R) or for an extended time to increase hardness (H) in a 2 × 2 factorial arrangement to yield NR, NH, UR, and UH. Blocks were weighed and hardness measured with a penetrometer 3 times weekly to determine intake and block hardness. Cow BW and BCS were recorded on d 0 and d 33. Cow data were analyzed as a completely random design with pasture as the experimental unit. Block hardness and disappearance were evaluated as repeated measures with pasture as the subject. Block hardness was influenced by the interaction between urea inclusion and cook time (P = 0.01). Blocks without urea were hardest regardless of cook time (NR = 8.3, NH = 8.1 kg/cm²); including urea softened blocks, but increasing cook time increased hardness (UR = 4.57, UH = 5.34 kg/cm², SE = 0.16). A cook × urea × day interaction existed (P = 0.03) for block intake, driven by greater intake (P < 0.03) of UR than all other block types from d 7 to 19. Block intake was influenced by the interaction between urea inclusion and cook time (P = 0.01). Urea inclusion increased intake, but longer cook time reduced intake of urea containing blocks by 44% (P < 0.01) while longer cook time resulted in only numerical reductions in intake of N blocks (1.06, 0.59, 0.46, 0.35 ± 0.05 kg/d; UR, UH, NR, NH, respectively). Block type did not result in significant BCS changes; however, including urea tended (P = 0.07) to increase BCS change (U = 0.22, N = -0.28). Similarly, BW change was not affected by treatment (P > 0.21), but increased for all treatments during the study.

Key Words: Protein, Supplement, Self-Fed

TH50 Effects of three levels of rumen degradable protein supplementation on performance of early weaned calves grazing stargrass and receiving soybean hulls. T. Saraiva¹, J. M. B. Vendramini^{*1}, L. E. Sollenberger², U. Inyang¹, R. Farias¹, and J. D. Arthington¹, ¹University of Florida, Ona, ²University of Florida, Gainesville.

Warm-season grasses have reduced concentrations of CP fraction A, rapidly degradable in the rumen, and rumen degradable protein may be a limiting factor on performance of early weaned beef calves grazing warm season grasses. The objective of this study was to evaluate the effects of different levels of rumen degradable protein supplementation on performance of early weaned calves grazing stargrass (*Cynodon nlemfuensis*) pastures and receiving 0.85% BW of soybean hulls. Calves were weaned on 6 Jan. 2007 at an average age of 84 d. They grazed annual ryegrass (*Lolium multiflorum*) pastures until 5 May 2007, when they were moved to experimental pastures where they remained until 22 Aug. 2007. The treatments were three levels of rumen degradable protein supplementation, soybean meal (SBM, 35% RUP 65% RDP), a 50:50 mixture of SBM-soyplus[®](modified expeller soybean meal, 60% RUP 40% RDP), or soyplus[®], supplemented at 0.15% BW, and distributed in a randomized incomplete block design. Treatments SBMSP and SP were replicated three times and SBM two times. The experimental units were 0.51-ha pastures, each divided into two paddocks for rotational stocking (14-d grazing and 14-d rest period). Four calves were assigned to each pasture. Every 28 d, calves were weighed and average daily gain calculated. Herbage mass was measured every 14 d using the disk plate meter methodology. Hand plucked samples were collected every 14 days and were analyzed for CP and IVOMD. There was no difference ($P \geq 0.10$) in forage CP (11%), IVOMD (56%), herbage mass (1880 kg/ha), and herbage accumulation (99 kg/ha/d) among treatments. Calves average daily gain did not differ among treatments (0.56 kg/d). The levels of rumen degradable protein treatments tested in this study did not improve performance of early weaned calves grazing stargrass and receiving soybean hulls. It is likely that soybean hulls supplementation supplied the RDP required by early weaned calves grazing stargrass and affected the response of the rumen degradable protein treatments.

Key Words: Early Weaned Calves, Stargrass, Rumen Degradable Protein

TH51 Comparing mathematical models to estimate *in vitro* gas production kinetic parameters of the forage consumed by grazing cattle. M. Murillo-Ortiz, M. A. Cerrillo-Soto*, E. Herrera-Torres, O. Reyes-Estrada, A. Juárez-Reyes, G. Nevárez-Carrasco, and E. Ávila-Rodríguez, *Universidad Juárez del Estado de Durango, Durango, Dgo. México.*

The goodness-of-fit test of three mathematical models: Mitscherlich (M1), McDonald (M2) and Orskov and McDonald (M3) to describe the kinetic parameters of *in vitro* gas production from forage selected by grazing cattle was evaluated. Extrusa samples from four steers were incubated in 100 ml calibrated glass syringes. Gas production measures overtime were fitted to the models. The residual mean square (RMS) and the mean square of predicted error (SMPE) were used as selection criteria. The NLIN procedure NLIN (SAS, 2003) was utilized to estimate the kinetic parameters and to evaluate the goodness-of-fit of the models. The parameters and the statistical criteria were then analyzed in a completely randomized design. Means were compared using Tukey's test. The gas produced from the soluble fraction **a** (ml/500 mgDM) was different among models ($P < 0.05$). Values ranged from

-12.2 with M3 to 0.709 with M1. The highest value ($P < 0.01$) for the gas produced from the insoluble but slowly degradable **b** (ml/500mgDM), was recorded with M1 (97.4 ml/500mgDM) and the lowest with M3 (60.5 ml/500mgDM). The potential gas production **a+b** was similar in M2 (100.5ML/500mgDM) and ($P > 0.05$) M1 (98.1ml/500mgDM); however, both values were higher ($P < 0.05$) than those obtained with M3 (48.3ml/500mgDM). The constant rate of gas production **kd** was highest ($P < 0.05$) with M1 (7.2 % h^{-1}) and the lowest with M3 (3.4 % h^{-1}). Regarding to the statistical criteria to evaluate the goodness-of-fit test of the models, both the RMS and the SMPE were different ($P < 0.05$) among models. M1 had the best goodness-of-fit with values of 7.5 for RMS and 20.3 for SMPE which were lower to those registered with M2 (RMS=15.0; SMPE=58.1) and with M3 (RMS=40.3; SMPE= 112.5). It is concluded that M1 had the best statistical performance to describe the kinetic parameters of *in vitro* gas production.

Table 1. Statistical criteria for fitting of the models to evaluate *in vitro* gas production kinetics

Models	Parameters					
	a	b	a+b	kd	I	lag
M1	0.70 ^c	97.4 ^a	98.1 ^a	7 ^a	2.74	
M2	4.75 ^b	95.3 ^a	100.5 ^a	4 ^b		4.3
M3	-12.2 ^a	60.5 ^b	48.3 ^b	3 ^c		
Means	5.8	84.4	82.3	4.6		
SD	1.8	2.6	3.3	0.01		
			Selection criteria			
Models	RMS	SMPE				
M1	7.6 ^c	20.3 ^c				
M2	15.0 ^b	58.1 ^b				
M3	40.3 ^a	112.5 ^a				
SD	0.27	0.91				

Means within columns with different superscript differ ($P < 0.05$); RMS=residual mean square; SMPE=square mean of predicted error; I and lag=lag phase (h); a, b (ml/500mgDM); kd (% h^{-1})

Key Words: *In Vitro* Gas, Models, Grazing

TH52 Comparison of techniques for estimation of forage dry matter intake by cattle grazing grass pastures. M. Undi*, K. H. Ominski, C. Wilson, and K. M. Wittenberg, *University of Manitoba, Winnipeg, Manitoba, Canada.*

Four techniques were compared for their ability to estimate forage DMI of grazing animals. In the Cage technique, the difference between forage clipped from 0.25m² quadrats inside and outside grazing cages after 12 to 20 days of grazing represented forage consumed by grazing animals. The second technique used n-alkane controlled release capsules to measure DMI of individual animals (n-alkane marker technique). The other two techniques were prediction equations; one utilized BW and ADG to estimate DMI (Minson equation) and the other related dietary net energy concentration and BW to DMI (Net Energy equation). The four methodologies were applied to a three-year study evaluating liquid hog manure on the productivity of grass pastures. The study utilized steers of a relatively uniform body size on six continuously-grazed grass pastures. When individual animal intakes were compared, the Net Energy equation estimated lower ($P < 0.05$) DMI than the Minson equation, with the n-alkane marker technique being intermediate. Dry matter intake (mean±SD, kg d⁻¹) was 5.3±0.76, 7.3±0.53, and 6.5±2.58 for the Net Energy equation, Minson equation, and n-alkane marker

technique, respectively. Dry matter intake estimated by the Cage technique averaged $17.5 \pm 11.61 \text{ kg d}^{-1}$ and was higher ($P < 0.05$) than estimates from the other techniques. Dry matter intake estimates from different techniques were ranked ($P < 0.05$): Cage technique > Minson equation > n-alkane marker technique > Net Energy equation. The DMI estimates generated by the Cage technique had the largest coefficient of variation, with extreme values representing a DMI range from 0.3 to 15.2% BW. The strongest correlation ($r = 0.48$; $P = 0.0001$) in DMI estimates was between the Net Energy and Minson equations due to the inclusion of BW as a component in both equations. The n-alkane marker technique and prediction equations produced repeatable DMI estimates. These results suggest that prediction equations can be useful for rapid DMI estimation and that the n-alkane marker technique may be more suitable when a wide range of pasture conditions are expected over the course of the evaluation period.

Key Words: Grazing Cages, N-Alkanes, DMI

TH53 An alternative method to assess 24h ruminal *in vitro* neutral detergent fiber digestibility. J. P. Goesser*, P. C. Hoffman, and D. K. Combs, *University of Wisconsin, Madison*.

Run to run variance due to the inconsistent nature of rumen fluid inoculum confounds comparisons of forage *in vitro* NDF digestibility (NDFD) analyzed in different repetitions or laboratories. Our objective was to determine if priming rumen fluid and allowing it to produce a standard amount of gas before inoculating samples improved assay repeatability. In two experiments, we compared run to run variance of NDFD estimates between two modified Goering and Van Soest (1970) *in vitro* assays. In both assays, dried, ground (1mm) alfalfa samples (0.5 g) sealed in Ankom F57 bags were placed in 125 ml Erlenmeyer flasks and incubated with Van Soest *in vitro* media and 10 ml of rumen fluid. In experiment 1, rumen fluid was collected from a cannulated cow fed a high forage diet and prepared one of two ways; rumen fluid was either used immediately after it was collected and strained through cheese cloth (GVA), or strained fluid was combined with buffer, reducing solution and 12.5mg cellulose/ml rumen fluid and allowed to produce 0.3ml gas/ml rumen fluid prior to inoculation (RPA). The assay was repeated 5 times, with 13 samples per method. In experiment 2, inoculum was prepared one of three ways; RPA, GVA except rumen fluid was collected and pooled from two cows (GVP), or RPA with fluid pooled from 2 cows. The *in vitro* assays were repeated 5 times with 8 samples per method. NDF was analyzed using Ankom²⁰⁰ forage fiber analyzer and 24h NDFD was determined as: $\text{NDFD (\% of NDF)} = 100 \times [(\text{NDF}_{0\text{h}} - \text{NDF}_{\text{residue}}) / (\text{NDF}_{0\text{h}})]$. Data for each experiment were analyzed using a mixed model procedure and repetition sum of squares for each technique were determined and compared with an F-test to assess technique repeatability. In both experiments rumen fluid priming significantly reduced rep sums of squares, 51.2 v. 503 and 23.3 v. 164, compared to the respective GVA or GVB. However priming significantly decreased NDFD values, 22.5 v. 24.8 and 23.9 v. 26.6%, compared to GVA and GVB, respectively. Priming rumen fluid with cellulose improved ivNDFD assay precision, but depressed ivNDFD.

Key Words: In Vitro, NDF Digestion, Methods

TH54 Improvement of the rumen fluid priming method for measuring *in vitro* NDF digestibility. J. P. Goesser*, P. C. Hoffman, and D. K. Combs, *University of Wisconsin, Madison*.

Recently we developed an alternate method to assess 24h *in vitro* NDF digestibility (ivNDFD) based on priming rumen fluid inoculum. Priming rumen fluid inoculum with cellulose improved ivNDFD assay repeatability but depressed ivNDFD means. Our objective in this study was to determine if priming with a mixture of carbohydrate and urea would affect ivNDFD mean and variance. Three modified Goering and Van Soest (1970) ivNDFD assays were evaluated over 24, 28, 48, 54, and 72h using dried, ground (1mm) alfalfa or wheat straw (0.5g) sealed in Ankom F57 forage fiber bags. Bags were placed in 125ml Erlenmeyer flasks and incubated with Van Soest media and 10 ml of rumen fluid. Rumen fluid was collected prior to feeding from two cannulated cows fed a high forage diet and was prepared in one of three ways; pooled rumen fluid was strained and used immediately to inoculate flasks (GV); strained, pooled fluid was combined with buffer, reducing solution and 0.125mg primer/ml rumen fluid and allowed to produce 0.3ml gas/ml rumen fluid prior to sample inoculation (CG); CG method without the primer mixture (UN). The assay was repeated 5 times, with 5 time points and 2 subsamples/time point/method. Neutral detergent fiber was analyzed using an Ankom²⁰⁰ forage fiber analyzer and NDFD was determined as: $\text{NDFD (\% of NDF)} = 100 \times [(\text{NDF}_{0\text{h}} - \text{NDF}_{\text{residue}}) / (\text{NDF}_{0\text{h}})]$. Results were analyzed using a mixed model procedure, and data were subset by method to obtain repetition sum of squares, which were compared with an F-test to assess method repeatability. The ivNDFD rate (%/h), extent (% NDF), and lag time (h) did not differ between the methods (6.47, 47.4, 10.6 and 4.67, 45.2, 12.3) for alfalfa and straw respectively. Rep sums of squares was reduced with CG compared to GV (19 v. 228, $P < 0.018$), however mean NDFD estimates were similar (35.51 v. 35.94). These results suggest the modified ivNDFD method using rumen fluid primed with a mixture of carbohydrate and urea reduced run to run error and resulted in similar estimates of NDFD as the modified Goering and Van Soest method.

Key Words: In Vitro, NDF Digestion, Methods

TH55 Comparison of means and run to run variation of *in vitro* NDFD between two labs using different *in vitro* NDFD methods. J. P. Goesser*, L. M. Bauman, P. C. Hoffman, and D. K. Combs, *University of Wisconsin, Madison*.

This study compared the results and precision of a modified *in vitro* NDFD assay (CG), run in our research lab, to a modified Goering and Van Soest (1970) ivNDFD assay (COM) run at the UW-Marshfield Soils & Forage Laboratory (Marshfield, WI). Nine dried, ground (1mm) forage samples were evaluated in duplicate in three repetitions for 24, 30, and 48h ivNDFD by both laboratories, using a coded design where neither laboratory technician could identify the samples. The method in our research lab was: forage samples (0.5g) sealed in Ankom F57 forage fiber bags, were placed in 125ml Erlenmeyer flasks and incubated with Van Soest media and 10ml of rumen fluid. Rumen fluid inoculum was collected prior to feeding from two cannulated cows fed a high forage diet and was combined with buffer, reducing solution and 0.125mg priming mixture/ml rumen fluid and allowed to produce

0.3ml gas/ml rumen fluid prior to inoculation. The primer consisted of a mixture of carbohydrate and NPN substrates. NDF was analyzed using an Ankom²⁰⁰ forage fiber analyzer. The procedure at Marshfield was: forage samples (0.5g) were weighed into 125ml Erlenmeyer flasks and incubated with Van Soest media and 10ml of rumen fluid. Rumen fluid was from a cannulated cow fed a high forage diet. Samples were inoculated immediately after collecting rumen fluid. Feed and residual NDF was analyzed using the Van Soest method (<http://uwlab.dyndns.org/marshfield/>). In both labs, NDFD was determined as: $\text{NDFD (\% of NDF)} = 100 \times [(\text{NDF}_{0\text{h}} - \text{NDF}_{\text{residue}}) / (\text{NDF}_{0\text{h}})]$. Results were analyzed using a linear mixed model procedure, and repetition sum of squares were compared with an F-test to assess method repeatability. The rep sums of squares did not differ, but ivNDFD standard errors for CG and COM were 0.823 and 1.41, respectively. A rep by time interaction ($P < 0.001$) was evident for COM, which was not significant for CG. These data suggest the CG method, run in our lab, was more precise than the COM procedure run in a commercial setting across 24, 30 and 48h time points.

Key Words: In Vitro, NDF Digestion, Methods

TH56 Amount of sample NDF affects estimates of in vitro NDF digestibility. J. P. Goeser*, P. C. Hoffman, and D. K. Combs, *University of Wisconsin, Madison*.

The amount of forage sample dry matter is known to affect estimates of *in vitro* NDF digestibility (ivNDFD). The objective of this study was to determine if the amount of sample NDF also affects estimates of ivNDFD. *In vitro* NDFD of six forages (bm3 whole-plant corn and stover, normal whole-plant corn and stover, alfalfa silage, and wheat straw) were compared. Each forage was dried, ground (1mm), and weighed into Ankom F57 forage fiber bags to achieve 0.125, 0.25, or 0.5 g of NDF per sample bag. Sample dry matter weights ranged from approximately 0.15 to 1.5 g per bag. Samples were digested in duplicate using a modified ivNDFD assay for 0, 24, 30, or 48 h. Rumen fluid inoculum was collected and pooled from two cannulated donor cows. Inoculum was mixed with buffer, reducing solution and primed with a mixture of carbohydrates and nitrogen, and allowed to produce 0.3 ml gas/ml of rumen fluid mix prior to inoculating feed samples. NDF digestibility was calculated as: $\text{NDFD (\% of NDF)} = 100 \times [(\text{NDF}_{0\text{h}} - \text{NDF}_{\text{residue}}) / (\text{NDF}_{0\text{h}})]$ and data were modeled using SAS Proc Mixed. The model included fixed effects of NDF level, forage, time, and all interactions. Forage, time and NDF level all significantly ($P < 0.0001$) affected ivNDFD. As amount of sample NDF increased from 0.125 g to 0.5 g, ivNDFD decreased from an average of 39.78 to 28.03% of NDF across the three time points. Interactions were significant for NDF level and feed, feed and time, NDF level and feed and time, and tended to interact ($P < 0.059$) for NDF level and time. In conclusion, as the amount

of sample NDF increased, estimates of ivNDFD decreased for each forage. *In vitro* NDFD estimates were also affected by forage and time. These results suggest that differences in NDF digestibility due to factors such as forage maturity could be partially confounded by differences in the amount of sample NDF if forages are weighed into the *in vitro* systems by dry matter weight, rather than amount of sample NDF.

Key Words: NDF, In Vitro, NDF Digestion

TH57 Measures of acid detergent lignin recovery and evaluations of the 2.4 time lignin factor for estimating indigestible NDF. E. Raffrenato*, M. E. Van Amburgh, and P. J. Van Soest, *Cornell University, Ithaca, NY*.

The Cornell Net Carbohydrate and Protein System uses 2.4 times acid detergent lignin (ADL) in a ration with NDF to estimate indigestible NDF (iNDF) in forages (Chandler et al. 1980). Previous tests for nutritional uniformity indicated an average recovery of 86%. However, sintered glass filters with a 40 μm aperture might not achieve complete recovery of fine particles (Uden, 2006). The objectives of our study were to evaluate ADL recovery and to assess the ratio between ADL and iNDF after improved recovery of ADL in order to estimate iNDF. Thirty forage samples of various species and ADL content were analyzed for ADL content in Gooch crucibles of porosity of 40 μm , with or without glass microfiber filters (1.5 μm ; Whatman[®], 934-AH). The same samples were also fermented *in situ* for 16 d using bags of PPT monofilament fabric with porosity of 15 μm and an open area of 8.5% (Ankom Technology). The bags were inserted into a PVC tube and in the rumen of two fistulated dry cows. The same samples were also fermented for 16 d in the same bags in a Daisy Ankom System. Medium and rumen fluid were renewed every 4 d. All bags were analyzed for NDF after 16 d. Ratios between ADL and NDF, for estimation of iNDF, were back calculated with the iNDF obtained after the fermentations. Recovery of ADL varied among samples, but was generally higher using the filter paper. ADL recoveries were between 1 and 75% higher using the filter paper with higher recoveries for the lower ADL forages (corn silages and vegetative grasses). Long fermentations were consistent within specie for both *in-situ* and *in-vitro* procedures. The 2.4 factor was not constant and was impacted by the increased ADL recoveries. The observed ratio was higher in forages higher in ADL and NDF (2.4 to 4.2). Further, the observed ratio was lower in most corn silages and grasses and ranged from 1.4 to 2.5. The data suggest re-evaluation of the lignin procedure to improve recovery of lignin particles and the development of forage family and specie-specific equations for the estimation of the iNDF value.

Key Words: Lignin, NDF

Growth and Development: Nonruminant Species

TH58 Supplementation of arginine plus conjugated linoleic acid decreases the fat/lean mass ratio in rats. J. Nall*¹, G. Wu¹, K. H. Kim², S. B. Smith¹, and L. A. Ford¹, ¹Texas A&M University, College Station, ²National Institute of Animal Science, Suwon, Korea.

This experiment tested the hypothesis that the combination of dietary conjugated linoleic (CLA) plus arginine will decrease fat accumulation and increase muscle mass. Twenty-four male Sprague Dawley rats were assigned to treatments in a 2 × 2 factorial design with 6 rats per treatment group (control: 2.55% alanine + 1.5% canola oil; arginine: 1.25% arginine-HCl + 1.5% canola oil; conjugated linoleic acid (CLA; mixed isomers): 2.55% alanine + 1.5% CLA; arginine + CLA: 1.25% arginine + 1.5% CLA). There was no significant difference in food intake over the 5-wk treatment period. Both arginine and CLA increased final body weights ($P < 0.04$). Abdominal fat mass ($P = 0.08$) and the abdominal fat:lean body mass ratio ($P = 0.04$) were decreased by CLA but were unaffected by arginine. Epididymal fat pad weight was not affected by arginine or CLA ($P > 0.55$). CLA tended ($P < 0.07$) to decrease the plasma oleic/stearic acid ratio, primarily by increasing stearic acid, consistent with a depression ($P = 0.0001$) in the concentration of oleic acid in liver in CLA-supplemented rats. Conversion of ¹⁴C-labeled glucose and palmitic acid to total lipids and CO₂ in epididymal adipose tissue *in vitro* was unaffected by CLA. However, arginine decreased ($P = 0.02$) palmitic acid incorporation into total lipids in epididymal adipose tissue. Also, there was a significant arginine × CLA interaction for glucose incorporation into lipid in epididymal adipose tissue ($P = 0.02$). Arginine stimulated lipid synthesis from glucose in the absence of CLA, but had no effect in the presence of CLA. In liver, arginine increased the rate of conversion of glucose to CO₂ ($P = 0.06$). The combination of arginine plus CLA depressed the concentrations of plasma arginine and lysine ($P = 0.05$ and 0.04 , respectively). The data indicate that the combination of arginine plus CLA decreases the fat/lean mass ratio, which may be due to effects on the metabolism of both liver and adipose tissue. (Funded in part by the National Institute of Animal Science, Rural Development Administration, Korea.)

Key Words: Adipose Tissue, Arginine, Conjugated Linoleic Acid

TH59 Developmental regulation of delta-like protein 1 (DLK1) expression during chicken muscle development and regeneration. J. Shin*, D. Bae, J. A. Deilius, S. G. Velleman, S. Lim, J. D. Latshaw, M. P. Wick, and K. Lee, *The Ohio State University, Columbus.*

DLK1 has been known to be responsible for muscle hypertrophy of calipye sheep and diseases associated with muscle development as shown in human uniparental disomy (UPD) chromosome 14 and mouse UPD12. However, no study to date has shown the expression pattern of DLK1 during muscle development regarding its role in specific developmental stages. Therefore, we investigated the temporal expression and localization of DLK1 during specific stages of chicken muscle development. Chicken DLK1 (gDLK1) mRNA was significantly induced by 2-fold at day 1 after cell differentiation and thereafter gradually decreased in primary chicken myoblast cultures ($p < 0.05$). During mouse C₂C₁₂ cell differentiation, DLK1 protein, absent at D0, was expressed as early as D2 and reached maximal amounts at D4 when the myotubes were actively formed. DLK1 protein expression was decreased at D6 when the length and thickness of myotubes increased. During the muscle repair process

in chickens, gDLK1 mRNA expression was dramatically induced by 4-fold at day 7 after injury ($p < 0.05$), recapitulating the expression pattern observed in normal muscle development. Although gDLK1 gene expression decreased after hatching in both meat- (broiler) and egg-type (layer) chickens, broiler chicken muscle had 3-fold greater expression of gDLK1 compared to layers ($p < 0.01$). The temporal expression of DLK1 and localization of its protein in differentiated myoblasts and early myotube suggest its important role in these developmental processes. These findings provide a new insight into the role of DLK1 in muscle development, regeneration, and associated muscle diseases and support the DLK1 gene as a selection marker for superior muscling in food animals.

Key Words: Delta-Like Protein 1 (DLK1), Myotube Formation, Muscle Development

TH60 Serum amyloid A protein mediates the regulation of docosahexaenoic acid on the expression of porcine genes related to lipid metabolism. S. T. Ding*, C. H. Chen, and H. J. Mersmann, *Natioanl Taiwan University, Taipei, Taiwan, ROC.*

Serum amyloid A protein (SAA) is an apolipoprotein that may replace apolipoprotein A1 (apoA1). Porcine hepatic SAA mRNA is increased by dietary docosahexaenoic acid (DHA) treatment. The purpose of this study was to investigate the role of SAA protein in regulating gene expression related to lipid metabolism in pigs. We demonstrated that 100 μM DHA treatment significantly increased SAA and apoA1 mRNA expression in porcine hepatic cell culture ($P < 0.05$). Therefore, we produced porcine SAA recombinant protein and found that addition of 40 nM SAA to porcine preadipocytes in culture stimulated interleukin-6 (IL-6) mRNA expression ($P < 0.05$), similar to the biological function of SAA in human. We also found peroxisome proliferator-activated receptor γ (PPARγ) and PPARα mRNA were decreased (40% and 60%, respectively) in differentiated adipocytes after treatment with 2 μM SAA. In addition, the SAA treatment caused an increase in inflammatory cytokine gene expression (IL-6 and tumor necrosis factor α), and glycerol release ($P < 0.05$), indicating increased lipolysis. Because the expression of perilipin, a lipid droplet-protective protein, was reduced by the SAA treatment, we hypothesized that SAA increased lipolysis by decreasing the expression of perilipin, which would then allow an increase in hormone sensitive lipase activity. In conclusion, we demonstrated that the DHA-induced SAA gene expression decreased PPAR expression to consequently down-regulate the expression of several genes involved in lipid metabolism. Accordingly, SAA may play a role in mediating the function of dietary DHA on lipid metabolism and could be a factor regulating obesity.

Key Words: Porcine Adipocyte, Perilipin, Serum Amyloid A Protein

TH61 Exocrine pancreatic insufficiency arrests growth of young pigs even after the parenteral or enteral feeding of an elemental diet. S. Rengman*¹, O. Fedkiv¹, J. Botermans², J. Svendsen², B. R. Weström¹, and S. G. Pierzynowski¹, ¹Lund University, Lund, Sweden, ²Swedish University of Agricultural Sciences, Alnarp, Sweden.

Weaned pigs fed a commercial feed maintain normal growth while pigs with induced exocrine pancreatic insufficiency (EPI) show an arrested growth during the same conditions. Supplementation with a pancreatic enzyme preparation to the feed is known to normalise the growth of young EPI-pigs. Our aim was to further evaluate the importance of the exocrine pancreas of the growth in weaned pigs.

To induce EPI, the main pancreatic duct was ligated close to the duodenal papilla and then cut between the ligatures. Two weeks later the pigs were fitted with gastric fistulas and jugular vein catheters after which the pigs were given 10 days of recovery.

Conventional pigs were fed a commercial pig feed for young pigs, n=5, elemental diet (ED) intragastrically (ig), n=3 or intravenously (iv), n=3 during 6 days. Pigs with EPI were fed a commercial pig feed, n=6, ED ig, n=6, ED iv, n=6 or a fat-enriched diet (with or without pancreatic enzyme supplementation) during 6 days. The pigs received 0.504 MJ/kg/day of the commercial pig feed or the ED while 0.641 MJ/kg/day of the fat-enriched diet. Weekly weight gain was compared among the groups.

The three groups of pigs that were fed pig feed, ED ig or ED iv, all showed a normal increase in bwt, 14%/week, similar to ordinary production pigs. The recorded weight change in EPI-pigs that were fed pig feed, ED ig or ED iv spanned from -6 to 3% bwt/week. The significant difference in growth between conventional pigs and EPI-pigs was $p \leq 0.001$ for pig feed and ED iv and $p \leq 0.01$ for ED ig. The group that were fed a fat-enriched diet supplemented with pancreatic enzymes, showed a normalised growth, compared to the group receiving fat-enriched diet without pancreatic enzymes $p \leq 0.001$.

Conventional pigs maintain a normal growth independently of diet (pig feed or ED) and administration routes (enteral or parenteral) while the EPI-pigs showed an impaired growth or even lost weight when receiving the same treatments. A proper digestion and absorption of nutrients is not enough to maintain normal growth in weaned pigs with EPI.

Key Words: Pancreas, Growth, Pig

TH62 Indispensability of exocrine pancreatic function for the growth of young weaner pigs. O. Fedkiv*, S. Rengman, B. R. Weström, and S. G. Pierzynowski, *Lund University, Lund, Sweden.*

Data regarding the role of exocrine pancreatic enzymes for the growth of pigs of different ages is inconsistent. Thus, the aim of the study was to highlight the role of exocrine pancreas secretion for growth and performance of pigs in different age. The experiments were performed on 24 crossbred pigs. In order to develop exocrine pancreatic insufficiency (EPI), the pancreatic duct was ligated in 6 pigs at the age of 6 weeks (weaners, 10.5 ± 1.3 kg) and in 6 pigs at the age of 15 weeks (growers, 43 ± 5 kg). Parallel studies were performed on control pigs at age 8 weeks (13.2 ± 0.7 kg) and 15 weeks (37 ± 4 kg), respectively. The pigs were fed *ad libitum* during one hour, twice a day (in the morning and in the evening) with a commercial feed (Växtill 320, Lantmännen, Sweden). Weekly recordings of food consumption and growth were performed before, during and after supplementation with a pancreatic enzyme preparation (Creon® Minimicrospheres™, SolvayPharma GmbH, Hanover, Germany) starting 4 weeks after pancreatic duct ligation (PDL). PDL in weaners caused growth arrest while it had a little effect on the growth of growers. The daily weight gain (DWG) and daily feed consumption (DFC) in EPI pigs and corresponding controls one week before, one week during pancreatic enzyme supplementation (PES) and one week after are presented in the table below. Pancreatic

exocrine secretion is indispensable to ensure growth of weaner pigs while not for growers. Feed supplementation with a preparation of pancreatic enzymes improves appetite and ensures lower feed conversion in control and in EPI pigs.

Table 1.

Pigs	DFC before (kg/day)	DWG before (kg/day)	DFC during PES (kg/day)	DWG during PES (kg/day)	DFC after (kg/day)	DWG after (kg/day)
EPI weaners	0.33±0.06 ^a	0±0.1 ^A	0.46±0.07 ^b	0.29±0.04 ^B	0.29±0.06 ^a	0±0.3 ^A
Control weaners	0.85±0.09 ^c	0.67±0.1 ^C	1.1±0.07 ^d	0.83±0.2 ^C	1.3±0.13 ^c	0.67±0.16 ^C
EPI growers	2.2±0.3 ^{f,g,h}	1.1±0.36 ^D	3.2±0.6 ⁱ	1.4±0.26 ^D	3.0±0.86 ^h	0.72±0.25 ^C
Control growers	2.1±0.2 ^f	1.2±0.35 ^D	2.6±0.17 ^{f,g,h,i}	1.4±0.16 ^D	2.8±0.18 ^{g,h,i}	1.3±0.17 ^D

Different letters given with results describe statistical differences when $p < 0.05$

Key Words: Pigs, Growth, Exocrine Pancreatic Secretion

TH63 Effects of maternal low and high protein diets on body composition and skeletal muscle properties of newborn piglets. C. Rehfeldt, C. Kalbe, J. Block, G. Nuernberg, B. Stabenow, D. Loesel*, and C. C. Metzges, *Research Institute for the Biology of Farm Animals, Dummerstorf, Germany.*

To study the impact of maternal low and high protein intake on body composition and cellular properties of skeletal muscle of the offspring, 40 German Landrace gilts were artificially inseminated (age 8 mo, 148 kg) and fed iso-energetic diets (11.6 MJ ME/kg DM) with high (HP, 30%; n=14), low (LP, 6%; n=14) or control protein (CP, 12%; n=12) levels throughout gestation. The resulting median of litter size was 13. All piglets were weighed at birth and 4 of them were taken from each litter for detailed analyses.

Birth weight was lower in LP and HP compared with CP piglets (1.19, 1.22, 1.38 kg, respectively; $P < 0.01$). Preliminary data reveal that LP and HP piglets exhibited a higher percentage of internal organs ($P = 0.08$). The weight of the kidneys was significantly affected by diet ($P = 0.01$) with being increased in HP piglets. Within large litters (>13) HP piglets exhibited a higher percentage of skeletal muscle tissue than LP piglets (44.5 vs 41.6%; $P = 0.05$). Skeletal muscle characteristics were analyzed in *semitendinosus* (ST), *longissimus*, and *biceps femoris* muscles. Weight ($P = 0.09$) and circumference ($P = 0.02$) of ST muscle were affected by diet and tended to be lowered by 11% in LP piglets. On average of all muscles protein/RNA ratio was decreased by 12% in LP ($P < 0.05$), which was more pronounced in piglets of litters >13 showing also numeric decreases in protein concentration and creatine kinase activity ($P = 0.07$; 0.04, respectively, for diet*litter size class). Total DNA content in ST muscle was higher in HP compared with CP ($P = 0.09$; 12%) and LP ($P < 0.05$; 15%). The results suggest that a 50% decrease in protein supply to gilts during pregnancy impairs intrauterine growth and skeletal muscle development, in particular in piglets of large litters. In contrast, a respective increase in nutritional protein stimulates myonuclear proliferation, which may indicate a higher potential for postnatal lean growth. (supported by DFG, KA 1844/1-1, PAK 24).

Key Words: Pregnant Gilts, Muscle Cellularity, Development

TH64 Body composition of transgenic pigs expressing the myostatin pro domain. A. D. Mitchell* and R. J. Wall, *USDA-ARS, Animal Bioscience and Biotechnology Laboratory, Beltsville, MD.*

Previous results have shown that male mice expressing a myostatin pro domain construct (MLC-Pro) have increased body weight, more total body lean mass, and lower percentage of total body fat. Founder transgenic (TG) pigs were generated by standard pronuclear microinjection techniques using the same MLC-Pro construct. Subsequently, MLC-pro TG and littermate control pigs were produced by mating a G-2 TG boar with non-TG females. The purpose of this study was to use dual energy X-ray absorptiometry (DXA) to monitor, in vivo, the course of changes in body composition of female control (n = 19) and female MLC-Pro TG (n = 19) pigs between 60 and 120 kg BWT. The female TG pigs expressing the MLC-Pro construct has less total body

lean mass at 60, 100 and 120 kg BWT when compared to littermate controls ($P < 0.05$). Consequently, at the same weights the TG females had a higher ($P < 0.05$) percentage of total body fat (9.0 vs. 11.2, 14.4 vs. 19.3, and 15.3 vs. 20.9%, respectively). There was no difference in total body bone mineral content. When the pigs were restrictively fed at maintenance energy intake for eight weeks starting at either 60 or 100 kg BWT, the change in body composition was similar for TG and control pigs. Likewise, when the pigs restricted at 60 kg were subsequently fed ad libitum to 100 kg, the response was similar for TG and control pigs. These results indicate that TG female pigs expressing the MLC-Pro construct have a higher percentage of total body fat compared littermate controls and that these differences persist during a period of restricted intake.

Key Words: Swine, Myostatin, Body Composition

Growth and Development: Ruminant Species

TH65 Characterization of putative mammary stem cells in intact and ovariectomized prepubertal heifers. N. Korn¹, L. Riggs², R. M. Akers³, and S. Ellis*¹, ¹Clemson University, Clemson, SC, ²Louisiana State University, Baton Rouge, ³Virginia Polytechnic Institute and State University, Blacksburg.

Prepubertal ovariectomy impairs mammary development in heifers through poorly understood mechanisms that may relate to changes in stem cell physiology. A trial was conducted to determine whether ovariectomy alters the frequency or proliferative activity of mammary stem cells, as assessed by localization of retained bromodeoxyuridine (BrdU) label and detection of proliferative cell markers (Ki67) in parenchymal cell populations. At 35d of age, all heifers were injected with BrdU once per day (5mg/kg BW, iv in pH8.5 physiologic saline) for 5d to label putative stem cells. On d40, all animals underwent either an ovariectomy (OVX; n=17) or sham (INT; n=18) operation. Groups of heifers were sacrificed at 15d intervals to provide tissues for histologic analysis of parenchymal cells. At least 5 non-sequential sections per animal were stained for dual detection of Ki67 and BrdU. Statistical comparisons were complicated by heterogeneous variation and confounded effects of treatment (OVX vs. INT) on parenchymal growth. In control animals sacrificed at 40d age (n=2), BrdU- and Ki67-double positive (DP) cells were distributed throughout the basal, embedded, and luminal strata of the epithelium. At d55, there was a marked reduction in BrdU retention and DP cells in INT animals, but distribution of DP cells through the parenchymal strata was unaltered. In samples from d70 to d160 heifers, DP cells were very rarely observed in parenchyma from INT animals, primarily due to reduced BrdU retention. In OVX animals, abundant BrdU labeling was seen at d55 and d70, but very few DP cells were observed, likely because of reduced Ki67 labeling. Between d85 and d160, BrdU retention in OVX animals declined steadily and became almost undetectable at d160. Our data suggests that ovariectomy does not abruptly alter populations of mammary stem cells. Instead, ovariectomy reduces proliferation and may allow for gradual senescence.

Key Words: Mammary Stem Cells, Prepubertal, Ovariectomy

TH66 Cloning the promoter region for bovine phosphoenolpyruvate carboxykinase gene and identification of propionate responsive region. S. L. Koser*, M. Thomas, and S. S. Donkin, *Purdue University, West Lafayette, IN.*

Cytosolic phosphoenolpyruvate carboxykinase (PCK1) is a rate-limiting enzyme for gluconeogenesis that is sensitive to nutritional and hormonal status. Bovine genomic sequence data was scanned using BLAST to determine matches to the 5' end of mRNA for bovine PCK1 mRNA. A 1459 bp fragment of bovine PCK1 was cloned by PCR that included 221 nt corresponding to the 5' untranslated region and 1238 nt of the proximal promoter. Segments corresponding to -815, -409, and -251 through +197 of the promoter of the bovine PCK1 gene were ligated to the firefly luciferase reporter gene. Constructs were transfected into rat hepatoma (H4IIE) cells and tested for their ability to drive gene expression. Cotransfection with renilla luciferase reporter served as a transfection control. A promoterless vector and a reporter driven by the SV40 promoter served as negative and positive controls for the experiment. Transfections were established over a 5-h period and cells were exposed to either 2.5 mM propionate, or vehicle for 23 h. Cells were harvested and the abundance of firefly and renilla luciferase were

determined in cell extracts. All bovine PCK1 promoter constructs tested were capable of driving expression of luciferase. Basal expression, as the ratio of firefly to renilla luciferase activity, was enhanced ($P < 0.05$) from 0.28 to 1.09 when the size of the promoter construct was reduced from -815 to -409 but truncation to -251 did not further alter basal expression. Propionate induced ($P < 0.05$) expression of all constructs compared to controls although the response for the -215 construct was muted relative to constructs -815 and -409. When luciferase expression ratios were adjusted for basal activity the -409 promoter construct of PCK1 was most responsive to propionate and further truncation to -251 reduced ($P < 0.05$) this responsiveness (706 vs. 484 \pm 98 as a percent of control). The data indicate response elements for propionate are located within -251 and -815 of the bovine PCK1 promoter. Supported by USDA-CSREES NRI Grant no. 2006-35206-16646.

Key Words: Propionate, Liver, Gene Expression

TH67 Quantification of glucose-6-phosphatase mRNA abundance in liver of transition dairy cows. E. M. Cedeño*, S. L. Koser, and S. S. Donkin, *Purdue University, West Lafayette, IN.*

Glucose-6-Phosphatase (G6Pase) catalyzes the final reaction for both gluconeogenesis and glycogenolysis, hydrolyzing glucose-6-phosphate (G6P) to glucose and inorganic phosphate. The activity of G6Pase appears to be largely controlled on the transcriptional level and predominantly exerted by hormonal cues and reduced feed intake. Therefore we hypothesized that G6Pase would be responsive to the onset of calving in transition dairy cows. Eleven mature Holstein cows were given ad libitum access to feed (1.61 Mcal NE/kg) beginning 28 days prior to expected calving. After calving all cows received a diet containing 1.67 Mcal NE/kg. Liver biopsy samples were obtained on days -28, +1, and +28 relative to calving. Total RNA was extracted, reverse transcribed to cDNA and used in real time PCR analysis for G6Pase and glyceraldehyde-3-phosphate dehydrogenase (GAPDH). Primers spanning exon junctions were selected based on bovine genomic sequence data. Expression of G6Pase was compared among days relative to calving and analysis accounted for the effect of day and cow x day. There was a tendency ($P = 0.08$) for G6Pase mRNA to be elevated at calving. Abundance of G6Pase mRNA relative to GAPDH was 0.8 vs. 1.1 \pm 0.28 for -28 and +1 days relative to calving. G6Pase was elevated ($P < 0.05$; 1.80 \pm .28) at +28 days relative to calving and precalving abundance. The data indicate that increased expression of G6Pase at calving and postcalving in liver is part of the adaptation to increased hepatic glucose release in transition cows.

Key Words: Gluconeogenesis, Liver, Transition Cows

TH68 Plasma and tissue concentrations of glucose, acetate, propionate, lactate, and hydroxybutyrate in calves subjected to conventional and accelerated milk replacer programs. H. A. Weeks*, A. G. Rius, K. M. Daniels, R. M. Akers, C. Umberger, and M. D. Hanigan, *Virginia Polytechnic Institute and State University, Blacksburg.*

The objective of the study was to evaluate the effects of milk replacer (MR) composition and feeding rate on plasma, liver, and muscle glucose,

lactate, acetate, propionate, and hydroxybutyrate concentrations. It was hypothesized that high rates of MR intake would cause delayed initiation of rumination resulting in reduced plasma and tissue acetate concentrations. Plasma and tissue samples previously collected from 24 Holstein heifer calves were used for the analyses. Water and starter (20% CP, 1.43% fat) were offered ad libitum and calves were fed twice daily one of four MR (n=6/treatment). Treatments were: 1) control MR (CON; 20% CP, 20% fat fed at 441 g DM/d), 2) a high protein MR (HPLF; 28% CP, 20% fat) fed at 951 g DM/d, 3) a high protein high fat MR (HPHF; 27% CP, 28% fat) fed at 951 g DM/d, and 4) treatment 3 fed at 1431 g DM/d (HPHF+). All samples were deproteinized, lyophilized to dryness, reconstituted in phosphate buffered D2O containing 0.5 mM DSS as an internal standard, and subjected to nuclear magnetic resonance spectroscopy. Spectra were phase adjusted and baseline corrected before calculation of peak integrals. All peaks were normalized to a constant DSS peak area of 100. Plasma concentrations of acetate (P<0.001) and lactate (P<0.02) increased with age reflecting onset of rumination. Increased nutrient supply from MR resulted in significant increases in plasma glucose (P<0.001) and decreased plasma acetate (P<0.01). Plasma propionate, lactate, and hydroxybutyrate were not affected by treatment. Dietary treatments did not significantly affect metabolite concentrations in liver or muscle. However concentrations of glucose (P<0.001), acetate (P<0.001), propionate (P<0.05), and hydroxybutyrate (P<0.001) were significantly greater in liver than in muscle. It was concluded that increasing nutrient intake from MR delays onset of rumination, but changes in blood concentrations of metabolites were not reflected in tissue concentrations.

Key Words: Calf, Acetate, Glucose

TH69 Effect of β -mannanase enzyme mixture addition to soy-containing milk replacers on growth and health of neonatal calves. M. E. Van Amburgh¹, L. Nabte-Solis¹, E. B. Helmes², D. A. Ross¹, and T. D. Sonnenberg¹, ¹Cornell University, Ithaca, NY, ²ChemGen, Gaithersburg, MD.

The objective of this study was to evaluate the performance of a high protein, soy protein concentrate (SPC) containing milk replacer (MR) fed to pre-ruminant calves with or without β -mannanase-based enzymes prior to and during the weaning phase of growth. Fifty-six Holstein bull calves were purchased and randomly assigned to one of four dietary treatments. Calves were 14 \pm 12 d of age at the initiation of treatments and mean weight at assignment of treatments was 48 \pm 5.33 kg. Milk replacer was provided at 0.28 Mcal GE/kg BW^{0.75} during the first 7 days and then increased to 0.32 Mcal GE/kg BW^{0.75}. The positive control diet consisted of a commercially available MR formulated with all milk ingredients (Excelerate, MSC Specialty Nutrition, Dundee, IL, 28% CP, 15% fat). The remaining treatments received a soy-containing MR that was formulated with 50% of the protein replaced by a SPC (Profine VF, Solae Inc., St. Louis, MO). Two different levels of a feed enzyme product, SZP (ChemGen Corp., Gaithersburg, MD), were added to two of the three SPC-containing MR at the time of mixing to provide the four treatments: all milk MR; two SPC-containing MRs with two levels of the enzyme mixture measured by β -mannanase activity; and the SPC-containing MR with no added enzymes. Calves were fed MR from day 1 to 35, then on day 36 were offered a commercially available starter and weaned by day 56. Milk replacer intake and overall DMI were not different among treatments (P = 0.3) and overall DMI averaged 1.65 \pm 0.08 kg over the 63-day period. The enzyme treatments did not significantly affect DMI. Daily gain of calves among treatments were

not different (P = 0.3) through the study, and averaged 0.90 kg/d. Replacing 50% of the protein in a 28% CP all-milk MR with a low antigen SPC had no significant effect on calf growth or health. The addition of β -mannanase-based enzymes to the SPC containing MR showed a trend (P<0.08) towards increased feed efficiency and ADG of the calves.

Key Words: Calves, Soy Protein Concentrate, Enzymes

TH70 Effects of *Bacillus subtilis* natto on performance and morphological features of ruminal papillae in dairy calves. H. T. Zhang, J. Q. Wang*, D. P. Bu, S. Y. Luan, L. F. Deng, L. Y. Zhou, H. Y. Wei, and K. L. Liu, *Chinese Academy of Agricultural Sciences, Beijing, China.*

Two types of *Bacillus subtilis* natto culture (Na, N1) were added to the milk/starter to evaluate effects of natto culture on the growth of calves and development of ruminal papillae. 24 Holstein bull calves of 7 \pm 1d of age were divided into three groups. Natto was provided in two ways: first, natto cultures were mixed with milk and provided to all the calves. Calves were weaned until the intake of starter was up to 2% of their weight, and four calves were slaughtered randomly after weaning. In the second experiment, natto cultures were fed directly and the calves were slaughtered 8 weeks after weaning. Ruminal epitheliums at the area of ventral rumen sac were obtained. In the first experiment, weaning day of N1 group (49.7 d) shortened significantly when compared with the control group (57 d) (P<0.05). In the second experiments, average daily gain of N1 and Na group enhanced about 16.2% (P=0.09) and 22.1% (P=0.02), respectively. DMI data showed a similar pattern. Calves fed with natto culture enhanced carcass yield with remarkable difference (P=0.01). In respect of rumen papillae, the number and the surface of papillae per cm² mucosa of Na and N1 groups increased remarkably compared with control. Under electron microscope, we found the shape of the papillae of control was leaf-like, narrow stalk, clumping, parakeratotic and dark-brownish color. In contrast, papillae of Na and Ni groups were flattened, tongue-shaped and straw-colored. The shape and size of the ingesta which packed into the surface of papillae were also different. Results from the present study indicated that supplementation of natto culture could promote the development of rumen papillae and the growth of calves.

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Key Words: Calf, Ruminal Papillae, Natto

TH71 Increasing levels of dietary corn oil to grazing steers alters lipogenic gene expression. S. K. Duckett*, S. L. Pratt¹, and E. Pavan², ¹Clemson University, Clemson, SC, ²INTA, Balcarce, Argentina.

Subcutaneous adipose tissues were collected at slaughter from eighteen steers fed increasing levels of dietary corn oil [0 g/kg BW (NONE), 0.75 g/kg BW (MED) and 1.5 g/kg BW (HI)]. Steers rotationally grazed endophyte-free tall fescue pastures for 197 d and were supplemented individually with cottonseed hulls plus dietary corn oil level treatment. Subcutaneous adipose tissues were processed for RNA extraction. Relative gene expression of genes involved in lipogenesis [fatty acid synthase (FASN), acetyl Co-A carboxylase (ACC), lipoprotein lipase (LPL), stearoyl Co-A desaturase (SCD), Spot-14], transcriptional

events [peroxisome proliferators-activated receptors (PPAR γ), CCAAT/enhancer-binding proteins (C/EBP α), sterol regulatory binding proteins (SREBP-1), and STAT-5], and housekeeping (GAPDH and β -actin) was determined by qRT-PCR. At the MED level of oil supplementation, FASN and SCD mRNA expression were up-regulated ($P < 0.05$) by 1.4-fold compared to NONE. In contrast, FASN and SCD mRNA expression were down-regulated ($P < 0.05$) by 0.7- and 0.8-fold for HI versus NONE. LPL mRNA expression was up-regulated ($P < 0.05$) in HI vs. NONE and unchanged ($P > 0.05$) in MED vs. NONE. For the HI oil supplementation level, Spot-14, SREBP-1 and NFY were up-regulated ($P < 0.05$) compared to NONE. Relative expression of other genes (ACC, PPAR γ , C/EBP α , and STAT-5) were unaffected ($P > 0.05$) by dietary treatment. High levels of oil supplementation (8% dietary fatty acids, DM basis) to grazing steers up-regulated gene expression of key enzymes responsible for the uptake of dietary fatty acids (LPL), and down-regulated those involved in de novo fatty acid synthesis (FASN) and conversion of saturated to monounsaturated fatty acids (SCD).

Key Words: Beef, Supplementation, Gene Expression

TH72 Lipogenic gene expression in steers finished on high concentrate diets and pasture with or without energy supplementation. S. K. Duckett*¹, S. L. Pratt¹, and E. Pavan², ¹Clemson University, Clemson, SC, ²INTA, Balcarce, Argentina.

Twenty-eight Angus steers (289 kg) were finished on a high concentrate diet (85% concentrate/15% roughage; C), or endophyte-free tall fescue pastures with either corn grain supplement (0.52% BW; PC), or corn oil plus soybean hull supplement (0.10% BW corn oil plus 0.45% BW soybean hulls; PO), or no supplement (pasture only; P). Subcutaneous adipose tissues were processed for RNA extraction and fatty acid composition by GLC. Relative gene expression of genes involved in lipogenesis [fatty acid synthase (FASN), acetyl Co-A carboxylase (ACC), lipoprotein lipase (LPL), stearoyl Co-A desaturase (SCD), Spot-14], transcriptional events [peroxisome proliferators-activated receptors (PPAR γ), CCAAT/enhancer-binding proteins (C/EBP α), sterol regulatory binding proteins (SREBP-1), and STAT-5], and housekeeping (GAPDH and β -actin) was determined by qRT-PCR. SCD mRNA expression was up-regulated ($P < 0.001$) by 7-, 18- and 46-fold for PO, PC and C, respectively, over P. Monounsaturated fatty acid (MUFA) content (g/100g) was also increased ($P < 0.05$) by 21%, 38%, and 75% for PO, PC, and C, respectively, compared to P. FASN mRNA expression was up-regulated ($P = 0.0036$) by 4.6- and 8.8-fold for PC and C, respectively, compared to P. Palmitic acid, the end product of de novo fatty acid synthesis, was also increased by 24% and 55% for PC and C, respectively, compared to P. Finishing steers on a high concentrate diet (C) down-regulated ($P = 0.005$) STAT5 mRNA by 21-fold compared to pasture only (P). Spot-14 mRNA expression was up-regulated ($P < 0.0001$) by 3-, 2-, and 13-fold for PO, PC, and C, respectively, compared to P. Relative expression of other genes (ACC, LPL, PPAR γ , C/EBP α , and SREBP-1) were unaffected ($P > 0.05$) by dietary treatment. Corn grain fed as a supplement or in a high concentrate diet up-regulated gene expression of key lipogenic enzymes responsible for the conversion of saturated fatty acids to MUFA (SCD) and de novo synthesis of fatty acids (FASN).

Key Words: Beef, Supplementation, Gene Expression

TH73 Melengestrol acetate enhances adipogenic gene expression in an *in vitro* muscle-derived cell transdifferentiation model. K. Y. Chung* and B. J. Johnson, Kansas State University, Manhattan.

We hypothesized that within postnatal skeletal muscle there was a population of muscle cells that have unique characteristics to accumulate lipid droplet. Under appropriate stimuli, these particular cells could be induced down the adipose tissue pathway, to form marbling, rather than muscle. Muscle-derived cells (MDC) were digested from semimembranosus muscle tissue of three 14-month crossbred steers. Isolated MDC were plated on pre-coated matrigel plates. Addition of insulin, oleic acid, and ciglitizone (IOC) for 7 days resulted in morphological differences in MDC compared to control cultures. Multilocular lipid droplets stained with Oil-Red-O were located not only in single MDC but in fused myotubes. Relative PPAR γ mRNA levels in MDC incubated with IOC were increased ($P < 0.05$). However, myogenin mRNA levels in MDC incubated with IOC were repressed ($P < 0.05$) compared to non-treated MDC. Cultures of MDC treated with 10 nM estradiol (E₂) showed low lipid droplet compared with control cultures. However, cultures treated with 10 nM melengestrol acetate (MGA) resulted in cultures with highly distributed lipid droplets not only in single cell but in the myotubes. Relative C/EBP β and PPAR γ mRNA levels from MDC treated with MGA were increased ($P < 0.05$) compared to control cultures. Estradiol treatment had no effect on mRNA levels. The addition of both E₂ and MGA to MDC increased ($P < 0.05$) C/EBP β mRNA level and tended ($P = 0.06$) to increase PPAR γ mRNA level. Relative C/EBP β , PPAR γ , and myogenin mRNA levels were investigated with C2C12, C3H 10T(1/2), and 3T3-L1 cells. Treating cultures with 10 nM MGA increased ($P < 0.05$) C/EBP β level in C2C12 myoblasts and tended ($P = 0.08$) to 3T3-L1 preadipocytes. There was no difference ($P > 0.05$) in relative myogenin mRNA level among control, E₂, and MGA treatments. These data indicate that indeed there are populations of cells present in postnatal skeletal muscle that under the appropriate stimuli in a culture model will differentiate into adipogenic pathway. In addition, the synthetic progestin, MGA appeared to upregulate genes necessary for the adipogenesis in the MDC.

Key Words: Melengestrol Acetate, Transdifferentiation, Muscle-Derived Cell

TH74 More selenium (Se) accumulates in whole blood, red blood cells, and liver of beef heifers when supplemented by an organic vs inorganic source. S. F. Liao*, W. R. Burris, K. R. Brown, J. A. Boling, and J. C. Matthews, University of Kentucky, Lexington.

To determine if source of dietary Se supplement differentially affects Se concentrations of blood constituents and liver tissue in growing cattle, 30 Angus heifers (261 \pm 6 d of age) were fed a corn silage-based diet with no Se supplementation for 75 d. Heifers (BW 393 \pm 9 kg) then were randomly assigned to 3 mineral supplement treatments (n = 10) and individually fed the supplement plus 7.8 kg/d of a basal cracked corn and cottonseed hull-based diet for 105 or 106 d, using a Calan gate system (5 heifers/pen). The basal diet supplied 0.4 mg Se/d per head, whereas the mineral supplements provided no additional Se/d (control), 3 mg inorganic Se/d as sodium selenite (ISe), or 3 mg organic Se/d as Sel-Plex (OSe; Alltech, Inc.). Selenium effects on feed efficiency and Se content of blood and liver samples were analyzed by ANOVA. Treatments did not affect ADG (0.58 to 0.67 kg/d) or feed:gain (14.4 to

12.1). Although plasma Se content was not affected, Se in whole blood, red blood cells and liver of ISe and OSe treatment animals was 18 and 59%, 31 and 62%, and 31 and 81% higher ($P < 0.0001$), respectively, than for controls (Table 1). Moreover, whole blood, red blood cells, and liver tissue of OSe animals contained 35, 24, and 38% more ($P < 0.05$) Se than did ISe, respectively. These data show that more Se accumulates in the measured Se pools (except for plasma) of growing heifers when Se is supplemented in the organic (Sel-Plex) vs inorganic (sodium selenite) form.

Table 1. Effect of dietary selenium (Se) supplementation on tissue Se concentrations

Item	Control	Se supplementation		SEM	P value ¹
		Inorganic Se	Organic Se		
Whole blood, $\mu\text{g/mL}$	0.17 ^a	0.20 ^b	0.27 ^c	0.009	<0.0001
Red blood cells, $\mu\text{g/mL}$	0.26 ^a	0.34 ^b	0.42 ^c	0.011	<0.0001
Plasma, $\mu\text{g/mL}$	0.05	0.11	0.08	0.029	0.289
Liver ² , $\mu\text{g/g}$	0.26 ^a	0.34 ^b	0.47 ^c	0.027	<0.0001

^{a,b,c}Means within a row lacking a common superscript letter differ ($P < 0.05$). ¹P values associated with the ANOVA F test. ²Wet weight basis.

Key Words: Bovine, Se Supplementation, Se Tissue Concentration

TH75 Basal content of sugar transporter mRNA in small intestinal epithelia of beef steers is differentially increased by abomasal vs ruminal infusion of starch hydrolysate. S. F. Liao*, D. L. Harmon, E. S. Vanzant, K. R. McLeod, J. A. Boling, and J. C. Matthews, *University of Kentucky, Lexington.*

Glucose and fructose are absorbed from the small intestinal lumen by SGLT1 and GLUT5, respectively, whereas GLUT2 mediated the transport of glucose and fructose across both basolateral and apical membranes. To test that mRNA content of these transporters in duodenal (D), jejunal (J), and ileal (I) epithelia is differentially altered by ruminal vs abomasal infusion of corn starch hydrolysate (SH; by α -amylase, at 20% of ME intake), 18 ruminally and abomasally catheterized Angus steers (BW \approx 260 kg) were assigned to either water (basal), ruminal SH, or abomasal SH infusion treatments ($n = 6$) and fed an alfalfa-cube based diet at $1.3 \times \text{NE}_m$ requirement. After 14 or 16-d of infusion, steers were killed, small intestinal epithelia harvested, and total RNA extracted. Real-time RT-PCR analysis was conducted to quantify the relative (mRNA:18S rRNA) expression of SGLT1, GLUT5, and GLUT2. Basal expression of SGLT1 and GLUT2 mRNA was greatest ($P \leq 0.10$) by J, whereas J and D expression of GLUT5 mRNA was greater ($P \leq 0.07$) than I. GLUT5 mRNA content was not affected by SH infusion. In contrast, D SGLT1 mRNA content was increased ($P = 0.07$) 64% by ruminal SH infusion and abomasal SH infusion increased ($P \leq 0.05$) I expression of SGLT1 mRNA by 1.3-fold and GLUT2 mRNA by 6.0-fold. These results indicate that increased luminal SH increases the potential for glucose absorption across the I epithelium, increased rumen microbe-derived nutrient supply increases the potential for apical uptake of glucose (GLUT2), whereas fructose uptake potential (GLUT5) was not changed. When viewed with previous findings that SGLT1 activity is insensitive to increased luminal SH, the results also indicate that luminal substrate control of glucose uptake capacity in

cattle is complex. For GLUT2 and GLUT5, the findings in this trial are novel for cattle and suggest that GLUT2 activity may respond to luminal substrate supply.

Key Words: Bovine, SLC2 and SLC5 Gene Expression, Substrate Regulation

TH76 Roles of increased IGF-I expression and the estrogen 17β , androgen and IGF-I receptors in estradiol- 17β and trenbolone acetate- stimulated proliferation of cultured bovine satellite cells. E. Kamanga-Sollo¹, M. E. White¹, M. R. Hathaway¹, K. Y. Chung², B. J. Johnson², and W. R. Dayton*¹, ¹University of Minnesota, St. Paul, ²Kansas State University, Manhattan.

A combined estradiol 17β (E2)/trenbolone acetate (TBA) implant causes a significant increase in muscle IGF-I mRNA and both E2 and TBA stimulate a significant increase in IGF-I mRNA level in bovine satellite cell (BSC) cultures in media containing 10% fetal bovine serum (FBS). Even though treatment of cultured BSC with E2 or TBA in media containing 1% IGF-BP-3-free swine serum results in increased proliferation there is no effect on IGF-I mRNA expression, suggesting that increased IGF-I expression may not be responsible for anabolic steroid enhanced BSC proliferation. To further examine the role of estrogen, androgen and IGF-I receptors and their respective ligands in E2 and TBA-stimulated BSC proliferation, we assessed the effects of specific inhibitors on E2 or TBA-stimulated proliferation of BSC. Both ICI 182 780 (an estrogen receptor blocker) and flutamide (an inhibitor of androgen receptor) suppressed ($p < 0.05$) E2 and TBA-stimulated BSC proliferation, respectively. JB1 (a competitive inhibitor of IGF-I binding to the IGF-I receptor) reduced ($p < 0.05$) both E2 and TBA-stimulated proliferation in BSC cultures. Both the Raf-1/MAPK kinase (MEK)1/2/ERK1/2, and the phosphatidylinositol 3-kinase (PI3K)/Akt pathways play significant roles in the actions of IGF-I on proliferation and differentiation of myogenic cells. PD98059, an inhibitor of the MAPK pathway, and wortmannin, and inhibitor of the PI3K pathway, both suppressed ($p < 0.05$) E2 and TBA-stimulated proliferation of cultured BSC. Our data suggest that IGF-I plays a role in E2 and TBA stimulated proliferation of cultured BSC even in the absence of increased IGF-I expression.

Key Words: Anabolic Steroid, Satellite Cells, IGF-I

TH77 Effects of trenbolone acetate (TBA), Estradiol (E2) and combined TBA/E2 implants on muscle IGF-I and IGF-II mRNA levels in feedlot steers. M. S. Pampusch¹, M. E. White¹, M. R. Hathaway*¹, K. Y. Chung², B. J. Johnson², and W. R. Dayton¹, ¹University of Minnesota, St. Paul, ²Kansas State University, Manhattan.

We have previously shown that a combined TBA/E2 implant significantly increases IGF-I mRNA levels in longissimus dorsi (LD) muscles of feedlot steers by 28 days after implantation. Here we compare the effects of E2 (24 mg), TBA (120 mg) and combined E2 (24 mg)/TBA (120 mg) implants on IGF-I mRNA levels in the LD muscles of steers implanted for 28 days. Five yearling steers per group were implanted with each implant and 5 control steers received no implant. Steers were weighed weekly starting on d0 and muscle biopsy samples were taken from each steer on d0 (prior to implantation) and on d28. RNA was prepared from each sample and real-time RT-PCR was used to determine

the levels of IGF-I and IGF-II mRNA. Total weight gain over the 28 d period of the study was significantly greater ($p < 0.05$, $n = 5$) for steroid-treated steers than for control steers. The IGF-I mRNA levels in LD muscles of control animals were not different on d0 and d28. On d28 of implantation, the IGF-I mRNA level was 60% higher ($p < 0.05$, $n = 5$) in E2/TBA implanted animals than in control steers. Similarly, on d28 the LD muscle IGF-I mRNA level was 70% higher ($p < 0.05$, $n = 5$) in E2 implanted steers than in control animals. In contrast the TBA implant did not significantly increase LD muscle IGF-I mRNA levels after 28 days of implantation. Muscle IGF-II mRNA levels were not affected by any of the implants. These data suggest that E2 is responsible for the increased muscle IGF-I mRNA level observed in steers implanted with a combined E2/TBA implant.

Key Words: IGF-I, Anabolic Steroid, Muscle

TH78 Effects of androgen and estrogen (E2) receptor blockers and E2-conjugated BSA on estrogen and trenbolone acetate-stimulated IGF-I expression in cultured bovine satellite cells. E Kamanga-Sollo¹, M. E. White*¹, M. R. Hathaway¹, K. Y. Chung², B. J. Johnson², and W. R. Dayton¹, ¹University of Minnesota, St. Paul, ²Kansas State University, Manhattan.

Even though combined implants containing androgenic and estrogenic steroids are routinely used to enhance muscle growth in domestic meat producing animals, in particular cattle, there is no consensus concerning the mechanism by which they enhance muscle growth. A combined trenbolone acetate (TBA)/estradiol 17 β (E2) implant has been shown to increase muscle IGF-I mRNA level and satellite cell number in yearling steers. Additionally, TBA or E2 treatment of cultured bovine satellite cells (BSC) resulted in increased IGF-I mRNA expression. The objective of the present study was to further evaluate the mechanisms of TBA and E2 action on BSC. Flutamide, an androgen receptor blocker, suppresses ($p < 0.05$) TBA-stimulated IGF-I expression by cultured BSC indicating TBA functions through the classical androgen receptor. In contrast, ICI 182 780 (ICI), an estrogen receptor blocker, did not suppress E2-stimulated IGF-I expression in BSC cultures. In fact, treatment of cultured BSC with 100 nM ICI in the absence of E2 resulted in a 2-fold increase ($p < 0.05$) in IGF-I mRNA level. BSA-conjugated-E2 (E2-BSA) binds to estrogen receptor (ER)- α and ER- β but is not able to cross the cell membrane. E2-BSA (10, 100, or 300 nM) did not stimulate proliferation of cultured BSC indicating that E2-stimulated proliferation is mediated through classical intracellular ER receptors; however, 100 nM E2-BSA did stimulate ($p < 0.05$) IGF-I mRNA expression. These results raise the possibility that binding of E2 to cell surface receptors, rather than intracellular ER, is responsible for E2-stimulated IGF-I expression in BSC and suggest that the effects of E2 on IGF-I mRNA level in these cells may not be mediated through the classical genomic mechanisms involving ER- α and the AP-1 response element as it is in others tissues examined to date.

Key Words: IGF-I mRNA, Muscle, Receptor Blockers

TH79 Proglucagon and GLP-2 receptor mRNA distribution in the ruminant gastrointestinal tract. C. C. Taylor-Edwards*, D. B. Edwards, M. J. Doig, E. S. Vanzant, K. R. McLeod, J. A. Boling, J. C. Matthews, and D. L. Harmon, University of Kentucky, Lexington.

The role of glucagon-like peptide-2 (GLP-2) in ruminants is relatively unknown, despite its importance in the regulation of gastrointestinal growth in non-ruminants. This experiment investigated the mRNA expression pattern of proglucagon (GCG), the precursor of GLP-2, and the GLP-2 receptor (GLP-2R) in the ruminant digestive tract. Effects of nutrient supply on mRNA expression patterns and measures of gastrointestinal mass were tested using three infusion treatments: water (control) or an additional 20% of ME intake as starch hydrolysate into the rumen or abomasum. Eighteen ruminally and abomasally cannulated Angus steers (260 kg BW) were blocked by weight and randomly assigned to treatment ($n = 6$). Steers were fed an alfalfa-cube diet at $1.3 \times NEM$ requirement. Steers were infused for 19 to 21 d, with the first 7 d of the period used as an adaptation period to infusion in which the amount of starch hydrolysate infused was incrementally increased each day. Steers were killed, gastrointestinal tissues weighed, and epithelial samples obtained from the forestomachs (rumen, omasum, and abomasum) and intestines (duodenum, jejunum, ileum, and colon). After extraction of total RNA from collected epithelia, real-time PCR was used to determine the expression of GCG and GLP-2R mRNA relative to 18S rRNA. Treatment had no effect on empty BW or mass of most gastrointestinal tissues except the small intestine; abomasal starch infusion increased small intestinal weight (% empty BW) by 17% ($P = 0.003$) and 18% ($P = 0.002$) compared with water or ruminal starch infusion, respectively. Expression of GCG mRNA was 5000-fold greater ($P < 0.0001$) in intestines than forestomachs. Likewise, GLP-2R expression was 49-fold greater ($P < 0.0001$) in intestines than forestomachs. Although dietary treatment did not affect expression patterns of GCG and GLP-2R mRNA, these results describe the tissue distribution of mRNA for the GLP-2 precursor and the GLP-2 receptor in ruminants.

Key Words: Glucagon-Like Peptide-2, Ruminant, mRNA Expression

TH80 Effects of overfeeding adolescent ewe lambs on progeny growth. G. J. Eckerle*, R. V. Anthony, and R. K. Peel, Colorado State University, Fort Collins.

Adolescent lambs, impregnated by embryo transfer and fed ad lib throughout gestation, are reported to produce growth restricted offspring. It was our objective to determine if ad lib feeding of periparturient ewes following natural mating at the second observable estrus, impacted birthweight and postnatal growth characteristics of the offspring. Two replicate studies were completed, in which singleton-bearing ewe lambs were fed a complete gestational diet (11.4 MJ metabolic energy/kg DM) at a rate which met NRC gestational age requirements (MN; $n = 8$ year 1, $n = 7$ year 2) or were fed ad lib (15% refusal rate) throughout gestation (HN; $n = 6$ year 1, $n = 7$ year 2). There was no effect ($P \geq 0.10$) of gestational intake on lamb birthweight (year 1: 5.0 ± 0.23 vs. 4.9 ± 0.20 kg; year 2: 5.01 ± 0.42 vs. 5.68 ± 0.40 kg; MN vs. HN respectively), lamb abdominal circumference or crown-rump length. However, during year 2, neonatal death loss was increased in HN pregnancies (0% vs. 57%; MN vs. HN), due to increased ($P \leq 0.01$) dystocia (1.0 ± 0.0 vs. 3.5 ± 0.7 score; 1=no assistance to 5=cesarean section). During year 1, lambs were weaned at 80 days of age and fed ad lib (11.4 MJ metabolic energy/kg DM) until 140 days of age. Neither preweaning (0.32 ± 0.018 vs. 0.33 ± 0.015 kg/d, MN vs. HN) nor overall (0.28 ± 0.009 vs. 0.29 ± 0.010 kg/d; MN vs. HN) growth rate were effected ($P \geq 0.10$) by gestational intake. During year 2, lambs remained with their dams until they were weaned at 60d., and were fed ad lib until reaching the target slaughter weight (59 kg). Similar to year 1, no differences ($P \geq 0.10$) were observed in growth rate, target weight age, or in carcass characteristics (rib eye

area, back fat thickness and percent kidney pelvic and heart fat) collected at slaughter. Collectively, our results indicate that ad lib feeding adolescent ewe lambs, which conceived to natural service, does not impact fetal or postnatal growth rate of the progeny, but may result in increased dystocia rate and neonatal mortality.

Key Words: Peripubertal Lambs, Gestational Overfeeding, Progeny Growth Rates

TH81 Biological efficiency of crossbred beef cattle finished on feedlot and slaughtered with distinct body weights. R. Mello^{*1,3}, M. H. de Faria², A. C. de Queiroz³, F. D. de Resende², D S Henrique³, and F Maldonado², ¹Universidade Federal de Roraima, Boa Vista, RR, Brazil, ²APTA, Colina, SP, Brazil, ³Universidade Federal de Viçosa, Viçosa, MG, Brazil.

The objective in this trial was to assess the bionutritional efficiency of crossbred F1 Red Angus ± Nellore (1/2 RA 1/2 N) and F1 Blond D'Aquitain ± Nellore (1/2 BA 1/2 N) young bulls finished on feedlot and slaughtered with 480, 520 and 560 kg of shrunk body weight (SBW). A completely randomized experimental design in a 2 ± 3 (2 genetic groups ± 3 slaughter weights) factorial arrangement with six replicates was used. Data were analyzed in the SAS[®] software using initial SBW as a covariate. The table below shows the least-square means of ADG, DMI, gain to feed ratio (GFR), biologic multivariate nutritional index (BMNI), Kleiber ratio (KR) and residual feed intake (RFI). There was no difference among the different treatments for ADG. There was not significant effect for GG, SW and interaction on relative DMI (% BW and g/BW^{0.75}). As the slaughter weight rised the absolute DMI (kg/d) increased. The 1/2 BA 1/2 N young bulls slaughtered with 480 kg had lower (P<0.05) feed:gain ratio (5.2) than others (> 6.8), but GFR and KR didn't differ (P>0.05) among treatments. The 1/2 BA 1/2 N young bulls had lower (P<0.05) BMNI and RFI than 1/2 RA 1/2 N young bulls. The lighter young bulls had lower (P<0.05) BMNI in relation to the heavier young bulls. Thus, crossbred F1 Blond D'Aquitain ± Nellore young bulls and lighter animals are more bionutritionally efficient in the finishing phase on feedlot than F1 Red Angus ± Nellore and heavier animals.

Table 1. Least square means

	Genetic Group (GG)		Slaughter Weight (SW)		
	½ RA ½ N	½ BA ½ N	480	520	560
ADG, kg/d	1.490	1.614	1.636	1.475	1.544
DMI, kg/d	10.8	10.4	10.1 ^b	10.4 ^{ab}	11.4 ^a
DMI, % BW	2.21	2.15	2.18	2.15	2.20
DMI, g/BW ^{0.75}	104.8	100.8	101.5	100.9	106.1
GFR	0.139	0.156	0.161	0.142	0.140
BMNI	5.87 ^B	5.07 ^A	4.72 ^b	5.51 ^{ab}	6.19 ^a
KR	14.4	15.7	16.3	14.4	14.5
RFI	0.312 ^B	-0.327 ^A	-0.078	-0.085	0.140

Within a row, means followed by different capital letters and by different small letters differ (P<.05), respectively, among GG and SW by Tukey test

Key Words: Animal Performance, Feed Efficiency, Residual Feed Intake

TH82 Estimation of carcass and empty body chemical composition of Nellore and Caracu breeds. S. F. M. Bonilha^{*1}, L. O. Tedeschi², I. U. Packer³, A. G. Razook¹, L. A. Figueiredo¹, R. F. Nardon⁴, and G. F. Alleoni⁴, ¹Instituto de Zootecnia, Agência Paulista de Tecnologia dos Agronegócios, Sertãozinho, SP, Brazil, ²Texas A&M University, College Station, ³Universidade de São Paulo/ESALQ, Piracicaba, SP, Brazil, ⁴Instituto de Zootecnia, Agência Paulista de Tecnologia dos Agronegócios, Nova Odessa, SP, Brazil.

Linear regressions, based on 9-11th rib section chemical composition, were developed to estimate carcass and empty body chemical composition of 56 selected Nellore (NeS), 52 control Nellore (NeC), and 56 selected Caracu (CaS) bulls, with 20 to 24 mo of age at slaughter. Carcass composition was obtained after grinding, homogenizing, sampling, and analyzing edible fraction + bones. Empty body chemical composition was obtained after grinding, homogenizing, sampling, analyzing, and combining blood, hide, head + feet, viscera, and carcass. The percentages of water and ether extract (EE) were determined both on the rib section and on carcasses of group 1 (36 NeS; 36 NeC; and 36 CaS bulls). In group 2 (20 NeS; 16 NeC; and 20 CaS bulls) empty body percentages of water and EE were also determined. Linear regressions were developed between carcass and rib section compositions (for group 1) and between carcass and empty body compositions (for group 2). The interactions between chemical components and genetic groups in the developed equations were not significant (P > 0.05). The 9-11th rib section percentages of water (RW) and EE (RF) precisely predicted (r² > 0.75) the percentage of carcass water (CW): %CW = 29.0806 + 0.4873×%RW, r² = 0.81, SE = 1.06; %CW = 64.8316 - 0.3549×%RF, r² = 0.78, SE = 1.14. The percentages of RW and RF precisely predicted the percentage of carcass fat (CF): %CF = 10.4039 + 0.5179×%RF, r² = 0.86, SE = 1.26; %CF = 61.6067 - 0.6928×%RW, r² = 0.85, SE = 1.33. Linear regressions (r² > 0.75) between percentages of CF and CW and empty body water (BW) were found: %BW = -9.7560 + 1.1637×%CW, r² = 0.88, SE = 1.43; %BW = 73.1673 - 0.8274×%CF, r² = 0.88, SE = 1.41. Linear regressions (r² > 0.75) between percentages of CF and CW and empty body EE (BF) were found: %BF = 0.3667 + 1.0393×%CF, r² = 0.98, SE = 0.65; %BF = 101.3752 - 1.4095×%CW, r² = 0.91, SE = 1.47. Chemical composition of 9-11th rib section precisely estimated carcass percentages of water and EE. Good linear regressions were detected between carcass and empty body chemical composition.

Key Words: 9-11th Rib Section, Ether Extract, Water

Horse Species

TH83 Temporal variables of the Arabian and Morgan Western Pleasure Jog. M. Nicodemus* and A. Luckett, *Mississippi State University, Mississippi State.*

The western pleasure class is one of the most popular rail classes for the Quarter Horse, Paint Horse, Arabian, and Morgan. However, kinematic research defining western pleasure gaits is only available for the stock-type breeds. Therefore, the objectives of this study were to define the jog of the western pleasure Arabian and Morgan and to compare the jog of these two breeds. 7 registered Arabians and 7 registered Morgans showing in a western pleasure class at their respective national competitions were filmed at 60 Hz performing the jog. Carded judges for their respective breeds selected the horses and strides that were used in this study according to breed standards. Frame-by-frame analysis of 5 strides for each horse was performed to determine temporal variables. Means (standard deviations) were determined with duration variables given as a percent of stride duration. Effect of breed type for each variable was tested using a one-way analysis of variance ($P < 0.05$). Both breeds performed a symmetrical, 4-beat stepping gait with a lateral footfall sequence and diagonal couplets (Table). For both breeds, the majority of the stride was spent in the stance phase with the longest period of limb support being diagonal bipedal support (Arabian: $83 \pm 3\%$, Morgan: $77 \pm 3\%$) followed by quadrupedal support (Arabian: $12 \pm 1\%$, Morgan: $16 \pm 1\%$). Analysis of variance indicated no significant difference between breeds for the measured variables. The only distinguishing factor between the two breeds was that only the Arabian demonstrated pairing of the diagonal limbs as the limbs came off the ground. Due to this pairing of the diagonal limbs found only in the Arabian, the Arabian was the only breed that lacked a period of tripodal limb support with two hind limbs. The objective description of these gaits from these measured variables can be applied in the selection and evaluation of the western pleasure Arabian and Morgan.

	Arabian	Morgan
Velocity (m/s)	1.69±0.16	1.92±0.21
Stride Length (m)	1.57±0.19	1.86±0.17
Stride Frequency (strides/s)	1.08±0.08	1.03±0.04
Stride Duration (ms)	921±48	971±42
RF Stance (%)	58±2	60±1
LF Stance (%)	59±1	60±3
RH Stance (%)	56±2	59±2
LH Stance (%)	56±1	59±3
Tripodal-2 Fore (%)	5±4	5±3
Tripodal-2 Hind (%)	0±0	2±1
LF-RH Advanced Placement (%)	3±2	2±1
RF-LH Advanced Placement (%)	2±1	3±1
LF-RH Advanced Lift-Off (%)	0±0	2±1
RF-LH Advanced Lift-Off (%)	0±0	2±2

Key Words: Temporal Variables, Western Pleasure, Jog

TH84 Use of chicken vs. chukar (*Alectoris chukar*) egg yolk as components of freezing media for stallion semen. S. E. Harmon and G. W. Webb*, *Missouri State University, Springfield.*

Recent published reports have indicated a possible increase in post-thaw motility and viability for stallion spermatozoa when the chicken egg yolk

in the freezing media is replaced by that of other avian species (including duck, quail and pigeon). Two experiments were conducted to compare the affects of chicken vs. chukar (*Alectoris chukar*) egg yolk on post thaw motility of stallion spermatozoa. In each experiment, three ejaculates were collected from each of 4 stallions. Immediately post collection aliquots of each ejaculate were diluted 1:1 with INRA 96™ extender (IMV, International), centrifuged to remove the seminal plasma, split into 8 parts and resuspended with one of 8 fast freeze (experiment 1) or 8 slow freeze extenders (experiment 2) to a final concentration of 150×10^6 spermatozoa/ml. Aliquots frozen using the fast freeze method were diluted with extenders which consisted of Lactose-EDTA containing 4% glycerol and either 13, 16, 19, or 22% of either chicken or chukar egg yolk and allowed to equilibrate for 30 min and loaded into 0.5 ml straws. Prior to freezing straws were suspended 8 cm above the liquid nitrogen for 10 min. Aliquots frozen using the slow freeze method were diluted in INRA 96™ supplemented with 4% glycerol and either 2, 4, 6, 8% of either chicken or chukar egg yolk. Aliquots were then placed in a 23° C water bath for equilibration and cooling to 4° C over a 2 h period prior to freezing using the same procedure as (experiment 1). After a minimum of 2 wks storage two straws per ejaculate/treatment combination were thawed and evaluated for motility using CASA (CEROS®; Hamilton Research Inc, Beverly, MA). Post storage percentage of intact acrosomes of these same samples was evaluated following staining with Spermac Stain™ (FertiPro, Beernem, Belgium). Data were analyzed using a GLM procedure with a one-way ANOVA and Tukey's used to test differences between treatments. Within freezing method (fast vs. slow) there was no effect ($P \leq 0.05$) of egg yolk source on post thaw motility or percentage of intact acrosomes and therefore no advantage observed by substitution of chicken with chukar egg yolk as a component of freezing diluents for stallion spermatozoa.

Key Words: Stallion, Semen, Egg Yolk

TH85 Nutrient composition and selection preferences of forages by feral horses: The horses of Shackleford Banks, North Carolina. S. J. Stuska¹, S. E. Pratt^{*2}, H. L. Beveridge², and M. J. Yoder², ¹*Cape Lookout National Seashore, Harkers Island, NC*, ²*North Carolina State University, Raleigh.*

Health of the horses of Shackleford Banks is influenced by the nutritional composition of the plants that are consumed. Over the years, cases of developmental orthopedic disease have been observed in growing horses, which may be due to nutritional imbalances in the diet. However, assessing nutritive status of wild herbivores is challenging; it is difficult to accurately determine what is being consumed. Forage nutrient content analysis coupled with fecal analysis can give an estimate of the nutritive profile for the animal, though it does not determine total daily intake. Horses were observed and representative samples of what they were eating were collected during four seasons over two years. Samples were analyzed for DM, CP, Ca, P and DE (reported as DM). Fresh fecal samples were also collected and pooled during the second year of the study for microhistological analysis to estimate selection and proportions of plant species consumed. Significant differences in seasonal variation in plant consumption and nutritive content was determined with ANOVA. Plant selection and nutrient composition of the plant was significantly different across the seasons. In the fall, sea oats (*Uniola paniculata*) (41.6%), centipede grass (*Eremochloa ophiuroides*) (23.9%)

and smooth cordgrass (*Spartina alterniflora*) (12.5%) made up 78.0% of the horse's diet. In the winter, consumption of sea oats decreased by half, while the variety of plants consumed increased. In the spring, centipede consumption dropped in favor of increased sea oats, cordgrass, and pennywort. In the summer, sea oats (30%), centipede (14.8%) and cordgrass (19.5%) made up 64.3% of the horse's diet with other plants making up the difference. Cordgrass had the highest DE (2.28 ± 0.32 Mcal/kg) and CP ($10.2 \pm 2.1\%$) throughout the year. Sea oats and centipede had lower mean nutrient profiles over the seasons; 1.7 ± 0.05 Mcal/kg DE, $5.31 \pm 0.4\%$ CP and 1.8 ± 0.09 Mcal/kg DE, $5.07 \pm 1.4\%$ CP respectively. Given the average nutrient composition of the forages, high dietary intakes would be required for these horses to meet their nutritional needs. It is possible that nutrient deficiency contributes to growth problems observed in these horses.

Key Words: Feral, Horse, Nutrition

TH86 Estimation of body weight in ponies. G. S. Owen*¹, E. L. Wagner¹, and W. S. Eller², ¹Auburn University, Auburn, AL, ²Louisiana State University, Baton Rouge.

The ability to accurately estimate body weight in horses and ponies is of great benefit in the dosage of medication and anthelmintics, as well as in feeding management practices. An established formula is widely used to estimate the body weight of horses, where estimated weight (lbs), (kg) = (heartgirth² x body length)/(330 in³), (11880 cm³). The objective of this study was to validate the use of a weight estimation formula in ponies, which measure less than or equal to 14.2 hands (147.3 cm) at the withers. Sixty-eight ponies were weighed on a calibrated livestock scale, and measurements of heartgirth, body length and height at the withers were recorded. Mean pony height was 134.4 ± 10.8 cm, with a mean scale weight of 343.7 ± 82.6 kg and a mean body condition score of 5.7 ± 1.0 on a nine-point scale. A paired t-test determined that there was a significant difference ($P < 0.05$) between actual weight (343.7 ± 82.6 kg) and weight estimated by the established formula (310.2 ± 76.4 kg). Linear regression was used to fit the body measurements and weight data to a model based on the established formula. Due to the low n in the model, bootstrap estimation with 5000 replications was used to estimate the parameters. A new coefficient (299 in^3 , 10787 cm^3) was estimated in fitting the model ($R^2 = 0.99$). The estimated denominator was found to be significantly different from the denominator in the previous formula ($P < 0.05$). Inclusion of the new coefficient in the formula appears to reliably estimate the actual body weight in ponies.

Key Words: Pony, Weigh Estimation, Body Measurements

TH87 Basal insulin and glucose concentrations in horses of North Carolina. K. M. Owens*, S. E. Pratt, L. E. Dowler, and M. T. Cloninger, North Carolina State University, Raleigh.

In equines, research suggests an associative role of decreased insulin sensitivity (insulin resistance) in disease states such as laminitis and metabolic syndrome. There are little data available regarding values of insulin sensitivity among large horse populations due, in part, to the difficulty of quantification. Basal glucose and insulin concentrations have been used to estimate glucose and insulin dynamics. The objectives of this study were to determine ranges of basal glucose and insulin

concentrations in horses of North Carolina and to determine how these are related to management and innate factors (diet, age, gender, breed, etc.). Horse owners were solicited through various North Carolina equine publications and websites to identify volunteers. Horses (n = 366) were sampled at their home farms by one of three trained personnel between August and December, 2007. Owners completed a questionnaire with information pertaining to age, breed, medical history and exercise protocols. Also, body weight, feed intake and body condition score (BCS) was assessed by the authors. Blood samples were collected via jugular venipuncture for assessment of serum insulin (INS) and plasma glucose at least 4 hours post-feeding or exercise. The insulin: glucose ratio (I:G) was calculated from this data. Mean (\pm SD) INS and I:G were 13.7 ± 29.4 mIU/L and 3.2 ± 2.6 mIU/L/mM respectively. Both I:G and INS were positively correlated with age (I:G $r = 0.129$, $P = 0.025$; INS $r = 0.118$, $P = 0.040$) and BCS (I:G $r = 0.135$, $P = 0.019$; INS $r = 0.161$, $P = 0.005$). Neither body weight nor concentrate consumption (as % body weight) were related to INS or I:G. There were no significant differences among mares, geldings or stallions. Breeds had significantly different I:G ($P = 0.030$), with pony breeds being significantly higher than breeds such as the Quarter Horse. Pony breeds, older horses and those with high BCS should be carefully managed. Approximately 9% of horses sampled were hyperinsulinemic (defined as INS > 30 mIU/L) regardless of BCS. While not a quantitative measure of insulin sensitivity, hyperinsulinemia may indicate a risk for insulin resistance and associative conditions.

Key Words: Equine, Insulin, Glucose

TH88 Equine identification in the Amish community: An overview of a survey conducted in Pennsylvania. A. Swinker*, K. Vanderman, H. McKernan, A. Graeff, and B. Gill, The Pennsylvania State University, University Park.

Amish are a Christian settlement from Europe that settled in North America in the eighteenth and nineteenth centuries. The Amish relied heavily upon equid for transportation and farm work. Today they reside in 27 states. Pennsylvania's Amish population totals 4,294 households. About 70 percent of the US Amish live in Ohio, Pennsylvania, and Indiana; with Lancaster County, PA being the second largest settlement. Understanding the concerns of the Amish is essential to help NAIS (National Animal Identification System) with equine tracking and identification. The average Pennsylvania Amish household reported owning 5.6 equid. The objectives of this study were; 1) acquire an Amish population to survey, 2) sample the Amish community to measure their concerns and acceptance of NAIS and 3) to acquire questionnaires completed by Amish families. A total of 78 Amish households were asked to participate in the survey. Thirty-two families did participate in the survey. The survey was conducted by an enumerated written questionnaire and asked questions related to equine ownership, animal and premises identification. Surveys were edited for completeness, legibility, accuracy and validity. Data were analyzed, SPSS (SPSS Inc., Chicago, IL) for descriptive and inferential statistics. Sample consisted of 2 women and 30 men, 25 percent reported to be in the horse business. Eighty-seven percent of surveyed respondents refused to participate in the NAIS program, one person was willing to participate and 3 were uncertain. Eighty eight percent of respondents reported hearing about NAIS by word of mouth while 43 percent read about it in newspapers or breed magazines. Of those sampled only one had a premises ID number and four were unsure. Twenty Seven reported they did not have a premise ID number. When asked about their level of concerns the Amish report a high level of concern about recovering

lost or stolen horses. They also considered tracing sources of, spread of and notification of disease a high concern. However, confidentiality of information was rated moderate and an improved identification method for horses was of low concern.

Key Words: Equine, Amish, Identification

TH89 Equine show and event manager survey of resistance to the implementation of national equine identification. A. Swinker*, K. Vanderman, A. Graeff, K. Vines, and B. Gill, *The Pennsylvania State University, University Park*.

The NAIS (National Animal Identification System) is a program to identify and record the movement of animals in the event of a foreign animal disease outbreak. Survey objectives were to collect input from equine event managers concerning the National Animal Identification System and identify its application to the equine industry. A fifteen question on-line survey was developed related to emergency preparations, premises information, equine travel, NAIS opinion, and how NAIS could be incorporated into equine event management. The survey was sent to 250 email addresses reaching 243 equine show managers with representation from all 50 states and Canada. Shows of a variety of sizes were represented, ranging from large sanctioned breed shows to small local events. The survey was open to invited participants only. At the close of the data collection 152 people visited the site and 115 had completed surveys. The return rate was 47.3%. Seven addresses were undeliverable. Data were analyzed using SPSS (SPSS Inc., Chicago, IL) for descriptive and inferential statistics. Twenty-five percent of the surveyed managers reported being in favor of NAIS, 42% were neutral, 14% were unsure while 18% were opposed. Survey results showed a real need to educate equine show managers on the benefits of NAIS. When asked, at your equine event, would microchipping equid for identification be useful 40% reported that it would be useful to verify equine ID and prevent fraud. Thirty-seven percent reported it would prevent/deter theft of equid from the show grounds and 34% reported it would prevent the incorrect equine from being shown. However, 53% reported NAIS will increase paper work at events. Equine show and event managers reported some benefits of utilizing NAIS.

Key Words: Equine, Show, Identification

TH90 United States equine owner's survey on the implementation of national equine identification. K. Vanderman*, A. Swinker, H. McKernan, B. Gill, and R. Radhakrishna, *The Pennsylvania State University, University Park*.

A survey was designed to assess the composition of the equine industry, and identify resistance to and the impact of the National Animal Identification System (NAIS) on equine owners. A six-section, traditional paper survey was developed with questions related to ownership, emergency preparations, premises information, equine travel, NAIS opinion, and demographic characteristics. A mailing list of 10,010 name/addresses of horse owners was created representing 14 major equine groups. A sample (N= 2,783) received surveys randomly with follow up mailings, resulting in a response rate of 50.16%. SPSS (SPSS Inc., Chicago, IL) was used for descriptive and inferential statistics. Pearson's correla-

tion, simple linear regression and multiple regression were used to determine the relationship between select variables. Data showed that 55.5% of equine owners do not have a plan of action for their equid during a disaster and 80% do not practice biosecurity. The majority of owners (62.8%) reported they were not familiar with NAIS, 32.7% were somewhat familiar, and 4.2% were very familiar. Sixteen percent were interested in participating in NAIS, 52% were unsure, while 32% were not interested. Over 73% identify their equine by color/markings, followed by DNA (43.3%), tattoos (30.8%), and hair whorls (21.9). About 3% use microchipping to identify their equid. Approximately 81.4% were familiar with microchipping as a form of identification, and 21.7% own other animals that were microchipped. The majority of respondents were "very concerned" regarding tracing the source of a disease and eliminating its spread (47.5%), being notified about disease outbreaks in their area (57.5%), recovering lost or stolen equid (49.9%), and maintaining confidentiality of information (40.9%). Survey results indicated that equine owners should be educated about the spread of disease, the role of NAIS, and additional benefits of participation such as equine theft recovery. This education would assist the equine industry in its acceptance of NAIS.

Key Words: Equine, Identification, NAIS

TH91 Equine veterinarians and health care professionals survey of resistance to the implementation of national equine identification. N. Dreschel*, K. Vanderman, A. Swinker, E. Jedrzejewski, and J. Werner, *The Pennsylvania State University, University Park*.

The National Animal Identification System (NAIS) is a program to identify and track animals for disease monitoring. A survey was designed to evaluate equine health care professionals' attitudes towards NAIS and the application of NAIS to the equine industry. A twenty-seven question survey related to emergency preparations, premises information, equine travel, NAIS opinion, disease outbreaks, and how NAIS can be utilized in a veterinary clinic measured participants' responses. An online survey was e-mailed to equine veterinarians and health care professionals that were members of AAEP's (American Association of Equine Practitioners) chat group. This group represents veterinarians from all regions of the United States. The survey was available only to these invited participants and was not open to the public. At the close of the survey, 158 people have visited the survey site and 139 surveys were completed. SPSS (SPSS Inc., Chicago, IL) was used for descriptive and inferential statistics. Pearson's correlation, simple linear regression and multiple regression were used to determine the relationship between select variables. Of those who reported, 47% are in favor of NAIS, 4% are opposed, and 50% are neutral or unsure. When asked, "Do you feel that NAIS will be useful in quickly stopping the spread of a foreign animal disease?", 55% reported yes and 45% felt it would not. Equine health care providers rated their familiarity with NAIS as not at all familiar (17%), somewhat familiar (62%), or very familiar (21%). The majority of respondents (75%) do not use microchip numbers as part of their client database, although 53% are currently microchipping animals. Other studies have shown that equine owners receive the majority of their equine care information from their veterinarians. By further informing this group, there is an opportunity to increase awareness and education of NAIS.

Key Words: Equine, Identification, Veterinarians

TH92 Application of forensic science technique to the management of an endangered horse population. E. Bömcke*^{1,2} and N. Gengler^{1,3}, ¹*Gembloux Agricultural University, Gembloux, Belgium*, ²*FRIA, Brussels, Belgium*, ³*FNRS, Brussels, Belgium*.

Implementing conservation strategies needs the knowledge of relationships inside the concerned population. The aim of the study was to find tools to help breeders to manage populations with weak pedigree information. The Skyros pony is an indigenous Greek breed with breed risk status is defined as critical-maintained (Food and Agriculture Organization). Partial pedigree information is available, but its quality is poor as the average number of generation-equivalents is under 0.8 for the first known generation and under 1.4 for the second to the fifth. A method used in human forensic science and called Familial Searching was tested in this study to improve the pedigree. First, 99 living individuals were genotyped at 16 microsatellite loci. For ungenotyped animals, conditional expectation of gene contents was calculated given molecular and pedigree data. In Humans, Familial Searching is used, in addition to matching DNA evidence directly to criminal profiles, to search for people (present in a database) who are related to an individual that left the DNA evidence. This method is based on the calculation of decision statistics (likelihood ratio (LR)) between the genotype of an individual and the genotype of each other analyzed individual, where a higher LR indicates greater probability to be related, a value of zero means no probability to be related. The known pedigree was used as 'local' prior information, i.e. information related to specific pairs of individuals. General knowledge about the studied population (generation interval, sexual maturity, ...) was considered as 'global' prior information. Including prior information reduced the number of comparisons by over 50%. First results showed that the parents were always classified into the 5 highest LR. It also simplified parentage verifications, as it allowed the detection of 90% of false parentage (LR=0). By creating new links in the pedigree through the detection of unregistered parents, the percentage of animals with one or both unknown parents decreased and consequently the number of generation-equivalents increased. Therefore Familial Searching was found to be a useful tool to improve the pedigree of the Skyros breed.

Key Words: Likelihood, Pedigree, Horse

TH93 Sites of active nutrient absorption in the equine gastrointestinal tract. B. E. Aldridge*, T. B. Lescun, and J. S. Radcliffe, *Purdue University, West Lafayette, IN*.

Nine horses were used to investigate active nutrient absorption in the proximal (13.7 m from the ileocecal junction) and distal (9.1 m from the ileocecal junction) jejunum, ileum (5 cm from the ileocecal junction) and mid-right ventral colon using modified Ussing chambers. Immediately following euthanasia, intestinal tissues were collected and mounted in modified Ussing chambers to determine basal short-circuit current (I_{sc}), and to determine the capacity for active glucose, phosphorus, glutamine, and glycyl-sarcosine absorption in each portion of the intestine based on changes in I_{sc} following the addition of 10 mM of each compound to the mucosal buffer. Chambers were osmotically balanced by adding mannitol to the serosal buffer. Finally, carbachol was added to the serosal buffer to test for chloride secretory ability. Basal I_{sc} and active glutamine absorption were not different (P>0.10) between intestinal sections. Active glucose absorption tended (P<0.10) to be higher in the ileum than the proximal jejunum and right ventral colon with the distal jejunum being intermediate. Phosphorus absorption was higher

(P<0.02) in the right ventral colon (18.45 μA/cm²) compared to the proximal (7.9 μA/cm²) and distal jejunum (10.3 μA/cm²) and ileum (7.3 μA/cm²). Greater active absorption (P<0.05) of the di-peptide glycyl-sarcosine was observed in the distal jejunum and right ventral colon compared to the proximal jejunum, with the ileum being intermediate. Secretion of chloride ion, following a serosal carbachol challenge, was greater (P<0.01) in the right ventral colon (19.07 μA/cm²) compared to the proximal (3.97 μA/cm²) and distal jejunum (4.96 μA/cm²) and the ileum (3.04 μA/cm²). Based on the results of this experiment, the importance of each section of the intestine differs depending on the nutrient being evaluated.

Key Words: Nutrient, Absorption, Equine

TH94 Genistein reduces LPS stimulated TNFα release from equine monocytes. A. R. Taylor* and J. A. Clapper, *South Dakota State University, Brookings*.

Endotoxemia is often manifested by an overproduction of circulating proinflammatory cytokines, such as tumor necrosis factor-α (TNF) in response to lipopolysaccharide (LPS). Genistein is a non-steroidal tyrosine kinase inhibitor that has been shown to decrease the release of TNF from circulating monocytes in response to LPS. To further examine if genistein could be used to reduce LPS stimulated TNF release in the horse the following experiment was performed. Blood (180 mLs) was collected by jugular venipuncture from a mature healthy gelding and the isolated leukocyte rich plasma was layered over Histopaque 1077 and centrifuged to obtain an enriched monocyte population. Monocytes were washed twice in sterile PBS, counted, and diluted to 1 x 10⁷ cells/mL in RPMI 1640. Monocytes were then added to polystyrene tubes (4 x 10⁶ cells/tube) and incubated at 37°C in 5% CO₂ for 2 h to allow monocytes to adhere. Non-adherent cells were decanted and monocytes were covered with RPMI 1640 containing 1% FBS and 0, 1 pM, 1 nM, 10 nM, 1 μM and 10 μM genistein and incubated an additional hour at 37°C in 5% CO₂. Media was then replaced with media containing the various concentrations of genistein with and without 100 pg/mL LPS (*E. coli* O55:B5) and incubated for 6 h at 37°C in 5% CO₂ after which the supernatants were collected by centrifugation and frozen at -80°C until assayed for TNF by ELISA. Triplicate tubes were prepared for each genistein-LPS combination. Differences in supernatant concentrations of TNF-α were determined using the Proc Mixed procedure of SAS. Supernatant concentrations of TNF in tubes containing no LPS were not different (P>.05) and were at the detection limit of the assay. Supernatant concentrations of TNF decreased (P<.05) as genistein concentrations increased. Tubes containing 1 and 10 μM genistein produced less (P<.05) TNF than the 1 pM and 1 nM tubes in response to LPS, however, they were not different (P>.05) than LPS alone. These preliminary data suggest that genistein may be beneficial in reducing TNF release in response to LPS in the horse.

Key Words: Equine, Genistein, LPS

TH95 Effect of exercise and superoxide dismutase on systemic antioxidants and nitric oxide in horses. E. D. Lamprecht*, C. A. Bagnell, and C. A. Williams, *Rutgers, The State University of New Jersey, New Brunswick*.

The main objectives were to evaluate effects of exercise and oral superoxide dismutase (SOD) supplementation on systemic antioxidant status and nitric oxide (NO) in horses. Standardbred mares ($n = 12$) were used in this double blind, randomized crossover design. Horses were assigned to a treatment (TRT; 3 g/d of oral SOD powder with 3000 IU) or placebo (CON; 3 g/d cellulose powder) group. Mares were supplemented for 6 wks, completed a 6 wk wash-out period and were crossed over for another 6 wk supplementation. A repeated sprint exercise treadmill test (RSET) was conducted on d 28 (RSET 1,3) and d 42 (RSET 2,4) during each phase. Blood samples were collected before exercise (PRE), at peak effort (PEAK), 30 min, 2h, 4h, 24h, and 36h post exercise (POST). Samples were analyzed for plasma NO, erythrocyte total glutathione (tGSH) and glutathione peroxidase (GPx). Data were analyzed using a mixed model ANOVA with repeated measures in SAS. Results showed main effects for exercise test and sample time. Nitric oxide was higher for RSET 1 and 2 ($P < 0.01$) compared to RSET 3 and 4. A decrease in NO between 30 min POST and 4h POST ($P < 0.01$) was followed by an increase at 36h POST to pre-exercise values ($P < 0.01$). Relative to the other RSET, tGSH was lower ($P = 0.051$) and GPx activity was higher ($P < 0.01$) during RSET 4. Both tGSH ($P < 0.01$) and GPx ($P < 0.01$) were higher at PEAK compared to all other samples. No treatment effect of SOD was detected. Decreased NO levels for RSET 3 and 4 and increased GPx activity during RSET 4 may reflect a physiological adaptation to exercise or a change in reproductive hormone profile due to seasonal variation between trial phases. The NO peak at 36 h POST may indicate a delayed pro-inflammatory response to tissue microdamage. Elevated levels of tGSH and GPx at PEAK may be a compensatory antioxidant response to exercise-induced oxidative stress. Sample analysis for systemic SOD concentration and other markers of inflammation and oxidative stress is currently underway to identify benefits of oral SOD supplementation in horses.

Key Words: Equine, Oxidative Stress, Exercise

TH96 Evaluation of plasma alpha-tocopherol daily within-horse variation. P. D. Siciliano*, L. E. Dowler, and S. E. Pratt, *North Carolina State University, Raleigh.*

Two experiments were conducted to evaluate plasma alpha-tocopherol concentration (TOC) daily within-horse variation (Exp. 1) and to determine the effect of a single meal on plasma TOC (Exp. 2). In Exp. 1 venous jugular blood samples were collected from 4 pregnant (mo 6 to 7 of gestation) mares of light horse breeding (5 to 11 yr of age) between 730 and 830 followed by 8 hourly samples and analyzed for plasma TOC. All horses were fed 5 kg DM of grass hay 18 h prior to sample collection and received no additional feed during the sampling period. Water was always available. Results were analyzed using ANOVA for repeated measures design. Mean (\pm SD) plasma TOC over the sampling period for horses 1, 2, 3, and 4 was 3.75 ± 0.20 , 4.72 ± 0.15 , 4.23 ± 0.11 and 3.99 ± 0.12 $\mu\text{g/ml}$, respectively and was unaffected by time. In Exp. 2 seven horses 4 mares and 3 geldings of light horse breeding (3 to 12 yr of age) were randomly assigned to 1 of 2 treatments followed by reversal of treatments 24 h later: fasted (FST; $n = 7$) or fed (FD; $n = 7$). At 730 FD horses were offered 2.1 kg DM of grain-mix-concentrate (187 IU vitamin E/kg DM) plus 3.3 kg DM mixed grass hay while FST horses received no feed. Neither group received any feed for the period 18 h prior to 730. Venous jugular blood samples were collected at 1030 from all horses and analyzed for plasma TOC. Results were analyzed as a paired t-test using the PAIRED statement of SAS. The mean (\pm SD) within horse paired treatment difference was not significant (0.05

± 0.12 $\mu\text{g/ml}$). The results suggest within horse plasma TOC does not vary significantly over an 8-hr period in fasting horses and is unaffected 3 h following a hay grain meal.

Key Words: Alpha-Tocopherol, Horse, Vitamin E

TH97 Effect of selenium supplementation and dietary energy manipulation on mares and their foals: Foaling parameters and foal physical characteristics. B. J. Karren*¹, J. F. Thorson², C. A. Cavinder¹, C. J. Hammer², and J. A. Coverdale¹, ¹Texas A&M University, College Station, ²North Dakota State University, Fargo.

To investigate maternal plane of nutrition and role of Se yeast on foaling parameters and physical characteristics of foals, 28 Quarter Horse mares were utilized in a randomized complete block design. Mares were blocked by expected foaling date and assigned randomly within block to dietary treatments. Dietary treatments were arranged as a 2x2 factorial with two levels of nutrition, pasture or pasture plus grain (fed at 0.75% BW) and two levels of Se supplementation (0 or 0.3 mg/kg BW) equaling four treatment groups: pasture (P), pasture + grain (PG), pasture + grain + Se (PGS), or pasture + Se (PS). P and PS mares received approximately 100% of calculated NRC DE requirements, while PG and PGS received 120%. Selenium supplementation began 110 d prior to estimated foaling (d 0) and all dietary treatments were terminated at parturition. At parturition foaling parameters: time of water break to birth, time to stand, time to nurse, and time of birth to placenta expulsion were recorded. Colostrum samples were collected and quality estimated via refractometer and colostrometer. Placenta weight, foal birth weight, foal wither and hip height, foal body length, and total length of gestation were recorded. All data were analyzed using PROC GLM of SAS. Time of water break to birth, time to stand, time to nurse, time of birth to placental expulsion, placental weight, foal birth weight, wither and hip height, and body length were not affected ($P > 0.10$) by nutrition or Se supplementation. However, PG and PGS mares had greater BW ($P < 0.03$) prior to foaling, and greater colostrum refractometer values (Brix %) ($P = 0.01$). There was a nutrition x Se interaction ($P = 0.01$) with PGS mares having the shortest gestational length and PS mares having the longest. These data indicate that maternal plane of nutrition but not supplemental Se effects BW and colostrum quality (Brix %) of mares. Additionally, the interaction between nutrition and Se supplementation may affect gestational length. Despite differences in nutrition and Se supplementation there was no difference in foaling parameters or foal physical characteristics.

Key Words: Se, Foaling

TH98 Effect of selenium supplementation and dietary energy manipulation on mares and their foals: Placental dynamics. J. F. Thorson*¹, B. J. Karren², M. L. Bauer¹, C. A. Cavinder², J. A. Coverdale², and C. J. Hammer¹, ¹North Dakota State University, Fargo, ²Texas A&M University, College Station.

To investigate maternal plane of nutrition and role of Se yeast on placental dynamics, 28 quarter horse mares were used in a randomized complete block design. Mares were blocked by expected foaling date and assigned randomly within block to dietary treatments. Dietary treatments were arranged as a 2x2 factorial with two levels of nutri-

tion, pasture or pasture + grain (fed at 0.75% BW) and two levels of Se supplementation (0 or 0.3 mg/kg BW). This resulted in four treatments: pasture (P), pasture + Se (PS), pasture + grain (PG), and pasture + grain + Se (PGS). P and PS mares received approximately 100% of calculated NRC DE requirements, while PG and PGS received 120%. Selenium supplementation began 110 d prior to the estimated foaling (d 0) and all dietary treatments were terminated at parturition. At parturition, placental expulsion time and weight were recorded and two samples collected. Placental samples were placed in cryogenic vials, snap frozen in liquid nitrogen, and stored at -60°C until DNA, RNA and protein analysis. Samples were analyzed for concentrations of DNA and RNA using the diphenylamine and orcinol procedures. Protein in tissue homogenates was determined with Coomassie brilliant blue G, with bovine serum albumin as the standard. Concentration of DNA was used as an index of cell number, with protein:DNA and RNA:DNA ratios used as indices of cellular size and potential activity, respectively. All data were analyzed using a GLM model of SAS. There was no effect ($P \geq 0.20$) of Se or level of nutrition on cell number, potential cellular activity, placenta expulsion time, or placental weight. However, mares supplemented with Se had decreased ($P = 0.02$) placental cell size (32.50 mg protein/mg DNA) compared to mares not supplemented with Se (24.14 mg protein/mg DNA). Results indicate Se supplementation reduced cellular size without deviation in cell number or gross placental weight, while maternal plane of nutrition did not affect any placental parameters measured. Further studies are needed to understand the physiological significance of a reduced placental cellular size.

Key Words: Equine, Placenta, Selenium

TH99 Digestible energy requirements of two and three year old fillies receiving light exercise. J. E. Ringler*, B. D. Cassill, K. C. Watson, S. Hayes, and L. M. Lawrence, *University of Kentucky, Lexington.*

The National Research Council (NRC, 2007) recently published a method for calculating the digestible energy (DE) requirements of

growing horses receiving regular exercise. The method uses equations based on body weight (BW), age, average daily gain (ADG), and activity level. This study compared actual DE intakes of young horses receiving regular exercise to the DE requirements predicted using the NRC (2007) equations. Six fillies (five 2 year olds and one 3 year old, average BW of 450 kg) were individually housed and fed during four experimental periods (P), 35, 36, 25, and 28 d in length, respectively. Alfalfa cubes were offered at 1.4% BW in P1 and 1.5% BW in P2, P3, and P4. The amount of concentrate was adjusted to produce an ADG of approximately 0.2 kg/d. During P1 all fillies received the same concentrate; in P2, P3, and P4 fillies received either the P1 concentrate or one of two other concentrates, which were assigned as part of a different study. All fillies received the same light exercise (averaging 5 mph for 40 min, 5d/wk). Daily DE intakes and predicted DE requirements were averaged by period and horse and compared using paired t-tests. When individual horse data were averaged by period, the actual DE intakes (Mcal/d) were 21.1 (P1), 24.6 (P2), 24.7 (P3), 24.0 (P4), and were not different from the predicted requirements of 22.3, 23.2, 23.8, and 23.9, respectively ($P > 0.128$). When averaged within horse, the actual and predicted DE requirements (Mcal/d) were: Horse 1: 24.7 and 24.2 ($P = 0.544$); Horse 2: 21.8 and 20.6 ($P = 0.511$); Horse 3: 24.1 and 22.5 ($P = 0.405$); Horse 4: 24.1 and 21.7 ($P = 0.102$); Horse 5: 21.7 and 22.2 ($P = 0.509$); and Horse 6: 25.2 and 28.5 ($P = 0.263$), respectively. Predicted values ranged from 90.0 to 113.1% of the actual values. While a small number of horses were used, data from this study suggest the NRC (2007) equations predict the average actual DE requirements of two to three year old horses receiving light exercise, but that differences among individuals exist.

Key Words: Growth, NRC Equation, Prediction Equation

International Animal Agriculture

TH100 A model of personal preparation for the international agricultural teaching and extension program between the United States and China. J. Peng*, *Purdue University, West Lafayette, IN.*

There are prosperous agricultural education collaborations between the U.S. and China as a result of intensifying global economic integration. A globally competent person is one of the many factors that can affect the success of an international agricultural program between the U.S. and China. With growing globalization, the increased demand for qualified persons to fill international agriculture educator positions at colleges and universities prompted the idea of writing this paper. This autoethnographic study mainly draws on an animal agricultural educator's long-term personal life and professional agricultural education experiences in China as well as a six-year (2002-2007) personal life and professional agricultural education experiences in the U.S. This autoethnographic study specifically focuses on an animal agricultural educator's beliefs and practices relate to the U.S.-China culture and agricultural science learning. This autoethnographic study outlines the important personal preparation experiences that relate to the international agriculture teaching and extension program between the U.S. and China. The personal preparation experiences eventually build up the personal competence for the international agricultural teaching and extension program. Among the personal competence, the understanding of other cultures and languages is emphasized as a basic communication skill that is required to work in an international program. Personal motivation is another key competence that is required to work in any international program. Using the real examples of an international agriculture educator, this paper indicates the role as well as the specialization areas of individuals who plan to work in the international agricultural teaching and extension arena. Overall, this paper presents an innovative model of the preparation of an educator in the international agricultural teaching and extension area, with also the hope for the other educators and administrators to evaluate and generate their own 'ideal' personnel qualifications for that area.

Key Words: International, Personal Preparation, Agricultural Teaching and Extension

TH101 Energy and financial analysis of the conversion of a conventional beef cattle production system to an organic beef food-chain in Veracruz, Mexico. P. Fajersson*¹, G. Alvarado¹, G. Benítez¹, I. J. González¹, J. Nieto¹, W. Sangabriel¹, and P. Parada², ¹*Colegio de Postgraduados, Campus Veracruz, Veracruz, Mexico*, ²*Carnes La Rumorosa, Poza Rica, Veracruz, Mexico*.

Energy and financial analyses were conducted for the conversion of a conventional 730 ha pasture based 550 head beef cattle system (CPS) to an organic beef cattle foodchain (OBF), selling beef in 8 states in Mexico, to evaluate its sustainability and profitability over time. Visits to the OBF, interviews with the owner and a questionnaire were used to obtain production costs, quantify inputs and collect data to calculate the energy and financial costs before and after the conversion. In the energy analysis, the inputs used were identified, quantified, each assigned a value and then transformed into energy units (thousands of BTU) and compared, and also used to determine critical points of the foodchain to identify opportunities to improve resource use. A sensibility analysis of 3 future scenarios identified strengths and weaknesses in a dynamic environment. The fixed costs were USD 525,010 over time, but the

variable ones (USD 85,932 in the CPS) were less than in the OBF (USD 67,227). The marginal gain of the fixed costs were USD -448,296 and USD -368,682, respectively, while the difference between return on investment was 21% in the CPS and 63% in the OBF, which represents the real gain from the conversion. Using only the variable costs, the marginal gain was USD 86,407 for the CPS and USD 166,022 for the OBF, in a 1 to 1.92 ratio. The organic certification increases production costs, but guarantees access to value added markets. It is possible for the OBF to achieve the required increase in beef production to remain competitive without deterioration of natural resources in its low input, organic agroforestry system, but the economic gain depends on the value added to the organic beef. The energy flow reflected the utilization of natural resources and the values their direct and indirect use in generating beef for society. In this context, the OBF was more efficient, 0.65 compared to 0.45, and 3.2 times more efficient in producing a kg of beef than the CPS. The conversion increased the system's sustainability and the OBF remained profitable in all future scenarios.

Key Words: Organic Beef, Energy Efficiency, Profitability

TH102 A meta-analysis on effects of supplementing low quality roughages with tree foliages on intake and growth in sheep. A. K. Patra*, *West Bengal University of Animal and Fishery Sciences, Belgachia, Kolkata, India.*

A meta-analysis of data obtained from previous studies was conducted to understand the responses of foliage supplementation on intakes of basal DM (BDMI), total DM (TDMI), and daily gain (ADG). Thirty-four published studies containing 223 treatments and 1127 sheep met criteria for inclusion in the meta-analysis. Major predictive variables considered were percentages of foliages in diet (SPTP), CP in foliages (SCPP), CP in basal roughages (BCPP), CP in diet (CPP) and foliage CP intake (SCPI). TDMI (g/d) increased quadratically ($P < 0.001$) with increasing SCPP, SCPI ($R^2 = 0.66$), BCPP, SPTP ($R^2 = 0.58$) and CPP ($R^2 = 0.73$). The maximal TDMI was 778 g/d at 42% SPTP, 894 g/d at 19.8% CPP, 893 g/d at 148 g/d SCPI and 749 g/d at 26.4% SCPP ($P < 0.001$; $R^2 = 0.58, 0.73, 0.66, \text{ and } 0.37$, respectively). BDMI increased quadratically with increasing SPTP, CPP and BCPP; but decreased quadratically with increasing SCPP ($P < 0.001$; $R^2 = 0.07$). The breakpoint of BDMI was 570 g/d at 6.58% of CPP ($P < 0.001$, $R^2 = 0.28$). Overall, BDMI responded at very low level of SPTP, peaking at 7.6% SPTP with 572 g/d of BDMI ($P < 0.001$, $R^2 = 0.72$). However, when BCPP was less than 3%, the maximal BDMI was 489 g/d at foliage levels of 25.7%. When BCPP was between 3 to 6%, maximal BDMI was at 13% of foliage and the basal forage intake of 597 g/d; However, BDMI decreased linearly with SPTP when BCPP was greater than 6%. Foliage CP content did not influence on BDMI (g/d) when basal diets had CP percentage greater than 4%, but decreased quadratically with increasing SCPP when BCPP was less than 4%. ADG responded positively and quadratically to SCPP, SCPI, STPT, CPP and TDMI (g/d) and the relationships were moderate to high. Maximal ADG was 42 g/d at 43% SPTP, 41 g/d at 9.4% CPP, 42 g/d at 53 g/d SCPI, 35 g/d at 25% SCPP and 46 g/d at 889 g/d TDMI ($P < 0.001$; $R^2 = 0.74, 0.84, 0.74, 0.29 \text{ and } 0.74$, respectively). Results indicate that the interactions of quality and quantity of foliage and quality of basal forage influence the intake of DM and animal performance in sheep.

Key Words: Foliage Supplements, Meta-Analysis, Intake

Lactation Biology

TH103 Identification of internal controls for quantitative PCR in mammary tissue from lactating cows receiving various lipid supplements. A. K. G. Kadegowda^{*1}, M. Bionaz², B. Thering², L. S. Piperova¹, R. A. Erdman¹, and J. J. Loores², ¹University of Maryland, College Park, ²University of Illinois, Urbana.

Dietary lipid supplements affect mammary lipid metabolism through changes in lipogenic gene expression. Quantitative PCR (qPCR) is one of the most sensitive, reliable, and accurate techniques available to date for gene expression analysis. However, variation introduced in qPCR data by analytical/technical errors needs to be accounted for via normalization using appropriate internal control genes (ICG). Objectives were to mine individual bovine mammary microarray data on >13,000 genes across 66 cows from two independent studies to identify the most suitable ICG for normalization of qPCR. In addition to unsupplemented control diets, cows were fed saturated or unsaturated lipids (fish oil, Energy Booster) for 21 d, or were infused with supplements (Butterfat, CLA mixture, long-chain fatty acids) into the abomasum to modify milk fat synthesis and fatty acid profiles. GeneSpring[®] GX identified 49 genes that did not vary in expression across the 66 samples. Subsequent gene network analysis revealed that 22 of those genes were not co-regulated. Among those, COPS7A, CORO1B, DNAJC19, EIF3K, EMD, GOLGA5, MTG1, UXT, MRPL39, GPR175, and MARVELD1 (sample/reference expression ratio = 1 ± 0.1) were selected for qPCR analysis upon verification of goodness of BLAT/BLAST sequence and primer design. Relative expression of B2M, GAPDH, and ACTB, previously used as ICG in bovine mammary, was highly unstable (0.9 ± 0.6) across studies. Gene stability analysis, via geNORM software, uncovered EMD, MARVELD1, MRPL39, GPR175, UXT, and EIF3K as the most stable genes and, thus, suitable as ICG. geNorm also indicated that use of 3 to 5 ICG was most appropriate for calculating a normalization factor. Overall, results showed that the geometrical average of at least three among EMD, MARVELD1, MRPL39, GPR175, UXT, and EIF3K is ideal for normalization of mammary qPCR data in studies involving lipid supplementation of dairy cows.

Key Words: House Keeping Genes, Quantitative PCR, Lipid Supplements

TH104 Gene network analysis in mammary tissue of lactating cows receiving abomasal infusions of butterfat, long-chain fatty acids, or CLA. A. K. G. Kadegowda^{*1}, L. S. Piperova¹, S. L. Rodriguez-Zas², R. E. Everts², H. A. Lewin², R. A. Erdman¹, and J. J. Loores², ¹University of Maryland, College Park, ²University of Illinois, Urbana.

Abomasal infusion of butterfat and long-chain fatty acids (LCFA) induced the most contrasting responses in the concentrations of milk FA with ≤ 16 -carbons (greater with butterfat) and polyunsaturated FA (greater with both) relative to control. To better characterize gene networks associated with lipid synthesis and other cellular processes that might be responsive to dietary lipid, mammary tissue from lactating cows receiving no lipid (control; $n = 6$) or abomasal infusions of 400 g/d butterfat ($n = 4$), 245 g/d LCFA (59% cocoa butter + 36% olive oil + 5% palm oil; $n = 4$), or 100 g/d conjugated linoleic acid (CLA, 10 g of t10c12 CLA; $n = 6$) was used for gene expression analysis. Transcript profiling was conducted with a 13,257 bovine oligonucleotide (70-mers)

array. Annotation was based on similarity searches using BLASTN against human, mouse and bovine RefSeq, human, mouse, and bovine UniGene, and bovine TIGR. Cy3- and Cy5-labelled cDNA from mammary and a reference standard were used for hybridizations. ANOVA ($P \leq 0.01$) identified >300 differentially expressed genes in mammary due to treatments. Relative to control, LCFA infusion resulted in 295 genes and butterfat in 101 genes with changes in expression of 1.5-fold or greater. Gene network analysis identified inflammatory response (54 genes), cell growth/proliferation (104 genes), and cell death (90 genes) as modified families of related genes due to LCFA vs. control. Similar analysis in cows receiving butterfat identified lipid metabolism (14 genes), molecular transport (15 genes), and cell morphology (16 genes) as gene families most affected. Interestingly, signaling pathways most affected by butterfat included acute-phase response and complement system. Overall, results indicate that supply of short and medium chain FA (butterfat) vs. LCFA affect expression of previously-unrecognized cellular gene networks.

Key Words: Lactation, Genomics, Fatty Acids

TH105 Differential expression of lipid transporters and their regulators during the lactation cycle in the bovine mammary gland. O. Mani¹, M. T. Sorensen², K. Sejrsen², R. M. Bruckmaier^{*1}, and C. Albrecht¹, ¹University of Bern, Switzerland, ²University of Aarhus, Denmark.

The transport of lipophilic compounds across mammary gland (MG) epithelial cells determines milk lipid content and composition. ATP-binding cassette (ABC) transporters are known to play a pivotal role in cellular lipid efflux. As only scarce information is available about the transfer of lipids and cholesterol in the MG, we investigated the expression of lipid transporters and their regulators during lactation and dry period (DP) in dairy cows.

Repeated MG biopsies were taken from 10 cows at the end of lactation (d 347), during DP (d 48, 16 ante partum - ap) and subsequent lactation (d 14, 42, 88, 172 post partum - pp). mRNA levels of ABCG2, ABCA1, ABCA7, ABCG1 and NPC1, their regulatory genes LXRA and PPARg, and regulators of sterol synthesis SREBF1 and SREBF2 were determined by real-time RT-PCR.

mRNA levels of ABCG2 were significantly increased pp and throughout lactation as compared to the DP ($P < 0.0001$). ABCA1 and ABCA7 were elevated during the DP ($P = 0.0197$ and < 0.0001 , resp.) as compared to mid and late lactation and downregulated pp ($P = 0.0443$ and 0.0003 , resp.). ABCG1 showed no significant changes between the different functional stages of the MG. The intracellular cholesterol transporter NPC1 as well as LXRA and PPARg were elevated pp ($P = 0.0003$, 0.0271 and 0.0375 , resp.). SREBF1 was increased throughout lactation ($P < 0.0001$) as compared to the DP; a similar but not significant expression pattern was observed for SREBF2.

These results indicate that lipid transporters show differential expression between lactation and DP. This may be due to physiological changes in the MG like immigration of macrophages or accumulation of fat due to loss of liquid in the involuting MG. To test these hypotheses and to elucidate underlying molecular mechanisms cellular localization of candidate transporters in the MG will be investigated.

Key Words: Mammary Gland, Lipid Transporter, Dairy Cow

TH106 Unprotected conjugated linoleic acid (CLA) negatively affects milk production and secretion of milk components in dairy ewes. D. E. de Oliveira*¹, M. P. Soares¹, F. J. Bianchetti¹, R. Fornazier¹, M. R. Fachinello¹, M. Girardi¹, D. Fernandes¹, D. Soster¹, M. A. S. da Gama², M. G. C. D. Peixoto², S. de O. Juchem³, and L. O. Tedeschi⁴, ¹Universidade do Estado de Santa Catarina, Chapecó 89801-070, SC, Brasil, ²Embrapa Gado de Leite, Juiz de Fora, MG, Brasil, ³University of California, Davis, ⁴Texas A&M University, College Station.

Feeding conjugated linoleic acid (CLA) in a rumen-inert form to dairy ewes has been shown to increase milk production, alter milk composition, and increase the CLA content in milk fat. However, few studies utilized unprotected CLA sources. The objective of this study was to evaluate the effects of an unprotected CLA supplement (28% of c-9, t-11 and 28% of t-10, c-12 isomers) on milk yield and composition of dairy ewes. Twenty four lactating Lacaune ewes (40 to 70 DIM) were used in a cross-over design and received two treatments: 1) Control (C) and 2) CLA (30 g/d). The CLA supplement was mixed into the concentrate (1.2 kg/d, as-fed) and fed in two equal meals after morning and afternoon milkings. Ewes were individually fed 2.5 kg/d of corn silage and grazed a pasture of annual ryegrass and white clover. Each experimental period consisted of 21 d: 7 d for adaptation and 14 d for data collection. All ewes were fed the C diet for 7 d before the second collection period to prevent any carry-over effect. Milk production was daily recorded and milk samples were collected at each milking and a daily composite was obtained. Milk samples were analyzed for contents of fat, protein, lactose, and somatic cell count (SCC). Data were analyzed as repeated measurement design using PROC MIXED procedure of SAS, assuming period and ewe within treatment sequence as random effects. The CLA treatment decreased milk fat content (CLA = 3.86, C = 5.62%; P<0.01, SD=0.15), milk yield (CLA = 1.73, C = 1.88 kg/d; P<0.01, SE=0.08) and milk lactose content (CLA = 4.48, C = 4.55%; P<0.01, SD=0.06). Ewes fed CLA had greater milk protein content (CLA = 5.00, C = 4.91%; P<0.01, SE=0.06) and linear SCC score (CLA = 3.93, C = 3.34; P<0.01, SE=0.25). Secretion of all milk components was reduced by CLA. As previously shown in dairy cows (Bell and Kennelly, 2003, JDS 86:1321-1324 and Keating AF et al., Domest. Anim. Endocrinol (2007)), it is possible that relatively large amounts of c-9, t-11 and t-10, c-12 CLA isomers might have reached the abomasum of these ewes and resulting in precocious involution of mammary gland.

Key Words: Conjugated Linoleic Acid, Mammary Gland, Milk Components

TH107 Effects of rumen-protected choline administration on mRNA expressions of selected enzymes involved in mammary lipid metabolism. L. Pinotti*¹, F. D'Ambrosio¹, R. Bruckmaier², C. Albrecht², V. Dell'Orto¹, and A. Baldi¹, ¹University of Milan, Milan, Italy, ²University of Bern, Bern, Switzerland.

Aim of this study was to investigate the effects of rumen-protected choline administration on mRNA expressions of selected enzymes involved in mammary lipid metabolism. Eight pregnant multiparous Saanen goats were assigned to one of two experimental groups: CTR, control group, no choline supplementation; RPC, supplemented with 4 g/day choline chloride in rumen-protected form (Sta-Chol 50%, Ascoc Chimici, Forli, Italy). Treatment was administered individually from day -30 to day 30

relative to kidding. Through the first month of lactation milk yield and composition were measured weekly. On day 28 in milk, from the same animals mammary tissue samples were collected under sterile conditions. Samples were stored at -80°C until RNA extraction. Synthesis of cDNA was performed by reverse transcription-polymerase chain reaction. Glyceraldehyde 3-phosphate dehydrogenase and beta-actin were chosen to confirm a constant gene expression level in the investigated total RNA extractions. Quantitative analysis of PCR products was carried out from cDNA fragments of FAS (Fatty acid synthase), LPL (Lipoprotein Lipase), SREBP-1 (Sterol regulatory binding protein-1), SREBP-2 (Sterol regulatory binding protein-2), and PPAR γ (Peroxisome proliferator-activated receptor gamma). mRNA expression levels have been normalized to GAPDH relative to total RNA and presented as logarithm dualis. Data were analyzed by the general linear model procedure of SAS. Milk yield and milk composition did not differ between groups. Moreover, choline supplementation did not affect the mRNA expressions of the enzymes involved in mammary lipid metabolism. However, present results are based on a limited number of goats, thus possible choline effects at mammary gland levels in lactating dairy goats deserve further investigation.

Key Words: Choline, Mammary Gland, Lipid Enzymes

TH108 Hormonal influence on mammary tissue composition in pre-pubertal Holstein heifers. B. P. Hudson*¹, B. T. Velayudhan¹, S. E. Ellis², and R. M. Akers¹, ¹Virginia Polytechnic Institute and State University, Blacksburg, ²Clemson University, Clemson, SC.

It is known that mammary gland growth and development are hormonally regulated. However, hormonal regulation is poorly understood in pre-pubertal heifers. The purpose of these two studies was to evaluate the effects of exogenous bovine somatotropin (bST) or ovariectomy on mammary tissue composition in pre-pubertal Holstein heifers. In a first experiment, 19 heifers (7 \pm 4 d of age) were randomly assigned to one of two treatments bST (500 mg; n=10) or placebo (0.9% saline; n=9). Animals were administered treatments every three weeks beginning on day 23. All animals were fed milk replacer and calf starter for eight wk and thereafter starter and hay. Mammary parenchyma (PAR) and fat pad (MFP) were harvested for analysis of protein, lipid and DNA at two times (after the second or after the fourth injection). There was a significant increase in total DNA, total protein, DNA/100 kg BW and protein/100 kg BW due to day and a significant treatment by day interaction on DNA and lipid concentration in PAR. In MFP there was a treatment by day interaction for DNA and protein/100 kg BW. In the second study, 36 heifers were randomly assigned to one of two treatments, ovariectomy (OVX; n=18) or sham (INT; n=18). All animals were fed traditional milk replacer and calf starter. Treatments were applied on 40 d of age and mammary samples were harvested either at 55, 70, 85, 100, 130, or 160 d age. Composition of PAR was not affected by ovariectomy (p>0.05), while MFP protein concentration was decreased in OVX (26.6 vs 22.6 \pm 1.2 μ g/mg MFP). Total protein as well as DNA and lipid per 100 kg BW in MFP were significantly affected by age. There was an age by treatment interaction effect on total DNA and lipid in MFP. In conclusion, bST and ovariectomy impacted the composition of MFP but not PAR.

Key Words: Mammary, bST, Ovariectomy

TH109 Feeding genistein to prepubertal gilts stimulates their mammary development. C. Farmer^{*1}, S. Gilani², M.-F. Palin¹, H. Weiler³, M. Vignola⁴, R. K. Choudhary⁵, and A. V. Capuco⁵, ¹*Agriculture and Agri-Food Canada, Dairy and Swine R & D Centre, Sherbrooke, QC, Canada*, ²*Nutrition Research Division, Health Canada, Ottawa, ON, Canada*, ³*McGill University, Ste-Anne-de-Bellevue, QC, Canada*, ⁴*Nutreco Canada Agresearch, St-Romuald, QC, Canada*, ⁵*USDA-ARS, Bovine Functional Genomics Lab, Beltsville, MD, USA*.

The possible role of dietary genistein on mammary development of prepubertal gilts was investigated. Forty-five gilts were fed one of three diets from 90 d of age until slaughter (day 183 ± 1). Diets were: without soya (CTL0, n=15); soya-based commercial (CTLS, n=15); and soya-based commercial with 2.3 g/d of genistein (GEN, n=15). All diets were isonitrogenous and isocaloric. Jugular blood samples were obtained on days 89 and 183 to determine concentrations of genistein, prolactin, estradiol, IGF-I and cross-linked N-telopeptide of type I collagen (NTx, day 183 only). At slaughter, mammary glands were excised, parenchymal and extraparenchymal tissues were dissected and composition of parenchymal tissue was determined. Histochemical analyses of mammary parenchyma were performed and mRNA level of specific genes determined. Dietary genistein increased parenchymal protein ($P < 0.05$) while decreasing dry matter ($P < 0.05$) and tending to lower fat content compared to the CTLS, but not the CTL0, diet. There was more parenchymal DNA (1.26 vs. 0.92 mg/g, $P < 0.05$) in GEN than CTLS gilts. Circulating concentrations of hormones or NTx were not affected by GEN ($P > 0.1$) but concentrations of genistein were greater ($P < 0.0001$) in GEN than CTLS gilts. Percent ER α -positive epithelial cells was lower ($P < 0.05$) in GEN than CTLS gilts whereas BrdU labelling index was unaltered ($P > 0.1$). Transcript levels for ER α , ER β , IGF-I, EGF, EGFR and TGF α were not altered by treatments ($P > 0.1$). Feeding dietary genistein to prepubertal gilts led to hyperplasia of mammary parenchymal tissue.

Key Words: Genistein, Gilts, Mammary Development

TH110 Evidence that prolactin does not drive the milk yield response to frequent milking in early lactation. J. G. Titus^{*1}, H. M. Crawford², E. H. Wall¹, G. E. Dahl², and T. B. McFadden¹, ¹*University of Vermont, Burlington*, ²*University of Illinois, Urbana*.

Frequent milking of dairy cows in early lactation causes an increase in milk yield that persists throughout lactation, however the mechanisms regulating this response are unknown. We hypothesized that prolactin (PRL) released during additional milkings stimulates the increase in milk yield; therefore blockade of PRL secretion in frequently-milked cows should eliminate the milk yield response. Our objectives were to determine effects on milk yield and to gain insight into potential mechanisms of action by measuring mammary cell proliferation and apoptosis as well as expression of genes associated with angiogenesis. Eighteen multiparous Holstein cows were assigned to one of three treatments for the first 21 d of lactation: twice-daily milking (2 \times), four-times daily milking (4 \times), or four times daily milking plus administration of the prolactin inhibitor, bromocriptine (Bromo) at two of the four milkings. Milk weights were recorded daily and blood samples were obtained on d 1, 4, 7, 14 and 21 of lactation for quantifying plasma PRL. Mammary biopsies were taken at 8 ± 3 DIM for determination of [3H]-thymidine incorporation into DNA in vitro, mammary cell apoptosis, and isolation

of total RNA. During treatment, milk yield was lower in the 2 \times group than in the 4 \times or Bromo groups (33.4, 37.3 or 38.0kg/d, $P < 0.001$), but was not different between 4X and Bromo treatments ($P > 0.4$). Mean PRL concentrations were greater in 4 \times cows than in 2 \times or Bromo cows (12.4, 9.2 and 7.0ng/mL, $P < 0.01$), but did not differ between 2X and Bromo cows ($P > 0.1$). Incorporation of [3H]-thymidine was greater in 2X cows relative to both of the 4X groups ($P < 0.01$) whereas mammary cell apoptosis was not affected by treatment ($P \geq 0.9$). Mammary expression of PRL receptor, insulin-like growth factor 2, insulin-like growth factor binding protein 5, and the vascular endothelial growth factor receptors, flt-1 and flk-1 did not differ among treatments ($P > 0.9$), suggesting that angiogenesis was not affected. We conclude that increases in plasma PRL do not drive the milk yield response to frequent milking in early lactation.

Key Words: Frequent Milking, Prolactin, Angiogenesis

TH111 Reduced nursing frequency during prolonged lactation in the mouse decreases milk production and increases mammary expression of tryptophan hydroxylase 1 (TPH1), but does not accelerate mammary gland remodeling. D. L. Hadsell^{*1}, W. Olea¹, D. Torres¹, J. George¹, and R. J. Collier², ¹*Baylor College of Medicine, Houston, TX*, ²*The University of Arizona, Tucson*.

We have observed that lactating mouse dams nursed 4 times per day (4X) maintained lactation, but had lower milk yields by the weigh-suckle-weigh method, than dams nursed ad libitum (AL). Therefore, we hypothesized that decreased nursing frequency would also decrease lactation persistence, increase mammary gland remodeling, and alter the expression of genes linked to milk production (α -lactalbumin), mammary involution (lactoferrin) and mammary secretory cell feedback inhibition (TPH1). To test this hypothesis, milk output, mammary epithelial and adipocyte content, and mammary gland gene expression was measured on days 8, 14, or 28 postpartum in dams (n=5-16/treatment group) that nursed either AL or 4X for up to 3 weeks. Milk yield (1.3±0.1 g) was lower on day 14 in 4X than AL, which had similar yield to day 8 of the pretreatment period (2.4±0.3 g). On days 14 and 28, milk production in both groups was similar, and both were lower than that observed on day 8. Mammary epithelial content in 4X dams, as determined in cytokeratin 8 stained tissue sections, was higher than AL on day 28 (70±2 and 56±2 %). Alveolar luminal area was greater in 4X than AL on both days 14 (4030±201 and 3307±207 μm^2) and 28 (3293±246 and 2010±275 μm^2). Mammary adipocytes in perilipin-stained tissue sections, were larger in AL than 4X on day 28 (374±53 and 134±5 μm^2). Expression of α -lactalbumin and lactoferrin genes was greater on day 28 than day 8 postpartum, but not affected by nursing frequency. Expression of the TPH1 gene was higher in 4X than AL on day 14 (4.2±0.9 and 1.7±.3 fold over day 8), but similar to AL on day 28. These data suggest that reduced nursing frequency decreases milk synthesis through a mechanism involving serotonin biosynthesis, but may also delay the normal mammary gland remodeling that occurs with prolonged lactation. This project was supported by National Research Initiative Competitive Grant no. 2007-35206-17831 from the USDA Cooperative State Research, Education, and Extension Service.

Key Words: Milking Frequency, Mammary Involution, Serotonin

TH112 Evaluation and classification of milking disorders in Swiss dairy cattle. C. J. Belo¹, S. Schlegel², J. Moll³, and R. M. Bruckmaier*¹, ¹University of Bern, Bern, Switzerland, ²Swiss Federal Institute of Technology Zurich, Zurich, Switzerland, ³Swiss Brown Cattle Breeders Federation, Zug and ASR, Bern, Switzerland.

Morphological dysfunction of the udder and the teat as well as pathophysiological reduction of the release of oxytocin perturb or inhibit milk removal. To evaluate the incidence of these disorders and to classify them as anatomical or pathophysiological, questionnaires were sent to 2099 Swiss dairy farms with at least 25 dairy cows representing the major breeds in Switzerland (Brown Swiss: BS, Holstein: HO, Red Holstein x Simmental: SI). A high percentage of the questionnaires were returned (BS: 78%, HO: 73%, SI: 72%). Thus we have obtained information on a total of 67548 cows. Of these cows, 2642 (BS: 5%, HO: 3%, SI: 3%) were reported with poor milkability and 1198 problem cows (BS: 2.5%, HO: 1%; SI 1%) were regularly treated with oxytocin. In addition, 242 of the dairy farms that had reported animals with poor milkability were contacted by phone and asked for more details about the reported disorders and the specific activities performed in case of problem. The farmers reported milk ejection disorders (SI: 76%, HO: 63%, BS: 48%), poor milkability (BS: 34%, HO: 21%, SI: 7%) and external factors such as stray voltage, engine disturbances and other animal diseases (BS: 28%, HO: 16%, SI: 15%). Apart from using oxytocin, the farmers reported careful teat stimulation, massage of vulva and udder, air blown into the vagina or homeopathy. About half the dairy farms have culled the animals because of the problem.

51 cows were selected in 18 farms which had reported a supposed disturbed milk ejection, i.e. an incomplete delivery of the milk based on a lack of oxytocin release. The presence of milk ejection disorder was investigated by recording the milk flow with a mobile unit (LactoCorder). After cessation of spontaneous milk flow, oxytocin was injected iv. and the amount of residual milk was measured. In 18% of the tested cows disturbed milk ejection was not detected, contrary to the assumption of the farmers.

Key Words: Milk Ejection, Inhibition, Cattle

TH113 Prestimulation combined with a short waiting time before cluster attachment affects milk removal in dairy cows. S. Kaskous*¹ and R. M. Bruckmaier², ¹Damascus University, Damascus, Syria, ²University of Bern, Bern, Switzerland.

The suitability of combining manual prestimulation with a short waiting time before cluster attachment and machine milking was investigated. 21 dairy cows in their second to sixth lactation were divided in three lactational stages with seven animals each, early (<100 d), mid (100 to 200 d) and late (>200 d) lactation. In addition, cows were classified based on their estimated degree of udder filling as a ratio between the actual milk yield and the maximum storage capacity. During the experiment, cows were machine milked twice daily at 5 a.m. and 4 p.m. and milk flow curves were recorded. The animals were manually prestimulated for 15, 30 or 45 s, followed by a waiting time of 0, 30, 45 or 60 s, i.e. 12 different treatments were applied for each animal. The treatments were performed in a random sequence for each animal, but remained unchanged for two subsequent milkings (morning and evening). Total

milk yield did not significantly differ between treatments in all stages of lactation and at all degrees of udder filling. Average milk flow (AMF) and peak flow rate (PFR) in early lactation, and similarly in mid lactation (udder filling 60-100%) were highest after a prestimulation of 30 s followed by a waiting time of 30 or 45 s, or after a prestimulation for 45 s without additional waiting time ($p < 0.05$). In late lactation and at low degrees of udder filling (20-40 %), AMF and PFR were highest after a prestimulation of 45 s combined with a waiting time of 30, 45 or 60 s ($p < 0.05$). In conclusion, total milk yield does not differ between prestimulation treatments and additional waiting time as applied in the present study. An optimal course of milk removal is reached after a prestimulation of 30 s, combined with a waiting time of 30 to 45 s in early and mid lactation. In late lactation a prestimulation for 45 s is required, combined with an additional waiting time of 30 to 60 s.

Key Words: Prestimulation, Waiting Time, Milking

TH114 Identification of internal controls for quantitative PCR in swine mammary gland during pregnancy and lactation. S. Tramontana^{1,2}, M. Bionaz*², A. Sharma², D. E. Graugnard², E. A. Cutler², P. Ajmone-Marsan¹, W. L. Hurley², and J. J. Loo², ¹Università Cattolica del Sacro Cuore, Piacenza, Italy, ²University of Illinois, Urbana.

High-throughput microarray analysis is an efficient means of obtaining a genome-wide view of transcript profiles across physiological states. However, quantitative PCR (qPCR) remains the chosen method for high-precision mRNA abundance analysis. Essential for reliability of qPCR data is normalization using internal control genes (ICG). Identification of reliable ICG is now, more than ever before, a fundamental step for accurate gene expression profiling. To identify swine ICG, we mined mammary microarray data on >13,000 genes at -34, -14, 0, 7, 14, 21, and 28 d relative to parturition in 27 cross-bred primiparous gilts. GeneSpring GX analysis revealed *TBK1*, *PCSK2*, *PTBP1*, *API5*, *VAPB*, *QTRT1*, *TRIM41*, *TMEM24*, *PPP2R5B*, and *AP1S1* as the most stable genes (sample/reference = 1 ± 0.2). We also included 9 genes previously identified as ICG in bovine mammary. Co-regulation on these 19 genes was assessed using gene network analysis, which identified *AP1S1*, *API5*, *MTG1*, *VAPB*, *TRIM41*, *MRPL39*, and *RPS15* as having no known co-regulation. *UXT* and *ACTB* were added to this list and mRNA abundance of the 9 genes measured by qPCR. Expression of all ICG chosen decreased ($P < 0.05$) markedly during lactation. Gene stability analysis, via geNorm software, identified *API5*, *VAPB*, and *MRPL39* as the most stable ICG and indicated that the use of 3 ICG was most appropriate for calculating a normalization factor. In a previous study with bovine mammary tissue, decreased mRNA of stably-expressed genes during lactation was apparent, and due to a dilution effect brought about by large increases in expression of highly abundant, metabolism-related genes. To verify this effect, highly-abundant mammary genes such as *CSN1S2*, *SCD*, and *LTF* were evaluated by qPCR. The tested ICG had a negative correlation with these genes, demonstrating the presence of a dilution effect as in bovine mammary tissue. Overall, results underscore the importance of proper validation of internal controls for qPCR and highlight the limitations of using time effects as the criteria for selection of appropriate ICG.

Key Words: Genomics, Involution, Milk Synthesis

TH115 Serial mammary biopsies in cows do not alter overall milk production. H. Dover*, M. VandeHaar, J. Liesman, O. Patel, L. De Vries, and K. Plaut, *Michigan State University, East Lansing.*

Serial biopsies of the mammary gland are useful in studies of mammary biology; however, many researchers assume the cow's long term milk production might be impaired. The objective of this study was to determine the effect of mammary biopsies during late lactation through the dry period on overall milk production. Six multigravid cows were biopsied approximately 275-290 days in milk (biopsy 1), 7 days after dry off (biopsy 2), 3 weeks (biopsy 3) and 1 week (biopsy 4) before expected calving date. Animals were sedated with xylazine hydrochloride, and the biopsy site was numbed with lidocaine gel before lidocaine injection. A biopsy tool (AgResearch, Hamilton, NZ) powered by a cordless drill was used to obtain approximately 1 g of mammary tissue per biopsy. Immediately after biopsies 1 and 4, a teat cannula was inserted into the biopsied quarter to drain any accumulated blood. For approximately 3 days, cows were hand stripped at each milking until blood clots were no longer observed in the milk. Cows joined the milking herd after biopsy 1 and 4. Analysis of milk yields during the lactation prior to and following the biopsies indicate that milk production in biopsied cows was not different from the herd ($P>0.1$). At 30-60 days in milk, primiparous cows averaged 35 kg/day of milk prior to biopsy and 48 kg/day in the lactation following biopsy; for multiparous cows, milk yield averaged 50 kg/day prior to biopsy and 54 kg/day in the lactation following biopsy. The use of teat cannulae after biopsy appears to improve cow comfort. Results show that serial mammary biopsies do not impair milk production in dairy cows.

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Key Words: Mammary Gland, Biopsy, Milk Production

TH116 Effect of dry period length on calving related disorders. M. S. Gulay*¹, M. J. Hayen², K. C. Bachman², and H. H. Head², ¹*Mehmet Akif Ersoy University, Faculty of Veterinary Medicine, Department of Physiology, Burdur, Turkey,* ²*University of Florida, Gainesville.*

Objectives were to evaluate effects of dry period (60 vs. 30 d), with or without estradiol cypionate (ECP) injections, on incidence rates of digestive problems and displaced abomasum (DP), retained fetal membranes (RFM), metritis (MET), clinical mastitis (MAS), ketosis (KET), or foot problems (FOOT) during the first 60 d postpartum. One hundred eighty-nine multiparous Holstein cows from two separate trials were combined for analyses. Dry period treatments included 30 d dry+ECP (30DE; n=48), 30 d dry (30D; n=44) and 60 d dry (60D; n=97). Single injections of ECP (7.5 ml; 15 mg; 30DE) or 7.5 ml of cottonseed oil (30D) were supplemented i.m. at final milk removal; 60D group was the control group and received no ECP or cottonseed oil. Across all treatment groups the incidence rates (number of diseased cows divided by the total number of cows) for DP, RFM, MET, MAS, KET, and FOOT were 8.5, 6.4, 12.7, 19.6, 4.2, and 9.5%, respectively. No significant Chi-Square values ($P<0.1$) were detected among the treatment groups. Incidence rates of DP, RFM, MET, MAS, KET, and FOOT for 30DE, 30D and 60D groups were 2.8, 6.5, and 12.4%; 6.8, 4.2, and 7.2%; 9.1, 10.4, and 15.5%; 22.7, 18.8 and 18.6%; 4.6, 4.2 and 4.1%; and 9.1, 6.3, and 11.3%, respectively. The proportions of sick cows in the 3

groups (number of cows having one or more cases of diseases divided by the total number of cows) were 36.4, 35.4, and 48.5%, respectively. When 30DE and 30D groups were combined and compared to the 60D group, a significant difference was detected between short and longer dry period, but only for DP ($P<0.05$). Moreover, proportions of sick cows in the combined 30D dry group also tended to be lower (38.9 vs. 48.5%; $P=0.08$). Odds ratio values suggested that cows given longer dry periods were 1.68 times more likely to get sick during first 60 d after calving. Thus, results indicated that shortening dry period length (30D) with or without supplemental ECP did not negatively affect postpartum calving disorders compared to cows given 60D and improved health status slightly.

Key Words: Dry Period Length, Transition Period, Diseases

TH117 Dietary energy management during pregnancy and its effects on transition health in dairy heifers. M. S. Laubach¹, D. B. Carlson², L. Mabasa², K. S. Cho², A. W. Fowler², and C. S. Park*², ¹*South Dakota State University, Brookings,* ²*North Dakota State University, Fargo.*

The objective of this study was to determine if a gestational one stair-step compensatory nutrition regimen (SSCN) affects metabolic and immune status of dairy heifers during the transition period. The experiment consisted of two sequential trials (20 heifers for trial 1; 10 heifers for trial 2). Holstein heifers (95 d in gestation) averaging 511 kg of body weight were assigned into two groups: control and treatment (SSCN). The control diet [14% crude protein (CP); 2.35 Mcal/kg metabolizable energy (ME)] was intended for a constant gain of 0.45 kg/d throughout the last two trimesters of gestation. The SSCN heifers were fed a restriction diet (18.5% CP; 2.35 Mcal/kg ME) during the second trimester at 70% of the ME intake of control heifers, and a realimentation diet (14% CP; 3.05 Mcal/kg ME) during the third trimester. Blood was collected around parturition on d -14, -11, -9, -7, -5, -4, -3, -2, -1, 0 (within 3 h of calving), 1, 2, 3, 4, 5, 7, 9, 11, and 14 to monitor various metabolites, total white blood cell counts (WBC), and lymphocyte populations [cluster of differentiation 3 (CD3), CD4 and CD8]. In both trials, serum glucose, insulin, triglycerides, and nonesterified fatty acids were not different between groups before or after parturition. SSCN heifers before parturition tended to have higher WBC ($P = 0.06$); however, after parturition there was no difference between groups. The CD8 cells tended to be higher ($P = 0.10$) in the SSCN group compared with the control before parturition and were higher ($P = 0.02$) after parturition; the increase of CD8 cells in SSCN heifers may be related to the enhancement of immune cell production due to increased compensatory energy metabolism from the realimentation diet during the last trimester. SSCN heifers yielded 4% more milk than control heifers (34.8 vs. 36.1 kg/d; $P = 0.18$). These results indicate that SSCN did not affect general metabolic parameters, but moderately improved immune status of transition heifers.

Key Words: Transition Heifer, Compensatory Growth

TH118 Please see abstract 54.

Nonruminant Nutrition: Mineral

TH119 Impact of massive doses of copper or zinc on growth performance and nutrient digestibility of newly weaned piglets.

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This study was conducted to evaluate the impact of massive dose of copper (Cu) or zinc (Zn) on the growth performance and digestive capacity of newly weaned piglets. Twenty three castrated male piglets, (7.4 kg) were used for the growth and digestibility studies. The three post-weaning diets were formulated according to NRC and only Zn or Cu was supplemented according dietary treatment: 1) Control diet (C): 25 ppm Cu and 134 ppm Zn; 2) Cu diet: 135 ppm Cu and 123 ppm Zn; 3) Zn diet: 28 ppm Cu and 2,343 ppm Zn. The pigs were individually fed with specific diet for 12 days. Feed intake was daily determined and pig weight was evaluated on d0, 8 and 12. On d8, chromic oxide (0.25%) was added to diets as indigestible marker. The faeces and urine were collected during d9 to 12 to evaluate the digestibility and retention of nitrogen, energy, phosphorus and calcium. Results showed that Cu supplementation improved ($P<0.05$) ADG, ADFI et G:F ($P<0.05$) and Zn supplementation tended to increase ADG and G:F ($P<0.09$) during the overall period of d0 to 12 compared to Control diet. During d8 to 12, Zn and Cu supplementations were increased ADG, ADFI and G:F ($P<0.05$). During collect period, Cu supplementation was increased total absorption and retention of nitrogen, energy and phosphorus ($P<0.05$). Zn supplementation was also increased total absorption and retention of energy ($P<0.05$) and tended to increased absorption and retention of nitrogen and phosphorus ($P<0.09$). However, Zn and Cu supplementations did not have any effect on digestibility and retention:ingestion ratio of nitrogen, energy and phosphorus. For calcium, Zn and Cu supplementation did not have any effect on total absorption and retention but reduced the retention:ingestion ratio ($P<0.05$). These results suggest that the effect of Zn and Cu supplementations on growth performance (ADG, ADFI, G:F) can not be associated to better nutrient digestibility and retention efficiency.

Key Words: Piglet, Zinc, Copper

TH120 Effect of different Ca and P level on early growth of fast-growth lines of Wulong Goose.

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Two hundred and eighty-eight 1-day-old Wulong geese of Fast-growth Lines were selected to be fattened respectively in netting bed, and then divided into eight groups with three replications in each group, twelve geese for each replication. The basal diets were added with different contents of Ca and NPP (non-Phytate Phosphorus) in a completely randomized design involving a 4 × 2 factorial arrangement of treatments. Ca and NPP were added with pure CaCO₃ and NaH₂PO₄. The result suggested that, during the early period (0-4week), the proportion of Ca and NPP had significant influence on its growth ($P<0.05$), the most absolutely increasing was 1168±95.6g in the four weekend when the dietary level of Ca was 0.65% and NPP was 0.30% (the proportion of Ca and NPP was 2.17:1), and the least absolutely increasing was 820±33.3g when the dietary level of Ca was 0.55% and NPP was 0.40% (the proportion of Ca and NPP was 1.38:1), so were the eviscerated weight with giblet ratio (1871±85 and 1473±99) and feed/gain (F/G)

(2.24±0.36 and 1.90±0.41). But the alkaline phosphatase (AKP) activity was not significantly affect by the Ca and NPP level ($P>0.05$). The Wulong geese grew well at the proportion between 1.88:1 and 2.50:1, and grew worst at 1.38:1.

Key Words: Wulong Goose, Ca, NPP

TH121 Effects of dietary *Escherichia coli* phytase supplementation on growth performance, carcass quality and excretion of copper and zinc concentrations in finishing pigs.

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This study was conducted to evaluate the effects of dietary *Escherichia coli* phytase supplementation on growth performance, carcass quality and excretion of copper and zinc concentrations in finishing pigs. The total of seventy two [(Landrace×Yorkshire) × Duroc] pigs (65.43±0.72 kg in average initial body weight) were used in 56 days assay. Dietary treatments included 1) CON (basal diet) 2) P5 (basal diet + phytase 0.05%) and 3) P10 (basal diet + phytase 0.1%). There were three dietary treatments with six replicate pens per treatment and four pigs per pen. During the overall periods, ADFI (Average daily feed intake) was increased ($P<0.05$) in phytase supplementation treatments (2.752 and 2.751 kg) compared to CON treatment (2.566 kg). At the 5th week, dry matter, nitrogen and ash digestibilities were higher ($P<0.05$) in P5 treatment (73.59, 84.12 and 33.71%, respectively) than in CON (66.43, 74.16 and 14.29%, respectively) and P10 treatments (71.19, 80.95 and 26.50%, respectively) and CON treatment (74.16%) showed the lowest ($P<0.05$) effect on nutrition digestibility. However, phosphorus digestibility was higher ($P<0.05$) in both phytase supplementation treatments (66.76 and 63.15%) than in CON treatment (47.58%). The pH of *M. logissimus dorsi* was significantly higher ($P<0.05$) in CON treatment (5.72) than phytase supplementation treatments (5.57 and 5.58). L* value of *M. logissimus dorsi* muscle color was significantly increased ($P<0.05$) in P10 treatment (57.25) compared to CON (54.94) and P5 treatments (54.32). Also, a* value was increased ($P<0.05$) in CON treatment (16.89) compared with phytase supplementation treatments (16.18 and 16.65). However, excretion of copper and zinc concentrations were no difference among the treatments. In conclusion, the results of the experiment was affected by dietary *Escherichia coli* phytase supplementation on ADFI, digestibilities, pH and color of meat in finishing pigs.

Key Words: *Escherichia coli* Phytase, Growth Performance, Excretion of Copper and Zinc Concentrations

TH122 Effects of rare earth supplementation on growth performance, blood immunological parameters, meat quality and fecal odor emission gases in finishing pigs.

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This study was conducted to evaluate the effects of rare earth supplementation on growth performance, blood immunological parameters,

meat quality and fecal odor emission gases in finishing pigs. The total of sixty four [(Landrace×Yorkshire)×Duroc] pigs (65.42±1.16 kg in average initial body weight) were used in 10 weeks assay. Dietary treatments included 1) NC (antibiotic free diet), 2) PC (NC diet + 6 weeks 44ppm of tylosin/ 4 weeks 22ppm of tylosin) 3) RE1 (NC diet + 100ppm of RE), 4) RE2 (NC diet + 200ppm of RE). There were four dietary treatments with four replicate pens per treatment and four pigs per pen. During the overall periods, there were no significant differences in ADG (Average daily gain), ADFI (Average daily feed intake) and gain/feed ratio among treatments ($P>0.05$). Dry matter and nitrogen digestibility were higher in RE2 treatment than other treatments ($P<0.05$). Also, energy digestibility was higher in RE2 treatment than PC and RE1 treatments ($P<0.05$). At the 6th week WBC (white blood cell) was significantly increased ($P<0.05$) in RE1 treatment than NC and RE2 treatments. L^* value of *M. logissimus dorsi* muscle color was significantly increased ($P<0.05$) in rare earth supplementation treatments compared to NC treatment ($P<0.05$). In fatty acid contents of leans, total MUFA was significantly higher in RE2 treatment than others treatments ($P<0.05$). Also, total UFA was significantly increased in RE2 treatment compared with NC and PC treatments ($P<0.05$). In fatty acid contents of fats, total SFA of rare earth supplementation treatments were lower than in PC treatments ($P<0.05$). UFA:SFA ratio was significantly higher in rare earth supplementation treatments than PC treatment ($P<0.05$). In fecal odor emission, NH_3 was significantly decreased ($P<0.05$) in rare earth supplementation treatments compared to NC and PC treatments. In conclusion, the results of the experiment was affected by rare earth supplementation on digestibilities, meat quality, fatty acid and fecal odor

Key Words: Rare Earth, Growth Performance, Fecal Odor Emission Gases

TH123 The effect of different copper (inorganic and organic) and fat (tallow and glycerol) sources on growth performance, nutrient digestibility, and fecal excretion profile in growing pigs (regional study). Y. Huang^{*1}, J. S. Yoo¹, H. J. Kim¹, Y. J. Chen¹, J. H. Cho¹, Y. K. Han², and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Sungkyunkwan University, Suwon, Korea.

A 2 × 2 trial was conducted to investigate the effect of different copper (inorganic and organic) and fat (tallow and glycerol) sources on growth performance, nutrient digestibility, gas emission, diarrhea appearance, and fecal Cu concentration in growing pigs. The trial used 96 pigs (63 d of age) with an average initial weight of 28.36 ± 1.14 kg. Pigs were assigned to four treatments: 1) basal diet with 134 ppm Cu (Korea recommendation) as CuSO₄ + tallow; 2) basal diet with 134 ppm Cu as CuSO₄ + glycerol; 3) basal diet with 134 ppm Cu as CuMet + tallow; 4) basal diet with 134 ppm Cu as CuMet + glycerol. During the entire experimental period, there were no differences among treatments in the magnitude of improvement for ADG (average daily gain), ADFI (average daily feed intake) and G/F (gain: feed) ratio. Nitrogen (N) digestibility of pigs fed diets with organic copper was improved compared with those of pigs fed diets with inorganic copper ($P<0.05$). The interaction of Cu × fat was observed on both nitrogen ($P<0.05$) and energy ($P<0.01$) digestibilities. Ammonia emission was significantly lower in organic copper added treatments than inorganic copper added treatments ($P<0.05$). Mercaptan and hydrogen sulfide emission were decreased by the addition of glycerol ($P<0.05$). Neither main effects of Cu or fat source nor their interaction was observed on diarrhea appearance during all the experimental period. The copper concentration in feces was significantly lower in organic copper source treatments than

that in inorganic copper source treatments ($P<0.05$). The result of this experiment indicate that substitute organic copper for inorganic copper in diet has less fecal Cu excretion, while it has no effect on the growth performance. The different fat (tallow and glycerol) source have interaction with different copper source on nutrient digestibility. Glycerol supplementation could decrease sulfuric odorous compound concentrations in different source of Cu.

Key Words: Copper, Fat Source, Growing Pig

TH124 The effects of 200 ppb added chromium from chromium propionate on the growth performance and carcass characteristics of finishing pigs. J. R. Bergstrom^{*1}, M. D. Tokach¹, S. S. Dritz¹, J. L. Nelssen¹, R. D. Goodband¹, J. M. DeRouchey¹, J. D. Hahn², and F. R. Valdez², ¹Kansas State University, Manhattan, ²Kemin Industries, Inc., Des Moines, IA.

A total of 1,207 pigs (initial BW = 30.7 kg; PIC, 337×1050) were used in a 103-d experiment to evaluate the effects of 200 ppb Cr from KemTRACE[®] (KemTRACE[®] is a registered trademark of Kemin Industries, Inc.) brand Chromium Propionate (CrPr) on growth performance and carcass characteristics. There were 22 pens per treatment with 25 to 28 pigs per pen evaluating CrPr from d 0 to 84; and 11 pens per treatment evaluating CrPr (0 and 200 ppb) and Paylean[®] (0 and 10 ppm) in a split-plot arrangement from d 84 to 103. Pigs were randomly allotted to a corn-soybean meal-based diet with 3% added choice white grease (control diet) or the control diet with 200 ppb Cr from CrPr. Treatments were fed in three 4-wk phases (d 0 to 28, 28 to 56, and 56 to 84). On d 84, pigs fed the control or Cr treatment were allotted to a fourth dietary phase containing either 0 or 10 ppm Paylean[®]. For the d 0 to 84 period, growth performance of pigs fed the control or 200 ppb CrPr was not different (915 vs 916 g/d ADG). From d 84 to 103 and overall (d 0 to 103), pigs fed diets containing Paylean[®] had increased ($P<0.01$) ADG (1143 vs 969 g/d and 951 vs 926 g/d, respectively) and final weight (128.3 vs 124.5 kg). However, a CrPr × Paylean[®] interaction ($P<0.04$) was observed for d 84 to 103 ADFI and G:F and overall (d 0 to 103) G:F. From d 84 to 103, adding Paylean[®] to the control reduced ADFI (2833 vs 2711 g/d); whereas, adding Paylean[®] to diets containing CrPr increased ADFI (2744 vs 2845 g/d). Added CrPr alone increased G:F from d 84 to 103 (0.35 vs 0.34) and overall (0.393 vs 0.387) compared to the control; whereas, pigs fed both Paylean[®] and CrPr had lower G:F than those fed Paylean[®] alone from d 84 to 103 (0.41 vs 0.42) and overall (0.397 vs 0.403). Neither Paylean[®] or CrPr influenced any of the carcass characteristics measured. Using the high energy diets in this trial, there was no observed response to the dietary inclusion of Cr from CrPr in grow-finish pigs.

Key Words: Chromium, Lysine, Ractopamine HCl

TH125 Evaluation of organic and inorganic trace minerals for pigs. Y. L. Ma^{*}, M. D. Lindemann, G. L. Cromwell, R. B. Cox, and G. Rentfrow, University of Kentucky, Lexington.

Crossbred pigs weaned at 21 ± 3 d (n = 144; BW = 7.4 ± 0.28 kg) were used to assess an organic form of several trace minerals to standard inorganic forms on performance and meat quality when trace minerals were deleted for various times preslaughter. Pigs were allotted to 24

pens (6 pigs/pen) based on gender and BW and fed a diet containing either inorganic ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, ZnO , $\text{FeSO}_4 \cdot \text{H}_2\text{O}$, MnO) or organic (Bioplexes®; Alltech Inc., Nicholasville KY) trace minerals (Cu, Zn, Fe, Mn) at the NRC (1998) requirement for each of 5 phases of BW from 7 to 120 kg (equivalent to 14, 14, 42, 28, 42-d periods, respectively). The pigs were weighed bi-weekly throughout the 140-d experiment. Two pigs were removed from each pen at the end of Phase IV (BW = 82.6 ± 0.80 kg), and again at the end of Phase V (BW = 126.6 ± 3.08 kg) for the determination of carcass measurements and collection of tissue samples (heart, liver, kidney, and spleen). After Phase IV, 3 pens from each treatment were switched to a common diet without trace mineral supplementation in 2-wk intervals. This resulted in 4 groups within each mineral treatment in which trace mineral supplementation was deleted for 0, 2, 4, and 6 wk of Phase V. ADG, ADFI, and G:F were not affected ($P > 0.27$) by the treatments during the first 4 phases (inorganic vs. organic: 773 vs. 778 g/d, 1,680 vs. 1,708 g/d, and 0.461 vs. 0.456, respectively). ADG for all phases was also not affected (inorganic vs. organic: 858 vs. 864 g/d, $P = 0.69$). Tissue weights, carcass shrink, LEA, and 10th rib BF were not affected by the source of mineral or length of mineral deletion ($P > 0.32$). Loin chop 48-hr drip loss was linearly decreased (6.43, 5.79, 6.54, 4.43%, $P = 0.06$) as the duration of mineral deletion was increased. Mineral deletion resulted in a quadratic effect for the Hunter L* color scores (d 0: 54.1, 56.3, 57.4, 55.2, $P < 0.05$; and d 6: 56.6, 57.9, 59.1, 57.3, $P = 0.08$) and the d 6 a* score (10.6, 10.3, 9.9, 10.6, $P = 0.08$). The results failed to show an effect of trace mineral source on growth performance or carcass characteristics; however, some aspects of meat quality were affected by the duration of mineral deletion.

Key Words: Trace Minerals, Pigs

TH126 Iron status evolution of weaned piglets fed different iron sources. P. Schlegel^{*1}, S. Durosoy¹, and M. Dupas², ¹*Pancosma S.A., Geneva, Switzerland*, ²*IDENA, Sautron, France*.

Three hundred eighty four (384) twenty-one day old weaned piglets (Large White*Landrace)*(Large White*Pietrain) were assigned on BW, gender and litter origin to 32 slotted pens. Piglets were fed ad-libitum a basal weaner diet (day 0-21) followed by a basal starter diet (day 21-42). Weaner and starter basal diets were formulated on wheat, barley, soy and contained 11.2 and 10.2 MJ/kg NE, 19.7 and 17.7 g/kg CP, respectively. Basal diets were not iron-supplemented. Dietary treatments were: basal weaner and starter diets supplemented with 100 mg/kg Fe from FeSO_4 or supplemented with 100 mg/kg Fe from crystalline iron glycinate (FeGly, B-TRAXIM® 2C Fe, Pancosma S.A., Switzerland). Prior study, piglets had free access to a commercial creep feed and were injected with 100 mg of iron dextran. Blood samples were collected on two identified piglets (one female, one castrated male) per pen on days 0, 21 and 42 for Hemoglobin (Hb) and hematocrit (Ht) analysis and red blood cell count (RBC). Between day 0 and 21 Hb was measured every second day using Hemocue® kit. Initial Hb, Ht and RBC were similar between treatments. The Hb evolution for the first 21 days was variable over time (day effect: $p < 0.10$). Hb depressions occurred during the first two days and between day 14 and 18 when compared with initial values. The Hb evolution from d0 to 21 was different between dietary treatments ($p < 0.05$) whereas Hb was hardly above 8 g/dl with FeSO_4 and hardly below 8 g/dl with FeGly. There was no source*day interaction ($p > 0.10$). On day 21, piglets fed FeGly had increased Hb levels (+15.5%, $p < 0.05$); increased Ht (+12.3%, $p < 0.001$) and increased RBC (+5.1%, $p < 0.10$) compared to FeSO_4 . On day 42, Hb and Ht were increased ($p < 0.001$)

for FeGly compared to FeSO_4 . Results of this study suggest that Fe from FeGly is more bioavailable than FeSO_4 and reduces therefore the risk in anemia when supplemented to post-weaning piglets.

Key Words: Iron, Bioavailability, Piglet

TH127 Effects of sodium bisulfate on growth performance of weaning pigs. J. Jarrett^{*}, S. Carter, J. Bundy, M. Lachmann, and T. Walraven, *Oklahoma State University, Stillwater*.

Two experiments were conducted to determine growth performance of weaning pigs fed sodium bisulfate (NaHSO_4), as a potential acidifier, at varying levels of inclusion. Pigs were stratified by sex, weight and ancestry and assigned to one of four dietary treatments containing 0, 0.2, 0.4, and 0.8% inclusion of NaHSO_4 . All diets were formulated on a total lysine basis for a typical, 4 phase, nursery-feeding program (1.60, 1.50, 1.35, and 1.20%). NaHSO_4 was added at the expense of sodium chloride. Pigs and feeders were weighed weekly to determine ADG, ADFI, and G:F. In Exp. 1, 200 pigs (5 pens/trt; 10 pigs/pen) were fed a common Phase 1 diet. Pigs were then allotted to one of four treatments for Phases 2 - 4. In Phase 2, there was no difference ($P > 0.10$) in ADG or ADFI among treatments, but G:F tended to improve (linear, $P < 0.07$) with increasing NaHSO_4 . There were no differences ($P > 0.10$) in ADG, ADFI, or G:F for Phases 3 and 4. Overall in Exp. 1, there was no difference ($P > 0.10$) in ADFI; however, ADG ($P < 0.05$) and G:F ($P < 0.06$) improved quadratically as NaHSO_4 levels increased in the diet. In Exp. 2, 240 pigs (6 pens/trt; 10 pigs/pen) were allotted at weaning in the same fashion to the four dietary treatments fed in all four phases. During Phase 1, there was no effect ($P > 0.10$) of NaHSO_4 on ADG, ADFI, or G:F. In Phase 2, NaHSO_4 addition increased (linear, $P < 0.04$) ADG and tended to improve G:F (linear, $P < 0.09$). No differences ($P > 0.10$) were observed in growth performance for Phase 3. During Phase 4, NaHSO_4 increased (linear, $P < 0.02$) ADG and tended to increase G:F (linear, $P < 0.07$). Overall, in Exp. 2, there was no effect ($P > 0.10$) of NaHSO_4 on ADFI or G:F, but increasing inclusion of NaHSO_4 tended to improve ADG (linear, $P < 0.07$). When combining results from both experiments (11 pens/trt) for Phases 2 - 4, ADG tended to increase (linear, $P < 0.06$) and G:F improved (quadratic, $P < 0.03$) for pigs fed NaHSO_4 . These results suggest that feeding NaHSO_4 at 0.4 or 0.8% inclusion may improve growth performance in weaning pigs.

Key Words: Weaning Pigs, Sodium Bisulfate, Growth Performance

TH128 Effects of dietary inorganic sulfate levels on growth performance and markers of intestinal inflammation in growing pigs. T. E. Weber^{*1}, C. Spence², T. R. Whitehead², and B. J. Kerr¹, ¹*USDA-ARS, Ames, IA*, ²*USDA-ARS, Peoria, IL*.

Ethanol co-products may contain moderate amounts of inorganic sulfur. In the intestine, inorganic sulfate is reduced to hydrogen sulfide by sulfate-reducing bacteria. Hydrogen sulfide has been found to alter the inflammatory response in rodent models, but the impact of dietary sulfate on inflammation in pigs has not been reported. In a 35 d experiment, pigs ($n = 64$; 13.3 ± 1.7 kg) were fed diets containing 0, 0.625, 1.25, 2.5, or 5.0% calcium sulfate. Two control diets containing reduced levels of calcium and sulfur were also fed. On d-35, all pigs were weighed and samples of intestinal tissue and mucosa were harvested from pigs fed 0

and 5% calcium sulfate for analysis of cytokine, intracellular adhesion molecule 1 (ICAM1), and suppressor of cytokine signaling 3 (SOCS3) mRNA. The activity of mucosal alkaline phosphatase and sucrase, and the abundance of I κ B α and phosphorylated p22/p44 MAP kinase (MAPK) in intestinal tissue were also determined. Increasing dietary sulfate had no impact on ADG or ADFI, but there was a cubic effect ($P < 0.05$) for G:F as sulfate levels increased. There was no difference in growth performance found in pigs fed reduced calcium or sulfate levels when compared to pigs fed the diet containing added inorganic sulfate. Real-time RT-PCR analysis revealed that feeding 5% inorganic sulfate increased ($P < 0.05$) the relative abundance of ICAM1, tumor necrosis factor α (TNF α), and SOCS3 mRNA and tended ($P < 0.09$) to increase the relative abundance of IL-6 mRNA in ileal tissue compared to pigs fed 0% added inorganic sulfate. In pigs fed diets containing 5% inorganic sulfate there tended ($P < 0.10$) to be a decrease in IL-6 and TNF α mRNA. Pigs fed 5% inorganic sulfate had a reduced ($P < 0.05$) abundance of I κ B α and an increase ($P < 0.05$) in phosphorylated MAPK in ileal tissue, but there was no effect in colon tissue. Addition of 5% inorganic sulfate had no impact on mucosal alkaline phosphatase or sucrase activity. These data suggest that growing pigs can tolerate relatively high levels of dietary inorganic sulfate and that high sulfate levels alter intestinal inflammatory mediators.

Key Words: Pig, Sulfate, Cytokine

TH129 Differential expression of 15 selenoprotein genes in various tissues of pigs. H. Zhao¹, J. C. Zhou¹, X. Xia¹, K. N. Wang¹, J. G. Li¹, Y. Zhao¹, Y. Liu¹, and X. G. Lei^{*1,2}, ¹*Sichuan Agricultural University, Ya'an, China*, ²*Cornell University, Ithaca, NY*.

Although 25 selenoproteins have been identified in mice, there is little information on the sequences and expression of the new selenoproteins in pig tissues. Recently, we have cloned porcine *gpx2*, *sel X*, *sel N*, *sel P*, *sel I5* and *sps2*. This experiment was to determine expression profiles of these 6 genes and another 9 selenoprotein genes (*gpx1*, *gpx3*, *gpx4*, *di1*, *di3*, *sel M*, *sel W*, *sel K*, and *txnr1*) in 7 porcine tissues by quantitative real-time RT-PCR. Weanling male pigs (BW = 10.3 \pm 0.32 kg, n=4) were fed a corn-soybean meal diet containing 0.3 mg Se/kg for 8 wk, and were killed to collect liver, kidney, loin, brain, testis, pituitary, and thyroid for total RNA isolation. Relative mRNA levels of the selected genes were detected using the One-Step SYBR Green Real-Time RT-PCR

(7900HT, Applied Biosystems, Perkin Elmer, Foster City, CA), and normalized with the levels of beta-actin and glyceraldehydes 3-phosphate dehydrogenase. The inter-tissue comparisons were estimated using the Delta-delta method (Applied Biosystem). Results indicate detectable mRNA expression for all the 15 genes in all the 7 assayed tissues. Liver, kidney, and muscle had the highest expression of *gpx1*, *gpx3*, *sel P*, *sel W*, *sel X*, *sps2*, *sel K*, and *txnr1*. Pituitary showed a high expression of *gpx3*, *gpx4*, *di3*, *sel I5*, and *sel N*. In the thyroid, expression of *sel M* was the highest, followed by *sel P* and *sel N*. In the brain, expression of *sel W* ranked the highest, followed by *sel P* and *sel N*. In conclusion, the 15 selenoprotein genes were differentially expressed in a tissue- and protein-specific fashion in growing pigs.

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Key Words: Quantitative Real-time RT-PCR, Selenium, Sus Scrofa

TH130 Intestinal and renal Type II NaPi co-transporter gene expression patterns in growing pigs fed with different levels of dietary calcium. Y. Yin*, S. X. Wang, T.-J. Li, R.-L. Huang, X.-F. Kong, P. Kang, Q. Hu, Z. Liu, and W. Wang, *The Chinese Academy of Sciences, Changsha, Hunan, P.R. China*.

This study was conducted to investigate the effect of different levels of dietary calcium on the patterns of NaPi-II co-transporter mRNA expression in growing pigs. 25 barrow pigs (20.9 \pm 0.95 kg) were fed a diet containing 5 different levels of Ca (0.29, 0.44, 0.60, 0.75, and 0.91%) by using different supplementations of limestone powder. Each trial lasted for 35 days and the pigs were slaughtered on the last day. Jejunum and kidney samples were collected to measure the mRNA expression of NaPi-IIc and NaPi-IIa using real-time PCR. Compared with the calibrator Ca level of 0.60% according to the NRC (1998), pigs fed diets with Ca level of 0.44%, 0.75 % and 0.91% had higher mRNA expression of NaPi-IIc in jejunum (1.49, 13.60 and 7.65) and NaPi-IIa in kidney (2.15, 6.53 and 8.48). Pigs fed with Ca level of 0.29% had lower mRNA expression of NaPi-IIa. These results suggest that the levels of dietary calcium affect mRNA expression of NaPi-II in jejunum and kidney.

Key Words: Pigs, Sodium-Dependent Pi Absorption, Phosphorus

Nonruminant Nutrition: Protein and Amino Acids

TH131 Determination of the order of limiting amino acids in milk-based liquid diets for pigs from 1.5 to 5.5 kg. A. I. Broome¹, R. J. Harrell², J. Odle¹, K. E. Sullivan¹, and J. H. Eisemann^{*1}, ¹North Carolina State University, Raleigh, ²Novus International Incorporated, St. Louis, MO.

This experiment was designed to determine the order of limiting amino acids (AA) beyond lysine (LYS) in a whey-skim milk-caseinate diet to be fed to low birth weight pigs. Initial pig weight was 1.71±0.30 kg (Rep. 1) and 1.62±0.11 kg (Rep. 2). The order was determined using a deletion assay. This was done using a positive control (PC) diet with AA concentrations and ratios to LYS at or above NRC recommendations, a negative control (NC) diet that reduced AA concentrations and ratios to LYS to 60% of the PC diet ratios, a supplemented negative control (Supp. NC) diet with AA supplemented to provide concentrations and ratios to LYS similar to the PC diet, and deletion diets which removed threonine (THR), tryptophan (TRP), sulfur amino acids (SAA), or phenylalanine (PHE) from the Supp. NC diet to levels in the NC diet. All diets contained 4.2 Mcal GE and 20.6 g LYS/kg DM. Diets were fed ad libitum (n=8/diet). Gain, intake, G:F, and PUN concentration were analyzed for effects of diet, replicate, and interaction. The SEM values were 7.33 g/d, 7.72 g DM/d, 0.02, and 0.33 mM, respectively, for diet main effect. Gain for animals fed PC (346 g/d), NC (269 g/d), and Supp NC (315 g/d) diets differed (P<0.05). Gain of pigs on all deletion diets was similar. The SAA deletion diet produced less gain (291 g/d, P<0.05) than Supp. NC diet. Intake was similar in pigs fed PC (306 g DM/d) and NC diets (310 g DM/d) and greater (P<0.05) than for pigs on all other diets. Feed efficiency decreased for pigs fed NC diet (0.87, P<0.05) compared to all other diets. Pigs fed SAA deletion diet had the greatest (P<0.05) PUN concentration (6.96 mM). Pigs fed THR deletion diet (5.70 mM) and PC diet (5.55 mM) had similar concentrations. Based on increased PUN concentration and decreased gain in pigs fed the SAA deletion diet relative to the Supp. NC diet, it is likely that SAA were next limiting. Threonine would likely be next limiting after SAA, also based on increased PUN concentrations.

Key Words: Limiting Amino Acids, Liquid Diets, Pigs

TH132 Use of distillers dried grains with solubles and soybean hulls in nursery pig diets. F.F. Barbosa*, S.S. Dritz, M.D. Tokach, J.M. DeRouchey, R.D. Goodband, and J.L. Nelssen, Kansas State University, Manhattan, Kansas, United States.

Two 21-d experiments with 1,584 pigs in each experiment were conducted to evaluate growth performance of nursery pigs fed different levels of distillers dried grains with soluble (DDGS) or soybean hulls. In each experiment, pigs (10.9 kg in Exp. 1 and 12.4 kg in Exp. 2) were allotted to 72 pens (36 pens of barrows and 36 pens of gilts) with 22 pigs per pen on day 21 after weaning. A pen of barrows and gilts shared a common feeder and, thus, feeder was the experimental unit. In Exp. 1, treatments were a corn-soybean meal based control diet or the same diet with 7.5%, 15%, or 22.5% added DDGS. Increasing DDGS from 0 to 22.5% did not influence ADG (P>0.26; 506, 512, 516, or 515 g/d) or ADFI (P>0.21; 758, 754, 737, or 743 g/d); but linearly (P<0.004) increased G:F (0.67, 0.68, 0.70, and 0.69). The survival rate (99.0 to

99.5%) was not affected (P>0.60) by diet. In Exp. 2, treatments were arranged as a 2 x 2 factorial with either 0 or 15% DDGS and 0 or 4% soybean hulls. Adding DDGS, soybean hulls or the combination of DDGS and soybean hulls to the control diet did not influence (P>0.17) ADG (557, 555, and 542 vs. 555 g/d). There was an interaction (P<0.01) between DDGS and soybean hulls for ADFI and a trend for an interaction (P<0.09) for G:F. Adding DDGS reduced ADFI and increased (P<0.04) G:F to a greater extent when added to the control diet (786 vs 822 g/d; 0.71 vs 0.68) than when added to the diet containing soybean hulls (789 vs 804 g/d; 0.69 vs 0.69). Adding soybean hulls to the control diet did not affect (P>0.17) pig performance. The survival rate (99.5 to 100%) was not affected (P>0.31) by treatments. In summary, 15 to 22.5% DDGS and up to 4% soybean hulls were added to diets for 12 to 24 kg pigs without influencing ADG while increasing levels of DDGS (up to 22.5%) improved feed efficiency in these experiments.

Key Words: Distillers Dried Grains with Solubles, Soybean Hulls, Nursery Pigs

TH133 Amino acid supplementation of hydrolyzed feather meal diets for finisher pigs: I. Growth performance and serum metabolite profile. K. C. Divakala^{*1}, L. I. Chiba¹, R. B. Kamalakar¹, S. P. Rodning¹, E. G. Welles¹, K. A. Cummins¹, J. Swann², F. Cespedes², and R. L. Payne³, ¹Auburn University, Auburn, AL, ²American Proteins, Inc., Hanceville, AL, ³Evonik-Degussa Corp., Kennesaw, GA.

The objective of this study was to determine the possibility of replacing soybean meal (SBM) in pig diets completely with feather meal (FM). Corn-SBM, finisher (F) 1 and 2 positive control diets (PC) were formulated to contain 6.1 and 4.7 g apparent ileal digestible (AID) Lys/kg, respectively, and corn-FM, negative control diets (NC) were formulated to be iso-N to the PC. The NC were supplemented with AA to satisfy all the AID indispensable (Ind) AA requirements based on the 1998 NRC AID AA (NRC; NC + Lys and Trp) and the assumption that the apparent ileal digestibility of all Ind AA in FM is 40% (40-2AA = NC + Lys, Trp, and Thr, but no His and Ile, and 40All = NC + Lys, Trp, Thr, His, and Ile). Forty-five gilts and 45 barrows (57.8 ± 0.8 kg; 3 gilts or 3 barrows/pen) were randomly assigned to 5 F-1 diets. At 81.0 ± 1.4 kg, pigs were offered F-2 diets. Pigs had ad libitum access to feed and water, and blood samples were collected at the end of the study (112.1 ± 1.8 kg). As expected, overall ADFI, AID Lys (representing Ind AA) intake (LysI), ADG, and G:F were greater and G:LysI was lower in pigs fed the PC than those fed the NC (P < 0.001). Overall G:LysI tended to be lower in pigs fed the NRC than those fed the PC (P = 0.083) or 40-2AA and 40All (P = 0.094), and pigs fed the 40All had numerically higher G:F (P = 0.119) and G:LysI (P = 0.160) than those fed the 40-2AA. Pigs fed the PC had more serum albumin and total protein (TP; P < 0.001) but less glucose (P = 0.031) and cholesterol (P < 0.001) than those fed the NC, and TP was higher (P = 0.031) in pigs fed the 40All than those fed the 40-2AA. Diets had no effect on urea N or triglycerides. The results seemed to indicate that pigs fed the FM diet supplemented with the necessary AA can utilize AA for weight gain as efficiently as those fed the corn-SBM diet.

Key Words: Finisher Pigs, Feather Meal, Growth Performance

TH134 Amino acid supplementation of hydrolyzed feather meal diets for finisher pigs: II. Carcass traits, meat quality, and internal organs. K. C. Divakala^{*1}, L. I. Chiba¹, R. B. Kamalakar¹, S. P. Rodning¹, E. G. Welles¹, K. A. Cummins¹, J. Swann², F. Cespedes², and R. L. Payne³, ¹Auburn University, Auburn, AL, ²American Proteins, Inc., Hanceville, AL, ³Evonik-Degussa Corp., Kennesaw, GA.

Forty-five gilts and 45 barrows were used to determine the possibility of replacing soybean meal (SBM) in pig diets completely with feather meal (FM). Pigs (57.8 ± 0.8 kg; 3 gilts or 3 barrows/pen) were randomly assigned to 5 finisher (F) 1 diets. At 81.0 ± 1.4 kg, pigs were offered F-2 diets. Corn-SBM, F-1 and F-2 positive control diets (PC) were formulated to contain 6.1 and 4.7 g apparent ileal digestible (AID) Lys/kg, respectively, and corn-FM, negative control diets (NC) were formulated to be iso-N to the PC. The NC were supplemented with AA to satisfy all the AID indispensable (Ind) AA needs based on the 1998 NRC AID AA (NRC; NC + Lys and Trp) and the assumption that apparent ileal digestibility of all Ind AA in FM is 40% (40-2AA = NC + Lys, Trp, and Thr, but no His and Ile, and 40All = NC + Lys, Trp, Thr, His, and Ile). Pigs had ad libitum access to feed and water, and all pigs were slaughtered at 112.1 ± 1.8 kg. Pigs fed the PC had less average backfat than those fed the NC ($P = 0.016$) or the NRC ($P = 0.020$). The LM was greater ($P < 0.001$) in pigs fed the PC or the 40All than those fed the NC or the 40-2AA, respectively. Pigs fed the PC had greater ($P < 0.01$) % lean, lean gain (LG), and LG:F than those fed the NC, but their LG:F or LG:Lys (representing Ind AA) intake (LysI) was similar to those fed the NRC. The LG:F ($P = 0.030$) and LG:LysI ($P = 0.028$) were lower in pigs fed the NRC than those fed the 40-2AA and the 40All, and LG:LysI tended to be higher ($P = 0.068$) in pigs fed the 40All than those fed the 40-2AA. Pigs fed the 40All had greater ($P < 0.001$) meat color, firmness, and marbling scores than those fed the 40-2AA. Diets had no clear effect on organ weights. The results seemed to indicate that pigs fed the FM diet supplemented with the necessary AA can utilize AA and feed for LG as efficiently as those fed the corn-SBM diet.

Key Words: Finisher Pigs, Feather Meal, Carcass Traits

TH135 Effects of dietary crude protein level on concentrations of fecal volatile fatty acids, and fecal and urinary ammonia and volatile organic compounds in growing pigs. S. B. Cho^{*}, D. W. Kim, O. H. Hwang, C. W. Choi, W. T. Chung, J. H. Lee, I. B. Chung, and B. S. Lee, *National Institute of Animal Science, RDA, Suwon, Republic of Korea.*

Present study aimed to investigate effects of dietary crude protein (CP) level on concentrations of fecal volatile fatty acids (VFA), and fecal and urinary ammonia and volatile organic compounds (VOC) in growing pigs. Twenty boars were allotted to one of four dietary treatments in randomized complete block design with five replicates. Dietary treatments consisted of four corn-soybean based meals containing 10, 12, 14, or 16% CP. Synthetic amino acids of lysine, methionine and threonine were added into the diet to provide similar contents of limiting amino acids among treatments. Pigs were housed individually in metabolic cages to allow collection of feces and urine. Fresh feces and urine samples were collected to analyze concentrations of VFA, ammonia, and VOC. Total VFA concentration from fresh feces for CP 10% diet (12.3g/kg) was higher ($P < 0.05$) than that from the other diets (mean 7.7g/kg). Fecal ammonia concentration for CP 14% diet (6.0g/kg) was lower ($P < 0.05$) than that from the other diets (mean 7.6g/kg). Phenol (10.0mg/kg), p-cresol (408.4mg/kg) and ammonia (2.1g/kg)

concentration in urine under 12% diets decreased ($P < 0.05$) compared with those over CP 14% diets (22.2mg/kg, 883.2mg/kg and 5.4g/kg, respectively). Present results indicate that dietary CP level may regulate odor-producing substances in growing pigs.

Key Words: Crude Protein, Pig, Volatile Organic Compounds

TH136 Feed preferences in nursery pigs fed diets containing varying fractions and qualities of dried distillers' grains with solubles (DDGS). B. S. Seabolt¹, E. van Heugten^{*1}, K. D. Ange-van Heugten¹, and E. Roura², ¹North Carolina State University, Raleigh, ²Lucta SA, Barcelona, Spain.

Three experiments were conducted to evaluate nursery pig preference of diets containing DDGS of different quality and levels of inclusion. Pigs were adjusted to a commercial diet (without DDGS) at weaning for at least 10 d and subsequently housed individually. Each pen contained two identical feeders positioned side by side and preference was measured for two days. In Exp. 1, 60 pigs (11.63 ± 0.27 kg BW) were given a choice between a control diet (0% DDGS) and a diet containing either 0, 10, 20 or 30% DDGS. In Exp. 2, 80 pigs (10.25 ± 0.20 kg BW) were given a choice between a control diet (0% DDGS) and a diet containing either 0% DDGS, 30% good quality DDGS or 30% poor quality DDGS. Quality was determined by odor and color of the DDGS. In Exp. 3, 80 pigs (11.15 ± 0.18 kg BW) were given a choice between a control diet without DDGS and a diet containing either 10% or 20% good quality, or 10% or 20% poor quality DDGS. Feed disappearance was measured for two days in each experiment and preference was calculated as intake of the test diet as a percentage of total feed intake. In Exp. 1, a linear decrease ($P < 0.001$) in preference for DDGS containing diets was observed, where preferences were 58.2%, 34.8%, 26.4%, and 17.2% for the 0%, 10%, 20% and 30% DDGS inclusion, respectively. In Exp. 2, no significant differences in preference were detected between good and poor quality DDGS when fed at 30% of the diet. In Exp. 3, no significant differences in preference between the control diet and 10% good or poor quality DDGS were evident. However, mean intake was greater ($P < 0.05$) for the control diet (439 g/d) compared to the 20% good quality DDGS (144 g/d). Mean intake was also greater ($P = 0.09$) for the control diet (407 g/d) compared to the 20% poor quality DDGS (242 g/d). Nursery pigs prefer a diet without DDGS over a diet containing DDGS even at low inclusion levels. Quality of DDGS as defined in this study had no effect on preference.

Key Words: Dried Distillers Grains with Solubles, Pigs, Preference

TH137 Effect of dietary protein level on serum haptoglobin and pro-inflammatory cytokine concentrations in piglets challenged with *Escherichia coli* K88. F. O. Opapeju^{*1}, R. L. Payne², and C. M. Nyachoti¹, ¹University of Manitoba, Winnipeg, MB, Canada, ²Evonik-Degussa Corporation, Kennesaw, GA.

A 14-d study was conducted to investigate the effect of dietary CP level on serum haptoglobin and pro-inflammatory cytokine concentrations in piglets challenged with enterotoxigenic *Escherichia coli* K88. Forty piglets (average BW = 5.32 ± 0.24 kg), housed in groups of 4 pigs per pen, were randomly allotted to 2 diets (5 pens/diet) immediately after weaning. Diet 1 contained 22.5% CP (high CP diet) and diet 2 contained

17.6% CP (low CP diet) supplemented with amino acids. The two dietary CP levels were achieved by using different combinations of corn, wheat and casein. The diets contained the same amount of ME and standardized ileal digestible Lys, Met + Cys, Thr, Trp, Ile, and Val based on the ideal protein ratio. Pigs were orally challenged with 6 mL of *E. coli* suspension (10^{10} cfu/mL) on d 8 after weaning. Blood samples were collected from 1 pig per pen on 7 d and 24 h before challenge and 8 h, 24 h, 72 h and 7 d post-challenge for determination of serum haptoglobin, TNF- α , IL-8 and IL-1 β concentrations in the serum. Pigs fed the low CP diet had lower ($P < 0.05$) levels of haptoglobin (9 vs. 25 mg/dL), TNF- α (106 vs. 138 pg/mL), IL-8 (52 vs. 119 pg/mL) and IL-1 β (72 vs. 116 pg/mL) at 8 h post-challenge compared with those fed the high CP diet. There were no effects of diet on any of the measured parameters at the other periods of blood collection. The results indicate that a low protein diet supplemented with amino acids fed to pigs immediately after weaning reduced inflammation resulting from an enterotoxigenic *Escherichia coli* challenge.

Key Words: Dietary Protein, Piglets, Pro-Inflammatory Cytokines

TH138 Influence of micronization (fine grinding) of soy bean meal and fullfat soy bean on nutrient digestibility and digestive traits in young pigs. D. G. Valencia, M. P. Serrano, R. Lázaro, M. A. Latorre, and G. G. Mateos*, *Universidad Politécnica de Madrid, Spain.*

A trial was conducted to test the effect of micronization (very fine grinding) of soybean meal (SBM) and fullfat soy bean (FFSB) on coefficient of ileal apparent digestibility (CIAD) of dietary components and digestive traits of piglets. The experimental design was completely randomized with 4 treatments arranged factorially (SBM and FFSB, micronized and ground) and six replicates each (one piglet). Four isonutritive diets (2,490 kcal NE/kg and 1.28% available Lys) were fed from 23 to 45 d of age. The main difference among them was the mean particle size of the soy bean product used (47 and 881 μ m for the SBM and 41 and 778 μ m for the FFSB, micronized and ground, respectively). In all cases the source tested supplied 5.5% of the dietary protein (CP). The CIAD of dietary components, the pH of the gastrointestinal tract (GIT) and the weight of digestive organs and spleen were measured at 45 days of age. Particle size did not affect any trait studied ($P \geq 0.10$). Type of soy bean product had no effect on CIAD of CP or amino acids ($P \geq 0.10$). However, piglets fed the SBM diets had higher CIAD of organic matter (0.765 vs. 0.705) and gross energy (0.761 vs. 0.711) than piglets fed the FFSB diets ($P \leq 0.001$). The pH of the different segments of the GIT was not affected by the soybean product used ($P \geq 0.10$). Pigs fed SBM had heavier pancreas (2.3 vs. 1.9 g/kg body weight; $P \leq 0.05$) and livers (35.9 vs. 32.7 g/kg body weight; $P \leq 0.01$) than pigs fed FFSB. The poor nutrient digestibility of pigs fed FFSB as compared to pigs fed SBM might be related to the conditions applied during processing of the bean. It is concluded that pigs fed soy bean meal had better digestibility of organic matter and gross energy than pigs fed FFSB and that fine grinding of the two soy protein sources does not affect nutrient digestibility.

Key Words: Particle Size, Soy Bean Products, Digestibility in Piglets

TH139 Effects of including field peas in diets fed to weanling pigs. H. H. Stein*¹ and D. N. Peters², ¹*University of Illinois, Urbana,* ²*South Dakota State University, Brookings.*

Two experiments were conducted to measure effects of including field peas in diets fed to weanling pigs. Pigs that were weaned at 20 d and fed a common starter diet for 2 wk post-weaning were used in both experiments. In Exp. 1, 120 pigs were randomly allotted to 5 treatments with 3 or 4 pigs per pen and 7 replicate pens per treatment. The control diet was based on corn (56.8%), soybean meal (16.0%), and extruded full fat soybeans (21.0%). Two additional diets were formulated by including 24.5 or 49.0% raw field peas in the control diet at the expense of corn and soybean meal. The last 2 diets were similar to these diets with the exception that 24.5 or 49.0% extruded field peas were used rather than raw field peas. All diets were provided on an ad libitum basis during 25 d. There were no differences among pigs fed the 5 treatment diets in ADG (574, 559, 548, 598, and 549 g/d), ADFI (1,013, 1,024, 962, 1,003, and 914 g/d) or G:F (0.57, 0.55, 0.58, 0.60, and 0.61 g/g). Experiment 2 used 168 pigs that were randomly allotted to 6 treatments with 4 pigs per pen and 7 replicate pens per treatment. A control diet containing corn (57.1%), soybean meal (27.0%), and dried whey (10.0%) was formulated. Five additional diets were formulated by including, 12, 24, 36, 48, or 60% field peas in this diet at the expense of corn and soybean meal. Pigs were fed experimental diets on an ad libitum basis during 4 wk and results showed that there were no differences in ADG, ADFI, or G:F among treatment groups (Table 1). It is concluded from these experiments that up to 60% raw field peas may be included in diets fed to pigs from 2 weeks post-weaning. Use of extruded field peas does not improve pig performance compared with raw field peas.

Table 1. Increasing concentrations of field peas in diets fed to weanling pigs (Exp. 2)

Peas, %	0	12	24	36	48	60	SEM	P-value, Linear	P-value, Quadratic
Initial BW, kg	8.94	8.92	8.92	8.92	8.95	8.94	0.729	0.99	0.98
ADFI, g	930	933	944	913	884	915	58	0.61	0.97
ADG, g	551	574	530	548	494	532	34	0.28	0.92
G:F, g/g	0.59	0.61	0.56	0.61	0.56	0.59	17	0.28	0.86
Final BW, kg	24.36	24.99	23.78	24.27	22.80	23.85	1.618	0.53	0.94

Key Words: Field Peas, Nursery Diets, Pigs

TH140 Effects of dietary pine cone meal on egg production, egg quality, serum cholesterol and cholesterol content and fatty acid composition of egg yolk in laying hens. S. O. Shin*¹, J. H. Cho¹, Y. J. Chen¹, J. D. Kim², J. H. Lee³, K. W. Park³, and I. H. Kim¹, ¹*Dankook University, Cheonan, Chungnam, Korea,* ²*CJ CheilJedang, Seoul, Korea,* ³*Korea National Arboretum, Pocheon, Gyeonggi, Korea.*

This study was conducted to evaluate the effects of dietary pine cone meal on egg production, egg quality, serum cholesterol, cholesterol content and fatty acid composition of egg yolk in laying hens. The total of 252 (51-wks) Hy-line brown commercial hens were used for 5 weeks. Dietary treatments included 1) T1 (basal diet + 1% cottonwood sawdust), 2) T2 (basal diet + 0.5% cottonwood sawdust + 0.5% pine cone meal) and 3) T3 (basal diet + 1% pine cone meal). During the overall period, there were no differences in egg production, egg weight and egg quality among treatments. Lipids profile (total, HDL, LDL cholesterol and Triglyceride) in serum was not affected by treatments. Egg yolk cholesterol was not different among the treatments. In fatty acid contents of yolk, C18:3 was higher ($P < 0.05$) in T1 treatment (0.33%) than T3 treatment

(0.27%). Total SFA, PUFA, MUFA and UFA/SFA were no differences in experimental period. In conclusion, results of the experiment was affected by dietary supplementation of pine cone meal on C18:3 fatty acid contents of yolk in laying hens, without adversely production.

Key Words: Pine Cone Meal, Serum Cholesterol, Laying Hens

TH141 Effects of dietary pine cone meal on growth performance, serum cholesterol, carcass quality and fatty acid composition and cholesterol content of meat in broiler chickens. S. O. Shin^{*1}, J. H. Cho¹, J. D. Kim², J. H. Lee³, K. W. Park³, and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²CJ CheilJedang, Seoul, Korea, ³Korea National Arboretum, Pocheon, Gyeonggi, Korea.

This study was conducted to evaluate effects of dietary pine cone meal on growth performance, serum cholesterol, carcass quality and fatty acid composition and cholesterol content of meat in broiler chickens. Three treatments were assigned to 480 (2 days) Arbor Acre broiler chicks with eight replications, allocating 20 broiler chicks in each replication. Dietary treatments included 1) CS (1% cottonwood sawdust), 2) PCM0.5 (0.5% cottonwood sawdust + 0.5% pine cone meal) and 3) PCM1.0 (1% pine cone meal). During the overall period there was no difference of growth performance among treatments. Also, cholesterol profile (total, HDL, LDL cholesterol and triglyceride) in serum and carcass characteristic were not affected by treatments. TBARS of leg and breast meat was significantly decreased ($P<0.05$) in PCM1.0 treatment (0.014 and 0.021 mgMA/kg, respectively) compared to CS treatment (0.025 and 0.030 mgMA/kg, respectively). In fatty acid contents of leg meat, C20:0 was significantly higher ($P<0.05$) in PCM0.5 treatment (0.32%) than PCM1.0 treatment (0.25%). Also, C18:3n3 was significantly lower ($P<0.05$) in PCM1.0 treatment (0.02%) than other treatments (0.04% and 0.04%). Cholesterol contents of leg, breast meat and abdomen fat were not affect by treatment. In conclusion, results of the experiment were affected by dietary supplementation of pine cone meal on TBARS of leg and breast meat.

Key Words: Pine Cone Meal, Growth Performance, Broiler

TH142 Effects of dietary level of brewer's grain on growth performance and digestibility in growing pigs. J. S. Yoo^{*1}, J. D. Kim², K. Y. Whang³, H. J. Jung⁴, S. B. Cho⁴, H. B. Seok¹, and I. H. Kim¹, ¹Dankook University, Cheonan, Choongnam, Korea, ²CJ CheilJedang, Seoul, Korea, ³Korea University, Seoul, Korea, ⁴National Institute of Animal Science, Korea.

This study was conducted to investigate the effects of dietary brewer's grain supplementation on growth performance and digestibility in growing pigs. A total of forty-eight pigs (18.1kg, average initial body weight) were used during 42 days. Dietary treatments included: 1) CON (basal diet), 2) BG5 (basal diet + 5% brewer's grain) and 3) BG10 (basal diet + 10% brewer's grain). Each treatment had 8 replicates of 2 pigs per pen in a randomized complete block design. Growth performance was not affected ($P>0.05$) by treatments. However, in nutrient digestibility, DM digestibility was higher ($P<0.05$) in BG5(79.67%) treatment than CON(77.39%) and BG10(78.43%) treatments. Nitrogen digestibility was the highest ($P<0.05$) in BG10(84.35%) treatment and among another(72.67%, 82.63%) treatments, also, BG5(82.63%) treatment

was higher ($P<0.05$) than CON treatment. Energy digestibility was higher ($P<0.05$) in BG5(80.88%) treatment than CON(78.41%) treatment. In conclusion, dietary brewer's grain supplementation had no influence on growth performance whereas improved nutrient digestibility in growing pigs.

Key Words: Brewer's Grain, Growth Performance, Pigs

TH143 Effect of bedding types and different crude protein levels on growth performance, visceral organ weight and blood characteristics in broiler chickens. Y. Huang^{*1}, J. S. Yoo¹, Y. J. Chen¹, J. H. Cho¹, J. D. Kim², J. D. Hancock³, and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²CJ CheilJedang, Seoul, Korea, ³Kansas State University, Manhattan.

The object of this study was to assess whether bedding types could influence the growth performance of broiler chickens fed on high and low crude protein (CP) diets. The broilers were bedded with clean hulls or shavings. For hundred and eighty broiler chickens (Ross) were divided into six treatment groups including: 1) high CP diet with rice hulls, 2) high CP diet with wood shavings, 3) high CP diet with coconut hulls, 4) low CP diet with rice hulls, 5) low CP diet with wood shavings, and 6) low CP diet with coconut hulls. Each treatment included four replicate pens with twenty broilers per pen. Weight gain, feed intake, feed/gain ratio, visceral organ relative weight, RBC, WBC, and lymphocyte levels were evaluated. The Bursa of Fabricius, liver and abdominal fat relative weight, WBC, and lymphocyte levels were not altered consistently by any of the treatments. For the overall period, weight gain and feed intake was higher in the coconut hulls treatment groups as compared with wood shavings treatments ($P<0.05$). Feed intake was also higher in low CP diet than in the high CP diet treatment groups ($P<0.05$). The concentration of RBC in blood was reduced significantly by bedding wood shavings while these levels were increased in rice hulls treatments ($P<0.05$). In conclusion, our results indicate that coconut hulls are suggested as a replacement of rice hulls and wood shavings as a resource for broiler bedding, and reduced CP level increases feed intake, especially in the finisher period.

Key Words: Bedding, Broiler

TH144 Comparative efficacy of import fish meals and fermented (*L. acidophilus* GB-LC2) fish meal on growth performance, protein cells concentrations in serum, nutrient digestibility in weanling pigs. J. H. Cho^{*1}, Y. J. Chen¹, J. S. Yoo¹, I. B. Chung², J. H. Ahn², and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²National Institute of Animal Science, RDA, Korea.

The current study was conducted in an effort to evaluate and compare the effects of feeding imported fish meals and fermented fish meal on growth performance, protein cells concentrations in serum, nutrient digestibility, backfat thickness and lean percent in weaning pigs. One hundred twenty pigs [(Landrace × Yorkshire) × Duroc] barrows (6.70±0.20kg) were used in a 35 - d feeding trial. Dietary treatments included: E1 (5 and 2.5% LT fish meal in phase 1 & 2, respectively), E2 (5 and 2.5% Bio-CP fish meal), LF (5 and 2.5% domestic fish meal) and FLF (5 and 2.5% fermented domestic fish meal). During 35 days after weaning, there were no difference in average daily feed intake and

gain/feed ratio (n=24) among the treatments ($P>0.05$). However, pigs fed the E2 diet had greater ($P<0.05$) average daily gain (n=24) than pigs fed LF diets during entire feeding period. Weekly backfat thickness and lean percent (n=48) were not affected ($P>0.05$) by the experimental diets during the entire 5-wk study period. No differences ($P>0.05$) were observed for concentrations of albumin, creatinine, blood urea nitrogen and total protein in serum (n=48) on 0, 14 and 35 days. On 7 days, creatinine concentrations was highest ($P<0.05$) for pigs fed the LF diet compare to pigs fed the E2 and FLF diets ($P<0.05$). During 35 days after weaning, pigs fed the E2 and FLF diets had a greater nitrogen digestibility (n=48) than pigs fed the LF diet ($P<0.05$). In conclusion, the results of this study indicate that fermented fish meal had similar effects on growth performance and nitrogen digestibility as compared to imported fish meal.

Key Words: Fish Meal, Nitrogen Digestibilities, Weaning Pigs

TH145 Effect of deoiled corn dried distillers grains with solubles, solvent extracted on nursery pig growth performance. J. Y. Jacela^{*1}, L. Brandts², J. M. DeRouchey¹, S. S. Dritz¹, M. D. Tokach¹, R. D. Goodband¹, J. L. Nelssen¹, R. C. Thaler², D. Peters², and D. E. Little³, ¹Kansas State University, Manhattan, ²South Dakota State University, Brookings, ³DairyNet Inc., Brookings, SD.

Deoiled corn dried distillers grains with solubles, solvent extracted (dDGS) is a co-product of ethanol production which is traditional dried distillers grains with solubles with a majority of oil removed. A total of 210 pigs (initial BW 9.9 kg) were used in a 28-day study to evaluate the effect of dDGS on nursery pig performance. From weaning to just prior to start of the trial, all pigs were placed on a common diet until they reached an average of 10 kg BW. Pigs were then blocked based on pen weights and each pen was randomly assigned to 1 of 5 dietary treatments. There were 7 pens per treatment with 6 pigs per pen. The treatments provided 0, 5, 10, 20, and 30% dDGS formulated to contain equivalent dietary ME and standardized ileal digestible (SID) lysine based from a previous study at Kansas State University. Pen weights were obtained on d 0, 14, and 28 and feed intake was recorded on a pen basis. Growth rate ($P>0.52$), feed intake ($P>0.95$), and feed efficiency ($P>0.55$) were similar between treatments regardless of the level of dDGS in the diet. Results from this experiment suggest that dDGS can be included in nursery pig diets of up to inclusion levels of 30% without affecting growth performance.

Table 1.

Item	dDGS, %					SE
	0	5	10	20	30	
Final wt, kg	22.7	22.8	22.2	22.4	22.3	0.6
ADG, g	455	459	452	445	442	19.7
ADFI, g	749	771	760	751	761	8.9
G:F	0.61	0.60	0.59	0.59	0.58	0.03

Key Words: Nursery Pig, Deoiled Corn Dried Distillers Grains, Growth

TH146 Evaluation of distillers dried grains with solubles (DDGS) and Allzyme[®] SSF in grow-finish pigs. J. Pierce* and J. Bannerman, Alltech, Inc., Nicholasville, KY.

An experiment was conducted to evaluate the effects of Allzyme[®]SSF on the growth performance and carcass quality of pigs fed diets containing graded levels of DDGS in grow-finish pigs. A total of 420 pigs (42 pens of 10 pigs/pen) were randomly allotted by weight and sex to six dietary treatments. Diets were corn-soybean meal based with DDGS substituting for corn and soybean meal. The diets were formulated to meet or exceed the NRC 1998 nutrient requirements for each of three growth phases. The six dietary treatments were arranged in a 3x2 factorial structure with 10, 20, or 30% DDGS without or with 200g/tonne of Allzyme[®]SSF, respectively. All pigs were weighed at the onset of the experiment and then 30, 73 and 111 days later. Each pig was tattooed and sent to a commercial slaughter facility in the Midwest. Backfat samples were taken from five randomly chosen carcasses from each pen and analyzed for iodine values (IV) as an indicator of the degree of fat saturation. Means for ADG and F:G for the entire 111 day experiment were 856, 855, 823, 855, 855, 853 g/d and 2.83, 2.83, 2.83, 2.76, 2.89, 2.83 for the six treatments, respectively. As the level of dietary DDGS was increased, ADG was decreased ($P<0.05$), however the addition of Allzyme[®]SSF maintained ADG which resulted in a DDGSxAllzyme[®]SSF interaction ($P<0.09$). Last rib back fat and ham pH were unchanged by treatment, however, loin depth decreased linearly as DDGS was increased in the diet ($P<0.05$). Iodine values increased linearly as DDGS was increased ($P<0.05$) indicating less saturated fat. The increased iodine values that result from feeding 30% DDGS to finishing pigs until slaughter may not currently be an acceptable practice because of reduced pork quality. However, there is a possibility of oil removal for biodiesel and other purposes growing in the future. The addition of Allzyme[®]SSF to diets containing DDGS can reduce cost of gain in growing-finishing swine while maintaining growth performance.

Key Words: Pigs, Distillers Grains, Enzyme

TH147 Comparison of finishing pigs performance when diets containing DL- methionine and cull chickpeas in substitution of soybean meal and corn. J. M. Uriarte*, J. F. Obregón, H. R. Guemez, F. G. Rios, and O. S. Acuña, Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México.

To determinate the effect of substitution of soybean meal and corn for cull chickpeas on growth performance, 48 pigs (BW = 53.63 ± 1.70 kg; Large white x Landrace x Large white x Pietrain) in groups of four were placed in 12 concrete floor pens (2.5 x 2.5 m). In a complete randomized experimental design, pens were fed one of three diets: 1) Diet with 15.2 % CP and 3.35 Mcal ME/kg, containing corn 76.5 %, soybean meal 15.5 %, and premix 4 % (CONT); 2) Diet with 17.1 % CP and 3.35 Mcal ME/kg with corn 42.5 %, cull chickpeas 50 %, soybean meal 3.5 %, and premix 4 % (CHP50) and 3) Diet similar to CHP50 with 0.2 % of methionine added (CHP50M). Pigs were weighed at days 0 and 48 of experiment and feed intake was recorded daily. The average daily gain (ADG) and feed intake/gain ratio were calculated from these data. Body weight at day 48 (95.17, 95.65 and 96.17 kg) was not affected ($P=0.91$) by CONT, CHP50 and CHP50M, respectively. ADG (0.82, 0.92 and 0.90 kg) was not similar ($P=0.04$) between dietary treatments.

Feed intake (2.47, 2.57 and 2.60 kg) was not modified ($P=0.66$) by treatments. Feed/gain ratio (3.04, 2.82, and 2.90) was similar ($P=0.30$) between treatments. It is concluded, that cull chickpeas with 0.2 % added DL-methionine can be used up 50 % in diets for finishing pigs without affecting growth performance.

Key Words: Chickpeas, Growth Performance, Methionine

TH148 Carcass traits of pigs fed with cull chickpeas with added DL-methionine. J. M. Uriarte*, J. F. Obregón, H. R. Guemez, F. G. Rios, O. S. Acuña, and A. R. Cortina, *Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México.*

To determine the effect of substitution of soybean meal and corn for cull chickpeas on carcass traits of the finishing pigs, 48 pigs (BW = 53.63 ± 1.70 kg; LW × Land × LW × Piet) in groups of four were placed in 12 concrete floor pens (2.5 x 2.5 m). In a complete randomized experimental design, pens were fed one of three diets: 1) Diet with 15.2 % CP and 3.35 Mcal ME/kg, containing corn 76.5 %, soybean meal 15.5 %, and premix 4 % (CONT); 2) Diet with 17.1 % CP and 3.35 Mcal ME/kg with corn 42.5 %, cull chickpeas 50 %, soybean meal 3.5 %, and premix 4 % (CHP50) and 3) Diet similar to CHP50 with 0.2 % of methionine to added (CHP50M). Pigs were weighed at days 0 and 48 of experiment. After 48 days nine pigs by treatment were slaughtered and carcass traits measured. Body weight at day 48 (95.17, 95.65 and 96.17 kg) was not affected ($P=0.91$) by CONT, CHP50 and CHP50M, respectively. Hot carcass weight (78.83, 76.13 and 77.45 kg) was similar between treatments ($P=0.66$), and carcass yield (78.43, 75.87 and 77.82 %) was not affected by treatments ($P=0.15$). Backfat (1.87, 1.90 and 1.78 cm) was no affected, rib eye area (35.80, 37.25 and 35.70 cm²) was similar between treatments. It is concluded, that cull chickpeas with 0.2 % added DL-methionine can be used at up 50 % of diets for pigs without affecting carcass traits.

Key Words: Chickpeas, Carcass Traits, Methionine

TH149 Comparison of chromic oxide and acid insoluble ash as digestibility markers in the determination of apparent total tract digestibility in finishing pigs. V. D. Naranjo*, S. Powell, T. D. Bidner, and L. L. Southern, *LSU Agricultural Center, Baton Rouge.*

Two experiments were conducted to compare Cr₂O₃ and acid insoluble ash (AIA) as digestibility markers for determining apparent total tract digestibility of DM (DMD), CP (CPD), and GE (GED) in early and late finishing pigs fed ad libitum. In both experiments, growth performance was determined at the end of the 14-d studies. Fecal samples were collected from each pig by rectal palpation on d 12, 13, and 14 and combined within day, pig, and pen (1 sample per pen) at the end of the collection period. Feed and fecal samples were analyzed for CP, GE, Cr, and AIA concentration. Finishing pigs (Exp. 1, n = 18 barrows, initial BW = 50 ± 2.90 kg; Exp. 2, n = 18 barrows and 18 gilts, initial BW = 85 ± 5.90 kg) were used. In Exp. 1, pigs were randomly assigned to 6 pens and fed a diet containing 1% added AIA (diatomaceous earth, Perma-Guard, Inc.) and 0.5% Cr₂O₃ (3,352 ppm Cr). In Exp. 2, pigs were assigned to 6 pens per diet (3 pens of 3 barrows and 3 pens of 3 gilts) on the basis of BW and sex to 2 diets (Diet 1 = 0.5% Cr₂O₃; Diet 2 = 1% added AIA). The diets were nutritionally adequate and based on corn and soybean meal.

In Exp. 1, the diet analyzed to contain 1.48% AIA and 3,171 ppm Cr. The 1.48% AIA is because both the diatomaceous earth and the Cr₂O₃ contribute to the total AIA in the diet. Pigs had an ADG of 827 g, ADFI of 2,382 g, and G:F of 0.35. No significant differences ($P > 0.10$) were observed in CPD (70.63 vs. 67.72 %), but DMD (85.40 vs. 83.95 %) and GED (82.05 vs. 80.26 %) were greater ($P < 0.10$) with the Cr₂O₃ marker. In Exp. 2, Diet 1 analyzed to contain 3,484 ppm Cr and Diet 2 analyzed to contain 1.0% AIA. Growth performance was not affected by diet ($P > 0.10$). Pigs had an ADG of 611 g, ADFI of 2,820 g, and G:F of 0.22. As in Exp. 1, no significant differences were observed in CPD (52.42 vs. 54.45%), but in contrast to Exp. 1, DMD (72.78 vs. 75.95%) and GED (66.34 vs. 71.19%) were greater ($P < 0.05$) with the AIA marker. These data suggest that Cr₂O₃ and AIA result in similar digestibility values and that CP digestibility is not as susceptible to the specific marker as DM and GE.

Key Words: Pig, Digestibility, Marker

TH150 Effects of dried distillers grains and Gromega365™ on sow bratwurst quality. H. White*¹, K. Hesselbrock¹, N. Augspurger², J. Spencer², A. Schinckel¹, and M. Latour¹, ¹Purdue University, West Lafayette, IN, ²JBS United, Sheridan, IN.

Feeding corn dried distillers grains with solubles (DDGS) to sows may impact the fatty acid profile and quality of final products such as bratwurst. The purpose of this study was to determine differences in bratwurst quality made from sows fed one of four dietary treatments: control [CON], control plus DDGS [CDDGS], control plus Gromega 365™ [CG], or DDGS plus Gromega 365™ [DDGSG] based on freshness quality scoring. DDGS was fed at 30% dietary inclusion during gestation and 15% during lactation. Freshness quality of bratwurst was based on a 1-4 scale (1=lowest and 4=highest). DDGSG bratwurst had a significantly ($P < 0.02$) higher overall quality score. Bratwurst fatty acid profiles also differed between treatments. The level of linoleic acid was significantly ($P < 0.0001$) higher in the DDGSG followed by the CDDGS group with both non DDGS treatments being lowest. The highest ($P < 0.0001$) calculated iodine value was observed in the CDDGS (65.6), followed by DDGSG (59.7) and the lowest being the two non DDGS diets (53.1 [CON] and 55.9 [CG]). In summary, there were noted differences in overall bratwurst quality which favored the DDGSG group. Similarly, when comparing the DDGS fed groups (DDGSG vs. CDDGS), the overall iodine value was lower in the DDGSG bratwurst.

Key Words: DDGS, Sows, Bratwurst

TH151 The effects of extrusion and inclusion of dried distillers grains on nitrogen retention in swine. A Dietz*¹, R.L. Atkinson¹, P Walker², and G Apgar¹, ¹Southern Illinois University, Carbondale, ²Illinois State University, Normal.

Eight steered ileal cannulated pigs (PIC L337×C22; 51.2 ± 3.8 kg) were used in a 4 × 4 repeated Latin square design to determine the effect of extrusion and protein source on N retention. Each period consisted of 5 d adjustment, 3 d total fecal and urine collection, followed by 2 d ileal collection, with 1 d rehydration between ileal collections. Semi-purified diets were formulated to supply 0.9% lysine from the following protein sources: 1) 100% non-extruded dried distillers grains +

solubles (DDG;ND); 2) 100% extruded DDG (ED); 3) 70:30% soybean meal:DDG mix non-extruded (NM); 4) 70:30% soybean meal:DDG mix extruded (EM). Protein sources were extruded using a single screw dry extruder. Treatments were balanced to meet AA requirements and fed at 9% metabolic body weight offered twice daily (0700 and 1700 h). Feed, feces and urine were analyzed for DM and N content. Data were analyzed using the MIXED procedures of SAS to compare effects of extrusion and inclusion of DDG. The inclusion of DDG decreased ($P < 0.01$) N intake and extrusion decreased N intake ($P < 0.0001$). As DDG increased in the diet, fecal N increased ($P = 0.01$). Although extrusion had no effect on N in the urine, increasing DDG in the diet decreased N in the urine ($P = 0.03$). However, neither extrusion nor protein source altered total N output ($P > 0.25$) or BV ($P > 0.12$). N digested (g/d) decreased with both extrusion ($P = 0.003$) and inclusion of DDG ($P < 0.0001$). Furthermore, N digestibility, as a % of N intake, decreased ($P = 0.003$) with DDG inclusion, however; digestibility was not effected ($P = 0.31$) by extrusion. N retention was reduced by both extrusion ($P = 0.01$) and inclusion of DDG ($P = 0.09$). Extrusion tended ($P = 0.07$) to decrease net protein utilization, however; protein source had no effect ($P = 0.99$) on utilization. These data suggest that protein source does not effect N utilization; however, extrusion of the diets containing DDG may decrease N retention.

Key Words: Dried Distillers Grains, Nitrogen, Swine

TH152 L-Tryptophan dietary supplementation stimulated an earlier feed intake and reduced the physical activity of early weaned piglets. M. Anguita¹, R. G. Hermes^{*1}, J. Gasa¹, D. Melchior², and J. F. Pérez¹, ¹Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain, ²Ajinomoto Eurolysine S.A.S., Paris, France.

L-Tryptophan (Trp) has been related with different metabolic functions that regulate feed intake, stress recovery and immune response. In the present study we evaluated if L-Tryptophan supplementation above the daily requirements proposed by different feeding systems (18% of the daily lysine-Lys- requirement) may improve the adaptation of piglets after weaning. A total of 30 piglets were selected from ten different sows (three piglets /sow, 6.80 kg \pm 0.372) and allocated into fifteen pens (two piglets/pen). Three dietary treatments were designed based on the Trp to Lys ratio and the feeding manner, and distributed to the different pens (one pig per sow was present in each treatment). Two treatments were administered *ad libitum*, Trp18 (Trp:Lys = 0.18) and Trp22 (Trp:Lys = 0.22), and a third treatment, rTrp22, were restrictively fed to the same intake shown by Trp18 from day four after weaning. Feed intake was daily registered and the posture of the animals (laying or standing) controlled ten times within a day on days 4 to 6 and 9 to 10. No differences ($p = 0.372$) were observed on the accumulated feed intake per animal on day 4 after weaning (314, 437 and 449 g for Trp18, Trp22 and rTrp22, respectively). However, differences were observed on the motivation of piglets to eat early after weaning. Three out of five pens (3/5) on Trp18 showed a feed intake below 50 g/animal 72 h after weaning, while 4 out of 5 on Trp22 showed a higher feed intake, above 90 g/animal 48 h after weaning ($p = 0.046$). Differences ($p \leq 0.001$) were also observed on the behavior of the animals on days 6, 9 and 10, with pigs fed on Trp22 showing a lower number of records (44%) standing up than Trp18 (62%) and rTrp22 (84%). Therefore L-Tryptophan supplementation may improve the adaptation of piglets after weaning by enhancing feed intake.

Key Words: Piglets, L-Tryptophan, Feed Intake

TH153 Lysine restriction and realimentation affected growth, blood metabolites, and myostatin and leptin expressions in weaned pigs. Y. X. Yang¹, J. Guo², Z. Jin¹, S. Y. Yoon¹, J. Y. Choi¹, M. H. Wang², X. S. Piao³, S. J. Ohh¹, B. W. Kim¹, and B. J. Chae^{*1}, ¹College of Animal Life Sciences, Chuncheon, Kangwon-Do, Republic of Korea, ²School of Biotechnology, Chuncheon, Kangwon-Do, Republic of Korea, ³National Key Lab of Animal Nutrition, China Agricultural University, Beijing, P. R. China.

A total of 128 weaned pigs (Landrace \times Yorkshire \times Duroc) were used in a 6-wk study to investigate the effects of lysine restriction and realimentation on performance, digestibility, blood profiles, and gene expressions of leptin and myostatin. Pigs were randomly allotted to four treatments on the basis of their body weights, each treatment comprised of four pens and each pen had 8 pigs. The starter diets fed to pigs during the first two weeks (P1) contained 1.350, 1.080, 0.945 or 0.810% lysine levels. Then common grower 1 and 2 diets were offered for two weeks (P2 and P3 containing 1.150 and 0.950% lysine, respectively) each. During P1, average daily gain (ADG, 391, 335, 306 and 295 g/d) decreased linearly ($P < 0.05$) with the increasing levels of lysine restriction. Final body weight did not differ ($P > 0.05$) among all the treatments. The apparent digestibilities of CP during P1 and P2, GE and CP during P3 were improved linearly ($P < 0.05$) with the decrease in dietary lysine levels. The apparent ileal digestibilities of Lys and Leu increased linearly ($P < 0.05$) with an increase in the degree of lysine restriction. Linear ($P < 0.05$) improvements in plasma triglyceride (29.8 to 40.0 mg/dl) and glucose (95.5 to 114.8 mg/dl) and decreased ($P < 0.05$) blood urea nitrogen (15.6 to 8.55 mg/dl), total protein (6.8 to 5.78 g/dl) and albumin (3.3 to 3.9 g/dl) during P1 were noticed with an increase in the degree of lysine restriction. During P2, pigs fed with lysine restricted starter diets had lower (linear, $P < 0.05$) blood urea nitrogen and total protein, however no differences in the plasma metabolites were noted during P3. The relative abundance of myostatin mRNA in skeletal muscle and leptin mRNA in subcutaneous adipose were lower ($P < 0.05$) in pigs fed lysine-restricted diets. These results indicated that pigs fed a lysine-restricted diet exhibited compensatory growth, while changes in myostatin and leptin mRNA abundance by lysine restriction suggested that lysine played a role in regulating protein and fat metabolism in young pigs.

Key Words: Lysine, Restriction, Pigs

TH154 Impaired translation initiation activation and reduced protein synthesis in weaned piglets fed a low-protein diet supplemented with essential amino acids. Y. Yin^{*1}, D. Deng¹, W. Chua¹, K. Yao¹, T. Li¹, R. Huang¹, Z. Liu¹, and G. Wu², ¹The Chinese Academy of Sciences, Changsha, Hunan, P.R.China, ²Texas A&M University, College Station.

Weanling mammals (including infants) often experience intestinal dysfunction when fed a high-protein diet. Recent work with the piglet (an animal model for studying human infant nutrition) shows that reducing dietary protein intake can improve gut function during weaning but results in inadequate provision of essential amino acids (EAA) for muscle growth. The present study was conducted with weaned pigs to test the hypothesis that supplementing deficient EAA (Lys, Met, Thr, Trp, Leu, Ile, and Val) to a low-protein diet may maintain the activation of translation initiation factors and adequate protein synthesis in tissues. Pigs were weaned at 21 days of age and fed diets containing 20.7, 16.7, or 12.7% crude protein (CP), with the low-CP diets supplemented with

EAA to achieve the levels in the high-CP diet. On d 14 of the trial, tissue protein synthesis was determined by the phenylalanine flooding method. Reducing dietary CP levels decreased protein synthesis in pancreas, liver, kidney, and longissimus muscle. A low-CP diet reduced the phosphorylation of eukaryotic initiation factor (eIF) 4E-binding protein-1 (4E-BP1) in skeletal muscle and liver and increased the formation of an inactive eIF4E 4E-BP1 complex in muscle, while decreasing the phosphorylation of mammalian target of rapamycin (mTOR) and the formation of an active eIF4E eIF4G complex in liver. These results demonstrate for the first time that chronic feeding of a low-CP diet suppresses protein synthesis in animals, in part, by inhibiting mTOR signaling. Additionally, our findings indicate that supplementing deficient EAA to low-protein diets is not effective in restoring protein synthesis or whole-body growth in weanling piglets. We suggest that conditionally essential amino acids (e.g. glutamine and arginine) may be required to maintain the activation of translation initiation factors and optimal protein synthesis in tissues of weanling pigs.

Key Words: mTOR Signaling, Protein Synthesis, Piglets

TH155 Effects of dietary protein level on intramuscular fat content and its fatty acid composition in lean and obese genotype finishing pigs. H.-J. Xu^{1,2}, Y.-L. Liu³, W.-T. Gu¹, Y.-L. Yin^{*1}, X.-F. Kong¹, R.-L. Huang¹, W.-J. Tang¹, and Z.-Q. Liu¹, ¹The Chinese Academy of Sciences, Changsha, Hunan, P.R. China, ²West Anhui University, Luan, Anhui, China, ³Wu Han Polytechnic University, Wuhan Hubei, China.

Effects of dietary protein level on intramuscular fat (IMF) content and fatty acid composition in lean and obese genotype finishing pigs were studied. Twenty two Crossbred (Duroc×Landrace×Large White) barrows and eighteen Ningxiang barrows were equally randomly assigned to two groups and fed diets I (14% CP) and diet II (15% CP), respectively. Longissimus dorsi (LD) and semitendinosus muscle (ST) samples were collected to determine IMF content and fatty acid composition. Ratio of oleic acid (C18:1) and linoleic acid (C18:2) in LD of Crossbred was lower (36.6% vs 47.1%, $p < 0.01$) and higher (19.0% vs 9.4%, $p < 0.01$) than that of Ningxiang, respectively, when diet I was fed. When diet II was fed, the IMF amount of LD in Crossbred was lower (1.49% vs 3.39%, $p < 0.01$) than that in Ningxiang and lower 1.49% vs 2.21%, $p < 0.05$) than that of its own ST; ratio of stearic acid (C18:0), C18:1 and C18:2 in LD of Crossbred was higher (17.0% vs 13.4%, $p < 0.01$), lower (33.4% vs 47.4%, $p < 0.01$) and higher (20.6% vs 10.3%, $p < 0.01$) than that of Ningxiang, respectively while ratio of palmitic acid (C16:0), C18:0, C18:1 and C18:2 in ST of Crossbred was lower (23.5% vs 27.3%, $p < 0.01$), higher (15.3% vs 11.3%, $p < 0.01$), lower (42.2% vs 50.6%, $p < 0.01$) and higher (17.2% vs 9.6%, $p < 0.01$) than that of Ningxiang; ratio of C18:1 in LD of Crossbred was lower (35.0% vs 43.8%, $p < 0.01$) than that of its own ST while ratio of C18:0 and C18:1 in LD of Ningxiang was higher (13.4% vs 11.4%, $P < 0.05$) and lower (47.4% vs 50.6%, $p < 0.05$) than that of its own ST, respectively. These results indicate that different muscle types of different breeds responded differently in IMF content and fatty acid composition to the change in dietary protein level.

Key Words: Fatty Acids, Protein, Genotype

TH156 Dietary protein intakes affects expression of the cationic amino acid transporter-1 gene in the small intestine of finishing pigs. C. Y. Shi^{1,2}, W. Y. Chu², T. J. Li², M. M. Geng², R. L. Huang², S.-Y. Bin¹, and Y.-L. Yin^{*2}, ¹Guangxi Normal University, Guilin, Guangxi, China, ²The Chinese Academy of Sciences, Changsha, Hunan, P. R. China.

This study was conducted to determine the effect of dietary protein intakes on expression of the cationic amino acid transporter-1 (CAT1) gene in the small intestine of finishing pigs. Thirty-six castrated male pigs (Duroc × Landrace × Large White), with an average initial body weight of 55.6 ± 7.0 kg, were randomly allocated to one of the three dietary treatments. The pigs were housed individually in floor pens and fed diets containing three CP levels (13%, 16%, and 19%). After 45 days of feeding, 3 pigs in each treatment were randomly selected to be slaughtered. The duodenum, jejunum and ileum were obtained for the analysis of mRNA levels for CAT1 using real-time RT-PCR. The results indicate that CAT1 mRNA levels in the duodenum, jejunum and ileum fed the 16% CP diets were 1.01 ± 0.14 , 1.55 ± 0.24 and 0.66 ± 0.19 , respectively, CAT1 mRNA levels in the duodenum, jejunum and ileum fed the 19% CP diets were 1.60 ± 0.23 , 1.91 ± 0.38 and 1.11 ± 0.57 , respectively, CAT1 mRNA levels did not differ ($P > 0.05$) between the two groups of pigs fed the 16% and 19% CP diets. However, the CAT1 mRNA levels were 1.95 ± 0.46 and 34.75 ± 7.13 , increased ($P < 0.05$) by 48% and 96%, respectively, in the duodenum and jejunum of pigs fed the 13% CP diet, when compared with pigs fed the 16% CP diet. In contrast, the CAT1 mRNA level in the ileum of pigs fed the 13% CP diet was 0.53 ± 0.26 and was 25% lower ($P < 0.05$) than that in pigs fed the 16% CP diet. These results indicate that dietary protein intakes differentially influence expression of the CAT1 gene in the different segments of the pig small intestine to regulate the absorption of basic amino acids derived from dietary protein.

Key Words: Gene Expression, Finished Pig, Intestine

TH157 Molecular cloning, distribution and expression of the amino acid transporter y+LAT1 gene in tissues of young Tibet pigs. W. T. Gu¹, W. Y. Chu¹, W. C. Wang¹, M. M. Geng¹, T. J. Li¹, Y. L. Yin^{*1}, and G. Y. Wu^{1,2}, ¹The Chinese Academy of Sciences, Changsha, Hunan, P. R. China, ²Texas A&M University, College Station.

The Tibet pig (a Chinese swine breed) has a relatively small body size and provides a useful model for studying mechanisms that regulate animal growth and development. As an initial step of our investigation, we cloned the gene encoding the amino acid transporter y+LAT1 (HGMW-approved gene symbol SLC7A7) from the small intestine of the Tibet pig. This sodium-dependent cationic-amino-acid transporter functions to transport of arginine, lysine, ornithine, and histidine in cells. The Tibet porcine SLC7A7 gene encoded 487 deduced amino acid residues, which show a higher degree of sequence similarity to the human y+LAT1 gene (92%) than to the rat (89%) and opossum (88%) counterparts. The membrane topology analysis indicated that the porcine y+LAT1 protein had 12 putative transmembrane domains. Confocal microscopic examination of porcine y+LAT-GFP-expressing Vero cells revealed the localization of the protein on the plasma membrane. Using the RT-PCR technique, the y+LAT1 mRNA was detected in the brain, kidney, duodenum, jejunum, ileum, liver, and skeletal muscle of Tibet

pigs at both 7 and 21 d of age. Interestingly, the y+LAT1 mRNA was present in the spleen and backfat of Tibet pigs at 21 d of age but absent from these two tissues at 7 d of age. These results indicate age- and tissue-dependent expression of the y+LAT1 gene in Tibet pigs.

Key Words: Amino Acid Transporter, Tibet Pigs, Gene Expression

TH158 Molecular cloning, distribution and expression of the amino acid transporter b0,+ AT mRNAs in young Tibet pigs. W. Y. Chu¹, W. C. Wang¹, W. T. Gu¹, M. M. Gen¹, T. J. Li¹, Y. L. Yin^{*1}, and G. Y. Wu^{1,2}, ¹The Chinese Academy of Sciences, Changsha, Hunan, P. R. China, ²Texas A&M University, College Station.

The amino acid transporter b0,+ AT functions to transport both neutral and basic amino acids by cells. This event is crucial for the absorption of dietary amino acids by the small intestine and the uptake of circulating amino acids by extraintestinal tissues. We used the Tibet pig (a Chinese swine breed), which has a relatively small body size, as a model to study mechanisms that regulate animal growth and development. Particularly, we succeeded in cloning the gene encoding the amino acid transporter b0,+ AT (HGMW-approved gene symbol SLC7A9) in the small intestine of Tibet pigs. The Tibet porcine SLC7A9 gene encoded 487 deduced amino acid residues, showing a higher degree of sequence similarity to the horse b0,+ AT gene (91.2%) than to the monkey (89.5%) and human (89%) counterparts. The membrane topology analysis indicated that the b0,+ AT protein had 12 putative transmembrane domains. Confocal microscopic examination of porcine b0,+ AT-GFP-expressing Vero cells revealed the localization of the protein on the plasma membrane. The RT-PCR analysis showed that the b0,+ AT mRNA was present in the brain, kidney, duodenum, jejunum, ileum, liver, and skeletal muscle of Tibet pigs at 7 and 21 d of age. The b0,+ AT mRNA was also in the spleen and backfat of Tibet pigs at 21 d of age but could not be detected in these two tissues at 7 d of age. These results indicate age- and tissue-dependent expression of the b0,+ AT gene in Tibet pigs.

Key Words: Amino Acid Transporter, Tibet Pigs, Amino Acid Transporter

TH159 Digestibility and metabolism of nitrogen and energy in finishing Ningxiang pigs. W.-J. Tang, X.-F. Kong, Z.-Q. Liu, R.-L. Huang, T.-J. Li, and Y.-L. Yin*, *The Chinese Academy of Sciences, Changsha, Hunan, P. R. China.*

The experiment was conducted to determine the effects of dietary crude protein levels on nutrient digestibility and metabolism of nitrogen and energy. Nine finishing Ningxiang pigs (boar, castration) with an average BW of 65.0 kg ± 2.5 kg were randomly assigned to 3 treatment groups with 3 replications of 1 pig, fed diets with 10.41%, 12.91% or 15.43%

CP, respectively. The experiment lasted 8 days, and all of the fecal and urinary samples were collected on the last three days. Results showed that pigs fed the diet with 12.91% CP level had the highest apparent digestibility of DM and energy, and the CP digestibility decreased with the increasing of dietary CP level ($P < 0.05$). Ingestive nitrogen, fecal nitrogen, urinary nitrogen, and total nitrogen in excretion, absorption and retention of nitrogen, and fecal and urinary energy increased with the increasing of dietary CP level ($P < 0.01$). Utilization and apparent digestibility of nitrogen, ME and ME/GE decreased with the increasing of dietary CP level ($P < 0.05$). These findings suggested that the dietary CP level had a significant effect on the digestibility of energy and crude protein, as well as the deposition and excretion of nitrogen.

Key Words: Protein, Utilization, Pigs

TH160 Ontogenetic development and nutritional regulation of Amino Acid Transporter EAAC1 in intestine of swine. X. Wu¹, C. Y. Xie², Y. L. Yin^{*1}, L. Wang³, W. Y. Chu¹, M. M. Geng¹, T. J. Li¹, R. L. Huang¹, and Y. Q. Hou³, ¹The Chinese Academy of Sciences, Changsha, Hunan, P. R. China, ²Huazhong Agricultural University, Wu Han, China, ³Wuhan Polytechnic University, WuHan, Hubei, China.

EAAC1 is responsible for the uptake of glutamate, a major metabolic fuel of the enterocyte through the Na⁺-dependent transport system X-AG. To evaluate the ontogenetic development and nutritional regulation of EAAC1 gene expression in small intestine, twenty Duroc×Landrace×Yorkshire crossbreed piglets (d 1, 7, 14, 21, and 28 d) were killed during lactation. Three intestinal segments (duodenum, jejunum, and ileum) were collected for total RNA and protein isolation. The abundance of mRNA and protein was evaluated using real time-PCR and western blotting using antibodies for EAAC1, respectively. Abundance of EAAC1 generally declined from d 1 to 14 and subsequently increased to d 21 in the jejunum. Intestinal of pigs 14 d were used for EAAC1 distribution in all segments. The results showed that abundance of EAAC1 mRNA and protein was greater in duodenum, and then jejunum and ileum (1.54:1.35:1.17 and 1.70:1.46:1, $P \leq 0.05$). Then intestinal segments from growing pigs (with average body weight of 55.6±7.0 kg) fed with four experimental diets with different dietary protein (DP) levels (13, 16, 19%, and 16% with 1% arginine) and DE levels (12.6, 14.6, 16.5 MJ/kg and 14.6 MJ/kg with 1% arginine) were studied. In general, both of the EAAC1 mRNA and protein abundance decreased from low to high DP (1.54:0.68:0.67 and 1.70:1.24:0.97), and 1% arginine enhanced EAAC1 expression in duodenum. On the contrary, EAAC1 protein had greater expression in high DE diet, and abundance in pigs with 14.6% DE added 1% arginine were lowest (1.10:1.69:2.13:1, $P \neq 0.05$). In conclusion, gene expression of EAAC1 is not only differentially distributed among intestinal segments, but also differentially regulated by age, and was affected by diet, especially by arginine.

Key Words: Amino Acid Transporter, Intestine, Pigs

Physiology and Endocrinology: Physiology of Heat Stress

TH161 Thermal and nutritional regulation of hepatic gluconeogenic genes in growing beef cattle. M. D. O'Brien*, L. C. Cole, J. B. Wheelock, S. R. Sanders, G. C. Duff, L. H. Baumgard, and R. P. Rhoads, *University of Arizona, Tucson.*

The effect of heat stress (HS) on hepatic expression of key gluconeogenic genes in growing beef cattle was examined and a pair-fed (PF) design was used to differentiate HS effects from those related to reductions in feed intake (FI) typically associated with HS. Holstein bull calves (134 ± 4 kg) were housed in climate-controlled chambers, fed an 86% concentrate, 14% protein diet and subjected to two experimental periods: 1) thermal-neutral (TN; 18-20°C) with ad libitum intake for 9 d and 2) HS (cyclical daily temperatures ranging from 29.4°C to 40.0°C) with ad libitum intake or PF (thermal-neutral conditions) for 9 d. Throughout the study, individual FI was measured on a daily basis whereas rectal temperature (RT) and respiration rate (RR) were measured at four h intervals. Liver biopsies were obtained on d 9 of each period. Hepatic total RNA was isolated, cDNA synthesized and real-time PCR analysis performed. During HS, RT and RR increased (39.0 to 40.6°C and 42 to 126 breaths/min; $P < 0.01$) and DMI decreased by 12%. By design, PF bulls received a similar plane of nutrition. Pyruvate carboxylase (PC) gene expression increased ($P < 0.05$) following HS exposure but remained unchanged during PF. Neither HS nor PF affected expression of the cytosolic phosphoenolpyruvate carboxykinase 1 (PCK) gene. Abundance of peroxisome proliferator-activated receptor- γ coactivator-1 α (PGC-1 α) mRNA, a transcriptional coactivator that acts at the promoter level of gluconeogenic genes such as PC and PCK, was measured. Despite altered PC gene expression, PGC-1 α mRNA abundance was unaffected by HS. Similarly, reduced FI during PF did not alter PGC-1 α gene expression. In summary, modulation of PC gene expression by HS appears to occur via mechanisms which are independent of reduced nutrient intake.

Key Words: Heat Stress, Cattle, Hepatic Gluconeogenesis

TH162 Seasonal differences in gene expression in oocytes from Holstein cows in a subtropical environment as revealed by gene array analysis. P. J. Hansen*¹, M. Salem², A. M. Brad¹, J. Yao², and G. W. Smith³, ¹University of Florida, Gainesville, ²West Virginia University, Morgantown, ³Michigan State University, East Lansing.

In dairy cows, oocyte competence for development after fertilization or electrical activation is reduced during and after heat stress. There is evidence that follicular function can be reduced by heat stress as early as ~30 d before ovulation. The molecular basis for the effect of heat stress on oocyte function is not well understood. Here, gene array analysis was used to identify differences in RNA transcript profiles between oocytes collected in summer and winter. Cumulus-oocyte complexes (COCs) were harvested from ovaries of Holstein cows collected at an abattoir in Florida. Only those with at least 4-5 layers of cumulus cells and evenly granulated oocyte cytoplasm were collected. Oocytes were denuded of cumulus cells and stored at -80°C in pools of ~20. A total of six pools were collected in summer (July-Aug) and six pools in winter (Jan-Feb). RNA was extracted from each pool, subjected to linear amplification and amplified RNA from each pool labeled and hybridized using a two-color, dye swap design to a bovine array consisting of 8,000 unique, 70-mer oligos representing predicted bovine mRNAs. Initial data analysis

revealed 105 and 44 transcripts with greater abundance in summer and winter, respectively ($P < 0.01$) and mapping to distinct gene ontology categories. Further analysis incorporating a false discovery rate of 6 % revealed 7 transcripts displaying greater abundance during summer. Three encode for genes of unknown function. Known genes encoding for transcripts of increased abundance during summer included glutathione S-transferase subunit isoform I, which participates in repair of oxidative stress damage, cyclin D2, which can activate CDK kinases involved in cell proliferation and block inhibition of cell cycle caused by retinoblastoma protein, PRA1 family protein 2, which is involved in protein trafficking, and 17-beta-hydroxysteroid dehydrogenase type 1, which is involved in steroid metabolism. Results are consistent with summer conditions causing an increase in transcripts for proteins that act to stabilize oocyte function during thermal stress. Support: BARD US3986-07

Key Words: Heat Stress, Oocyte, Gene Array

TH163 The effect of heat stress and exogenous bovine somatotropin on expression of genes associated with hepatic gluconeogenesis in lactating dairy cows. J. B. Wheelock*, A. J. LaNoce, M. D. O'Brien, S. R. Sanders, R. J. Collier, L. H. Baumgard, and R. P. Rhoads, *University of Arizona, Tucson.*

Recent evidence indicates heat stress (HS) alters whole-body glucose metabolism independently of HS-induced reductions in feed intake. The majority of bovine whole-body glucose demands are met by hepatic gluconeogenesis however it is unknown whether HS affects liver glucose production. Therefore, study objectives were to examine hepatic expression of key gluconeogenic genes in lactating dairy cows during HS or in thermal neutral pair-fed animals (PF) and administered bovine somatotropin (rbST) in each condition. Multiparous (99 DIM) Holstein cows [n = 10 (HS), n = 12 (PF)] were subjected to three 7 d experimental periods: 1) thermal neutral, ad libitum intake, 2) HS or PF, and 3) HS or PF with rbST (POSILAC[®]) administered on d 1 of period 3. HS temperatures were cyclical, ranging from 29.7 to 39.2°C. Milk yield, DMI, respiration rate (RR) and rectal temperature (RT) were measured daily. Liver biopsies were obtained on d 7 of each period for total RNA isolation, cDNA synthesis and real-time PCR analysis. Heat stress increased RR and RT and reduced DMI by 30%. By design, PF cows received a similar plane of nutrition. During HS and PF, milk yield decreased by 27.5 and 15.3%, respectively and increased following rbST administration (~13%). During PF, pyruvate carboxylase (PC) and cytosolic phosphoenolpyruvate carboxykinase (PCK) gene expression increased (60%, $P < 0.05$) or tended to increase (40%, $P < 0.10$), respectively. In contrast, PC gene expression increased by 45% ($P < 0.05$) but PCK mRNA abundance was unaltered by HS. Similarly, peroxisome proliferator-activated receptor- γ coactivator-1 α (PGC-1 α) mRNA abundance tended to increase ($P < 0.10$) during PF but was unaffected by HS. Administration of rbST did not alter gluconeogenic mRNA abundance despite causing a 2- and 3-fold increase ($P < 0.05$) in insulin-like growth factor-I (IGF-I) gene expression during HS and PF, respectively. In summary, HS leads to a change in hepatic gluconeogenic gene expression that appears independent of reduced feed intake.

Key Words: Heat Stress, Gluconeogenesis, Cattle

TH164 Heat shock modulates adipokines secretion in 3T3-L1 adipocytes. U. Bernabucci*, L. Basirico, P. Morera, N. Lacetera, B. Ronchi, and A. Nardone, *Dipartimento di Produzioni Animali, Viterbo, Italy.*

Several studies have demonstrated that high temperatures are responsible for modifications of lipid/carbohydrate metabolism in farm animals, but mechanisms are not yet clarified. Adipose tissue acts through secretory factors called adipokines (adiponectin and leptin) that are expressed in differentiated adipocytes and are involved in modulation of both lipid and glucose metabolism. To date there is no information concerning the possible relationship between heat stress and adipokines expression. Therefore, the objective of the present study was to investigate the effect of heat shock on adiponectin and leptin secretion in 3T3-L1 adipocytes. Adipocytes were incubated at different temperatures: 37 (control), 39 and 41°C. For each temperature, samples were collected after 0, 2, 4, 8, 16 and 24h of exposure. Adiponectin and leptin secretion were measured in cell culture media using commercial ELISA kits. As molecular markers of cell injury Hsp70.2 gene expression was determined by real time-PCR. Cell viability was determined by XTT assay. Heat shock affected adipokines secretion. Compared with 37°C, secretion of adiponectin increased ($P \leq 0.01$) at 39°C, while at 41°C, the protein was not detectable. Unlike adiponectin, the concentration of leptin increased ($P \leq 0.01$) at 41°C. The Hsp-70.2 gene expression was increased ($P \leq 0.05$) already at 39°C and the higher level ($P \leq 0.01$) was reached at 41°C compared with 37°C. Exposure to different temperatures did not affect cell viability. Results of the present study show that mild heat stress (39°C) caused an increase in adiponectin secretion, while severe heat stress (41°C) caused upregulation of leptin and downregulation of adiponectin. The study provides the first evidence of a direct modulation of heat shock on adiponectin and leptin secretion in 3T3-L1 adipocytes. Changes in leptin and adiponectin induced by severe heat stress might be involved in the alteration of lipid/carbohydrate metabolism occurring in animals exposed to a hot environment.

Key Words: Heat Shock, 3T3-L1, Adipokines

TH165 Effects of elevated ambient temperature on length of gestation and ruminal temperature at parturition of beef cows. E. C. Wright*, M. J. Prado-Cooper, C. L. Bailey, and R. P. Wettemann, *Oklahoma Agricultural Experiment Station, Stillwater, OK.*

Angus x Hereford cows ($n = 27$) were randomly assigned to four groups and AI to calve in mid August (MAug), late August (LAug), mid September (Sept) or mid October (Oct) to evaluate the effects of elevated ambient temperature on length of gestation and ruminal temperature at parturition. Temperature boluses (SmartStock, LLC) were placed in the rumen at 255 d of gestation. Boluses were programmed to transmit temperature every hr. Cows grazed native pasture in Oklahoma and had a body condition score of 6.5 ± 0.4 at calving. Length of gestation in five previous years were shorter (277.7 ± 1.4 d; $P = 0.01$) for cows that calved in August compared with cows that calved in October (281.8 ± 2.3 d). Maximum ambient temperatures during the week before the expected calving date were greater for MAug ($34.1 \pm 2.3^\circ\text{C}$) and LAug ($34.0 \pm 2.7^\circ\text{C}$, $P < 0.001$) compared with Sept ($29.7 \pm 3.5^\circ\text{C}$) and Oct ($28.5 \pm 3.2^\circ\text{C}$). Length of gestation was shorter for cows in MAug (274.7 ± 5.5 d, $P = 0.05$) compared with Oct (278.8 ± 3.1 d), but did not differ from LAug (277.0 ± 2.5 d, $P = 0.29$) and Sept (276.2 ± 3.1 d, $P = 0.50$). Ruminal temperature during the week before calving was not influenced by month of calving ($P = 0.84$) and averaged $38.8 \pm 0.27^\circ\text{C}$ for all months. Concentrations of cortisol in plasma 1 and 2 d before parturition were less for LAug (6.3 ± 5.7 ng/mL) compared with MAug (10.8 ± 5.9 ng/mL, $P = 0.03$) and Oct (12.5 ± 4.7 ng/mL, $P = 0.003$) cows. Exposure of beef cows to elevated ambient temperature results in shorter gestations.

Key Words: Gestation Length, Parturition, Beef Cow

Physiology and Endocrinology: Poultry and Swine Physiology

TH166 Egg shape index in fertility and hatchability of Japanese quail. G. Contreras*, A. Silman, C. B. Castro, J. J. Portillo, and A. Estrada, *Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México.*

The objective was to determine the effect of egg shape index on fertility and hatchability of Japanese quail. Quails (7 wk old; 120 females and 40 males) were housed in batteries with five levels and four cages per level. The quails were fed with diets containing 20.5 % of CP and 2.9 Mcal of DE/kg at a rate of 35 g per animal/d and feed was offered twice daily at 0800 and 1600 h. 540 eggs were collected during a nine wk period. Based on a length:width proportion, two groups were formed: ovoid (1.28 at 1.38) and redounded (1.18 at 1.27). The eggs were stored for three d at 8° C before incubation. The eggs were disinfected with formaldehyde gas (2X). 60 eggs (30 ovoid and 30 redounded) were put in a metallic rack with equal divisions and placed in an automatic incubator for 14 d at 37.7° C and 60 % relative humidity. At d 15 eggs were removed and placed in a hatching machine. The weights of chicks were recorded at 24 h. The un-hatched eggs were broken to investigate fertility and embryo development. The data were subjected to analysis of variance and means compared by Tukey test ($\alpha = 0.05$). To quantify and determine the relationship between shape index and external characteristics, Pearson's correlation analysis was used. Shape index did not affect ($P > 0.05$) fertility (95.8 %), hatchability (63.5 %) and hatching (56.67 %). Shape index affected ($P < 0.01$) the egg weight, egg length and egg width. Ovoid eggs were 2.2 % heavier than redounded eggs (14.41 vs. 14.09 g). There were a positive correlation ($P < 0.001$) between shape index and egg weight (0.22) and egg length (0.76), but a negative correlation with egg width (-0.26 and -0.08, ovoid and redounded, respectively). The chicks weight were modified ($P < 0.05$) by egg shape index, whereas the chicks hatched of eggs redounded were 2.64% lighter (9.83 vs. 9.57 g). The difference in birth weight of chicks in this study can be attributed more to the egg weight than shape index. The results indicate that the egg shape index of Japanese quail does not affect the fertility or hatchability during the first nine wk of lay.

Key Words: Shape Index, Japanese Quail, Fertility and Hatchability

TH167 Detection of microRNA in porcine somatic and reproductive tissues. S. L. Pratt*, E. Curry, and H. M. Barton, *Clemson University.*

MicroRNA (miRNA) are present in all mammalian tissues examined to date and are implicated in tissue/cell differentiation, carcinogenesis, and embryonic development. They function by altering the translation efficiency of mRNA. Estimates have been made predicting over 1000 miRNAs are encoded in the mammalian genome, but only 112 porcine miRNA have been identified. Our objective was to verify and/or establish the expression of 6 miRNA in somatic and reproductive tissues including liver, heart, kidney, lung, uterus, oviduct, ovary, corpus luteum and the cumulus oocyte complex (COC). Cycling gilts were sacrificed on d 9 of the estrous cycle (estrus = day 1). Tissues were collected, snap-frozen in liquid nitrogen and stored at -80°C until used for the isolation of miRNA. COC greater than 3 mm were aspirated from ovaries obtained from pre-pubertal gilts at slaughter. Criteria for oocyte selection were a uniform cytoplasm and at least 3 layers of cumulus cells. They were frozen in liquid nitrogen and stored at -80°C. Total cellular RNA

(tcRNA) was isolated from porcine tissues using the mirVana miRNA isolation kit (Ambion, Austin, TX). All tcRNA samples were subjected to end-point RT-PCR using the mirVana qRT-PCR miRNA detection kit and primer sets (Ambion, Austin, TX) and products visualized using non-denaturing slab gel electrophoresis. Visible products were subcloned into the pDrive vector (Qiagen, Valencia, CA) and used to transform competent *E. coli*. The plasmid was then isolated and subjected to dideoxy sequencing at the Clemson University Genomics Institute. PCR product was detected for miR-31 in all tissues examined except for the heart and liver. No product for the miR-124a primer set was detected in any tissue examined. Products were observed in all tissues for primer sets for miR-24, 92, 132, and 212. Our data suggest tissue restricted expression of miR-31 and -124a; however, future studies evaluating hormonal/developmental effects on their expression are required. In addition, studies to elucidate the identity of miRNA expressed in porcine reproductive tissues are required.

Key Words: Pig, microRNA, RT-PCR

TH168 Endocrine regulation of colostrum production in primiparous sows. A. Foisnet¹, C. Farmer², M. Etienne¹, J. Le Dividich¹, and H. Quesnel^{1*}, ¹INRA, Saint Gilles, France, ²Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada.

The aim of this experiment was to investigate hormonal changes potentially involved in colostrogenesis in sows. Colostrum production was estimated in 16 LR × LW sows during 24 h starting at the onset of parturition using piglets' weight gains (Devillers et al., 2004). Jugular blood samples were taken daily from day 105 of gestation until 2 days postpartum and were assayed for prolactin, progesterone (P4), estradiol-17β (E2) and cortisol. Lactose concentrations were measured in colostrum at the onset of parturition then 3, 6 and 24 h later. Colostrum production averaged 3.22 ± 0.34 kg. Four sows had a very low colostrum yield (1.10 ± 0.13 kg), while the others produced between 3.00 and 4.80 kg (3.93 ± 0.16 kg). Colostrum production was not correlated ($P > 0.1$) with litter size or litter weight at birth, nor with plasma E2 or cortisol concentrations at any time before farrowing. Colostrum production was correlated with serum prolactin concentrations during the 2 days before parturition (d-2 and d-1) ($r = 0.60$; $P = 0.014$), plasma P4 concentrations on d-1 and d0 (farrowing) ($r = -0.58$; $P = 0.018$) and with P4:E2 ratio on d-1 and d0 ($r = -0.54$; $P = 0.015$). The low producing sows tended to have lower prolactin concentrations on d-2 and d-1 than the 12 medium-to-high producing sows (12.88 ± 2.76 vs. 20.08 ± 1.62 ng/ml; $P = 0.079$) and higher P4 concentrations on d-1 and d0 (8.54 ± 1.53 vs. 5.56 ± 0.57 ng/ml; $P = 0.053$). A negative correlation between P4 concentrations and colostrum production was also observed in the ewe and was attributed to the inhibitory effect of P4 on lactose synthesis (Banchemo et al., 2006). In the present study, no correlation was found between plasma P4 concentrations and lactose concentrations in colostrum. Results suggest that impaired colostrum production is due to a hormonal imbalance. Devillers et al., 2004. *Anim. Sci.* 78: 305-313; Banchemo et al., 2006. *Reprod. Nutr. Dev.* 46: 447-460.

Key Words: Sow, Colostrum, Endocrine Control

TH169 Maintenance of pregnancy with Matrix[®] in PGF_{2α}-treated sows. C. E. Ferguson*, M. C. Poole, D. M. Gandy, and F. M. LeMieux, *McNeese State University, Lake Charles, LA.*

This experiment was conducted to evaluate the effectiveness of Matrix[®] in maintaining pregnancy post PGF_{2α} administration in swine. Nine crossbred sows (Yorkshire x Landrace) were maintained on gestation diets, naturally mated with a boar of proven fertility and diagnosed pregnant via ultrasonography at approximately 30 d post-mating. All sows received 15 mg of PGF_{2α} (Lutalyse, Pharmacia[®]) twice at 12 h intervals. Sows were randomly assigned to a control (n = 3) no Matrix[®] or treatment (n = 6) 30 mg of Matrix[®] at time of first PGF_{2α} administration. Treatments were administered for 6 consecutive d at 24 h intervals. Matrix[®] was administered daily via top dressing bread; control sows received bread without Matrix[®]. Ultrasound was used to determine pregnancy status throughout the experiment. Control sows began to abort within 2 to 3 d following first PGF_{2α} administration and the pregnancy was completely terminated (determined by the absence of viable fetuses and fluid within the uterus during ultrasound scanning) by 3 to 4 d post-PGF_{2α}. These females displayed estrus behavior and were mated by a boar following abortion. Sows receiving Matrix[®] remained pregnant for the entire 7 d Matrix[®] feeding period. Treatment sows completed the abortion process by 4 d post last Matrix[®] administration. It was concluded that all sows lacked functional corpora lutea (as result of PGF_{2α} administration) as evidence of all sows aborting in the control and treatment group following cessation of Matrix[®] administration. These results demonstrate that Matrix[®] at a dose of 30 mg per head per d can maintain pregnancy in sows at approximately 30 d of gestation treated with a luteolytic dose of PGF_{2α}. The significance of this finding is the development of a practical method of maintaining pregnancy in sows by top dressing a feedstuff with an exogenous progesterin.

Key Words: Sows, Luteolytic, Progesterin

TH170 Defined pattern of Sertoli cell differentiation in pubertal porcine testes. J. J. Ford* and T. H. Wise, *USDA/ARS/USMARC, Clay Center, NE.*

Number of Sertoli cells is a primary determinant of mature testicular size and sperm production. In boars, formation of the blood/testis barrier occurs by 4 mo of age in commercial breeds and signals the end of Sertoli cell proliferation. Previous studies established that expression of p27Kip1, a cyclin-dependent kinase inhibitor and a marker of Sertoli cell differentiation, was first detected at 70 d of age and by 90 d was apparent in tubules of most boars; however, its pattern of expression did not appear random. To test if Sertoli cell differentiation occurs in a defined pattern, one testis was removed from 25 crossbred boars at 90 d of age. From each testis, 2 aliquots of tissue were taken adjacent to the tunica and 2 other aliquots were sampled near the mediastinum. Tissues were fixed and embedded. Tissue sampled near the tunica was further divided into 2 regions, one < 1.5 mm and the other > 1.5 mm from the tunica. A minimum of 200 tubules from each of the 3 regions/boar was evaluated for tubule diameter and % with Sertoli cell nuclei positive for p27Kip1 assessed by immunohistochemistry. Mean diameter of seminiferous

tubules increased ($P < 0.01$) from 75.9 μm near the tunica to 90.2 μm in the mediastinum, and % of tubules positive for p27Kip1 was greater ($P < 0.001$) near the mediastinum than near the tunica. Tubules within the sub-tunica region were intermediate for both of these traits. Presence of p27Kip1 correlated positively ($P < 0.01$) with mean diameter of tubules within each of the 3 regions. Weight of the second testis at 10 mo of age correlated negatively ($P < 0.03$) with diameter of tubules within the mediastinum at 90 d of age. These findings establish that differentiation of Sertoli cells progresses from the mediastinum toward the tunica thereby implying that proliferation continues for a longer period at the outer region of the seminiferous tubules. Also, 90-d-old boars with testes containing small diameter tubules have a greater compensatory response to unilateral castration than 90-d-old boars with larger diameter seminiferous tubules.

Key Words: Boar, Puberty, Sertoli Cell

TH171 Comparison of domestic and feral pig physiology, immunity and growth. B. L. Davis*^{1,2}, M. A. Sutherland^{1,2}, P. J. Bryer^{1,2}, J. F. Smith^{1,2}, and J. J. McGlone^{1,2}, ¹*Pork Industry Institute, Lubbock, TX*, ²*Texas Tech University, Lubbock.*

Feral pigs in Texas are descended from introduced European wild pigs and escaped domestic pigs that have established wide-ranging populations. Little is known about the physiological, immune and performance differences between feral and domestic pigs. The objective of this project was to: 1) compare physiological, immune and growth measures between domestic and feral pigs, 2) determine the effect of the circadian rhythm on glucocorticoid secretion in feral and domestic pigs and 3) determine if feral pigs are carriers of common domestic swine diseases. Domestic (n=4) and trapped feral (n=4) pigs of approximately 3 wk of age were used for this comparative study. Body weights were recorded and blood samples were collected over time for analysis of cortisol concentrations, hematology values and immune measures. On day 6, blood samples were taken every 6 h over a 24 h period (0600, 1200, 1800, 2400 h). Cortisol concentrations were higher among feral compared with domestic pigs (111.8 vs. 37.2 \pm 13.85 ng/mL, $P < 0.01$) and were greater ($P < 0.01$) in feral compared with domestic pigs at 0600, 1200, 1800 and 2400 h. The percentage of lymphocytes (56.0 vs. 48.8 \pm 1.38 %, $P < 0.05$) and mean cell volume (57.0 vs. 52.5 \pm 0.69 %, $P < 0.005$) were greater among feral compared with domestic pigs. Red blood cell distribution width was lower in feral compared with domestic pigs (18.7 vs. 22.9 \pm 0.42 %, $P < 0.01$). Innate immune measures did not differ ($P > 0.05$) between feral and domestic pigs. Average daily gain was lower in feral compared with domestic pigs (0.1 vs. 0.3 \pm 0.04 kg/d, $P < 0.01$). Feral pigs tested negative for the Pseudorabies virus, but tested positive for Brucella abortus antibodies. Physiological, immune and growth difference were observed between feral and domestic pigs either due to environmental or genetic differences. Feral pigs were carriers of a swine and human pathogen and could be a potential biosecurity risk for commercial pig farms and human populations.

Key Words: Feral, Physiology, Pigs

Physiology and Endocrinology: Spermatozoa, In-Vitro Fertilization, and Embryo Transfer

TH172 Identification of fertility markers in seminal plasma proteins of cryopreserved bull semen: A proteomic approach. J. F. Odhiambo*, L. Corum, S. Wolfe, E. E. Felton, and R. A. Dailey, *West Virginia University, Morgantown.*

Secretions from the accessory sex glands are mixed with sperm at ejaculation and contribute a majority of semen volume. However, during cryopreservation, most seminal plasma is replaced with semen extenders, mainly egg yolk or milk proteins. Experiments in rodents and pigs showed that seminal plasma was important for fertility and fetal survival (O et al, 1988). Previously, we observed consistent success of pregnancy after AI with adjunctive seminal plasma. The precise nature of the active constituents remains unknown, but four proteins (Osteopontin, Spermadhesin Z13, BSP 30 kDa and Phospholipase A₂) have been identified as markers of fertility in dairy bulls (Moura et al., 2006). Therefore, the present study used a proteomic analysis of expression patterns of seminal plasma proteins in cryopreserved semen of bulls of known low fertility ($1.8 \leq \text{CFI} \leq 2.9$; CFI: Composite Fertility Index™, Select Sires Inc.) Proteins were separated by 2-dimensional SDS-PAGE followed by staining with Coomassie blue and analysis of polypeptide maps using CQuest software. Proteins were identified by capillary liquid chromatography nanoelectrospray ionization tandem mass spectrometry (CapLC-MS/MS). Low fertility bulls had three expression patterns. Spot volume analysis and peptide identification of the patterns indicated higher expression (55%) of proteins from semen extender between 30 to 60 kDa, a *train* (35%) of spots within 20 to 30 kDa, while the remainder of the spot volume was expressed below 20 kDa. Three spots were identified as: 1) Seminal plasma protein PDC-109 precursor [BSP-A1/A2], MW 15.4 kDa, pI 4.76, 2) Spermadhesin-1 precursor [Acidic seminal fluid protein], MW 15.0 kDa, pI 4.93, and 3) Spermadhesin Z13, MW 13.4 kDa, pI 5.50. Low fertility of dairy bulls has been associated with higher expression of Spermadhesin Z13 isoforms in accessory gland fluid (Moura et al., 2006). Therefore, identification of that protein and its precursor in seminal plasma of low fertility bulls corroborates and strengthens its potential use as a marker of low fertility in bulls.

Key Words: Spermadhesin, BSP-A1/A2, Seminal Plasma

TH173 Effect of sex-sorted sperm dosage on conception rates of Holstein cows and heifers. J. M. DeJarnette*¹, R. L. Nebel¹, C. E. Marshall¹, J. F. Moreno², C. R. McCleary², and R. W. Lenz², ¹*Select Sires, Inc., Plain City, OH*, ²*Sexing Technologies, Inc., Navasota, TX*.

Ejaculates were collected by artificial vagina from 3 Holstein sires and sorted to 90% purity for X-chromosome bearing spermatozoa (range 88 to 93%) using flow cytometry. Sorted sperm were diluted to 2.1, 3.5 or 5.0 x 10⁶ sperm per dose in an egg-yolk (20%), TRIS, glycerol (7%) extender. Collections were repeated until a total of >600 straws per sperm dose per sire were obtained. Each sperm dose was loaded into color-coded 0.25 mL French straws with alternate colors used to define treatments across sires. Within sires, straws were packaged at 9 per cane (3 of each color) and strategically allocated to 75 Holstein herds with

targets for 50% use in heifers and 50% in lactating cows. Straw color was recorded in the on-farm record keeping system at the time of insemination. Data were analyzed separately for cows and heifers. Among heifers, a total of 2,125 useable records were retrieved from 51 herds (238 ± 5.5 services/sperm dose/sire, range: 218 to 263). Conception rates in heifers were influenced by the sire by sperm dosage interaction. Within Sire A, conception rates of heifers were greater for the 5 x 10⁶ (59.5%) than for the 2.1 x 10⁶ (46.4%) sperm dose and intermediate for the 3.5 x 10⁶ sperm dose (52.2%). However across sires, sperm dosage had no effect on heifer conception rates (46.7%, 51.2% and 52.5% for 2.1, 3.5 and 5.0 x 10⁶ sperm dosages, respectively). Among cows, a total of 2,369 services were retrieved from 56 herds (263 ± 8.8 services/sperm dose/sire, range: 233 to 303). Conception rates of cows (29.4%) were not affected by sire or sperm dosage (27.0%, 29.1% and 30.3% for 2.1, 3.5 and 5.0 x 10⁶ sperm dosages, respectively). In conclusion, these data indicate increased sperm dosage may enhance virgin heifer conception rates for some (but not all) sires, whereas neither sire nor sexed-sperm dosage impacted conception rates of lactating cows. Additional studies of sexed-sperm dosage across a larger sampling of bulls are warranted to determine if and how such a practice can be cost effectively implemented for the benefit of the dairy industry.

Key Words: Sexed Semen, Flow Cytometry, Conception Rate

TH174 An update on the commercial application of sex-sorted semen in Holstein heifers. J. M. DeJarnette*, R. L. Nebel, and C. E. Marshall, *Select Sires, Inc., Plain City, OH*.

Insemination and (or) calving data were retrieved from herds that used sex-sorted semen (SS) in Holstein heifers from Jan, 2005 to Jan 2008. The unadjusted conception rate (CR) to SS across 132 herds and all service numbers was 45.2% (n=41,398). Across all herds, 74% of SS was used at 1st service, 18% at 2nd service, and 8% at ≥ 3 service. The unadjusted CR was 47%, 40%, and 34% for service numbers 1, 2 and ≥ 3 , respectively. Among 49 herds reporting ≥ 50 services to both sexed (724 \pm 132) and conventional semen (CS; 961 \pm 110), CR was influenced by herd and the service number x semen type interaction (See table). Among unsuccessful services in these 49 herds, heifers bred to SS were more likely to be re-inseminated in a normal 21 day interval than were CS bred heifers. Among all single births the percentage of female calves born to SS was 89.3% (n=13,515) and increased to 90.1% for validated gestation lengths of 265 to 295 d (n=7,768). Among twin births, a greater percentage ($P < 0.01$) of female-female pairs were observed for SS (74%, n=68) than CS (26%, n=197). Among 27 herds reporting ≥ 50 females calves born to SS (340 \pm 59) and CS (592 \pm 79), the percentage of still births was influenced by herd, age at freshening, month of freshening, and sire of conception but was not influenced by semen source ($P = 0.68$). Due to the known bias in use and preferential treatment of SS vs. CS, these results must be interpreted with caution. However, these data suggest SS averages ~45% CR in Holsteins heifers resulting in ~90% female offspring with no evidence of a negative effect on incidence of still births nor repeat intervals to estrus.

Table 1. Conception rates by service number and distribution of repeat AI intervals in 49 herds reporting ≥ 50 services to both sexed and conventional semen % (n)

	1st Service	2nd Service	≥ 3 rd Service		
Conventional	56.4 (21,864)	53.8 (13,389)	45.4 (11,772)		
Sexed	47.0 (26,465)	43.1 (6,375)	38.1 (2,567)		
Sexed as % of conventional	83.3%	80.1%	83.9%		
Repeat AI interval	<17 d	18-24 d	25-35 d	36-48 d	49-90 d
Conventional (n=17,184)	10.7%	65.4%	9.6%	9.6%	4.7%
Sexed (n=16,413)	7.4%	69.7%	8.8%	9.5%	4.6%

Key Words: Sexed Semen, Flow Cytometry, Conception Rate

TH175 Use of commercially available oocytes and sexed sperm for IVF/ET and AI in dairy cattle. S. Rasmussen*, Z. Brink, K. McSweeney, and G. E. Seidel, *Colorado State University, Fort Collins.*

Assisted reproduction technologies allow options for dairy farmers to improve herd genetics, provide greater biosecurity, and possibly increase profit in other ways. Transfer of embryos (ET) produced with sexed semen, and artificial insemination (AI) with sexed semen are examples. Sexed and non sexed semen from 3 bulls was used for either AI or to produce embryos in vitro. Holstein oocytes, matured in a portable incubator during shipment, were purchased commercially and fertilized 23 h after collection with standard IVF procedures using 1×10^6 sperm/mL. There was no difference in blastocyst rate per oocyte due to bulls: A (11.1%; n = 893), B (13.5%; n = 1531), or C (11.8%; n = 1362); however, sexed sperm resulted in fewer blastocysts (8.1%; n = 3018) than nonsexed sperm (15.4%; n = 768) ($P < 0.01$). Blastocysts were transferred 7.5 d after onset of IVF. Estrous cycles of cows at least 63 d post partum were synchronized as follows: reproductive tracts were scanned using ultrasonography, and cows with a normal-appearing uterus were injected with 100 μ g GnRH i.m. Seven d later cows were scanned again and given 25 mg of PGF₂ α i.m. only if a CL and follicle between 13-19 mm were present; cows not meeting these criteria were not used for this project; 2.5 d later cows received 100 μ g GnRH i.m. Cows were bred 16-18 h later with control ($>10 \times 10^6$ sperm/dose) or sexed semen (2×10^6 sperm/dose), or a fresh embryo was transferred one wk later. Pregnancy status was determined at ≥ 35 of pregnancy by ultrasound. Cows with dead or dying fetuses were considered non pregnant. There was no difference ($P > 0.1$) between sexed (36.9%; 31/84) and nonsexed AI (47.2%; 42/89) pregnancy rates, which were higher than sexed (19.4%; 14/72) or non sexed (23.2%; 16/69) ET pregnancy rates ($P < 0.05$). The pregnancy rate with sexed semen was 78.2% of control semen (mainly due to one bull which was 44.8% of control). Pregnancy rates were unsatisfactory with embryos produced in vitro from shipped oocytes under the conditions of this experiment. Supported by NRI grant no. 2006-55203-17390 from USDA.

Key Words: Sexed Semen, AI, IVF

TH176 Effects of heterospermic insemination on conception rates of lactating dairy cows. J. M. DeJarnette*¹, R. L. Nebel¹, D. Laansma², and C. E. Marshall¹, ¹Select Sires, Inc., Plain City, OH, ²Northstar Cooperative, East Lansing, MI.

This study evaluated the effects of heterospermic insemination on conception rate of Holstein cows. Three Holstein sires with above average conception potential as determined by one or more sire fertility ranking systems were selected for use in this trial. On each of two days, 2 ejaculates were collected by artificial vagina from each sire and evaluated for volume, concentration, and motility before and after pooling within sire. Aliquots were strategically removed from the within sire pools to create an across sire pool containing equal numbers of total sperm from each of the 3 sires (heterospermic). All 4 samples (3 homospermic, 1 heterospermic) were extended to 40×10^6 sperm/mL in an egg-yolk-Citrate-glycerol extender. Samples were loaded into color-coded 0.5 mL French straws (n = 500/sample/collection day; 4000 total), and frozen in liquid nitrogen vapor. Straws were randomly used in 5 herds of lactating Holstein cows during the months of Apr. through Oct., 2007. At the time of AI, straw color and collection date were recorded in the on-farm records management system. Data (n = 3,384) were extracted from electronic downloads and analyzed in least-square means models including the effects of herd, sire, batch within sire, parity, postpartum interval, season and all two-way interactions. Conception rates were influenced ($P < 0.05$) by interactions of herd with parity, season, and postpartum interval. All interactions and main effects of sire and semen batch were not significant ($P > 0.05$). Conception rates for sires A, B, C and the heterospermic mix were 26.8%, 25.3%, 29.3% and 25.4%, respectively (n = 846 ± 15 /sire). In conclusion, heterospermic insemination may provide a means to guard against poor conception rates should a subfertile sire be selected. However these data provide no evidence that the conception rate of a heterospermic mixture will be greater than that obtained from homospermic use of the highest conception bull(s) in the mix.

Key Words: Heterospermic Insemination, Mixed Semen, AI

TH177 Effects of preincubation of sperm at 38.5 or 40°C before insemination on developmental competence of bovine embryos derived from in vitro fertilization. K. E. M. Hendricks* and P. J. Hansen, *University of Florida, Gainesville.*

The ability of the preimplantation embryo to develop depends in part on genetic and non-genetic inheritance from gametes. Here, the hypothesis was tested that aging of ejaculated sperm would affect embryo competence for development. Oocytes were inseminated with frozen/thawed sperm maintained for 4 h at 38.5°C or 40°C. Control oocytes were inseminated with sperm not subjected to 4 h incubation. The percent of cleaved embryos that became blastocysts at d 8 after insemination (BI/CI) was used to assess embryo competence. In Exp. 1 (n = 9 bulls), oocytes were fertilized for 22 h and the resultant embryos cultured in 5% CO₂ in air. The percent of oocytes that became blastocysts (BI/Ooc) and BI/CI was lower for oocytes inseminated with preincubated sperm than for oocytes inseminated with control sperm ($P < 0.01$). There were no differences between oocytes inseminated with sperm at 38.5°C when compared to 40°C. For Exp. 2 (n = 13 bulls), embryos were cultured in 5% O₂. The percent of oocytes that cleaved (66.1 ± 3.2 , $60.2 \pm 3.2\%$, and $74.5 \pm 3.2\%$ for 38.5°C, 40°C and control; $P < 0.05$), BI/Ooc (23.6 ± 2.3 , $14.9 \pm 2.3\%$, and $27.9 \pm 2.3\%$, $P < 0.01$), and BI/CI (32.9 ± 2.9 , $22.2 \pm 2.9\%$, and $37.4 \pm 2.9\%$; $P < 0.05$) was lower for oocytes insemi-

nated with preincubated sperm. Similarly, BI/Ooc ($P < 0.05$) and BI/CI ($P < 0.05$) was lower for oocytes inseminated with sperm at 40°C than for oocytes inseminated with sperm at 38.5°C. A high cleavage rate in a parthenogenesis group ($38.9 \pm 3.2\%$) made interpretation of data difficult because of the possibility that fertilization rate was overestimated. Accordingly, Exp. 3 ($n = 8$ bulls) was carried out with fertilization reduced to 8 h. There were no differences between oocytes inseminated with sperm preincubated at 40°C compared to oocytes inseminated with sperm preincubated at 38.5°C. Results indicate that embryos produced with aged sperm can have reduced competence for development although aging effects were independent of temperature within the range of 38.5-40°C. Support: USDA NRICGP 2007-35203-18070 and BARD US 3986-07.

Key Words: Bovine, Sperm Preincubation, Embryo Developmental Competence

TH178 Paternal influence on the in vitro embryonic development of vitrified oocytes based on estimated relative conception rate. V. M. Anchamparuthy*, A. Dhali, R. E. Pearson, W. M. Lott, and F. C. Gwazdauskas, *Virginia Polytechnic Institute & State University, Blacksburg.*

Variation with in vitro fertilization (IVF) characteristics among bulls was reported, but has not been reported with vitrified oocytes. This study was designed to test the influence of sire based on ERCCR after AI with the frozen thawed semen on the in vitro embryonic developmental competence of 2 classes of vitrified oocytes ($n = 1,968$) derived from follicles of different diameters, small (less than 4 mm) and medium (4 to 10 mm). Follicle size had a significant ($P \leq 0.05$) impact on the developmental rates of embryos from cleavage to the blastocyst stage. The oocytes from medium sized follicles had a 9.9% increase in the cleavage rate compared to oocytes from small follicles. The increase in the blastocyst rate was only 5.9% between the oocytes from small and medium-sized follicles. The sires showed significant ($P \leq 0.05$) effects on embryonic developmental rates. Similarly, sire by follicle size interaction was significant for blastocyst rates and sire by treatment interaction was significant on cleavage and blastocyst rates. There were differences among bulls. Fertilized oocytes ($n = 1,685$) using semen from Bulls I, II, III, and IV showed cleavage rates of 49.3, 55.0, 50.0, and 40.9%, respectively ($P \leq 0.05$). Both morula and blastocyst stages of development were significantly different ($P \leq 0.05$) among bulls. While the developmental rates to morula were 26.4, 29.9, 23.4 and 16.7% for Bull I, II, III, and IV, respectively, and the blastocyst developmental rates were 18.1, 17.9, 10.0, and 10.0%, respectively. Bull I had the highest blastocyst development from vitrified oocytes (10.9%; $P \leq 0.05$) and the corresponding rate for its control oocytes was 25.3%. The blastocyst rates from the vitrified oocytes were 6.0, 2.5, and 1.0%, respectively, for Bull II, III and IV, with the corresponding rates in the control oocytes of 29.9, 17.4, and 18.9%, respectively. Our results show that differences in development exist in source of oocytes and sires used for IVF after vitrification. No correlation exists between post-IVF outcome and field fertility based on ERCCR.

Key Words: Bull, Oocyte, Vitrification

TH179 Effects of dietary fats differing in n-3/n-6 ratio on oocyte quality in dairy cows. M. Zachut*^{1,2}, I. Dekel¹, H. Lehrer¹, A. Arieli², A. Arav¹, and U. Moallem¹, ¹*Agriculture Research Organization, Bet Dagan, Israel*, ²*Faculty of Agriculture, Hebrew University, Rehovot, Israel.*

The objective of the current study was to examine the effects of feeding encapsulated fats containing different n-3/n-6 ratio on oocyte quality in dairy cows. Twenty-four multiparous Israeli-Holstein cows, averaging 114 DIM, were assigned to one of three treatment groups: 1) **Control** ($n = 7$) were fed a lactating cow diet; 2) **E-LNA** ($n = 8$) were supplemented with 1 kg/d of encapsulated fat containing 40% linseed oil which is high in linolenic acid; or 3) **E-LA** ($n = 9$) were supplemented with 1 kg/d of encapsulated fat containing 40% sunflower oil which is high in linoleic acid. Ovum pick-up (**OPU**) and *in vitro* fertilization (**IVF**) sessions ($n = 13$) began 94 d after the commencement of the dietary treatments, and were conducted on 5 cows per treatment twice a week. Plasma FA profile was significantly affected by dietary treatments; the percentages of C18:2, C20:3 and C20:4 in plasma were lower in E-LNA cows than in E-LA or control ($P < 0.004$), whereas the percentage of C18:3 in plasma was more than 5 fold higher in E-LNA cows as compared to E-LA or control cows ($P < 0.0001$). The average number of follicles aspirated during the OPU procedure from each cow at each session was higher in E-LNA cows than in control ($P < 0.01$; 11.4, 13.8 and 11.8 for control, E-LNA and E-LA, respectively), and the number of recovered oocytes per cow was higher in control than in E-LA ($P < 0.05$) but did not differ from the E-LNA. The average number of grade 1 oocytes per cow was lower in E-LA than in both other groups ($P < 0.05$). A total of 388 oocytes were selected for IVF across treatments. The percentage of matured oocytes did not differ among treatments; however the oocytes cleavage rate was higher in E-LNA oocytes than in control ($P < 0.05$; 43.0, 52.3 and 49.5% for control, E-LNA and E-LA, respectively). In conclusion, dietary fat with a high n-3/n-6 ratio (linseed oil) seems to positively affect ovarian follicle numbers and IVF cleavage rate.

Key Words: Linolenic Acid, Oocytes Quality

TH180 Influence of cysteine in conjunction with growth factors during in vitro production of bovine embryos. W. M. Lott*, V. M. Anchamparuthy, M. L. McGilliard, I. K. Mullarky, and F. C. Gwazdauskas, *Virginia Polytechnic Institute & State University, Blacksburg.*

Cysteine (Cys) supplementation to in vitro maturation (IVM) media increases cellular glutathione production, which reduces reactive oxygen species. Similarly, the beneficial effects of growth factors for improving the rate of blastocyst development have been reported, but not in conjunction with Cys. The aim of this study was to determine whether supplementation of Cys during oocyte maturation and growth factors, epidermal growth factor (EGF) and insulin-like growth factor-I (IGF-I), during embryo culture, would improve cleavage and blastocyst rates of in vitro produced bovine embryos. Bovine oocytes from slaughterhouse ovaries were matured in TCM-199, with or without the addition of Cys (0.6 mM) at 0 h (0 h Cys) or 12 h (12 h Cys) of maturation. Matured oocytes were fertilized in BSA. After in vitro fertilization, embryos were allocated to culture treatments using synthetic oviductal fluid medium. Culture treatments included fetal calf serum (FCS, 4%); IGF (100 ng/mL); EGF (10 ng/mL); IGF+EGF (100 ng/mL+10 ng/mL); 0 h Cys with

IGF; EGF; or IGF+EGF; and 12 h Cys with IGF; EGF; or IGF+EGF. Developmental scores were assigned to each embryo on d 2, 4, and 8 of culture. Even though rates for cleavage and blastocyst stage were not different ($P \geq 0.05$) among treatments, significant improvements in the proportion of oocytes undergoing cleavage (12 h Cys IGF+EGF, 75.3%) and blastocyst (0 h Cys IGF, 40.3%) formation were achieved when Cys was added to the maturation media, as compared to control (FCS: cleavage, 61.7% and blastocyst, 34.5%) without supplementation. Similarly a combined effect of IGF+EGF for the cleavage (72.6%) and blastocyst (37.8%) development was obtained. In conclusion, supplementation of Cys during IVM of oocytes, in conjunction with growth factors, excluding IGF-I, during *in vitro* culture, resulted in a similar embryonic development to that of FCS, and could effectively be used as a replacement for FCS.

Key Words: Cysteine, Embryo, Growth Factor

TH181 Simulated microgravity conditions affect preimplantation bovine embryo development *in vitro*. S. Jung*, S. D. Bowers, and S. T. Willard, *Mississippi State University, Mississippi State.*

Alternative *in vitro* embryo culture environments require further investigation to determine whether they may improve, or be deleterious to, embryo development. The objective of this study was to investigate bovine preimplantation embryo development in a simulated (and varied) microgravity environment *in vitro*. A Rotating Cell Culture System (RCCS) bioreactor with a High Aspect Ratio Vessel (HARV) was used to generate a low shear simulated microgravity condition. *In vitro* matured and fertilized bovine oocytes were cultured in mSOF (modified synthetic oviductal fluid supplemented with 8 mg/ml BSA and amino acids) at 39°C and 5% CO₂ in humidified air. On d 2 pi (post insemination), cleaved embryos (2-, 4-, and 8-cell stage embryos n=1524) were equally distributed to one of following culture conditions: Control, 100 µl microdrops of mSOF medium covered by mineral oil in a Petri dish; High Speed, 100 µl microdrops of mSOF medium with mineral oil overlay in HARV rotated at 34 rpm on a horizontal axis; Low Speed, 100 µl drops of mSOF medium with mineral oil overlay in HARV rotated at 3.7 rpm on a horizontal axis. The final developmental rates were assessed on d 9 pi. The experiment was replicated four times and arc-sine transformed data were analyzed by ANOVA and Fisher's PLSD test. The proportions of 2- to 8-cell stage embryos in the High Speed and Low Speed groups (100.0 and 99.6%, respectively) were significantly higher ($P < 0.05$) than 2- to 8-cell stage embryos in the Control group (67.7%) on d 9 pi; with only 1 embryo reaching the morulae stage for the Low Speed group. Thus in the Control group, a greater ($P < 0.05$) proportion of morulae and blastocyst stage (15.8% and 16.5%, respectively) embryos were achieved than in the High (0%) and Low (0% blastocyst and 0.4% morulae) groups. There were no significant differences ($P > 0.05$) in embryo development rates between the High and Low Speed groups with respect to any of the embryo stages noted on d 9 pi. These results indicate that simulated microgravity culture conditions have a negative impact on preimplantation bovine embryo development *in vitro*.

Key Words: Bovine Embryo, *In vitro* Culture, Microgravity

TH182 Insulin-like growth factor-1 reduces the anti-development effects of menadione on development of bovine preimplantation embryos. J. I. Moss* and P. J. Hansen, *University of Florida, Gainesville.*

Insulin-like growth factor-1 (IGF-1) can reduce effects of heat shock on development of preimplantation bovine embryos. The present objective was to determine whether IGF-1 can block other adverse environmental conditions affecting embryonic development. The approach was to evaluate effects of IGF-1 on embryos treated with menadione. This polycyclic aromatic ketone serves as a precursor for vitamin K2 and can inhibit development of mouse embryos (Toxicology 191:77). Bovine embryos were produced *in vitro* and cultured in KSOM-BE2 medium. At d 5 after fertilization, embryos ≥ 16 cells were placed in fresh drops ± 100 ng/ml of recombinant human [Arg3]-IGF-1 (analog with reduced affinity for IGF binding proteins). Menadione was added 1 h after addition of IGF-1 at a final concentration of 0, 1, 2.5 and 5 µM. Embryos were cultured for 24 h, washed, and then cultured in fresh KSOM-BE2 medium until d 8. The experiment was replicated 14 times with 120-204 embryos per treatment. The percent of embryos that became blastocysts at d 8 was affected by the menadione x IGF interaction ($P < 0.001$). Menadione reduced development in a concentration-dependent manner and IGF-1 reduced effects of 1 and 2.5 µM. Percent of embryos becoming blastocysts was $50.1 \pm 2.4\%$, $36.2 \pm 2.9\%$, $5.8 \pm 2.9\%$, and $0 \pm 2.6\%$ for 0, 1, 2.5 and 5 µM in the absence of IGF-1 and $37.0 \pm 2.5\%$, $46.3 \pm 2.5\%$, $13.0 \pm 2.5\%$ and $0 \pm 2.6\%$ in the presence of IGF-1. In conclusion, the anti-developmental action of menadione on development of bovine embryos can be blocked by IGF-1. Research supported by BARD US-3986-07 and USDA NRICGP 2007-35203-18070.

Key Words: Insulin-Like Growth Factor-1, Preimplantation Embryos, Menadione

TH183 Effect of the addition of hyaluronan to bovine embryo culture on *in vitro* survival after cryopreservation and *in vivo* survival following transfer to recipients. L. Bonilla*¹, J. Block^{1,2}, and P. J. Hansen¹, ¹University of Florida, Gainesville, ²EmboGen LLC, Gainesville, FL.

Experiments were conducted to determine whether hyaluronan could: 1) improve survival after cryopreservation, and 2) increase pregnancy rates following transfer to recipients. In experiment 1, embryos (n = 3,564 putative zygotes) were cultured in modified synthetic oviductal fluid (SOF) with 1.0 mM alanyl-glutamine in 5% (v/v) oxygen with either no surfactant, 1 mg/mL polyvinyl alcohol (PVA) or 4 mg/mL bovine serum albumin (BSA) and ± 1 mg/mL hyaluronan. Blastocyst and expanded blastocyst-stage embryos on day 7 were vitrified using open pulled straws (Mol. Reprod. Dev. 1998, 51:53-58). Vitrified embryos were thawed and then cultured for 72 h in modified SOF containing 10% (v/v) fetal bovine serum and 50 µM dithiothreitol. There was no effect of hyaluronan on re-expansion at 24 and 48 h or hatching rate at 72 h. Re-expansion rate at 24 and 48 h and hatching rate at 72 h was reduced ($P < 0.0001$) by BSA (24 h, 72.9 ± 2.6 vs. $22.6 \pm 4.8\%$, 48 h, 77.3 ± 2.7 vs. $20.7 \pm 4.9\%$, 72 h, 72.5 ± 2.7 vs. $21.5 \pm 5.0\%$). For experiment 2, heat-stressed lactating Holsteins were synchronized for timed-embryo transfer using the OvSynch protocol. Embryos produced *in vitro* were

cultured in modified SOF with 4 mg/mL BSA, 100 ng/mL insulin-like growth factor-1, and \pm 1 mg/mL hyaluronan. At day 7 after expected ovulation, a single embryo was transferred to each recipient with a palpable corpus luteum. Pregnancy was diagnosed by rectal palpation at d 35-90 of gestation. There was a treatment x embryo stage interaction ($P < 0.03$). Hyaluronan increased pregnancy rates for recipients that received morula and blastocyst-stage embryos (15/92=16.3% vs. 22/78=28.2%) but had no effect for recipients receiving expanded blastocysts (31/82=37.8% vs. 25/83=30.1%). There was no effect of hyaluronan on in-vitro survival after vitrification, but BSA reduced cryosurvival. Hyaluronan increased pregnancy rate among recipients that received morula and blastocyst-stage embryos, but not for recipients that received expanded blastocysts (USDA 2006-55203-17390).

Key Words: Hyaluronan, Vitrification, Embryo Transfer

TH184 Effect of progesterone concentration during follicular development on fertilization and embryo quality in dairy cows. R. L. A. Cerri^{*1,2}, R. C. Chebel², F. Rivera², C. D. Narciso², R. A. Oliveira², and J. E. P. Santos¹, ¹University of Florida, Gainesville, ²University of California Davis, Tulare.

Objectives were to evaluate the effects of differing progesterone (P4) concentrations on follicular dynamics and embryo quality. Lactating Holstein cows (n = 154), were randomly assigned to 1 of 2 treatments. Cows had their estrous cycle presynchronized and were then submitted to a modified Ovsynch (GnRH + CIDR, 7 d prostaglandin F2a [PG] + CIDR removal, 2 d GnRH, 12 h timed AI) starting on d 7 of the estrous cycle. Cows enrolled in the high P4 (HP) treatment received no further treatments and cows in the low P4 (LP) treatment received additional PG injections on d 2, 2.5 and 3 of the estrous cycle preceding the Ovsynch and on d 0, 2, 2.5 and 3 after the first GnRH of the Ovsynch. Ovaries were evaluated by ultrasonography and blood was sampled for P4 and estradiol (E2) concentrations throughout the study. Uteri were flushed 6 d after AI and recovered embryos/oocytes were evaluated. Concentrations of P4 were greater ($P < 0.01$) for HP cows from d 2 to 7 after first GnRH of Ovsynch (4.3 vs. 1.5 ng/mL); concentrations of E2 at PG (3.0 vs. 3.8 pg/mL) and at the last GnRH (4.6 vs. 5.3 pg/mL) were less ($P < 0.01$) for HP than LP. Proportion of cows in estrus at timed AI was less ($P = 0.01$) for HP than LP (5.3 vs. 38%). The ovulatory follicles of HP cows were smaller ($P < 0.01$) at PG (14.6 vs. 17.2 mm) and GnRH of the Ovsynch (16.9 vs. 19.7 mm), which resulted in smaller ($P = 0.03$) CL diameter 6 d after AI (22.8 vs. 24.3 mm). Double ovulation after the last GnRH of the Ovsynch was less ($P = 0.01$) for HP than LP (4.5 vs. 18.6%). Fertilization rate was similar ($P = 0.67$) and averaged 82.7%. Excellent and good quality embryos as a proportion of embryos ($P = 0.48$) and of embryo-oocytes ($P = 0.66$) were not different. Number

of blastomeres was similar ($P = 0.79$) for HP and LP, but proportion of live blastomeres tended to be greater ($P = 0.08$) for HP than LP (99.5 vs. 94.8%). Reducing P4 concentrations before and during the Ovsynch program altered E2 concentrations and follicular dynamics, but resulted in minor changes in embryo quality.

Key Words: Dairy Cow, Embryo, Progesterone

TH185 Milk production and rectal temperature during pregnancy in lactating dairy cow recipients. D. T. G. Jardina^{*1}, F. L. Aragon², M. B. Veras², S. Soriano³, N. Sobreira³, A. B. Scarpa¹, P. L. T. Justolin¹, and J. L. M. Vasconcelos¹, ¹FMVZ, Unesp, Botucatu, SP, Brazil, ²Policlinica Pioneiros, PR, Brazil, ³Farm Colorado, SP, Brazil.

The objective of this study was to evaluate factors that can influence pregnancy per embryo transfer (P/ET) in lactating Holstein cows. The trial was conducted between February and November 2007. Cows were milked 3 times a day and fed with total mixed ration. Recipient Holstein cows (n = 468) were synchronized with HeatSynch + CIDR protocol [CIDR in + GnRH (1 mL Fertagyl) - 7d - CIDR out + PGF2 α (5 mL Lutalyse) - 24h - Estradiol Cypionate (0.5 mL ECP)]. Cows were evaluated by ultrasonography for detection of CL and embryo transfers were done, non-surgically, 9 d after injection of ECP. P/ET was determined by presence of an embryo 21 d after transfer by ultrasonography and was analyzed by logistic regression. The regression model included the effects of month, body condition score, parity, days in milk (DIM), milk production, milk components (fat, protein, somatic cell count, urea), serum progesterone, rectal temperature, CL diameter, embryo (fresh vs. frozen/thawed) and interactions. Embryo influenced ($P < 0.01$) P/ET; 48.8% (150/307) with fresh and 28.1% (45/160) with frozen/thawed embryos. There was an interaction ($P < 0.05$) between milk production and rectal temperature, that were grouped by median. Number of cows, milk production, rectal temperature, DIM, serum progesterone, CL diameter and P/ET were: 1) low milk production/normal rectal temperature: n=128, 28.6kg of milk/d, 38.5°C, 264 DIM, 3.03ng/mL, CL 4.27cm² and 42.2%; 2) low milk production/high rectal temperature: n=105, 27.0kg of milk/d, 39.3°C, 292 DIM, 3.4ng/mL, CL 3.9cm² and 36.1%; 3) high milk/normal temperature with n=144, 42.2kg of milk/d, 38.4°C, 138 DIM, 3.1ng/mL, CL 4.6cm² and 47.7%; and 4) high milk production/high rectal temperature with n=91, 41.8kg of milk/d, 39.2°C, 141 DIM, 3.3ng/mL, CL 3.8cm² and 38.4%, respectively. These results indicated that high milk production did not affect pregnancy after ET in recipient lactating cows with normal rectal temperature.

Key Words: Embryo Transfer, Rectal Temperature, Milk Production

Production, Management and the Environment: Calf, Young Stock and Stress Management

TH186 Nursery performance in gilts farrowed by females housed in individual stalls and/or group pens during gestation. M. J. Estienne* and A. F. Harper, *Virginia Polytechnic Institute and State University, Blacksburg.*

Fetal programming is the process by which a stimulus in utero establishes a permanent response in the fetus impacting physiology later in life. O’Gorman et al. (2007; *J. Anim. Sci.* 85[Suppl. 2]:13) subjected sows to daily restraint for five min during wk 12 to 16 of gestation; Gilts farrowed by stressed sows exhibited puberty 14 d later than gilts farrowed by control females. The objective was to determine the effects of gestation housing on nursery performance in gilt offspring. Yorkshire × Landrace gilts were mated by AI and placed in individual stalls throughout gestation (n = 6); group pens throughout gestation (5 to 6 gilts/pen) (n = 6); or individual stalls for 30 d post-mating and then group pens for the remainder of gestation (n = 7). There were no effects of housing on litter size, although there was a trend (P = 0.11) for a greater number of pigs born alive for females kept in stalls throughout gestation (11.8) or in stalls for the first thirty days post-mating and group pens for the remainder of pregnancy (11.4), compared to gilts kept in group pens throughout gestation (9.2) (SE = 0.9). Barrows were cross-fostered among litters so that females were nursing a similar number of pigs (10.5 ± 0.3). Among treatments BW of gilt pigs were similar at birth (1.65 ± 0.05 kg; P = 0.46) and at weaning (24.6 ± 0.3 d of age; 8.67 ± 0.26 kg; P = 0.86). Gilts were placed in nursery pens each containing three pigs farrowed exclusively by females exposed to one of the three gestation housing systems (n = 9 pens/group). During the 5-week nursery study, ADG (0.53 ± 0.01; P = 0.93) and feed conversion efficiency (gain/feed; 0.57 ± 0.01; P = 0.93) were similar among groups. Gilt growth during the lactation and nursery phases of production was unaffected by the type of gestation housing to which dams were exposed. This suggests that if gestation housing does indeed affect gilt offspring performance via fetal programming, the effects are manifested later and not during early postnatal life. (Funded by the Virginia Pork Industry Board)

Key Words: Gestation Housing, Nursery Performance, Gilts

TH187 Group feeding dairy calves. D. G. Johnson*¹, C. Jergenson¹, and H. Chester-Jones², ¹*University of Minnesota, Morris*, ²*University of Minnesota, Waseca.*

Heifer calves were used to evaluate the effect of early life nutritional level in a group management system on growth, feed costs and health. Calves (n=237) were assigned to groups (n=25) of 10 in super hutches by birth order. Calves were born in March - June and October-December calving seasons, with age within group ranging from 4 days to >2 weeks. Cows calved unattended on pasture or in an open shed during extreme weather. Accelerated (AG) groups were fed 2.2% of birth weight as milk replacer powder reconstituted over 2 equal feedings daily until the youngest calf in the group was 5 weeks old, reduced to once daily feeding for at least one week, then weaned when the group consumption averaged .91 kg starter/calf/day. Conventional (CG) groups were fed 1.1% of birth weight as milk replacer once daily, then weaned when the

group consumed .91 kg of starter/head/day and the youngest calf in the group was >27 days old. Starter consumption (S) was restricted to 2.27 kg/day/calf, by group. Milk replacer (MR) was 22% protein, 20% fat. Calf starter was a premium 18% protein, highly palatable, low-molasses starter, but home ground 18% crude protein mix was utilized after per calf group consumption reached 2.2 kg. TMR was fed to groups that weighed >91kg. Feed cost to weaning per calf was AG, \$116.19 vs CG, \$54.52. Body weight and hip height, was recorded at birth weaning, 90 days, and 180 days. Statistical analysis was by Proc GLM /SAS with independent variables group and year, and birth weight as a covariate for individuals. Pen performance was weaning age (days), AG 55.1 vs CG 46.3 (P<.002); MR (kg), AG 37.2 vs CG 16.8 (P<.0001); S (kg), AG 14.2 vs CG 17.7 (P<.100); Gain at 35 days (kg), AG 10.9 vs CG 7.5 (P<.012); and Gain at 42 days (kg), AG 15.1 vs CG 10.9, (P<.027). Individual performance was weaning weight (kg), AG 67.4 vs CG 54.2 (P<.0001); 90-day weight (kg), AG 97.1 vs CG 94.5 (P<.014); 180-day weight (kg), AG 168.6 vs CG 169.9 (NS); weaning hip height (cm), AG 87.6 vs CG 83.1 (P<.0001); 90-day hip height (cm), AG 92.8 vs CG 92.5 (NS); and 180-day hip height (cm) AG 106.4 vs CG 169.9 (NS). Weights and hip heights of AG were higher than CG at weaning but diminished by 180 days of age.

Key Words: Calves, Group Feeding, Replacement Growth

TH188 Impact of an acidifier in milk replacer or calf starter on Holstein heifer performance and health. M. Raeth-Knight*¹, B. Ziegler², R. Larson², S. Hayes³, D. Ziegler⁴, H. Chester-Jones⁴, G. Golombeski¹, and J. Linn¹, ¹*University of Minnesota, St. Paul*, ²*Hubbard Feeds, Mankato, MN*, ³*Milk Products, Chilton, WI*, ⁴*University of Minnesota, Southern Research and Outreach Center, Waseca.*

The objective of this study was to evaluate the impact of an acidifier (ERASE Micropearls®; 20% fumaric acid, 10% orthophosphoric acid, 10% citric acid, 10% malic acid) added to 20% protein:20% fat milk replacer (MR) or calf starter (CS) on performance and health of individually housed Holstein heifer calves from 2-4 d of age for 56 d. One-hundred-ten calves (40.46 ± 0.73 kg) were randomly assigned to 4 treatments:- 1) 0% acidifier (A) in MR and CS (CON); 2) MR with 0.75% A (MRA) and CS; 3) CS with 0.75% A (CSA) and MR; 4) MRA and CSA. All calves were offered MR at 0.284 kg (as-fed) in 1.99 L water 2X daily for the first 35 d, then 1X daily from d 36 to weaning at 42 d. Respective CS (21% CP, DM basis) and water were offered free choice. Feed intake, fecal scores and treatment costs were recorded daily. Body weight (BW) was measured d 1, 14, 28, 42 and 56 and hip heights d 1 and 56. Data was analyzed as repeated measures using the PROC Mixed procedures of SAS. The addition of acidifier in MR or CS was not effective in improving the performance or health of calves pre or post-weaning. Pre-weaning (d 1 to 42) calves on the CSA treatment consumed 3.5 kg less starter and gained 2.8 kg less BW than calves on the CON or MRA treatments (P=0.06). Treatment costs from d 1-56 were numerically lower for the acidified treatments (\$1.72/calf) as compared to the control (\$2.30/calf). Under the conditions of this study use of an acidifier in milk replacer or starter did not enhance calf performance.

Table 1. Treatments

Item	CON	MRA	CSA	MRA + CSA	SE
Initial BW, kg	40.23	40.45	40.32	40.45	0.7
Final BW, kg	74.97	75.15	72.65	73.92	1.4
Day 1 to 56					
Total DMI, kg	61.97	63.49	58.41	60.95	2.0
Feed/gain, kg	1.83	1.84	1.81	1.83	0.03
Trt cost, \$/calf	2.30	1.93	1.50	1.77	0.5

Key Words: Dairy Calves, Feed Acidifiers, Feed Additives

TH189 Pre- and post weaning performance and health of calves fed different milk replacer programs using non-medicated additives and different feeding rates. S. Hayes^{*1}, B. Ziegler², R. Larson², D. Ziegler³, H. Chester-Jones³, M. Raeth-Knight⁴, J. Linn⁴, and G. Golombeski⁴, ¹*Milk Products, Chilton, WI*, ²*Hubbard Feeds, Mankato, MN*, ³*University of Minnesota Southern Research and Outreach Center, Waseca*, ⁴*University of Minnesota, St. Paul*.

One hundred-twenty-five 2 to 4 d-old dairy heifer calves (42.7 ± 0.84 kg) were randomly assigned to one of 5 medicated (20% protein:20% fat) milk replacer (MR) programs to evaluate their effect on pre- (42 d) and post weaning (43-56 d) calf performance and health. Calves were housed in individual calf pens within a curtain side-wall, naturally ventilated barn. Treatments (Trt) were:- 1), All-milk protein MR (control) fed at 0.284 kg (as-fed) in 1.99 L water 2X daily for 35 d, and then 1X daily from 36 to 42 d (MRC); 2), MRC fed as in Trt 1 for 21 d then reduced at d 22 to 1X daily at 0.46 kg in 3.18 L water to d 35, then 0.23 kg in 1.59 L water from 36 to 42 d; 3), MR including 5% spray-dried animal plasma and nutritional additives (APL) fed as Trt 1 for 21 d, then switched to MRC from 22 to 42 d fed same as Trt 1; 4), APL MR fed for 21 d as in Trt 3, then MRC fed 1X daily from 22 to 42 d as in Trt 2; 5) APL MR fed for 21 d as in Trt 3, then MRC fed at 0.23 kg 2X daily in 1.82 L water from 22 to 35 d, and 1X daily from d 36 to 42 d. Calves were offered a 21.2% CP (DM basis) texturized calf starter (CS) free choice with access to fresh water at all times. Total DMI from MR for 42 d averaged 22.72 kg/calf for Trt 1 & 3 and 20.76 kg/calf for Trt 2, 4, & 5. Milk replacer programs did not affect CS DMI or calf performance (P > 0.05). Overall 56-d daily gain and feed/gain averaged 0.69 and 1.89 kg, respectively. Under the conditions of this study, strategies to reduce MR feeding rate and/or the number of MR feedings resulted in similar performance and health compared to the control calves. Calves fed MR supplemented with APL showed similar performance and health to calves fed all milk protein milk replacers.

Key Words: Dairy Calves, Feeding Strategies, Performance

TH190 Pre- and post weaning performance and health of calves fed texturized calf starters with different processed corn or on a different milk replacer feeding schedule. B. Ziegler^{*1}, R. Larson¹, D. Ziegler², H. Chester-Jones², M. Raeth-Knight³, G. Golombeski³, and J. Linn³, ¹*Hubbard Feeds, Mankato, MN*, ²*University of Minnesota Southern Research and Outreach Center, Waseca*, ³*University of Minnesota, St. Paul*.

One hundred-eight 2 to 4 d-old dairy heifer calves (40.5 ± 0.81 kg) were randomly assigned to one of 4 treatments to evaluate their effect on pre- (42 d) and post weaning (d 43-56) calf performance and health. Calves were housed in 2.29 × 1.17 m individual calf pens, within a frame-steel curtain side-wall, naturally ventilated barn. All calves were fed a 20% fat, 20% protein all-milk protein medicated milk replacer (MR) with 19.7% CP (DM basis) calf starters (CS) fed free choice with access to fresh water. Treatments (Trt) were: 1), Texturized calf starter (CS) based on steam flaked corn, pellet and oats (SF); 2), CS based on whole corn and pellet (WC); 3), CS based on roasted corn, pellet and oats (RC); and 4) CS as in Trt 3 but fed a different MR feeding schedule (RC1X). Treatment 1, 2 and 3 calves were fed MR at 0.284 kg (as-fed) in 1.99 L water 2X daily for the first 35 d, then 1X daily from d 36 to 42 d. Treatment 4 calves were fed as the other calf groups for d 1-14 then offered 0.568 kg MR (as-fed) in 3.98 L water 1X daily from d 15-35 and 0.284 kg in 1.99 L water from 36 to 42 d. There was no effect on calf performance due to CS fed during the first 28 d (P > 0.05). During d 29-42, calves fed WC gained less (P < 0.05) than those fed RC. Calves fed WC had the lowest CS DMI (P < 0.05) during d 29-42. There were no Trt differences (P > 0.05) in overall pre-weaning calf performance. Overall 56 d calf performance was similar (P > 0.05). Daily gain and feed/gain averaged 0.66 and 1.98 kg, respectively. Under the conditions of this study, overall calf performance and health were not affected by corn form in the CS or milk feeding schedule. Once a-day milk feeding did not change CS intake as was anticipated.

Key Words: Dairy Calves, Calf Starters, Performance

TH191 Performance of post weaned Holstein heifer calves transitioned to group housing using different management strategies while fed a common diet. D. Ziegler^{*1}, B. Ziegler², M. Raeth-Knight³, R. Larson², G. Golombeski³, J. Linn³, and H. Chester-Jones¹, ¹*University of Minnesota Southern Research and Outreach Center, Waseca*, ²*Hubbard Feeds, Mankato, MN*, ³*University of Minnesota, St. Paul*.

Our objective was to evaluate the impact of three 14-d post-weaning transition grouping strategies on heifer performance over a 112 d study from 2 to 6 months of age. One hundred-eight Holstein heifer calves (77.38 ± 2.28 kg; 60 ± 1.6 d of age) were randomly assigned to 1 of 3 treatments. Treatments d 1-14 were: 1), Calves moved immediately from the nursery barn to group housing in a grower barn in 6 replicated 9.14 × 4.57 m pens of 6 calves/pen (GM); 2), Calves not moved but changed to group pens in 6 replicated 7.02 × 2.29 m pens of 6 calves/pen within the same nursery barn (GN); or 3), Calves not moved and continued to be individually housed d 1-14 in 2.29 × 1.17 m pens within the same nursery barn (IN). On d 15, calves assigned to GN and IN were moved to the grower barn in 6 replicated pens of 6 calves/pen (GN calves remained in their respective groups). During d 1-7 of the study all calves were fed a complete texturized 20.1% CP (DM basis) calf starter and d 8-14 transitioned to whole corn and pellet 17% CP (DM basis) grain mix. After the feed transition, all group pens were fed 2.73 kg/d of the grain mix for d 1-28 and 2.27 kg/d from d 29-112 with free choice hay. Transition strategy did not affect calf performance (P > 0.05) from d 1-14. Daily gain and feed/gain averaged 0.92 and 2.76 kg, respectively. The GM calves had higher (P = 0.03) daily gains (1.03 kg) from d 15-112 than GN (0.99 kg) calves with IN calves being similar (1.02 kg). Calves assigned to IN had lower feed/gain (P = 0.05) from d 15-112 (3.88 kg) compared to GN (3.99 kg) and GM (4.01 kg) calves.

Under the conditions of this study delaying socialization for 14 d resulted in similar growth as compared to calves grouped housed for 112 d.

Key Words: Dairy Calves, Transition Management, Performance

TH192 Performance and growth of Holstein dairy heifers fed grain mixes supplemented with differing protein and non-protein nitrogen sources. R. Larson^{*1}, B. Ziegler¹, M. Raeth-Knight², G. Golombeski², J. Linn², H. Chester-Jones³, and D. Ziegler³, ¹Hubbard Feeds, Mankato, MN, ²University of Minnesota, St. Paul, ³University of Minnesota Southern Research and Outreach Center, Waseca.

Ninety dairy heifers (88.3 ± 1.73 kg BW) were used in a 112-d study to evaluate feed intake and performance from 9 to 25 weeks of age. Heifers were housed in 9.14×4.57 m pens (6 heifers/pen) within a naturally ventilated bedded-pack pole barn and randomly assigned to 1 of 3 grower diets among 5 replicated pens/treatment. Treatments (Trt) were: -1), 16% CP grain mix (66.25% cracked corn, 32.5% pellet, 1.25% tallow) fed at 2.72 kg/d for 28 d and 2.27 kg/d from d 29 to 112 (CON); 2), Same as CON Trt with 1.01% urea in the grain mix (UREA); 3) Same as CON Trt with 6.01% rumen fermentation enhancer (FERMENTEN[®]; 43% CP, as-fed; FERM). Each treatment group was offered a 16.6% CP (as-fed) hay free choice (FC) for the duration of the trial. During the first 28 d, heifers fed UREA had lower ($P < 0.05$) daily gains than those fed CON, with FERM heifers being similar to the other groups. Heifer performance was similar across all groups from d 29 to 112 ($P > 0.05$). Overall 112 d gain was higher ($P < 0.05$) for CON heifers (1.08 kg/d) compared to those fed UREA (1.02 kg/d), with FERM heifers being intermediate (1.04 kg/d). There were no overall differences in total DMI, DMI as a percentage of BW, feed/gain or body condition score change ($P > 0.05$) which averaged 4.24 kg/d, 3.26%, 4.02 kg/kg gain and +0.80, respectively. Under the conditions of this study, heifers limit-fed a 16% CP grain mix containing urea (average 0.024 kg/heifer daily) with FC hay had lower overall gains from 9 to 25 weeks of age than those fed a grain mix without urea mainly due to the first 28 d of the study. Including a rumen fermentation enhancer in the grain mix (FERMENTEN[®]; average 0.14 kg/heifer daily) did not improve heifer performance.

Key Words: Dairy Heifers, Grain Mixes and Protein Sources, Performance

TH193 Performance and growth of young Holstein dairy heifers limit-fed diets based on body weight. H. Chester-Jones^{*1}, D. Ziegler¹, R. Larson², B. Ziegler², M. Raeth-Knight³, and G. Golombeski³, ¹University of Minnesota Southern Research and Outreach Center, Waseca, ²Hubbard Feeds, Mankato, MN, ³University of Minnesota, St. Paul.

Ninety dairy heifers (91.68 ± 0.72 kg BW) were used in a 112-d study to evaluate feed efficiency and performance from 9 to 25 weeks of age when reducing total DMI as a % of BW below an expected 3% or greater shown from previous studies. Heifers were housed in 9.14×4.57 m pens (6 heifers/pen) within a naturally ventilated bedded-pack pole barn and randomly assigned to 1 of 3 grower diets among 5 replicated pens/treatment. Treatments (Trt) were: 1), 18% CP grain mix control (58.75% cracked corn, 40% pellet, 1.25% tallow) fed at 2.72 kg/d for 28 d and 2.27 kg/d from d 29 to 112 with access to free choice (FC)

15.24% CP (DM basis) hay (CON); 2), 18% CP grain mix fed as for CON with limit hay feeding based on cumulative DMI of grain and hay to equal 3% of projected BW by 14-d periods (3DMI); 3), 18% CP grain mix fed at 2.72 kg/d for 14 d, 2.39 kg/d from d 15-28 and 2.05 kg/d d 29-112 with limit hay feeding based on cumulative DMI of grain and hay to equal 2.7% of projected BW by 14-d periods (2.7DMI). Initial BW and estimated daily gains were based on previous studies of 0.98, 1.07, 1.09, 1.0, 1.0, 0.98 and 0.93 kg by 14-d periods and were used to project period BW. Total DMI and DMI as a % of BW were lowest ($P < .05$) for heifers fed 2.7DMI for each 14-d period from d 15 to 112 except d 29-42 when CON had similar DMI to 2.7DMI ($P > 0.05$). Total DMI d 1-112 were 8.5 and 8.9% less for 2.7DMI than heifers fed 3DMI and CON, respectively. Overall 112 d daily gain was lowest (0.99 kg; $P < 0.05$) for 2.7DMI heifers being 5.7 (1.05 kg) and 9.2% (1.09 kg) less than those fed 3DMI and CON, respectively. There were no Trt differences ($P > 0.05$) in feed/gain. Although limit feeding young heifers under the conditions of this study did not improve feed efficiency, it did offer acceptable growth and body weight gain. Further research on optimum hay quality when limit feeding is needed.

Key Words: Dairy Heifers, Limit-Feeding Diets, Performance

TH194 Pre- and post weaning performance and health of calves fed milk replacers supplemented with trace minerals from differing sources. G. Golombeski^{*1}, S. Hayes², M. Raeth-Knight¹, B. Ziegler³, R. Larson³, D. Ziegler⁴, H. Chester-Jones⁴, and J. Linn¹, ¹University of Minnesota, St. Paul, ²Milk Products, Chilton, WI, ³Hubbard Feeds, Mankato, MN, ⁴University of Minnesota Southern Research and Outreach Center, Waseca.

One hundred-seven 2 to 4 day-old dairy heifer calves (40.1 ± 0.61 kg) were randomly assigned to one of 3 medicated, all-milk protein (20% protein:20% fat) milk replacers (MR) with supplemental trace mineral treatments to evaluate their effect on pre- and post weaning calf performance and health. Calves were housed in 2.29×1.17 m individual calf pens, within a curtain side-wall, naturally ventilated barn. Treatments were: 1), MR control containing inorganic trace minerals (INORGMR); 2), MR containing organic trace minerals (ORGMR); 3), ORGMR with organic selenium (Se; ORGSEMR). Milk replacers were fed at 0.284 kg (as-fed) in 1.99 L water 2X daily for the first 35 d, then 1X daily from d 36 to weaning at 42 d. Calves were offered a 21.4% CP (DM basis) texturized calf starter (CS) free choice and had access to fresh water at all times. Total DMI from MR for 42 d averaged 20.56 kg/calf. There were no pre- and post weaning performance differences by treatments ($P > 0.05$). Pre-weaning total DMI, gain and feed/gain averaged 37.23, 21.33, and 1.83 kg, respectively. Post weaning CS DMI, gain, and feed/gain averaged 25.60, 12.70 and 2.02 kg, respectively. Overall 56-d daily gain and feed/gain averaged 0.61 and 1.91 kg, respectively. Hip height gain was greater ($P < 0.02$) for calves fed ORGMR vs. those fed INORGMR. Calves fed ORGSEMR had higher ($P < 0.03$) serum Se on d 14 compared to those fed ORGMR with INORGMR being intermediate. Health treatment costs/calf were similar across treatments. Under the conditions of this study, feeding a MR containing organic trace minerals with or without organic Se did not affect pre- and immediate post weaning calf performance and health compared to calves fed MR with inorganic trace minerals.

Key Words: Dairy Calves, Milk Replacer Trace Minerals, Performance

TH195 Effect of the origin, month born, and shipment group on growth of Holstein heifers at a raising facility. J. Wohlt*¹, C. Jin¹, and J. Ferguson², ¹Rutgers University, New Brunswick, NJ, ²University of Pennsylvania, Kennett Square.

Twelve groups (9 to 23 head/shipment group) of Holstein heifers (total n = 179, 60 and 40% from PA and DE, respectively) were received at Rutgers University (New Brunswick) from either the University of Pennsylvania (Kennett Square) and/or the University of Delaware (Newark). Some shipments contained heifers from each origin as the same transportation route (161 km) was used. Heifers were approximately 3 months of age at receipt with the 12 shipments occurring between April 2004 and October 2005. Heifers were grouped in pens (5 to 7 head/pen) in a loose housing system and fed (NRC, 2001) diets for an 0.82 kg ADG. Once monthly each heifer between the ages of 3 to 18 months was weighed (Weight-By-Breed Management Tape), height at the withers measured, and body condition (1=thin, 5=fat) scored. Data were analyzed by ANOVA using GLM procedures with shipment groups, origin, and month born being main effects. Body weight increased (P < 0.01) linearly with heifer age, but height and body condition score increases were curvilinear. Growth rate, determined by linear regression analysis, did not differ with heifer origin: DE 0.84 kg/d, PA 0.83 kg/d. Heifer growth did differ (P < 0.01) among groups ranging from 0.73 to 0.97 kg/d. Heifers born between January and June compared to those born between July to December grew at a slower (P < 0.01) rate; 0.74 vs. 0.80 kg/d. The data suggest that early life events (nutrition, illness, etc.) may have long-term carry over effects on heifer growth at a raising facility.

Key Words: Dairy Heifer, Growth, Origin of Heifer

TH196 The association of mortality and 60 day culling rates with housing, feeding and pasture systems. C. D. Dechow*¹ and R. C. Goodling², ¹Penn State University, University Park, ²Pennsylvania State Cooperative Extension, University Park.

The objective of this study was to determine the association of various housing and management systems with measures of cow welfare, including mortality rates and culling by 60 days in milk (CR60). Herd surveys were received from 316 Pennsylvania dairy herds that participate in DHI herd testing and that had data available in 2005. The herd surveys identified feeding system (TMR = total mixed ration, CF = component feeding), housing system (FS=free stall, TS = tie stall, other), and pasture access (regular pasture, occasional pasture, exercise lot, no outdoor access). There was significant confounding of feeding, housing and pasture systems with herd size. Of herds with 100 cows or more (62%), 7% were TS, 22% had pasture access, and 97% fed TMR. Herds with fewer than 100 cows were more likely to have pasture access (62%), house cows in a TS (73%), or use CF (37%). Feeding, housing, and pasture system were analyzed with the GLM procedure of SAS. Least-squares-means (LSM) for mortality and CR60 were significantly higher in TMR fed herds (5.0% and 8.2%, respectively) than in CF herds (3.2% and 6.7%, respectively). Mortality rate was significantly lower in TS herds (3.3%) than in FS herds (4.9%), as was CR60 (6.3% versus 8.8%). Feeding, housing and pasture system were also combined into five total herd management systems. The most optimal herd environment (TS, CF, with pasture access) had LSM for mortality rate of 2.1% and CR60 of 5.3%, whereas the corresponding LSM for the least optimal environment (FS or other, TMR, no outdoor access) were 6.3% and 9.1%, respectively. While management system effects were highly

significant, they explained less than 10% of herd variation in mortality and CR60, which highlights challenges of associating cow welfare with herd type. In particular, the results indicate that legislative efforts to eliminate TS because of concern over limited cow movement may actually compromise cow welfare and reduce pasture access.

Key Words: Mortality, Housing, Pasture

TH197 How winter conditions affect feed intake of steers in different housing systems. H. Koknaroglu¹, Z. Otles², T. Mader³, T. Purevjav*⁴, and P. Hoffman⁴, ¹Suleyman Demirel University, Department of Animal Science, Isparta, Turkey, ²Frontier Science and Technology Research Foundation, Madison, WI, ³University of Nebraska, Lincoln, ⁴Iowa State University, Ames.

A total of 182 yearling steers of predominantly Angus and Hereford breeds, with mean body weight of 327 kg, were used in this study, which started on 8 November and finished on 12 April, to assess the effects of environmental factors on feed intake of steers in various housing systems. Housing consisted of outside lots with access to overhead shelter, outside lots with no overhead shelter and a cold confinement building. Ad libitum corn, 2.27 kg of 35% dry matter whole plant sorghum silage and 0.68 kg of a 61% protein-vitamin-mineral supplement was offered. Feed that was not consumed was measured to determine feed intake. The temperature data were recorded by hygro-thermographs. Hourly temperatures and wind speed were used to develop weather variables. Regression analysis was used and weather variables were regressed on dry matter intake (DMI). When addition of a new variable did not improve R² more than one unit, then the number of variables in the model was truncated. Cattle in confinement tended to have lower DMI than those in open lots and those in open lots with access to an overhead shelter (P > 0.05). Effect of cold was predominantly displayed in January in the three housing systems. In terms of explaining variation in DMI, in outside lots with access to overhead shelter, afternoon and peak temperatures were important factors, whereas in open lots, evening, nocturnal temperatures and windchill index were important factors (P < 0.05). In confinement buildings, daytime, nocturnal temperatures and windchill index were the most important factors explaining variation in DMI. Results show that winter conditions have detrimental effect on performance of cattle and when considering these results, cattle producers wishing to improve cattle feedlot performance should provide overhead shelter which provides more favorable conditions.

Key Words: Cold Stress, Dry Matter, Steers

TH198 Effect of age and breed on reproductive performance in the tropics. II. Beef heifers bred at 11 to 16 months of age. Year 2004. A. C. Pereira*¹, R. L. Remonato², G. R. Pacheco², E. J. Bungenstab¹, and S. P. Schmidt¹, ¹Auburn University, Auburn, AL, ²IACO Agricola S.A., Chapadão do Sul, Mato Grosso do Sul, Brazil.

The objective was to determine the influence of breed and age of eight breeds of beef heifers 11 to 16 mo old when exposed to bulls in a tropical environment. Breeds used were Bonsmara (BN), Boran (BO), Brahman (BR), Composite (CO), ½ Nellore x ½ Angus (F1), Nellore (NE), Senepol (SE), and Tuli (TU). Heifers born from July to December, 2002, (n = 9,235) were allocated by age and exposed to bulls Nov 1 to Dec

31, 2003, at 11, 12, 13, 14, 15, and 16 mo of age. Pregnancy status was determined by trans-rectal palpation. All ages had an effect on pregnancy rate ($P < 0.001$). Heifers at 16 month had a higher ($P < 0.01$) pregnancy rate ($32\% \pm 3.5$) compared with all other ages with exception of 15 month ($21\% \pm 3.4$). There also was a breed effect ($P < 0.01$). More F1 heifers were pregnant ($32\% \pm 1.1$; $P < 0.01$) than all other breeds; next were TU heifers ($18\% \pm 1.1$) which were higher ($P < 0.01$) than all other breeds with the exception of BN ($5.9\% \pm 6.3$) and BO (9.5 ± 6.3). There was an age x breed interaction on pregnancy rate ($P < 0.01$). F1 Heifers at 16 month ($65 \pm 2.9\%$) did not differ from SE breeding at 16 month ($60 \pm 15.8\%$) but had a higher pregnancy rate than all others. The heifer F1 breeding at 15 months (49 ± 2.1) did not differ from SE breeding at 16 months ($60\% \pm 15.8$) but had a higher pregnancy rate than all others. These data indicate that under the condition of this study in a tropical area, F1 and SE heifers were superior in pregnancy rate at 16 month, but F1 heifers may reach maturity as early as 15 mo of age.

Key Words: Beef Heifers, Reproduction, Breeding Season

TH199 Effect of age and breed on reproductive performance in the tropics. I. Beef heifers bred at 11 to 15 months of age. Year 2002.

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The objective was to determine the influence of breed and age of four breeds of beef heifers 11 to 15 mo of age when exposed to bulls in a tropical environment. Breeds used were Tuli (TU), Brahman (BR), Composite (CO), and $\frac{1}{2}$ Nellore x $\frac{1}{2}$ Angus (F1). Heifers born from July to December, 2000, ($n = 6,687$) were allocated by age and exposed to bulls from November, 2002 through January, 2003, at 11, 12, 13, 14, and 15 mo of age. Pregnancy status was determined by trans-rectal palpation. Age had an effect on pregnancy rate ($P < 0.01$). Heifers breeding at 15 mo had the highest ($P < 0.01$) pregnancy rate ($46 \pm 1.7\%$) followed by 14 mo ($37 \pm 1.1\%$), 13 mo ($26 \pm 1.0\%$), 12 mo ($14 \pm 0.9\%$) and 11 mo ($9 \pm 1.9\%$) which was not different from 12 mo. There also was a breed effect ($P < 0.01$). The F1 heifers had a higher ($P < 0.01$) pregnancy rate ($42 \pm 1.3\%$) than all other breeds. The TU heifers ($27 \pm 1.4\%$) were next and were higher ($P < 0.01$) than BR ($12 \pm 1.1\%$) but did not differ from CO ($23 \pm 1.1\%$). BR heifers ($12 \pm 1.1\%$) had the lowest ($P < 0.01$) pregnancy rate. There was an age x breed interaction on pregnancy rate ($P < 0.01$). F1 Heifers breeding at 15 mo ($67 \pm 5.1\%$) did not differ from F1 at 14 mo ($62 \pm 2.4\%$) and TU at 15 mo ($56 \pm 2.2\%$); however, those three had higher ($P < 0.01$) pregnancy rates than all others. These data indicate that in tropical areas, F1 heifers matured earlier and could be bred at 14 months of age.

Key Words: Beef Heifers, Reproduction, Breeding Season

TH200 Effect of early weaning of first-calf beef heifers. II. On calf and subsequent open heifer performance in the tropics.

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The objective was to investigate the effect of three calf weaning ages from first-calf heifers on subsequent dam and calf performance. From a herd of 650 $\frac{1}{2}$ Angus x $\frac{1}{2}$ Nellore primiparous heifers, 123 that had

male calves born between October 1 and 15 were selected and bred to composite bulls ($\frac{1}{4}$ Tuli, $\frac{1}{4}$ Angus, $\frac{1}{2}$ Brahman) during November and December. In March, following trans-rectal palpation, heifers were stratified by pregnancy status (63 pregnant or 60 open) and assigned randomly to three groups: normal weaning age at 7 mo \pm 7 d (7M), early weaned at 6 mo \pm 7 d (6M), or at 5 mo \pm 7 d (5M). No groups received supplementation. For all observations, d 0 = day 5M calves were weaned. Heifer body weights were taken on d 0, 30, 60, 90 and 315; body condition scores (BCS) were determined on d 0, 60 and 90; calf weights were taken on d 0, 30, 60, 90, 120, 150 and 315. Data reported here are for the 60 first-calf heifers that were not pregnant but were nursing their first calves. Heifer weights (410 ± 41 kg) and BCS (4.30 ± 0.5) were not different ($P > 0.05$) at d 0 when the 5M calves were weaned. By d 30 (420 vs. 395 kg) and continuing to d 90 (444 vs. 399 kg), 5M heifers weighed more ($P < 0.05$) than 7M heifers; 6M heifers were intermediate (426 kg) and not different from either 5M or 7M ($P > 0.05$). Similarly, BCS was greater for 5M than 7M at d 90 (5.4 vs. 4.9 ; $P < 0.05$), and 6M was intermediate (5.1 ; $P > 0.05$). Because these first-calf heifers were open, they were sold after calves were weaned. At d 0, there were no differences in calf weights (154 ± 16 kg). By d 30, 5M calves weighed less ($P < 0.05$) than 6M or 7M calves (170 , 187 , 185 kg, respectively). 5M calves continued to weigh less than 6M or 7M calves through d 150. By d 315, calf sale weights among weaning treatments were similar (290 ± 26 kg; $P > 0.05$). These data imply that early weaning (5M) will not affect calf sale weight, while significantly increasing cow weight, resulting on a heavier sale weight at 90 days after early weaning.

Key Words: Early Weaning Tropics, First-Calf Heifers, Performance

TH201 Effect of early weaning of first-calf beef heifers. I. On calf and subsequent heifer weights and pregnancy for third-parity in the tropics.

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The objective was to investigate the effect of three calf weaning ages from first-calf heifers on subsequent dam and calf performance. From a herd of 650 $\frac{1}{2}$ Angus x $\frac{1}{2}$ Nelore primiparous heifers, 123 that had male calves born between October 1 and 15 were selected and bred to composite bulls ($\frac{1}{4}$ Tuli, $\frac{1}{4}$ Angus, $\frac{1}{2}$ Brahman) during November and December. In March, following trans-rectal palpation, heifers were stratified by pregnancy status (63 pregnant or 60 open) and assigned randomly to three groups: normal weaning age at 7 mo \pm 7 d (7M), early weaned at 6 mo \pm 7 d (6M), or at 5 mo \pm 7 d (5M). No groups received supplementation. For all observations, d 0 = day 5M calves were weaned. Heifer body weights were taken on d 0, 30, 60, 90 and 315; body condition scores (BCS) were determined on d 0, 60 and 90; calf weights were taken on d 0, 30, 60, 90, 120, 150 and 315. Data reported here are for the 63 first-calf heifers that were pregnant. Heifer weights (422 ± 47 kg) and BCS (4.61 ± 0.49) were not different ($P > 0.05$) at d 0 when the 5M calves were weaned. By d 30 (436 vs. 402 kg) and continuing to d 90 (467 vs. 406 kg), 5M heifers weighed more ($P < 0.05$) than 7M heifers; 6M heifers were intermediate and not different from 5M (462 kg; $P > 0.05$). Similarly, BCS were similar for 5M and 6M at d 90 (5.7 vs. 5.6 ; $P > 0.05$) and greater than 7M (5.1 ; $P < 0.05$). There was a weaning treatment response for overall pregnancy rate. More ($P < 0.05$) 5M heifers were pregnant (87.5%) compared to 7M (50.0%); 6M heifers were intermediate and not different from 5M or 7M (66.7% ; $P > 0.05$). At d 0, there were no differences in calf weights (150 ± 19 kg).

By d 60, 5M calves weighed less ($P < 0.05$) than 6M or 7M calves (168, 187, 188 kg, respectively). The 5M calves continued to weigh less than 6M or 7M calves through d 150. By d 315, calf weights among weaning treatments were similar (285 ± 28 kg; $P > 0.05$). These data imply that early weaning (5M) will increase pregnancy rate at re-breeding without affecting calf weight when sold.

Key Words: Early Weaning Tropics, First-Calf Heifers, Performance

TH202 Effect of calving scheme, seasonal vs. year-round, on production, reproductive performance, and culling by organically-managed dairy herds in Southeastern Pennsylvania. K. Griswold^{*1}, H. Karreman², and J. High³, ¹Penn State Cooperative Extension, University Park, ²Penn Dutch Cow Care, Gap, PA, ³Lancaster DHIA, Manheim, PA.

The effects of seasonal calving (SC) vs. year-round calving (YRC) on production, reproductive performance and culling were examined using a combination of survey and DHIA data. Initially, 38 organically-managed (OM) herds using Lancaster DHIA services were recruited for the study, but only 29 herds returned completed surveys. The survey consisted of 308 questions concerning herd demographics, milk quality, health, reproduction, nutrition, and young stock. Monthly DHIA 202 report data from 2006 for each herd were used for the study. Data were analyzed using PROC MIXED within SAS. The model included the fixed effect of calving scheme and the random effect of farm. Significant differences were determined at $P < 0.05$, and trends were determined at $0.05 < P < 0.15$. LS means with standard errors are presented in the table below. The results indicate that SC herds produced significantly less total milk and total components per cow per year compared to YRC herds. Milk fat % was not affected ($P > 0.15$), but there was a trend for milk protein % to be greater for SC herds compared to YRC herds. For reproductive performance, SC herds had significantly fewer days to 1st service, greater pregnancy rates, and fewer days open compared to CM herds. The overall cull rate was not affected ($P > 0.15$) by calving scheme, but there was a trend for YRC herds to cull more cows for reproductive reasons whereas SC herds tended to cull more cows for mastitis. These results suggest that among organic dairies, seasonal calving herds have greater challenges with milk production and mastitis while year-round calving herds have greater challenges with reproductive performance.

Table 1. Effect of calving scheme on production, reproduction, and culling by organic dairy herds

Item	Seasonal	SE	Year-round	SE	P
Milk yield, kg/cow/yr	6,247	511	7,698	209	0.015*
Fat, kg/cow/yr	243	18	289	7	0.03*
Protein, kg/cow/yr	196	15	231	6	0.04*
Milk protein, %	3.20	0.07	3.08	0.03	0.12**
Days to 1st Service	79	6.6	96	2.7	0.02*
Pregnancy rate, %	25.3	2.2	16.1	0.9	0.0007*
Days Open	118	9.8	152	4.0	0.004*
Cows left herd for reproduction, %	1.3	2.2	5.2	0.9	0.11**
Cows left herd for mastitis, %	6.3	1.9	3.0	0.8	0.13**

*Difference $P < 0.05$, **Trend $0.05 < P < 0.15$

Key Words: Organic, Calving Scheme, Milk Yield

TH203 Influence of horn flies on the behavior of beef cattle. H. T. Boland^{*1} and G. Scaglia², ¹Virginia Tech, Blacksburg, ²Iberia Research Station, LSU Agricultural Center, Jeanerette, LA.

The horn fly (*Haematobia irritans*) is a common pest of cattle. When fly populations are high they can reduce animal performance leading to economic losses for producers. A study was conducted to evaluate the effects of a heavy burden of horn flies on the behavior of beef cattle. Angus-cross steers (n=4) that were being grass-finished on endophyte-free tall fescue (*Festuca arundinacea* Shreb.) were evaluated prior to and after application of 40% organophosphate ear tags. Fly-avoidance activities (head throw, tail or ear flick, front and rear leg kick, and skin twitch) and grazing behavior parameters (bite rate and number of feeding stations) were recorded over two-1 minute periods during morning and afternoon grazing bouts. High resolution digital photographs were taken of each steer from a lateral view at each sampling time. Images were analyzed with computer software to determine the number of flies present. Behavior and fly counts were monitored from 2 d prior until 3 d after fly tag application. Data were analyzed using the SAS procedures CORR and MIXED with Tukey's adjustment for means separation. There were more ($P=0.003$) flies present per animal before tagging (831) than after (203). Prior to tagging steers exhibited a greater number of tail flicks ($P=0.01$) and leg kicks ($P=0.002$). There was a linear effect of day ($P=0.06$) on bite rate (bites/min), with rate increasing after fly tags were applied. Bite rate was negatively correlated to the number of flies on the steers ($r=-0.31$, $P=0.006$) while the number of feeding stations was positively correlated ($r=0.43$, $P<0.0001$). Head throws ($r=0.27$), tail flicks ($r=0.50$), leg kicks ($r=0.47$), and skin twitches ($r=0.45$) were all positively correlated ($P \leq 0.02$) to the number of flies on the steers. High fly populations had a negative impact on the behavior of grazing cattle. Decreasing fly burdens can promote animal well-being by decreasing the display of fly-avoidance activities and increasing bite rate.

Key Words: Grazing Behavior, Bite Rate, Insecticide

TH204 Description of factors influencing reticular temperatures in lactating dairy cows. J. M. Bewley^{*}, M. E. Einstein, M. W. Grott, and M. M. Schutz, Purdue University, West Lafayette, IN.

The Phase IV Cattle Temperature Monitoring System (CTMS, Phase IV Engineering Inc., Boulder, CO) utilizes a passive bolus equipped with a temperature sensor, a stationary panel reader to query the bolus, and software to collect data. The biologically inert bolus resides in the cow's reticulum and is queried each time the cow passes the reader. Cow temperatures were collected immediately after each milking from 298 Holstein cows at the Purdue Dairy Research and Education Center (DREC) from June 1, 2006 to August 31, 2007. Cows were managed in 3 housing systems: a freestall barn (FS) with 128 stalls in 4 quadrants, a bedded-pack barn with an open grass lot (BP), and a geothermally-modified barn with tiestalls for overflow and sick cows and box stalls for recently fresh cows (GM). Ambient weather conditions were recorded at 0.5 h intervals at the Purdue Agronomy Research Farm, which is adjacent to the DREC. Raw cow reticular temperatures were edited to remove erroneous reads and temperatures potentially influenced by water intake. Unadjusted mean reticular temperature for the remaining 131,181 temperatures was $38.77 (\pm 0.44)$. The PROC MIXED procedure of SAS was used to assess the impact of milking time, parity, temperature humidity index (THI), housing system, days in milk, and milk production, on reticular temperatures. All main effects were significant ($P < 0.01$) except for THI which was, however, significant in 2-way interac-

tions (with barn, milk weight, or date). Temperatures decreased as cows progressed through lactation. Temperatures were higher for the PM milking than the AM milking ($P < 0.0001$). Variation in temperatures increased with increasing THI. After accounting for other effects in the model, the impact of increasing THI on reticular temperatures was higher for BP cows than FS or GM cows. An automated temperature monitoring system could be useful for herd management, however, variation caused by several factors must be considered for correct interpretation of temperatures provided by such a system.

Key Words: Temperature Monitoring, Reticular Temperature

TH205 Relationship of temperament and growth in the suckling beef calf. K. J. Matheney^{*1}, J. P. Banta¹, D. A. Neuendorff¹, T. H. Welsh, Jr.², R. C. Vann³, and R. D. Randel¹, ¹Texas AgriLife Research and Extension, Overton, ²Texas AgriLife Research, College Station, ³Mississippi State University, Raymond.

Exit velocity (EV) has been reported as an effective measure of temperament in Brahman calves after weaning (Curley et al., 2006; JAS 84:3100-3103). This experiment was conducted to evaluate the relationship of EV on weaning weight of suckling Brahman calves ($n = 109$). Additionally, evaluation of EV during the suckling period was examined from d 21-24 through weaning. Cows were assigned a temperament score from 1 to 3 (1 = calm, $n = 35$; 2 = intermediate, $n = 47$; 3 = temperamental $n = 27$). Exit velocity and BW were collected on d 21-24 and every 28 d through weaning; weaning BW was adjusted to 173 d according to BIF guidelines. Calves were classified at weaning based on EV, with calves 1 SD slower than the mean classified as calm (C; $n = 16$; 0.72 ± 0.18 m/s), calves 1 SD faster than the mean classified as excitable (E; $n = 23$; 3.61 ± 0.47 m/s), and all others classified as intermediate (I; $n = 70$; 1.77 ± 0.53 m/s). This was repeated with EV measurement taken 28 d prior to weaning, C ($n = 21$; 0.85 ± 0.23 m/s), I ($n = 71$; 2.11 ± 0.52 m/s), E ($n = 17$; 3.83 ± 0.55 m/s), and on d 21-24, C ($n = 13$; 0.24 ± 0.09 m/s), I ($n = 1.01 \pm 0.45$ m/s), and E ($n = 13$; 2.86 ± 0.50 m/s). The statistical model used for analysis included EV classification being tested, calf sex, and cow temperament as fixed effects; calf sire was included as a random effect. Classification by EV at weaning, 28 d prior to weaning, and d 21-24 were not significantly related to calf BW at weaning ($P > 0.10$; Table 1). Correlations were determined between EV on d 21-24 and at weaning ($r = 0.41$; $P < 0.001$), and 28 d prior to weaning with EV at weaning ($r = 0.69$; $P < 0.001$). The results from this experiment suggest that temperament does not affect growth of the suckling calf. These data suggest that calves can be evaluated for temperament using EV as early as 21-24 d of age.

Table 1. Effect of EV classification on adjusted weaning BW, kg

	Calm	Intermediate	Excitable	P =
Day 21-24	195.7 \pm 6.4	204.3 \pm 4.2	202.7 \pm 5.6	0.32
28 days prior to weaning	201.9 \pm 6.0	204.2 \pm 4.3	199.1 \pm 5.8	0.57
Weaning	204.1 \pm 6.1	203.9 \pm 4.3	199.2 \pm 5.4	0.58

Key Words: Temperament, Calves, Growth

TH206 Effect of supplemental saturated fatty acids on production and body temperature in heat-stressed mid-lactation dairy cows. J. P. Wang^{1,2}, D. P. Bu¹, J. Q. Wang^{*1}, X. K. Huo¹, T. J. Guo¹, H. Y. Wei¹, L. Y. Zhou¹, R. R. Rastani³, L. H. Baumgard⁴, and F. D. Li², ¹Chinese Academy of Agricultural Sciences, Beijing, China, ²Gansu Agricultural University, Gansu, China, ³MSC Specialty Nutrition, Dundee, IL, ⁴University of Arizona, Tucson.

Study objectives were to investigate the effect of supplemental saturated fatty acids (Energy Booster 100[®]) on body temperature, production and body condition of mid-lactation Holstein dairy cows ($n=48$; 184 ± 17 DIM; 30.8 ± 3.3 kg of milk/d and parity=2.2) experiencing heat stress. Cows were allocated into three treatments ($n=16$) according to a completely random block design and were fed individually in a tie-stall facility. Three treatment diets consisted of supplemental saturated fatty acids at 0, 1.5 or 3.0% of dry matter (C, LF and HF). The basal diet contained 44% forage and 56% concentrate. The supplemental fat replaced corn and soybean meal in the diet. Diets were isonitrogenous (CP=16.8%) and contained 1.54, 1.60 and 1.67 Mcal NE_L/kg DM in C, LF and HF, respectively. Cows were already heat-stressed at the beginning of the trial, and experimental diets were fed ad libitum as a TMR for 9 additional wk during heat stress conditions. Cows were milked 3 x/d and milk yields were recorded. Milk samples were collected weekly from 3 consecutive milkings and analyzed for composition. Ambient temperature and humidity were recorded 3 x/d, and rectal temperatures were monitored 3 x/d every other day. BCS and BW were measured weekly. During the experiment, the minimum, maximum and average THI were 64.2, 97.3 and 76.6, respectively. Overall rectal temperatures at 1400 h were 39.98^a, 38.98^b, and 39.25^{b,c}°C for C, LF and HF, respectively ($P < 0.05$). There was no treatment effect on DMI (20.1 kg/d), BCS (2.72) or BW (616.8 kg). Fat supplementation increased ($P < 0.05$) milk yield (26.4^a, 28.6^b, 28.5^b kg/d for C, LF, and HF, respectively). Milk fat content and total solids increased linearly ($P < 0.02$) with increasing fat supplementation. Supplemental saturated fatty acids reduced rectal temperatures and improved milk yield in mid-lactation heat-stressed dairy cows.

Key Words: Supplemental Saturated Fatty Acids, Heat Stress, Milk Yield

TH207 Ocular thermography as a measure of body temperature in beef cattle: Influences of environmental factors. S. M. Dray^{*1}, R. C. Vann², A. B. Chromiak¹, J. K. Lyons³, T. H. Welsh, Jr.³, R. D. Randel⁴, and S. T. Willard¹, ¹MAFES, Mississippi State University, Mississippi State, ²MAFES, Mississippi State University, Raymond, ³Texas A&M System, College Station, ⁴Texas AgriLife Research and Extension Center, Texas A&M System, Overton.

Our laboratory has shown that digital infrared thermal imaging (DITI) of the eye may be used as a measure of body temperature (BT) in livestock, with correlations to rectal temperature (RT; J. Anim. Sci. 84 (Suppl.1):354). However as environmental factors may have a negative influence on DITI, the objective of this study was to evaluate the impact of these factors on ocular DITI in beef cattle. Ocular temperature (TEMP) was measured with an infrared camera (FLIR, Wilsonville, OR). A total of 1027 observations were made using heifers (HF; $n=515$) and

steers (ST; n=453) among two breeds, Angus (A; n=658) and Brahman (B; n=368). Data were acquired over 3-months on numerous days at the same or multiple locations (MS, TX). Measures included: ambient TEMP (AMBT; °C), relative humidity (RH; %), TEMP-humidity index (THI), RT (°C) and maximum ocular TEMP (MAX EYE, °C). Analysis among these parameters used the Pearson Correlation Coefficient (r). Environmental measures ranged as follows: AMBT: 6.4°C to 36.2°C; RH: 28.4 to 91.0%; THI: 45.9 to 84.9. MAX EYE was highly correlated ($P < 0.01$) with AMBT ($r = 0.82$) and THI ($r = 0.81$), whereas there was a low correlation between RH and MAX EYE ($r = 0.14$). Overall, AMBT and MAX EYE were moderately correlated ($P < 0.05$) to RT ($r = 0.65$ and 0.74 , respectively). MAX EYE and RT relationships exhibited a similar trend when separated by gender (HF: $r = 0.71$; ST: $r = 0.75$; $P < 0.05$) and breed (A: $r = 0.74$; B: $r = 0.67$; $P < 0.05$). To assess variability of ocular DITI measures, standard deviation (EYE STD) within and among ocular images was examined in relation to environmental parameters. We noted that AMBT and THI were negatively correlated ($P < 0.01$) with EYE STD ($r = -0.87$ and -0.88 , respectively); as AMBT and THI decreased, EYE STD within ocular images increased. RH alone had no influence on EYE STD ($r = 0.02$; $P > 0.05$). In summary, ocular DITI was moderately correlated to RT (as was AMBT) among gender and breed. Changes in environmental TEMP influenced ocular DITI (MAX EYE and EYE STD), which needs to be considered when using ocular DITI as a measure of BT. [USDA-NRI: 2005-35204-15737; Biophotonics: #58-6402-3-0120]

Key Words: Thermography, Cattle, Body Temperature

TH208 Forced-traffic in automatic milking systems effectively reduces the need to fetch cows but alters eating behavior of dairy cattle. A. Bach^{1,2}, M. Devant², and A. Ferrer², ¹ICREA, Barcelona, Spain, ²IRTA-Unitat de Remugants, Barcelona, Spain.

Eighty five lactating Holstein dairy cows in loose housing conditions evenly distributed in 2 symmetrical pens, each containing 28 feeding

places, 2 waterers, and 1 automatic milking system (AMS) were used to evaluate the effects of the traffic type imposed to lactating cows through an AMS on milking frequency, feeding behavior, and milk production. The study followed a cross-over design with 2 periods and 2 treatments. Each period lasted 3 mo, with 1 mo of adaptation between periods. All cows were fed a partially mixed ration twice daily and up to 3 kg/d of a concentrate during the visits to the AMS. Treatments consisted on allowing free-traffic of cows throughout the pen or forcing cows to pass through the AMS before access to the feed bunk could be attained (forced traffic). Individual eating behavior and feed consumption were continuously monitored throughout the study using a computerized system. Individual milk production was recorded at each milking, and milk composition monthly. In addition, the number of cows fetched to the AMS was recorded. The number of voluntary and total milkings was greater with forced traffic (2.4 ± 0.04 and 2.5 ± 0.06 milkings/d, respectively) than with free traffic (1.7 ± 0.06 and 2.2 ± 0.04 milkings/d, respectively). Total DMI was numerically lower and milk production numerically greater with forced (20.4 ± 0.61 and 30.9 ± 0.79 kg/d, respectively) than with free traffic (21.2 ± 0.61 and 29.8 ± 0.79 kg/d, respectively). Milk fat content tended ($P = 0.06$) to be lower and milk protein was lower with forced traffic (3.44 ± 0.08 and 3.31 ± 0.02 %, respectively) than with free traffic (3.65 ± 0.08 and 3.38 ± 0.02 %, respectively). The number of meals was lower whereas meal duration and meal size was greater with forced traffic (6.6 ± 0.3 meals/d, 20.4 ± 0.65 min/meal, and 2.7 ± 0.09 kg/meal, respectively) than with free traffic (10.1 ± 0.3 meals/d, 15.7 ± 0.65 min/meal, and 1.8 ± 0.09 kg/meal, respectively). Forced traffic improved the number of voluntary milkings but altered milk quality and eating behavior of dairy cattle.

Key Words: Robotic Milking, Behavior, Feeding

Ruminant Nutrition: Fats and Carbohydrates - Beef, Sheep, Misc. Ruminants

TH209 Effect of physical particle size on ruminal and post-ruminal disappearance of nutrients of a mixed concentrate in Holstein steers. H. H. Jahani-Azizabadi¹, M. Danesh Mesgaran^{*1}, and A. Rahmatimanesh², ¹*Ferdowsi University of Mashhad, Mashhad, Iran*, ²*Heram Talae Shargh Feed Mill Company, Nishabour, Iran*.

In situ ruminal and post-ruminal disappearance [dry matter (DM), crude protein (CP) and ether extract (EE)] of a mixed concentrate prepared as fine mesh (fm), fine pellets (fp) and coarse pellets (cp) were studied. All pellets were provided in a condition of 70°C with pressure of 3 bars in 7 seconds. Concentrate was composed of cereal grain, soybean meal, canola meal, fish meal, urea, wheat bran, beet pulp, bagasse, salt, sodium bicarbonate, mineral and vitamin premix, anionic salt, molasses, sugar, protected fatty acid and Mg oxide (318, 60, 150, 15, 3.6, 250, 33, 40, 6.7, 8.6, 8, 15, 55, 30, 5 and 2.1 g/kg DM, respectively). Four Holstein steers (430±50 kg, BW) fitted with ruminal fistulae and T-shaped intestinal cannulae were used. Steers fed (DM basis) 2.5 kg of alfalfa hay, 2.1 kg of corn silage, 1.5 kg of straw and 2.5 kg of concentrate (170 g CP/kg of DM). Approximately 5 g of sample (DM) was placed in polyester bag (12×19 cm, pore size of 48 µm, n=8), then incubated in the rumen for 12 h. After removal from the rumen, bags were washed and dried. Then, 1 g DM of un-ruminal disappeared sample was weighed into a mobile bag (3×6 cm, pore size of 48 µm, n=8) and inserted in small intestine, then removed from the voided feces and rinsed in cold tap water. DM, EE and CP of intact and incubated samples were determined. Data were analyzed using completely randomized design. Ruminal DM, CP and EE disappearance of fm was significantly (P< 0.01) lower than fp and cp. Ruminal DM, CP and EE disappearance of fp was significantly (P< 0.01) higher than cp (0.71, 0.61 and 0.65 vs. 0.67, 0.58 and 0.59, respectively). Post-ruminal DM, CP and EE disappearance of fm concentrate (0.45, 0.50 and 0.80, respectively) was significantly (P< 0.01) higher compared with fp (0.35, 0.38 and 0.68, respectively) and cp (0.39, 0.38 and 0.57, respectively). Results of the present study indicated that the physical particle size of a mixed concentrate might impact on ruminal and post-ruminal disappearance of DM, CP and EE.

Key Words: Physical Processing, Disappearance, Mobile Nylon Bag

TH210 Comparative effects of whole, reconstituted- rolled, reconstituted-whole, dry-rolled and ground sorghum grain on growth and carcass characteristics in lambs. P. Orozco, R. Lazcano, and L. Corona*, *Universidad Nacional Autónoma de México. Facultad de Medicina Veterinaria y Zootecnia. Departamento de Nutrición Animal y Bioquímica, Cd. Universitaria, D.F., México, 04510.*

A growth trial was conducted to simultaneously evaluate five methods of sorghum processing for sheep. Experimental diets contained 73% sorghum grain. Sorghum processing treatments were as follows: 1) whole sorghum (WS), 2) reconstituted-rolled sorghum (RRS), 3) reconstituted-whole sorghum (RWS), 4) dry-rolled sorghum (DRS) and 5) ground sorghum (GS). RRS and RWS were reconstituted to 30% moisture and ensiled for 30d. Treatments effects on performance were evaluated in a 45-d finishing trial involving 20 Pelibuey ram lambs (33 kg±4.7) housed in individual pens. The experimental design was completely randomized

and data were analyzed using PROC GLM (SAS) with initial BW as a covariable. Lambs fed WS had lower (190 vs. 246g; P< 0.05) ADG, DMI (1.19 vs. 1.33kg; P< 0.05), gain: feed ratio (160 vs. 190g; P< 0.10), hot carcass weight (21.2 vs. 22.7kg; P< 0.05), dressing percentage (49.8 vs. 52.8%; P< 0.01), leg weight (5.6 vs. 5.0 kg; P< 0.10), chest weight (1.3 vs. 1.5kg; P< 0.10) and greater loin weight (2.76 vs. 2.21kg; P< 0.05) than sheep fed RWS. No differences (P> 0.05) between treatments were observed in initial weight, back fat thickness, KPF, LM area and shear force. Animals fed RWS had greater (1.2 vs. 1.1kg; P< 0.05) DMI; hot carcass weight (22.7 vs. 21.5kg, P< 0.05) and leg weight (5.6 vs. 4.8kg, P< 0.001) than lambs fed RRS. Lambs fed WS had lower (P< 0.05) dressing percentage (49.8 vs. 51.5%) and loin weight (2.4 vs. 2.8kg) than animals fed processed sorghum treatments. It is concluded that RWS enhances the growth performance and carcass characteristics in feedlot lambs compared to WS.

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Key Words: Sheep, Growth, Sorghum Processing

TH211 Effects of non-fiber carbohydrates supplementation on some blood metabolites of Holstein steers. F. Rezaii, M. Danesh Mesgaran, A. Heravi Mousavi*, and M. Nasiri, *Ferdowsi University of Mashhad, Mashhad, Iran.*

The aim of this study was to evaluate the effect of diets containing different non-fiber carbohydrates (sucrose or starch) on plasma glucose, urea nitrogen (PUN) and insulin in Holstein steers. Four fistulated Holstein steers (BW=280 ± 15 kg) were assigned to a 4 × 4 Latin Square with 21d periods; 17 days of diet for adjustment and 4 days of sample collection. A basal diet was formulated to be contained of alfalfa hay, barley grain, soybean meal and sugar beet pulp (400, 290, 190 and 50 g/kg, respectively). Starch (St) or sucrose (Su) or a 1:1 mixture of starch and sucrose (St+Su) was added to the basal diet at the rate of 70 g/kg DM. Diets were offered as 2-2.5 times of maintenance requirements (7 kg DM/d). Animals were fed twice daily at 0830 and 1630. Blood samples were collected before (0) and 2, 4, and 6 h after the morning feeding in tube containing heparin and immediately were centrifuged at 3000 rpm for 15 minute. The plasma was analyzed for glucose and PUN using commercial kits in the 0, 2, 4 and 6 h samples. The plasma samples were also analyzed for insulin in the 0 and 4 h samples. The data were analyzed using the MIXED procedure of SAS (2001) for a Latin Square design. The model contained the effects of period, cow, and treatment. Plasma glucose significantly decreased after supplementation diet with the non-fiber carbohydrates (p=0.043; 86, 70, 78 and 76 ± 3.7 mg/dL for control, Su, St and St+Su, respectively). The non-fiber carbohydrate supplementation decreased PUN significantly in compare with the control (p<0.01; 19, 15, 14, 13 ± 0.85 mg/dL for control, Su, St and St+Su, respectively). Plasma concentrations of insulin were similar among the diets (p=0.3). The result of this study demonstrated that sucrose and starch supplementations had significant impact on plasma glucose and PUN.

Key Words: Dairy Cow, Non-Fiber Carbohydrate, Sucrose and Starch

TH212 Ruminal and hindgut *in vitro* fermentation and methane production in concentrate-fed lambs. M. J. Ranilla*, M. L. Tejido, S. Ramos, C. Saro, M. E. Martínez, and M. D. Carro, *Universidad de León, León, Spain*.

The objective of the experiment was to study the *in vitro* fermentation characteristics in the rumen and hindgut of growing lambs fed a concentrate diet. Ruminal and caecal contents were obtained from fifteen concentrate-fed lambs (25 ± 0.4 kg body weight), diluted with buffer solution, and used to inoculate batch cultures containing cellulose or starch as substrates. Cultures were incubated at 39°C for 4 h before measuring the production of volatile fatty acids (VFA), gas and methane. There were substrate \times inocula interactions ($P=0.03$ to <0.001) for all measured variables, except for methane production ($P=0.38$). When starch was incubated with ruminal fluid, total VFA production was higher ($P<0.001$) than that with caecal contents (2883 vs 1860 μmol , respectively), and lower ($P<0.001$) proportions of acetate and butyrate, and greater ($P<0.001$) of propionate were observed. With cellulose as substrate, both total VFA production and acetate/propionate ratio were higher ($P<0.01$) for caecal inoculum than for ruminal fluid (730 vs 328 μmol and 3.76 vs 2.05, respectively). Molar proportions of the main VFA followed the same trend than with starch. For both substrates, gas production was greater ($P<0.001$) in cultures inoculated with ruminal fluid compared to those inoculated with caecal content (2.21 vs 1.13 μmol). Methane production tended ($P=0.09$) to be lower for ruminal inoculum compared to caecal (192 vs 226 μmol , mean values for both substrates), and was greater ($P<0.001$) with starch than with cellulose (360 vs 57.8 μmol). These results were probably due to both the high-concentrate diet fed to lambs which could have negatively affected the growth of ruminal cellulolytic microbes, and the short incubation time, since cellulose degradation rate is lower than that of starch. Methane/VFA ratios were lower ($P=0.03$) for rumen than for caecum (0.116 vs 0.157 mol/mol, mean values for both substrates). The calculated hydrogen recoveries for caecum were lower ($P<0.001$) than those for rumen (0.85 and 0.62, respectively), which would indicate that there are alternative hydrogen sinks in the caecum not appearing in the stoichiometric equation used for calculations.

Key Words: Rumen, Hindgut, Fermentation

TH213 Effect of *Bacillus cereus* var. *toyoi* supplementation on performance, metabolism, and histological morphology of the digestive tract in young Holstein bulls fed a high-concentrate diet. S. Martí¹, A. Bach^{1,2}, and M. Devant^{*1}, ¹*Animal Nutrition, Management, and Welfare Group, IRTA-Unitat de Remugants, Barcelona, Spain*, ²*ICREA, Barcelona, Spain*.

Thirty-two Holstein bulls (initial BW of 383 ± 26.5 kg) were distributed by BW in 8 pens randomly assigned to control (CTR) or *Bacillus cereus* var. *toyoi* ($0.2 \cdot 10^9$ CFU BT per kg concentrate, Toyocerin[®], Rubinum, S.A., Spain, BT) treatments. Animal BW and concentrate and straw consumptions, both offered *ad libitum*, were recorded every 4 wk. At 0, 50, and 91 d of the study at 0800 and at 1500 during four consecutive days (16 animals per day) rumenocenteses were performed and rumen pH was measured immediately. On the same days, blood samples were obtained to determine glucose, insulin, cortisol, lipopolysaccharide binding protein (LBP), and alpha1-acid glycoprotein (AGP) concentrations

analyses. Bulls were slaughtered at day 98 of the study, and rumen, jejunum, and cecum content samples were immediately collected to measure pH, and to determine N-NH₃, and VFA concentrations, and BT counts. Tissue samples from these sections of the GIT (gastrointestinal tract) were collected for the histological analyses. Hot carcass weight was recorded and carcass was graded according to the UE classification system. Treatment did not affect performance, feed consumption, feed efficiency, rumen pH, or serum glucose, insulin, cortisol, LBP, and AGP concentrations. Carcass conformation ($P=0.02$) and fatness ($P=0.14$) improved in BT bulls in contrast to CTR bulls. Jejunum pH tended ($P=0.08$) to be greater in BT bulls (6.84) than CTR bulls (6.61). Rumen molar proportion of butyrate, jejunum villus height and crypt depth were greater ($P=0.02$, 0.01, 0.13, respectively) in BT than in CTR bulls. Although no changes were observed in metabolic hormones, BT supplementation improved carcass conformation and fatness. These improvements might have been related to changes in the post-ruminal GIT but more research is needed to further elucidate the repercussions of BT supplementation in young Holstein bulls.

Key Words: Beef, Direct-Fed Microbials, Digestive Tract Histology

TH214 Blood cell profiles and plasma concentrations of glucose and cortisol of Nellore steers and bulls selected for low and high residual feed intake before and following a mild stressor. R. C. Gomes^{*1}, M. A. Ballou², R. F. Siqueira¹, T. R. Stella¹, J. A. Negrão¹, R. D. Sainz³, and P. R. Leme¹, ¹*University of São Paulo, Pirassununga, Brazil*, ²*Texas Tech University, Lubbock*, ³*University of California, Davis*.

The objectives were to determine whether Nellore cattle stratified into low and high residual feed intake (RFI) influenced the profiles of red and white blood cells and plasma concentrations of glucose and cortisol before and following a 24 h feed and water deprivation. Twenty-month old Nellore steers ($n=72$, 313 kg initial BW) and bulls ($n=48$, 413 kg initial BW) were fed a finishing ration for 74 days. Cattle were weighed every 21 d, and the lowest and highest RFI steers ($n=7$) and bulls ($n=10$) were stratified. Following stratification, cattle were submitted to 24 h of food and water deprivation. Blood was sampled prior to and following the withdrawal period. Hematological analyses included total and differential white blood cell counts and red blood cell count and morphology. Plasma was analyzed for glucose and cortisol concentrations. Low RFI steers had lower serum cortisol concentrations than high RFI steers (19.4 vs. 21.1 ng/mL; $P<0.04$). The 24 h withdrawal of feed and water did not alter serum cortisol concentrations. Variation in RFI did not influence either plasma glucose concentration or blood cell profiles. There was an interaction between castration and stress on plasma glucose concentrations ($P<0.03$). Glucose concentrations in bulls decreased from 114 to 97 mg/dL before and following deprivation, respectively, whereas it remained unchanged in steers. An interaction was evident between castration and stress on the neutrophil to lymphocyte ratio ($P<0.05$). In bulls, the neutrophil to lymphocyte ratio increased from 0.39 to 0.57 before and following the mild stress, respectively; whereas it was not altered in steers. A 24 h feed and water deprivation was a mild stressor in Nellore bulls only. Low RFI steers had lower cortisol concentrations; suggesting a link between RFI and hypothalamic-pituitary axis.

Key Words: Blood Parameters, *Bos indicus*, Feed Efficiency

TH215 Nutritional assessment of banana (*Musa paradisiaca*) leaves and pseudostems for ruminants. E. González-García^{*2}, O. Cáceres¹, H. Archimède², J. Arece¹, Héctor Santana¹, and Ramón Delgado¹, ¹Estación Experimental de Pastos y Forrajes 'Indio Hatuey', Matanzas, Cuba, ²INRA UR143 Unité de Recherches Zootechniques (URZ), Centre INRA-Antilles-Guyane, Domain Duclos, 97170 Petit Bourg, Guadeloupe (French West Indies).

Banana entire plant is, in practice, one of the most important feed resources available for sustainable animal feeding systems in tropics. However, few data are available about the potential use that ruminants can make from its byproducts. This experiment was conducted in order to determine average chemical composition and to assess the nutritive value of banana leaves and pseudostems for ruminant nutrition. Fresh material was daily obtained and transported from a local banana plantation (nearly allocated to the experimental farm), manually chopped (3-4 cm piece size) and individually distributed into two equilibrated meals: 0800 and 1630. The trial lasted 21 d (14 d adaptation, 7 d data collection). Six adult castrated Pelibuey wethers (BW=33±1.9 kg) were used, randomly housed in individual metabolism crates and the INRA French system of *ad libitum* (10% of refusal from previous day) feed supply and total feces collection was implemented. The DM (20.0 and 6.5%) and CP (142 and 25 g/ kg DM) contents were considered acceptable and low for leaves and stems, respectively. The CF was relatively high (> 21%) in both plant fractions. It was noteworthy the high (2.5 mcals/kg DM) ME of pseudostems; however, its low DM, CP and PDIMN affected voluntary intake, hence indicating that high DM (i.e. rice straw) and CP (i.e. forage legumes) feedstuffs are recommended as accompanying components in the diet. Future research opportunities exist for the optimum use of these highly available feed resources, focusing on basic strategic concepts like level of incorporation, productive purpose (milk?, meat?), physiological stage, among others.

Table 1. Nutritive value of banana

Item	DM, %	CP, g/ kg DM	CF, g/ kg DM	ME, mcal/ kg DM	PDIMN, g/ g DM	PDIME, g/ kg DM	Ca, g/ kg DM	P, g/ kg DM
Leaves	20.0	142	231	2.19	85.8	77.7	14.3	1.7
Pseudostems	6.5	25	205	2.50	11.5	42.2	10.4	2.4

PDIMN, microbial protein to be synthesized from degraded dietary N when energy is not limiting; PDIME, microbial protein synthesized from rumen fermented OM when degraded N is not limiting

Key Words: Banana Plant, Ruminant, Nutritive Value

TH216 The effect of replacing corn with glycerol on rumen fermentation and fiber digestibility. A. A. AbuGhazaleh¹, S. Abo El-Nor², and R. Babu^{*1}, ¹Southern Illinois University, Carbondale, ²Egyptian National Research Center, Cairo, Egypt.

The objective of this study was to evaluate the effect of substituting corn with glycerol on rumen fermentation and feed digestibility under in vitro conditions using continuous fermenters. Four fermenters were used in a 4 × 4 Latin Square design with four 10 d consecutive periods. Treatment diets (60:40 forage to concentrate) were fed at 45 g/d dry matter (DM) in three equal portions. The forage consisted of alfalfa pellets. The grain mix contained corn, SBM, soy hulls, minerals and vitamins. Glycerol replaced corn in the grain mix at 0% (T1; control), 15% (T2), 30% (T3) and 45% (T4). 25% of the overflow was collected

from each fermenter on days 8, 9, and 10 of each period, composited into one sample, freeze dried, and then analyzed for chemical composition. On day 10 of each period, rumen samples were collected from each fermenter at 3 and 6 hr after the morning feeding and analyzed for volatile fatty acid (VFA). Rumen acetate (43.44, 39.50, 37.83 and 33.86 mole/100 mole for T1 to T4, respectively) decreased ($P < 0.10$) while rumen butyrate (21.11, 24.96, 26.01 and 26.96 mole/100 mole for T1 to T4, respectively) increased ($P < 0.10$) with glycerol diets when compared with control. Acetate to propionate ratios (1.67, 1.60, 1.40 and 1.22) decreased ($P < 0.10$) only with T3 and T4 when compared with control. Rumen propionate, total VFA, and pH were not affected ($P > 0.10$) by treatment diets. NDF (38.63, 38.86, 33.41 and 31.88 % for T1 to T4, respectively) and ADF (29.50, 29.81, 24.61 and 25.05 % for T1 to T4, respectively) digestibility were lower ($P < 0.10$) with T3 and T4 when compared with control. In conclusion, glycerol could be used to replace corn in ruminant animals' diet at 15% without adversely affecting fiber digestibility. Substituting glycerol at 30 or 45% adversely affected rumen fiber digestion negatively impacting acetate production.

Key Words: Glycerol, VFA, Digestibility

TH217 Effects of replacing barley with corn grain in finishing diets on blood and rumen metabolites of Holstein male calves. F. Fatehi, K. Reza-Yazdi, M. Dehghan-Banadaky^{*}, M. Moradi-Shahrabak, and H. Bahrami, *Tehran University, Karaj, Tehran, Iran.*

Twenty five Holstein Male calves (body weight: 276±79 kg) were used to determine the effects of five different ratios of barley to corn grain (100:0, 25:75, 50:50, 75:25, 0:100) in finishing diets on blood metabolites and rumen parameters for 110 days. Calves were allotted by weight to 5 groups and used in a completely randomized design. Blood and rumen liquor were sampled every 30 days. There were no differences among concentration of blood Beta hydroxyl butyrate (BHBA), cholesterol, total protein, Ca, P and AST of calves. But calves fed diets with ratio of 0:100 and 25:75 (high corn) had significantly higher concentration of blood glucose and insulin and lower blood urea nitrogen (BUN) than other diets. Calves fed diets with ratio of 75:25 and 100:0 (high barley) had more blood concentration of non esterified fatty acids (NEFA) than other calves ($P < 0.05$). There were no differences among calves in rumen ammonia nitrogen concentration, but calves fed the diet with a ratio of 100:0 had lower rumen pH compared with the other calves ($P < 0.05$). Varying the ratio of barley and corn can impact blood and rumen metabolites in calves.

Key Words: Barley, Corn, Calves

TH218 Nutritional and growth patterns of Nellore bulls, steers and heifers, fed diets containing two concentrate allowance levels. P. V. R. Paulino^{*1}, S. de C. Valadares Filho¹, M. A. Fonseca¹, M. I. Marcondes¹, E. Detmann¹, N. K. de P. Souza¹, and R. D. Sainz¹, ¹Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil, ²University of California, Davis.

The objective in this work was to assess the effects of gender and concentrate allowance level (0.6 and 1.2% of body weight, BW) on performance, intake, digestibility and body and carcass composition of Nellore cattle. Thirty five animals (12 bulls, 11 steers and 12 heif-

ers) from a same contemporary group were used, being individually fed during 112 days and slaughtered at the end of the trial. The diets had 12% CP, and were corn silage based. The bulls were more efficient and had heavier ($P<0.05$) BW, empty body weight (EBW) and carcass weight, as a result of their increased rate of growth in comparison with the heifers ($P<0.05$). Dry matter and nutrients intakes were superior in the heifers ($P<0.05$) when compared with the bulls, whereas the steers had intermediate values. The digestibilities of all the nutrients, except EE, were not affected by gender ($P>0.05$). Only DM and OM digestibilities were affected by concentrate allowance levels, being greater ($P<0.05$) for the diet in which the concentrate allowance was 1.2% of the BW. Bull's carcasses were heavier and leaner ($P<0.05$) than the heifer's, with steer carcasses obtaining intermediate values. The subcutaneous depot of fat in the heifers was more pronounced than that of the males ($P<0.05$). Visceral and subcutaneous fat in the EBW (%) were greater for the heifers ($P<0.05$), although the rates of fat deposition in the different body depots were not influenced by gender ($P>0.05$). Concentrate allowance level did not affect ($P>0.05$) carcass traits and body and carcass composition of the animals. Protein and ether extract contents of the EBW of the bulls were, respectively, greater and smaller ($P<0.05$), than that of the heifers, with the steers presenting intermediate values. The bulls had more pronounced accretion rates ($P<0.05$) of muscle in the carcass and protein in the EBW than the heifers and steers. The carcass yield of commercial cuts was not affected by concentrate allowance levels ($P>0.05$), but by gender ($P<0.05$). Heifers and steers had higher yields of hind quarter ($P<0.05$) than the bulls, which had fore quarters more developed.

Key Words: Beef Cattle, Performance, Digestibility

TH219 Polynomial regression between ruminal bacteria population and pH in beef steers fed high forage diets. S. J. Liu, J. Q. Wang*, D. P. Bu, S. Liang, L. liu, H. Y. Wei, L. Y. Zhou, and K. L. Liu, *Chinese Academy of Agricultural Sciences, Beijing, China.*

The objective of this study was to evaluate regressive relationship between population of ruminal *F. succinogenes*, *B. fibrisolvans*, *R. albus* bacteria and ruminal fermentation parameters including pH value and volatile fatty acids (VFA). Four steers with ruminal cannulas were fed a high forage diets (forage to concentrate ratio 65:35). Ruminal fluid was collected on d 26, 27 and 28 of experimental period, starting at 0730 pre-feeding and at 1130 and 1730 post-feeding from the anterior, dorsal, and mid-ventral region of the rumen and pooled. Subsequently, this mixture was filtered through four layers of sterile cheesecloth, and immediately stored at -70 degrees C. Residual ruminal fluid was used to determine pH at sampling. A 100 mL sample of residual ruminal fluid was analyzed for VFA. Bacteria population was determined by real-time quantity PCR method. All data were analyzed using the MIXED procedure of SAS 8.2, and regression analysis adopted the polynomial regression procedure of SAS 8.2. Significance was declared at $P < 0.05$.

Steers fed high forage diet had no significant change relative to time in rumen acetate, propionate and the ratio of acetate to propionate, while pH significantly decreased over time ($P<0.05$). Our study showed that there existed a polynomial regression between the sum of *F. succinogenes*, *B. fibrisolvans*, *R. albus* number and rumen pH ($y = 397.89421 + 124.9846x + 9.35447x^2$; $R^2=0.55$, $P<0.05$). The relationship between *F. succinogenes*, *B. fibrisolvans*, and *R. albus* population and ratio of propionate to acetate and butyrate content was not strong ($R^2=0.29$, $P>0.05$). These results indicate that pH value is a sensitive index to reflect change of ruminal bacteria population compared with VFA.

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Key Words: Ruminal Bacteria Population, Ferment Parameter, Beef Steer

TH220 Effect of substitution barley grain with dried sugar beet pulp on venous blood gas of Holstein steers. M. Mojtahedi, M. Danesh Mesgaran*, A. Heravi Moussavi, and A. Tahmasebi, *Ferdowsi University of Mashhad, Mashhad, Iran.*

The objective of the present experiment was to evaluate the effect of substitution of barley grain with dried sugar beet pulp (SBP) on venous blood gas (VBG) of Holstein steers. Four Holstein steers with initial body weight of 368 ± 8 kg fitted with ruminal fistulae were used in a 4x4 Latin square design (28 days of each period). Basal experimental diet consisted of 15% corn silage, 20% alfalfa hay, 33% barley grain, 17% soybean meal, 13.8% wheat bran, 0.5% calcium carbonate, 0.2% salt, and 0.5% mineral and vitamin premix on dry matter basis. Barley grain was substituted with SBP as 0.0%, 33%, 66% or 100% (SBP0, SBP33, SBP66, and SBP100, respectively). Steers were fed 9.5 kg of DM as total mixed ration twice daily at 0800 and 1600 h. At the last day of each experimental period, blood samples were taken from Jugular vein after 4 h the morning feeding. Samples were immediately analyzed using Stat Profile pHox Plus blood analyzer (Nova Biomedical, USA) for pH, CO₂ pressure (pCO₂), O₂ pressure (pO₂), oxygen saturation (O₂Ct), base excess of extracellular fluid (BE_{ecf}), base excess of blood (BE_b), bicarbonate (HCO₃⁻), total carbon dioxide (TCO₂), and total hemoglobin (Hb). Data were analyzed using the GLM procedure of SAS ($Y = \text{Mean} + \text{Treatment} + \text{Animal} + \text{Period} + \text{residual}$) and the means compared by the Duncan test ($P < 0.05$). There were no significant differences ($P > 0.05$) between treatments in any of the blood biochemical parameters studied. Means of pH, pCO₂, pO₂, O₂Ct, BE_{ecf}, BE_b, HCO₃⁻, TCO₂, and Hb were 7.335, 47.28 mmHg, 29.08 mmHg, 6.53 ml/dl, -0.56 mmol/L, 0.26 mmol/L, 25.47 mmol/L, 26.94 mmol/L, and 8.97 g/dl, respectively. Results of the present study demonstrated that partial substitution of barley grain with sugar beet pulp in Holstein steers did not significantly affect blood pH and VBG values.

Key Words: Sugar Beet Pulp, Venous Blood Gas, Steers

TH221 Ruminal, fecal and urine pH of Holstein steers fed diets containing barley grain and(or) sugar beet pulp. M. Mojtahedi, M. Danesh Mesgaran*, A. Heravi Moussavi, and A. Tahmasebi, *Ferdowsi University of Mashhad, Mashhad, Iran.*

The aim of this study was to investigate the effect of diets containing barley grain and/or dried sugar beet pulp (SBP) on ruminal, fecal and urine pH of Holstein steers. Four Holstein steers with initial body weight of 368 ± 8 kg fitted with ruminal fistulae were used in a 4x4 Latin square design (28 days of each period). Basal experimental diet consisted of 15% corn silage, 20% alfalfa hay, 33% barley grain, 17% soybean meal, 13.8% wheat bran, 0.5% calcium carbonate, 0.2% salt, and 0.5% mineral and vitamin premix on dry matter basis. Barley grain was substituted with SBP as 0%, 33%, 66% or 100% (SBP0, SBP33, SBP66, and SBP100, respectively). Steers were fed 9.5 kg of diet DM as total mixed ration twice daily at 0800 and 1600 h. At day 25 of each experimental period, rumen fluid samples were collected, by suction,

before the morning feeding and during 8 hours post feeding (every 30 minute). Fecal and urine samples were collected during the last 7 d of each period. Sample pH was immediately recorded using a portable pH meter (Metrohm 744). Data were analyzed using the GLM procedure of SAS ($Y = \text{Mean} + \text{Treatment} + \text{Animal} + \text{Period} + \text{Time} + \text{Time} \times \text{Treatment} + \text{residual}$) and the means compared by the Duncan test ($P < 0.05$). Mean rumen pH was improved by inclusion of SBP in the diets ($P < 0.05$). Rumen pH for SBP0, SBP66, SBP100, and SBP33 was 6.22, 6.35, 6.36, and 6.49, respectively (SEM= 0.02). Fecal pH of steers fed SBP66 (7.01) and SBP100 (6.93) was significantly higher than SBP0 (6.65) ($P < 0.05$). Additionally urine pH of steers fed SBP66 (8.28) and SBP33 (8.14) was markedly higher compared with those fed SBP0 (7.83) ($P < 0.05$). Results from this study suggested that the inclusion of sugar beet pulp might improve ruminal, fecal and urine pH of Holstein steers fed high level of concentrate.

Key Words: Sugar Beet Pulp, pH, Steers

TH222 Feedlot performance, carcass traits and meat tenderness of *Bos indicus* type bullocks fed high concentrate diets. T. de O. Cucki¹, M. D. B. Arrigoni¹, C. L. Martins¹, L. A. L. Chardulo¹, A. C. Silveira¹, H. N. de Oliveira¹, R. da C. Cervieri¹, D. D. Millen¹, R. D. L. Pacheco^{*1}, S. R. Baldin¹, J. P. S. T. Bastos¹, T. M. Mariani¹, L. M. N. Sarti¹, R. S. Barducci¹, T. C. B. de Silva², ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Faculdade de Zootecnia/UNESP, Dracena, São Paulo, Brazil.

This study, conducted at São Paulo State University (UNESP) feedlot, Botucatu Campus, Brazil, was designed to evaluate the effect of *Bos indicus* breeds on performance, carcass traits and meat tenderness of bullocks fed high concentrate diet. It was used 96 8-mo-old bullocks (279.9±24.5 kg) of four *Bos indicus* based types (BT): 24 BNA (1/2 Brahman, 1/4 Nellore, 1/4 Angus), 24 PNA (1/2 Braunvieh, 1/4 Nellore, 1/4 Angus), 24 Brangus (5/8 Angus, 3/8 Brahman (BR)) and 24 Nellore (NE). BNA, PNA and BR were fed for 120 days, but NE was 184 days on feed. Rib eye area (REA) and back fat thickness (BFT) were taken by ultrasound. Meat samples were harvested between 12th and 13th ribs for shear force (SF), miofibrillar fragmentation index (MFI) and total lipids (TLIP) analysis. PNA and BR presented greater ($P < 0.05$) average daily gain in kilos (ADG) than BNA and NE (PNA=1.47, BR=1.52, BNA=1.28, NE=1.11). PNA, BR and BNA presented better ($P < 0.01$) feed conversion than NE (PNA=5.54, BR=5.35, BNA=5.43, NE=6.71). PNA and BR had greater ($P < 0.05$) dry matter intake (DMI) in kilos than BNA, but NE did not differ ($P > 0.05$) between BT (PNA=8.11, BR=8.14, BNA=6.98, NE=7.46). When analyzed as percentage of BW, PNA, BR and NE consumed ($P < 0.05$) more feed than BNA (PNA=2.14, BR=2.21, BNA=1.82, NE=2.15). NE presented heavier ($P < 0.05$) hot carcass weight in kilos than BR, but PNA and BNA did not differ between BT (PNA=250.04, BR=245.64, BNA=248.01, NE=252.48). No differences were observed ($P > 0.05$) for dressing percentage (PNA=53.45, BR=53.33, BNA=53.97, NE=56.11) and BFT in millimeters (PNA=5.06, BR=5.14, BNA=5.17, NE=5.05), but NE presented larger ($P < 0.05$) REA in cm² than PNA, BNA and BR (PNA=70.10, BR=72.65, BNA=69.10, NE=75.30). SF in kilograms (PNA=3.48, BR=3.15, BNA=3.75, NE=3.30), MFI (PNA=86.11, BR=78.41, BNA=69.80, NE=73.36) and TLIP in percentage (PNA=1.65, BR=1.65, BNA=1.85, NE=1.99) did not show differences ($P > 0.05$) between BT. Even presenting smaller REA, PNA and BR performed better than NE and BNA, but no effects on meat tenderness and fat deposition were observed.

Key Words: Carcass Traits, Feedlot, Performance

TH223 Frothy bloat-related shifts in the ruminal bacterial population in steers fed Bermuda grass hay and grazing wheat forage. W. E. Pinchak^{*1}, B. R. Min^{1,3}, C. Hernandez², and M. E. Hume², ¹Texas AgriLife Research, Vernon, TX, ²USDA-ARS, Southern Plains Agricultural Research Center, Food and Feed Safety Research Unit, College Station, TX, ³Ichthus Education Center, La Trinitaria, Chiapas, Mexico.

Seven strains of ruminal bacteria (*Streptococcus bovis* strain 26, *Prevotella ruminicola* strain 23, *Eubacterium ruminantium* B1C23, *Fibrobacter succinogenes* ssp. S85, *Ruminococcus flavefaciens* C94, *Selenomonas ruminantium*, and *Ruminobacter amylophilus*) were used to determine the relationships of select individual bacterial populations associated with changes in diet (Bermuda grass hay vs. wheat forage) and bloat severity on individual bacterial populations in the rumen of steers grazing wheat forage. Twelve ruminally cannulated steers grazing wheat forage for 70 day were used to evaluate the influence of bloat on the ruminal microbial biodiversity patterns. Steers were classified as non-bloat and bloat prone post-hoc after bloat was manifested and the classification applied retrospectively. The bacterial DNA density was greatest for *R. flavefaciens*, *S. bovis*, and *E. ruminantium* among tested strains when steers fed Bermuda grass hay (day 0). Steers grazed wheat forage for 50 days prior to the peak bloat period (day 50) resulted decreased density of six bacterial populations in non-bloated steers rumen fluid, but increased the bacterial density of 6 major rumen bacterial populations in bloated steers, indicating that frothy bloat may be associated with species-specific bacterial population. Steers grazed wheat forage over 70 days increased the density of *S. bovis* and *P. ruminicola* bacterial populations in non-bloated steers rumen fluid. The data collectively suggest that ruminal bacterial populations changed when steers experienced frothy bloat.

Key Words: Ruminal Bacteria, Frothy Bloat, Forages

TH224 Beef heifers performance fed with different forage sources. G. R. Siqueira^{2,1}, R. A. Reis^{*1,4}, R. P. Schocken-Iturrino^{1,4}, F. Dutra de Resende², T. T. Berchielli^{1,4}, M. de Toledo Piza Roth^{1,4}, and A. P. de Toledo Piza Roth^{1,3}, ¹São Paulo State University, Jaboticabal, São Paulo, Brazil, ²APTA Regional de Colina, Colina, São Paulo, Brazil, ³Fundaç o de Amparo Pesquisa do Estado de São Paulo, São Paulo, São Paulo, Brazil, ⁴Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brasilia, Distrito Federal, Brazil.

This research aimed to evaluate the Nellore x Angus beef heifers performance fed with different forage: in nature sugar cane (*Sacharum officinarum* L)- ISC, and different silage: corn (CS), in natura sugar cane (ISCS), ISCS plus *Lactobacillus buchneri* NCIMB 40788 -LB (ISCS-LB), burned sugar cane (BSCS), and BSCS plus LB (BSCS-LB). On the CS, and sugar cane (in natura, or silage) diets it were utilized, respectively 44%, and 37% of forage. Total mixed ration content 70.0% TDN, and 13.5% protein was used on the experiment. The trial was conducted during 127 days, using 54 beef heifers 12 months old, distributed in six treatments. The data were analyzed according a randomized block design with nine replications. Burned sugar cane silage showed highest DM losses (47.3%), compared to the ISCS (33.4%). LB reduced the DM losses of the BSCS in 11 unities. The DM intake (Table 1) were highest in CS treatment (7.36a) compared to the silage ISCS (6.32 bc), ISCS-LB (6.56 bc), BSCS (6.23 c). On the other hand, the intake, expressed like % BW (Table 1), showed highest values on the CS (2.62 a), ISC (2.45 ab), and BSCS-LB (2.45 ab). The data related

to the daily weight, and feed efficiency, showed that CS (0.865 kg/day, 9.00 kg/kg WG) can be replaced by ISC (0.874 kg/day, 8.30 kg/kg WG), or sugar cane silage (0.910 kg/day, 7.80 kg/kg WG). However, burned sugar cane silage need to LB to avoid dry matter, and nutritive values losses, consequently intake reduction.

Table 1. Dry matter intake-DMI (kg/day), intake in relation to body weight (%BW), daily gain (ADG), and feed efficiency (FE- kg/kg of weight gain) of the heifers

	Forage ¹						se	P≤F
	CS	ISC	ISCS	ISCSLB	BSCS	BSCSLB		
DMI	7.36a	6.82abc	6.32bc	6.56bc	6.23c	7.04ab	0.273	*
Intake (%BW)	2.62a	2.45ab	2.24bc	2.31bc	2.20c	2.45ab	0.083	**
ADG	0.865	0.874	0.866	0.907	0.895	0.974	0.048	0.70
FE	9.00	8.30	8.05	7.90	7.80	7.48	0.425	0.26

I. CS: corn silage, sugar cane (ISC), ISC silage (ISCS), ISCS + L. bucheneri-LB (ISCS-LB), Burned sugar silage (BSCS), BSCS-LB

Key Words: Additive, *Lactobacillus buchneri*, Sugar Cane

TH225 Effects of hay restriction with additional co-product supplementation on cow and calf performance and hay disappearance during a winter feeding program. A. Brauch*, J. Sexton, B. Wiegand, M. Kerley, D. Wilson, D. Mallory, H. Smith, M. Ellersieck, and J. Williams, *University of Missouri, Columbia*.

Fifty-six fall-calving Angus and Angus-Simmental cows (initial BW 525.1 ± 9.4 kg) with calves were used to determine the effects of limiting time of access to round bales of hay on cow and calf performance and hay disappearance. Average quality hay (8.1% CP; 55.7% TDN) was provided either ad libitum (24-h/d access) or was restricted to 8 h/d. Cows provided with ad libitum access to hay were supplemented with 1.8 kg•hd⁻¹•d⁻¹ of dried distillers' grains with solubles (DDGS) for early lactation and 1.5 kg•hd⁻¹•d⁻¹ of DDGS for mid lactation. Cows provided with restricted access to hay were supplemented with the same amount of DDGS plus 2.7 kg•hd⁻¹•d⁻¹ and 2.3 kg•hd⁻¹•d⁻¹ of soy hull pellets for early and mid lactation, respectively. Cows were assigned to one of eight 0.8-hectare paddocks of grazed tall fescue based on BW, body condition score (BCS), days postpartum (DPP), and parity. This resulted in seven cow-calf pairs per paddock and four paddocks per treatment. Adequate bunk space was provided in each paddock. Electric fencing was used to restrict access to hay from 4:00 PM until 8:00 AM the following morning. Initial results indicate that BW was not affected by treatment ($P>0.92$), nor was back fat ($P>0.14$). Cows receiving ad libitum access to hay showed a trend to maintain greater BCS ($P<0.07$) than cows with limited access. Calf BW and ADG were not affected by treatment ($P>0.18$ and $P>0.29$, respectively). Hay disappearance decreased ($P<0.0001$) when time of access was limited. These results indicate that limiting time of access to hay and providing additional co-product supplementation is an acceptable method for wintering beef cows and for extending hay reserves.

Key Words: Beef Cows, Hay Restriction, Co-Products

TH226 Effects of corn processing method on performance and carcass characteristics of finishing beef cattle fed diets containing sorghum wet distiller's grains plus solubles. J. Leibovich*, J. T. Vasconcelos, J. P. McMeniman, K. E. Hales, R. R. Reuter, R. J. Rathmann, and M. L. Galyean, *Texas Tech University, Lubbock, TX*.

One hundred and sixty crossbred steers (BW = 397.6 kg) were used in a finishing experiment to evaluate the effects of corn processing method on performance and carcass characteristics in diets containing sorghum wet distiller's grains plus solubles (SWDGS). Treatments were: (1) a dry-rolled corn (DRC)-based diet with no inclusion of SWDGS (DRC-0); (2) a DRC-based diet with inclusion of 15% (DM basis) SWDGS (DRC-15); (3) a steam-flaked corn (SFC)-based diet with 0% SWDGS (SFC-0); and (4) a SFC-based diet with 15% SWDGS (SFC-15). All diets were formulated to contain 14.5% CP and equal concentrations of fat. No significant interactions ($P \geq 0.20$) were noted for performance and carcass characteristics, except for marbling score and % of carcasses grading Choice or greater. The ADG by steers fed the DRC-based diets did not differ ($P = 0.72$) from that of steers fed SFC-based diets, but DMI was greater with DRC-based diets, resulting in lower ($P < 0.01$) G:F with DRC-based diets. Steers fed SFC-based diets had greater fat thickness at the 12th rib ($P = 0.03$), greater yield grade ($P = 0.02$), and a smaller LM area ($P = 0.08$) than steers fed the DRC-based diets. Inclusion of 15% SWDGS resulted in lower ADG ($P < 0.01$) and G:F ($P < 0.01$) compared with diets that did not contain SWDGS. In addition, steers fed SWDGS had lower HCW ($P = 0.01$) and dressing percent ($P = 0.03$) than those fed 0% SWDGS. Marbling score was less ($P < 0.06$) for cattle fed the SFC-0 diets than for those fed the DRC-0 and SFC-15 diets. Percentage of steers that graded Choice or greater was less ($P = 0.06$) for SFC-0 than for DRC-0. Results suggest that the response to 15% (DM basis) SWDGS in finishing diets was not affected by corn processing method. The inclusion of 15% SWDGS decreased G:F to approximately the same extent as replacing SFC with DRC.

Key Words: Beef Cattle, Distiller's Grain, Grain Processing

TH227 Feeding behavior of feedlot cattle from different breed types fed high concentrate diets with different NDF levels. L. M. N. Sarti^{1,3}, M. D. B. Arrigoni¹, C. L. Martins¹, D. D. Millen¹, R. D. L. Pacheco^{*1}, S. A. Matsuhara¹, M. Parrili¹, M. V. Fossa¹, J. P. S. T. Bastos¹, T. M. Mariani¹, R. S. Barducci¹, T. C. B. da Silva², L. F. S. Niero¹, S. R. Baldin¹, H. N. de Oliveira¹, ¹FMVZ/UNESP, Botucatu, São Paulo, Brazil, ²Faculdade de Zootecnia/UNESP, Dracena, São Paulo, Brazil, ³Apoio FAPESP.

The objective was to evaluate the feeding behavior of feedlot cattle from different breed types (BT) fed high concentrate diets with different NDF levels. The experiment was conducted at the experimental feedlot of the Veterinary Medicine and Animal Science College, São Paulo State University, Botucatu campus (UNESP), Brazil. Twelve bullocks, weaned at 8 months of age (258.4±32.7 kg) were randomly assigned according to BT: 4 Nellore (NE), 4 Three-way-cross (1/2 Braunvieh, 1/4 Angus, 1/4 NE (TC)) and 4 Canchim (5/8 Charolais, 1/4 NE (CC)) evaluated in four different diets (DD) containing different levels of concentrate and NDF (Concentrate (%) = 58 (DD1), 73 (DD2), 82 (DD3) and 85 (DD4); NDF (%) = 38.1 (DD1), 30.9 (DD2), 27.7

(DD3) and 23.0 (DD4); respectively) constituting a split plot design. Visual appraisal was used each 5 minutes during 24 hours to collect feeding behavior data as follows: eating time (ET), ruminating time (RT) and idle time (IT) expressed in minutes. ET decreased ($P < 0.05$) in DD4 when compared to the others diets evaluated (DD1=202.08, DD2=207.50, DD3=181.25, DD4=135.00). BT effect was found, where TC presented ($P < 0.05$) shorter ET (151.87) than NE (198.44) and CC (194.06). There was not interaction between BT and DD for ET. RT decreased ($P < 0.05$) in DD4 when compared to the others diets evaluated (DD1=454.58, DD2=415.42, DD3=385.83, DD4=310.42). There was not a BT effect ($P > 0.05$), but an interaction was found ($P < 0.05$) between BT and DD for RT, where a linear decrease was presented for CC (DD1=438.75, DD2=432.50, DD3=410.00, DD4=321.25) and TC (DD1=505.00, DD2=446.25, DD3=378.75, DD4=263.75). There were not DD and BT effects for IT, but an interaction was found ($P < 0.05$), where TC, CC and NE presented longer IT in DD4 (TC – DD1=740.00, DD2=811.25, DD3=880.00, DD4=1022.50; CC – DD1=788.75, DD2=756.25, DD3=788.75, DD4=957.50; NE – DD1=742.50, DD2=831.25, DD3=895.00, DD4=943.75). Bullocks fed high concentrate diets presented shorter ET and RT and longer IT as levels of NDF in diet decreased. TC showed shorter ET than CC and NE during the study, but no differences in RT and IT were found.

Key Words: Behavior, NDF

TH228 Dietary inclusion of crude glycerol changes beef steer growth performance and intramuscular fat deposition. B. A. Verse-
mann*, B. R. Wiegand, M. S. Kerley, J. H. Porter, K. S. Roberts, and
H. L. Evans, *University of Missouri, Columbia.*

The objective of this study was to assess the optimum and maximum levels of crude glycerol for inclusion in beef cattle feedlot diets. Crude glycerol sourced from a biodiesel production facility was included at graded levels in feedlot diets of crossbred steers ($n=72$). Steers (225kg) were randomly assigned in pens of 6 steers each to one of four experimental diets. Diets were formulated to include 0, 5, 10, or 20% glycerol. Glycerol replaced corn at 0, 10, 20 or 40%. Each diet combination was replicated three times. Body weights were recorded at the start, finish, and on 21d intervals throughout the experiment. Calves were fed once daily following a clean-bunk protocol. Pen was the experimental unit. Growth performance data including ADG, feed intake, and feed efficiency were recorded. Steers were humanely slaughtered after reaching an average live weight of 537 ± 12 kg and an average 12th rib fat depth (as determined by ultrasound) of 1.18 ± 0.13 cm. Carcass data was collected and yield and quality grades were determined. Data analysis resulted in a quadratic effect for ADG with 1.34, 1.39, 1.43, and 1.20 kg (SEM = 0.059) for 0, 5, 10, and 20% glycerol, respectively. Feed intake was not significantly affected across the treatment groups. However, in assessing contrasts for gain to feed, significance ($P < 0.02$) was observed between 10% glycerol and control with 0.15 and 0.16 (SEM=0.005), respectively. Furthermore, feed efficiency tended to improve ($P < 0.08$) when glycerol and control diets were compared (0.150 and 0.163, respectively). Efficiency also tended ($P < 0.06$) to follow a quadratic response with 0.15, 0.16, 0.17, and 0.16 for 0, 5, 10, and 20% glycerol, respectively. Intramuscular fat as evaluated by marbling score was different ($P = 0.04$) and measured 522, 503, 562, and 458 (SEM = 27.4) for 0, 5, 10, and 20% glycerol diets, respectively. No other carcass characteristics differed among treatment groups. Feeding glycerol to

beef finishing steers seems to be optimized at 10% dietary inclusion when considering the combination of feed efficiency improvement and intramuscular fat deposition.

Key Words: Glycerol, Beef Cattle, Feed Efficiency

TH229 Supplementation programs for wheat straw-based wintering cow programs. K. M. Wood*, I. B. Mandell, and K. C. Swanson, *University of Guelph, Guelph, ON, Canada.*

Fifty-three individually-fed, multiparous crossbred beef cows were used to investigate feeding of free-choice haylage or use of supplemental haylage, soybean meal, or dried corn distiller's grains plus solubles on performance of dry pregnant cows fed wheat straw-based diets. Cows were randomly assigned to 1 of 5 dietary treatments: free choice haylage ($n=7$; hayFC), haylage offered at 1% of bodyweight (BW) plus free choice access to straw ($n=12$; haycon), haylage offered at 0.5% BW plus free choice access to straw ($n=11$; hayneg), haylage offered at 0.5% BW plus soybean meal and free choice access to straw ($n=12$; SBM), haylage offered at 0.5% BW plus corn dried distiller's grains and free choice access to straw ($n=11$; DDGS). The supplement in SBM and DDGS treatments was included to make the non-straw component isonitrogenous to the non-straw component of haycon. Cows were fed for 16 weeks leading up to parturition. Data were analyzed using Proc mixed in SAS and treatments compared using a Tukey-Kramer test. Parity and pen were included as covariates in the model. There were no significant differences ($P > 0.05$) between treatment groups for changes in backfat, intramuscular fat, plasma urea nitrogen, and glucose between week 0 and week 16. Cows on hayneg had lower ($P < 0.05$) average daily gain (ADG) than all other treatment groups. Cows fed haycon also had lower ($P < 0.05$) ADG than DDGS and hayFC. Change in body condition score was greater in hayFC than hayneg ($P=0.036$). Cows on hayFC had a lower ($P < 0.05$) total dry matter intake than other treatments. Straw intake was significantly ($P < 0.05$) lower for haycon compared to other treatments, and also was lower ($P < 0.05$) for hayneg than SBM. This data indicates that feeding wheat straw-based diets supplemented with haylage, SBM, or DDGS may be an acceptable alternative to minimize winter feed costs without negatively affecting cow performance.

Key Words: Winter Feeding, Beef Cows, Straw

TH230 Effect of n-3 PUFA supplementation on embryo recovery rate, quality and gene expression in beef heifers. S. Childs^{1,2}, F. Carter², C. O. Lynch^{1,2}, J. M. Sreenan¹, P. Lonergan², A. A. Hennessy³, and D. A. Kenny², ¹Teagasc Production Research Centre, Athenry, Co. Galway, Ireland, ²University College Dublin, Belfield, Dublin, Ireland, ³Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork, Ireland.

The objective was to examine the effect of dietary n-3 polyunsaturated fatty acids (PUFA) on embryo development and gene expression in cattle. Heifers ($n=36$) were individually fed barley straw and concentrate containing a partially rumen-protected source of either (i) palmitic acid (CON), or (ii) n-3 PUFA (n-3 PUFA; 140g of EPA and DHA combined). Diets were isolipid and isonitrogenous and fed for 50 days. Superovulation was induced using FSH, embryos were recovered on

day 7 post AI (day 50) and graded according to IETS guidelines. Grade 1 morula and blastocysts were snap frozen in liquid N₂ and stored for gene expression analysis. Plasma and uterine flushings were collected for fatty acid analysis. Fatty acid methyl esters were separated by gas chromatography. Gene expression was assessed by Q-RT-PCR and quantified using the comparative Ct method for six genes involved in embryo development and/or lipid metabolism: BAX, LIF, Cx43, E-CAD, PPAR- α and PPAR- δ . Data were analysed using the MIXED and GENMOD procedures of SAS. Fold Δ values in gene expression were analyzed using the student's t-test. Dietary n-3 PUFA increased ($P < 0.001$) plasma concentrations of EPA and DHA. Similarly, dietary n-3 PUFA increased EPA ($P < 0.001$) and reduced arachidonic acid ($P < 0.05$) concentration in uterine fluid. The number of degenerate embryo recovered ($P < 0.05$) was lower on n-3 PUFA but diet did not affect embryo recovery or embryo quality ($P > 0.05$). Moreover, there was no effect of diet ($P > 0.05$) on expression of any of the genes analysed. Increased uterine n-3 PUFA and reduced arachidonic acid may lead to a more luteotrophic uterine environment; however, with the exception of a reduction in degenerate embryo numbers, there was no further evidence of an effect on embryo quality or gene expression. Results suggest that any effect of dietary n-3 PUFA on cattle fertility is not mediated through a direct effect on the embryo *per se*.

Key Words: n-3 PUFA, Embryo Quality, Gene Expression

TH231 Qualitative aspects of the carcass and meat of Nellore cattle fed diet with different levels of fat. J. Duarte Messana^{*1}, T. T. Berchielli¹, R. Carrilho Canesin¹, A. Ferreira Ribeiro¹, P. Braga Arcuri², and P. Moura Dian¹, ¹Faculdade de Ciências Agrárias e Veterinárias / UNESP- Campus Jaboticabal, Jaboticabal, São Paulo, Brazil, ²CNPGL/ Embrapa, Juiz de Fora, Minas Gerais, Brazil.

With the objective to evaluate the carcass and the meat qualitative characteristics of Nellore steer, fed diet with different levels of fat, eighteen males were used, castrated, with average weight 320 kg in the completely randomized design. The animals were fed on feedlot during 84 days with diets with different levels of fat (3%, 5% and 7%). The steers were slaughtered weighting 480 kg. After 24 hours chilling the carcass dressing percentage (CDP), rib eye area (REA) and fat thickness (FT) were determined. Two samples of Longissimus dorsi this muscle were collected, of which analyzed for shear force (SF), total cooking loss (TCL), water holding capacity (WHC) determination and sensory evaluation. The results showed that, there were not significant differences ($P > 0.05$) for CDP, REA, FT, SF, TCL WHC. However the treatment with higher levels of fat (7%) showed higher meat tenderness, measured by the taste panel (7,51 vs. 6,64 points) as compared to treatment with 3% of fat, and of better flavor were observed in the steer meat which received diet with 5% of fat. There were differences significant, in the accept global of meat, of animals feeding with 3% of fat as compared to received diets with 5% and 7% of fat. The results show that higher tenderness, flavor and overall palatability meat can be function of higher levels fat of diet.

Table 1. Means value and coefficients of variance (CV) of CDP, RA, SFT, SF, WHC, TCL, F, T, AGM

	Treatment			CV
	3%	5%	7%	
CDP	53.2 ^a	53.2 ^a	52.6 ^a	2.5
RA	66.5 ^a	71.5 ^a	67.5 ^a	10.1
SFT	7.0 ^a	7.1 ^a	7.3 ^a	19.1
SF	4.0 ^a	4.1 ^a	4.1 ^a	19.8
WHC	74.4 ^a	72.4 ^a	73.7 ^a	4.8
TCL	30.5 ^a	30.7 ^a	29.7 ^a	11.0
F	6.51 ^a	7.48 ^b	7.2 ^{ab}	17.8
T	6.6 ^a	7.2 ^{ab}	7.5 ^b	18.7
AGW	6.4 ^a	7.4 ^b	7.3 ^b	19.9

Mean, within a row, followed by different letters are different ($P < 0.05$) by test Tukey. 3%, 5% and 7% = levels of fat of diet

Key Words: Meat, Fat, *Bos indicus*

TH232 Effects of glycerin supplementation on performance and meat quality of young Holstein bulls fed high-concentrate diets. N. Mach^{*1}, A. Bach^{1,2}, and M. Devant¹, ¹Animal Nutrition, Management, and Welfare Group, IRTA-Unitat de Remugants, Barcelona, Spain, ²ICREA, Barcelona, Spain.

Forty-eight bulls (335 \pm 29 kg initial BW) were randomly assigned to 4 glycerin levels (0, 4, 8, and 12% of concentrate DM) with the objective of evaluating the effects of glycerin on performance, ruminal fermentation, metabolism, and carcass and meat quality in young Holstein bulls fed high-concentrate diets. Concentrates were isonitrogenous and formulated to be isocaloric (assuming a glycerin ME content of 3.38 Mcal/kg of DM). Concentrate and straw were fed ad libitum. Animal BW and feed consumption were recorded monthly. Additionally, rumen and blood samples were collected every month. Bulls were slaughtered after 91 d of study (464 \pm 40 kg final BW). A rumen mucosa was excised, and HCW, carcass backfat, and conformation were recorded. The area, Warner-Bratzler Shear Force, and i.m. fat content of LM were determined. Glycerin level did not affect daily concentrate intake (7.1 \pm 0.5 kg/d DM), straw intake (1.37 \pm 0.3 kg/d DM), total DMI (8.3 \pm 0.4 kg/d DM), ADG (1.35 \pm 0.4 kg/d), or feed efficiency (0.17 \pm 0.06). Similarly, rumen molar proportions of propionic, acetic and butyric acids, rumen liquid osmolarity, and the papillae characteristics were unaffected by treatment. However, a lesser rumen pH ($P < 0.05$), and a greater rumen VFA concentration ($P = 0.09$), plasma insulin concentration ($P < 0.05$), and insulin to glucose ratio ($P < 0.05$) were observed in bulls fed 8% glycerin concentrate level compared with those receiving the 0, 4 and 12% levels. No changes were observed in carcass and meat quality. The ME content of glycerin can be assumed to be 3.38 Mcal/kg of DM in young Holstein bulls fed high-concentrate diets. In addition, glycerin supplementation to levels close to 10% of total DMI do not incur in detrimental effects on performance, ruminal fermentation, metabolism, and carcass and meat quality parameters.

Key Words: Beef, Glycerin, Rumen

Ruminant Nutrition: Minerals and Vitamins - Dairy

TH233 Effect of dietary cation-anion difference on performance and blood acid-base balance of early-lactating dairy cows under heat stress. D. P. Bu, L. Jia, J. Q. Wang*, H. Y. Wei, and L. Y. Zhou, *Chinese Academy of Agricultural Sciences, Beijing, P.R. China.*

The objective of this study was to investigate the effect of dietary cation-anion difference (DCAD = Na + K - Cl - S in mEq/kg of DM) on lactation performance and blood acid-base balance of early-lactating dairy cows in hot weather. Thirty-six Holstein cows, 43 ± 13 d in milk were allocated into three groups (n=12) according to complete random block design. All diets contained 51% concentrate and 49% forage mix, which were fed ad libitum as a total mixed diet. Cows were fed either a low DCAD diet (L, +130.49 mEq/kg DM), a middle DCAD diet (M, +251.54 mEq/kg DM) or a high DCAD diet (H, +383.87 mEq/kg DM). The DCAD difference was provided through a combination of Potassium Bicarbonate and Magnesium Sulfate. Experimental duration was 7 wk. Cows were milked 3 times/d and milk yields were recorded weekly. Milk samples were collected weekly and analyzed for composition. Blood samples were taken on d 42 from coccygeal vein or artery at 4h postfeeding. The average daily minimum temperature, humidity index and THI were 30.09°C, 59.97°RH and 94.63, respectively. Milk yield and milk fat content were 31.5^b, 36.9^a and 34.1^{ab} kg/d, and 3.56^a, 3.20^b and 3.35^{ab} for L, M and H, respectively. With the increasing of DCAD, milk protein (P < 0.05) increased gradually. Blood pH and blood base excess increased predominantly via increased DCAD (P < 0.05). Increasing dietary DCAD tended to increase total carbon dioxide (P = 0.07), HCO₃⁻ concentration (P = 0.07), and glucose (P = 0.06). Increasing DCAD affected blood urea nitrogen (P < 0.002), total protein (P < 0.001) and serum albumin (P < 0.001), and serum creatine kinase (P < 0.05), but blood lactose (P < 0.07) tended to increase linearly as DCAD increased. Overall, diets with the middle level of DCAD (+251.54 mEq/kg DM) improved lactation performance and blood acid-base status in early lactation cows under heat stress.

Key Words: Cation-Anion Difference, Heat Stress, Blood Acid-Base Balance

TH234 Effects of different rates of abomasal infusion of nicotinic acid on plasma NEFA concentrations in feed-restricted Holstein cows. J. B. Pescara*, J. A. A. Pires, and R. R. Grummer, *University of Wisconsin, Madison.*

Five non-lactating Holstein cows were used in a 5×5 Latin square to test the effects of different rates of abomasal infusion of nicotinic acid (NA) on plasma NEFA concentration. From d 1 to 4 cows were fed at 30% of maintenance requirements once a day at 9 AM to increase plasma NEFA concentration. On d 5, feed was offered at the same level but divided in 24 equal doses and administered hourly via ruminal cannula. Treatments were hourly abomasal infusion of NA boluses at a rate of 0, 0.25, 0.5, 1 and 3 mg/kg BW per h for 12 h. Daily blood samples were collected prior to morning feeding. On d 5, blood samples were collected each hour, starting prior to treatment administration, and continuing for 24

h thereafter. Nine days were allowed between experimental periods. Plasma NEFA concentrations were 105, 326, 421, 501 and 467 ± 36 uEq/L from d 1 to 5 of feed restriction (time effect; P < 0.001). Mean plasma NEFA concentration during NA infusion was decreased by the highest dose (P < 0.001). Plasma NEFA concentration decreased (P < 0.001) from 448 to 138 ± 75 uEq/L 1 h after the first bolus of 3 mg NA/kg BW. A transient rebound occurred with plasma NEFA increasing to 303, 503 and 566 ± 75 uEq/L at 2, 3 and 4 h after initiation of infusion of the highest dose (trt x time effect; P < 0.001). However, 6 h after initiation of treatment, plasma NEFA concentration decreased to 105 ± 75 uEq/L and remained below 243 ± 75 uEq/L until termination of infusions. During the 12 h following termination of infusions, mean plasma NEFA concentration was 399, 404, 405, 407 and 743 ± 69 uEq/L, for 0, 0.25, 0.5, 1 and 3 mg NA/kg BW per h, reflecting a post-treatment rebound for only the highest NA dose (trt effect; P < 0.001). Plasma NEFA concentration increased to 794, 1374 and 1391 ± 36.8 uEq/L at 2, 3 and 4 h after termination of the highest dose (trt x time effect; P < 0.001). A dose of NA large enough to cause an antilipolytic effect is accompanied by rebound in plasma NEFA following termination of administration.

Key Words: Nicotinic Acid, Abomasal Infusions, Dairy Cow

TH235 Apparent ruminal synthesis and intestinal disappearance of vitamin B₁₂ analogues in dairy cows. D. E. Santschi*¹, C. L. Girard¹, and R. H. Allen², ¹*Dairy and Swine R&D Centre, Sherbrooke, QC, Canada,* ²*University of Colorado, Denver, CO.*

Vitamin B₁₂ is synthesized only by bacteria provided cobalt supply is adequate. Ruminal bacteria also produce vitamin B₁₂ analogues which may have functional value for the bacteria but could not be used by the host animal. Four lactating Holstein cows equipped with ruminal, duodenal (30 cm from pylorus) and ileal (60 cm from ileo-cecal valve) cannulae were used to evaluate apparent ruminal synthesis and small intestinal disappearance of vitamin B₁₂ analogues. Cows were fed a TMR with chromic oxide in 12 daily meals (DMI: 19.8 ± 0.5 kg/d). Duodenal and ileal samples were collected twice daily over 4 consecutive days (d1: 0800, 1400 h; d2: 1000, 1600 h; d3: 1100, 1700 h; d4: 0900, 1500 h). Analysis of vitamin B₁₂ analogues was done by LC/MS. Apparent daily ruminal synthesis was calculated as the intake of vitamin in the feed subtracted from the duodenal flow. Intestinal disappearance was calculated as the amount disappearing between the two intestinal cannulae. In addition to cobalamine (CBL), the biologically active form of the vitamin, 6 analogues were identified in duodenal and ileal digesta. Although CBL was not the major form synthesized by ruminal bacteria, it was the major form absorbed in the small intestine. Average daily intake of cobalt was 50 mg with 15 mg provided by the mineral premix as cobalt carbonate. Therefore, 11 % of the average daily intake of cobalt was used for apparent ruminal synthesis of analogues of vitamin B₁₂, of which only 4 % were incorporated into CBL.

Table 1.

	CBL ¹	COB ²	CRE ³	MADE ⁴	ADE ⁵	MSADE ⁶	OHBZA ⁷
Apparent ruminal synthesis (mg/d)							
Mean	49.7	1.8	21.9	32.1	5.0	1.6	14.3
SE	6.4	0.6	7.3	4.5	1.2	0.2	1.0
Apparent intestinal disappearance (mg/d)							
Mean	22.5	-3.2	2.2	4.9	-1.7	-0.1	5.2
SE	7.6	1.9	5.2	10.2	1.9	0.5	2.7

¹Cobalamin (active form); ²Cobinamide, CBI without the ribose and the phosphate groups; Substitution of 5, 6-dimethyl benzimidazole by ³cresol, ⁴2-CH₃-adenine, ⁵adenine, ⁶2-CH₃-S-adenine, ⁷5-OH-benzimidazole

Key Words: Dairy Cow, Vitamin B₁₂ Analogues, Ruminant Synthesis and Intestinal Disappearance

TH236 Effect of different form of selenium on the polyunsaturated fatty acids of milk fat from dairy cows fed fat diets. L. Q. Wang, J. Q. Wang*, D. P. B u, S. J. Liu, L. Wang, N. Xia, H. Y. Wei, and L. Y. Zhou, *Chinese Academy of Agricultural Sciences, Beijing, China.*

The objective of the present study was to evaluate influence of dietary selenized yeast and sodium selenite on polyunsaturated fatty acids of milk fat and selenium contents of plasma and milk from lactating cows fed with rich oil diets. 36 Chinese Holstein dairy cows were allocated into 3 groups as a randomized complete block design for 9 wk periods with measurements made during the last 6 wk. Cows were fed total mixed ration (TMR) with basal diet a forage-to-concentrate ratio of 60:40 and 4% soybean oil (control), basal diet plus 13.6 g of selenized yeast (13.6 mg of selenium/d) (SY), or basal diet plus 3.04 g/d of sodium selenite (13.6mg of selenium/d) (SS). Results showed that selenium concentration of plasma increased by 8.9% and 47.7% in the SS and SY groups compared with control, respectively ($P < 0.001$). At the same time, selenium in milk from SS and SY groups increased by 35.6% and 185.0% compared with control ($P < 0.05$). Polyunsaturated fatty acids in SY group enhanced by 11.6% when compared with control ($P < 0.05$). However, no difference was observed between control and SS group. These results demonstrated that dietary selenized yeast supplementation in rich fat diets could increase polyunsaturated fatty acids of milk fat. Acknowledgement; Research supported by the Ministry of Science and Technology (2006BAD12B03).

Key Words: Selenized Yeast, Sodium Selenite, Polyunsaturated Fatty Acids

TH237 Bone development in dairy heifers fed diets with and without supplemental phosphorus. N. M. Esser*¹, P. C. Hoffman¹, W. K. Coblenz², M. W. Orth³, and K. A. Weigel¹, ¹University of Wisconsin, Madison, ²US Dairy Forage Research Center, Marshfield, WI, ³Michigan State University, East Lansing.

The NRC 2001 P requirements for heifers (0.20-0.35 %) and endogenous levels (0.20-35 %) of P in feeds are similar suggesting supplemental P

in heifer diets may be minimally required. Because long-term studies are unavailable, 183 Holstein and 182 crossbred heifers were fed diets containing 0.38 (supplemented) or 0.28 (unsupplemented) % dietary P from 4-22 mo of age in a replicated pen design to evaluate related impacts on bone development and metabolism. Two sub-populations of heifers were selected mid-trial for measurement of bone development and metabolism. Thirty-two heifers at 21 mo of age, balanced by breed and dietary treatment were evaluated for bone development. External frame measurements included hip height, length, heart girth, hip width, cannon bone circumference, pelvic length, pelvic height, and pelvic width. Heifers were given a spinal block and tails were docked with the 13 and 14th coccygeal vertebrae retained. Tissue was removed from vertebrae, defatted and evaluated for ash and mineral content. The 13th coccygeal vertebrae were scanned using peripheral quantitative computed tomography. Cortical, trabecular and total bone densities were determined. A second sub-population (n=64) of heifers 12 mo, balanced for breed and dietary treatment, were evaluated for pyridinoline and osteocalcin levels to assess bone metabolism. Data were analyzed as a completely randomized design using PROC GLM of SAS with breed, treatment and their interaction. External frame measurements revealed significant differences ($P < 0.07$) in frame size between Holstein and crossbred heifers. Supplementing P had no effect ($P > 0.10$) on external frame measurements, bone density, or bone metabolism markers. Bone P and Mg contents were lower ($P < 0.08$) and bone K content higher ($P < 0.05$) in heifers fed no supplemental P. Data suggest P supplementation to heifers modestly increased bone P content but this increase in bone P was not reflected in frame growth, bone density or bone metabolism.

Key Words: Phosphorus, Bone Growth, Heifers

TH238 Dairy cows might discriminate between vitamin D₂ and vitamin D₃ in the gastro intestinal tract. L. Hymoeller*^{1,2}, S. K. Jensen², and M. O. Nielsen¹, ¹University of Copenhagen, Groenegaardsvej, Frederiksberg C, ²University of Aarhus, Blichers Allé, Tjele.

To study uptake of vitamin D₂ and D₃ from the gastro intestinal tract of dairy cows, rumen content from 5 high yielding cows with rumen fistulas was mixed with 250 mg of both vitamin D₂ and D₃. After mixing, rumen content was returned to the rumen of the respective cows. Blood was collected from cows 0, 8, 24, 32, and 96 hours after introducing vitamins into the rumen and samples of rumen content were collected after 0, 1, 2, 4, 8, 24, and 32 hours (in vivo). From the 1 hour in vivo sample of rumen content, 6 sub-samples from each cow were incubated at body temperature and taken out after 2, 4, 8, 12, 24, and 32 hours (in vitro). Rumen and plasma samples were analysed for content of vitamin D₂ and D₃ and plasma samples also for the physiologically active liver derived metabolites: 25(OH)D₂ and 25(OH)D₃ by HPLC with UV-detection.

In vivo rumen samples showed almost identical D₂ and D₃ concentrations at all sampling times ($P \geq 0.1$). After the 2 hour sample concentrations of D₂ and D₃ rapidly declined due to dilution effects of subsequent feedings and due to rumen contents passing out of the rumen. In in vitro samples there was no degradation of D₂ and D₃.

Plasma concentrations of both D₂ and D₃ increased rapidly within the first hours of the study, from undetectable amounts at 0 hours to peak concentrations of 99 ± 7 and 162 ± 7 ng/ml (mean \pm SEM), respectively, after 24 hours. The concentration of D₃ was significantly higher than the concentration of D₂ at all sampling times after the 0 hour sample ($P \leq 0.01$). Absorption rates and clearance rates were not the same for

D₂ and D₃, respectively. Initial plasma concentrations of 25(OH)D₂ and 25(OH)D₃ were 7 ± 0.8 and 52 ± 4 ng/ml, respectively, and they increased to a plateau of 36 ± 2 and 106 ± 9 ng/ml, respectively, within 32 hours. Concentrations 25(OH)D₃ were at all sampling times significantly higher than concentrations of 25(OH)D₂ (P ≤ 0.01), but curves were parallel. No significant amounts of other metabolites than 25(OH)D₂ and 25(OH)D₃ were detected.

This study shows that when D₂ and D₃ are available for uptake in equal amounts in the gastro intestinal tract of dairy cows, there might be a preference for uptake of D₃ over uptake of D₂.

Key Words: Vitamin D, Discrimination, Dairy Cow

TH239 Effects of supplements of folic acid, vitamin B₁₂ and rumen-protected methionine on whole body kinetics of glucose and methionine (Met) in lactating dairy cows. A. Preynat^{1,2}, H. Lapiere², C. Thivierge¹, M. F. Palin², J. J. Matte², A. Desrochers³, and C. L. Girard², ¹Universite Laval, Quebec, QC, Canada, ²Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada, ³Universite de Montreal, St-Hyacinthe, QC, Canada.

In order to determine the effects of rumen-protected methionine (RPM) and/or folic acid + vitamin B₁₂ on glucose and Met kinetics, 24 multiparous cows, assigned to 6 blocks based on previous milk yield, were fed a basal diet estimated to cover energy and protein requirements but only 76% of Met requirement and received supplements from 3 wk before to 16 wk after calving. Within each block, 2 factors were randomly assigned according to a 2 × 2 factorial arrangement: 1) no RPM (M-) or 18 g/d of RPM (M+; Mepron-85, Degussa); 2) no vitamin supplement (Vit-) or intramuscular injections of folic acid and vitamin B₁₂ (160 and 10 mg/wk; Vit+), (4 treatments: M-Vit-, M+Vit-, M-Vit+ and M+Vit+). At 12 wk of lactation, glucose and Met kinetics were measured using continuous infusions on different days of either D-[U-¹³C]glucose, L-[1-¹³C, ²H₃]Met or ¹³C[NaHCO₃]. There was no treatment effect on DMI (P=0.6). Vit+ increased milk production (P=0.01, 34.7 vs 38.9±1.0 kg/d) and yields of lactose, protein and total solids (P≤0.05). Whole body flux of glucose (absorption + gluconeogenesis + glycogenolysis) tended to increase (P=0.11, 802 vs 838±16 mmol/h) with Vit+, by an amount similar to the increase in lactose yield. There was no treatment effect on glucose oxidation, averaging 23% of glucose flux. Met flux increased (P=0.003, 20.0 vs 24.5±0.9 mmol/h) in M+ cows. Met used for protein synthesis increased with M+ (P=0.01, 14.5 vs 17.9±0.8 mmol/h) and Vit+ (P=0.06, 15.1 vs 17.3±0.8 mmol/h). Vit+ decreased the entry of Met in the transmethylation pathway, Met oxidation and plasma cysteine concentrations in M+ cows only, having no effect in M- cows (Met × vitamin, P≤0.06). Therefore, increased milk lactose and protein yields with Vit+, without change in DMI, were supported by a positive effect of B-vitamin supplement on glucose flux and Met used for protein synthesis.

Key Words: Dairy Cow, B Vitamins, Methionine

TH240 Effect of organic trace mineral (4-Plex[®]) supplementation on dry matter intake, milk production, health events, and body weight in dairy cows. K. S. Hackbart^{*1}, R. M. Ferreira¹, M. T. Socha², R. D. Shaver¹, M. C. Wiltbank¹, and P. M. Fricke¹, ¹University of Wisconsin, Madison, ²Zinpro Corp., Eden Prairie, MN.

Cows were assigned at dry-off to receive either inorganic trace mineral supplementation (C; n=32) or organic trace mineral supplementation (T; n=31). Trace minerals were provided through C or T premixes fed at 100 g/cow/d. Diets (both C and T) for dry and lactating cows contained supplemental Zn, Mn and Cu at 75, 65 and 15 ppm (DM basis), respectively. Cobalt was formulated for 2.1 and 1.1 ppm (DM basis) in dry and lactating cow diets (both C and T), respectively. Zinc, Mn and Cu sulfates and Co carbonate were used in the C premix. For T, 14 g/cow/d of 4-Plex[®] was fed through the premix to provide the following percentages of organic supplemental Zn, Mn, Cu and Co: dry cows - Zn (40%), Mn (26%), Cu (70%) and Co (100%); lactating cows - Zn (22%), Mn (14%), Cu (40%) and Co (100%). Premixes (C and T) were fed to dry cows (range = 40-72 d before calving) in 1.8 kg/cow/d concentrate through a computer feeder and to lactating cows (range = 69-116 d after calving) in a TMR. Post-calving daily dry matter intakes (DMI), daily milk production, and health events (lameness, ketosis, mastitis, milk fever, retained placenta) were recorded. Body weight (BW) was assessed at dry-off, calving, and monthly thereafter. Treatment did not affect DMI (C=21.37kg, T=21.35kg) or the incidence of any health events. Treatment did not affect milk production (C=41.43kg, T=42.24kg) until wk 13 (C=41.86kg, T=44.51kg; P=0.074) and wk 14 (C=41.56kg, T=44.71kg; P=0.042) post-calving. Treatment did not affect BW except at month 1, where C cows tended to be heavier (P=0.087) than T cows, and in BW change from calving to month 1, where T cows tended to lose more weight (P=0.053) than C cows. We conclude that supplementing organic trace minerals had no effect on DMI or health events and only affected milk production later in lactation, BW at 1 month post calving, and BW change from calving to 1 month post-calving.

Key Words: Organic Trace Minerals

TH241 Non-acid-base factors partly responsible for increased urinary calcium excretion when anionic salts are fed. L. Irvine¹, M. Freeman¹, D. J. Donaghy¹, and J. R. Roche^{*2}, ¹University of Tasmania, Burnie, Australia, ²DairyNZ, Hamilton, New Zealand.

The reduction in milk fever associated with lower prepartum DCAD is believed to be effected through changes in acid-base balance. However, this mechanism has recently been questioned. Data indicate improvements in calcium absorption when anionic salts are fed in insufficient quantities to affect systemic acid-base balance, and, more importantly, the linear relationship between DCAD and milk fever is inconsistent with the quadratic nature of the relationship between DCAD and blood or urine pH. Fifty-two cows were randomly allocated to 4 groups on the basis of age (7.7±2.44yr), calving date (29 July±3.5d), and milk production in the first 100 d of the previous lactation (2,563±380.9), ensuring groups were balanced for breed, BW (621±52.4), and previous incidence of milk fever. Treatments included a control, a low DCAD (LOW), a high DCAD (HIGH), and a neutral DCAD (NEUTRAL), the latter supplemented with both the LOW and HIGH treatment salts. Cows were orally supplemented with the appropriate mixture of salts in water and molasses twice daily, and the control group received water and molasses. Urine was sampled mid-stream on one day each week precalving, and a blood sample was collected 14d and 7d precalving, the day of calving, and d 1, 2, 3, 4, 7 and 14 postcalving. Covariate samples were collected prior to the trial. Data were analysed using ANOVA. Urine pH was reduced and urinary Ca/creatinine ratio increased in the LOW DCAD group precalving, verifying the effectiveness of the LOW DCAD treatment in increasing Ca absorption. Ca/creatinine tended (P<0.1) to be greater in the NEUTRAL treatment than the HIGH treatment, indi-

cating approximately 25% of the increase in calcium absorbed when anionic salts are fed is not acid-base balance related. Neither blood Ca at calving nor milk production was affected by treatment.

Table 1.

	CONTROL	LOW	HIGH	NEUTRAL	SED	P
Urine pH	8.25	7.57	8.29	8.11	0.131	<0.001
Ca/Creat	0.37	1.36	0.24	0.54	0.237	<0.001
Blood Ca	1.82	1.90	1.69	1.71	0.172	0.61
Milk yield	31.4	30.3	28.3	31.0	1.69	0.27
Fat%	4.19	4.05	4.46	4.20	0.213	0.28
Protein%	3.10	3.15	3.09	3.11	0.067	0.83

Key Words: DCAD, Anionic Salts, Milk Fever

TH242 Influence of a high potassium diet on the excretion of minerals after calving. M. Rérat¹, A. Philipp^{1,2}, H. D. Hess¹, F. Dohme^{*1}, and A. Liesegang², ¹Agroscope Liebefeld-Posieux Research Station ALP, Posieux, Switzerland, ²University Zürich, Zürich, Switzerland.

The aim of this study was to determine the effect of two diets, fed during the transition period and differing in their potassium content, on the mineral metabolism of dairy cows after calving. Five weeks before calving, 12 cows were paired by breed, age, number of lactations and milk production and randomly assigned to 2 dietary treatments (K₃₅ and K₁₅). The two experimental diets were based on hay and were formulated to be isoenergetic and isonitrogenous, but differed in their K content: 35 and 15 g/kg DM in K₃₅ and K₁₅, respectively. After calving all cows received the same diet based on hay K₃₅. The balance period started 24 to 48 h after calving and lasted for 7 d. Feces and urine were collected quantitatively and concentrations of minerals (Ca, P, and Mg) were analyzed in daily samples. Apart from d 2, urinary excretion of Mg was lower ($P < 0.05$) in group K₃₅ compare to group K₁₅. In contrast, fecal Mg excretion was higher ($P < 0.05$) with the higher dietary K content during the first 2 d of the balance period. Fecal Ca excretion of group K₃₅ was higher ($P < 0.05$) on d 2 and lower ($P < 0.05$) on d 7 compared to group K₁₅. During the last 2 d of the balance period, concentration of P in feces was lower ($P < 0.05$) in group K₃₅ than in group K₁₅. The lower urinary and higher fecal excretion of Mg in group K₃₅ could be related to a lower absorption of Mg in presence of a higher K level in the diet before calving. The higher fecal excretion of Ca on d 2 suggests that the Ca regulation system at the beginning of the balance period was less active in cows in group K₃₅ compared to group K₁₅. However, the lower concentrations of Ca and P in feces at the end of the balance period indicates a change in the Ca regulation system to a more active state. In conclusion these results suggest that the cows receiving a diet with high K level had a delayed activation of the Ca regulation system after calving.

Key Words: Potassium, Mineral Metabolism, Transition Period

TH243 Effect of selenium yeast on selenium status, thyroid hormone concentrations and passive transfer of immunoglobulins in dairy cows and calves. K. M. Koenig* and K. A. Beauchemin, *Agriculture and Agri-Food Canada, Research Centre, Lethbridge, AB, Canada.*

Forty Holstein cows (primiparous and multiparous) were fed TMR supplemented with 0.3 mg/kg Se as selenized yeast (Se yeast; Seleno-Source AF 2000, Diamond V Mills, Cedar Rapids, IA) or sodium selenite from 60 d prior to the expected calving date until 60 DIM to determine the effect of Se source on Se status of cows and their calves. Selenium status was assessed by measuring the Se concentration in whole blood, serum and milk, thyroid hormone concentrations in serum and the passive transfer of immunoglobulins to the calf. Cows and heifers were fed diets containing 0.38 to 0.40 mg Se/kg with no supplemental Se for 90 d before receiving the dietary Se treatments. The Se concentration of the TMR supplemented with the Se sources ranged from 0.62 to 0.81 mg/kg. Blood was collected from cows at 60 and 30 d prior to the expected calving date, at calving, and at 15, 30 and 60 DIM, and from their calves at 24 h and 56 d of age. Milk was collected at calving (colostrum) and at 15, 30 and 60 DIM. At birth, calves were removed from the dam and fed colostrum in an amount equivalent to 10% of their body weight within 12 h. There was no effect ($P > 0.05$) of dietary Se source on individual feed intake, milk yield and components, and somatic cell count. Whole blood Se concentration averaged 11% higher in cows fed Se yeast compared to selenite (291 vs 262 ± 5.9 ng/mL, $P < 0.05$). Serum Se concentration averaged 13% higher in cows fed Se yeast (128 vs 113 ± 5.8 ng/mL, $P < 0.05$). Maternal supplementation of Se yeast improved the Se status of calves at 24 h of age by increasing ($P < 0.05$) whole blood (252 vs 211 ± 16 ng/mL), serum (94 vs 75 ± 4.7 ng/mL), and colostrum (245 vs 174 ± 5.8 ng/mL) Se concentration by 19, 25 and 41% respectively. There was no effect ($P > 0.05$) of Se source on thyroid hormone concentrations or the transfer of immunoglobulins to the calf. Supplemental organic Se yeast improved the Se status of dairy cows and the transfer of Se to their calves when the dietary Se concentration of the basal diet was > 0.3 mg/kg.

Key Words: Selenized Yeast, Selenium, Thyroid Hormone

TH244 Plasma concentration of nicotinic acid and derivatives in response to abomasal infusions of nicotinic acid. J. A. A. Pires^{*1}, C. L. Girard², and R. R. Grummer¹, ¹University of Wisconsin, Madison, ²Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada, Lennoxville, QC, Canada.

The objective was to assess plasma concentrations of nicotinic acid (NA), nicotinuric acid (NUA) and nicotinamide (NAM) in response to abomasal NA infusions, given as single (experiment 1) or successive boluses (experiment 2) to feed-restricted non-lactating, non-pregnant, rumen-cannulated Holstein cows. Experiment 1 was a 4 × 4 Latin square with 1 wk periods. Each period consisted of 2.5 d of feed restriction and 4.5 d of ad libitum feed intake. Treatments were abomasal administration of 0, 6, 30 or 60 mg NA/kg BW, given as a single bolus 48 h after initiation of feed restriction. Areas under the curve during the 12 h of sampling were 0, 0.91, 26.6 and 106.1 ± 6.8 uM*min⁻¹ for NA, 0, 5.1, 32.8 and 46.5 ± 5.17 uM*min⁻¹ for NUA and 5.4, 16.3, 23.3 and 27.6 ±

2.7 $\mu\text{M}\cdot\text{min}^{-1}$ for NAM, for 0, 6, 30 or 60 mg NA/kg BW, respectively (trt, quadratic: $P < 0.01$). Approximate NA clearance rate was 0, 3.0, 1.65 and 1.26 ± 0.36 %/min, and half life was 0, 28.6, 44.8 and 58.6 ± 7 min for 0, 6, 30 and 60 NA/kg BW (trt, quadratic: $P < 0.05$). Experiment 2 was a randomized complete block design with 3 treatments and 6 cows. Treatments started 48 h after initiation of feed restriction and consisted of 0, 6 or 10 mg NA/kg BW per h for 8 h. Blood samples were collected for 12 h. Average plasma NA during the 12 h of sampling was 0, 34.7 and 144.1 ± 6.7 μM (trt, trt \times time, linear: $P < 0.001$), NUA was 0, 53.1 and 68.8 ± 8.2 μM (trt, trt \times time, linear: $P < 0.001$), and NAM was 10.8 ± 6.0 , 38.1 ± 6.8 and 35.9 ± 1.7 μM (trt \times time: $P < 0.001$) for 0, 6 and 10 mg NA/kg BW per h, respectively. Observed antilipolytic effects of NA (Pires et al., 2007; JDS 90:3725) were achieved at plasma NA concentration less than 10 μM . Supraphysiological doses of NA are readily cleared from plasma, with concurrent appearance of NUA, which is a catabolite excreted in urine. There was a comparatively modest increase in NAM, a biologically active form of the vitamin niacin.

Key Words: Niacin, Bovine, Pharmacokinetics

TH245 Carry-over effects of iodine and selenium supplements in lactating dairy cows. M. Battaglia, M. Moschini, G. Piva*, and F. Masoero, *Università Cattolica del Sacro Cuore, Piacenza, Italy.*

Iodine (I) and selenium (Se) are essential trace elements due to their roles in the regulation of thyroid metabolism and anti-oxidant properties. An improvement of milk I and Se contents could be important for children and pregnant women. An experimental trial was carried out on lactating cows to determine the I and Se carry-over (CO) in milk. Twelve cows (559 kg body weight, 211 days in milk) were randomly allotted to three diet groups ($n = 4$) and individually fed using a Calan Broadbent[®] feeding system. The diets were basal diet (CTR), CTR + 23.8 mg I + 2.2 mg Se (T1), and CTR + 45.5 mg I + 4.3 mg Se (T2) and were fed to cows for twenty-eight days after a two weeks adaptation period to the CTR diet. Sources of I and Se were KI and Na₂SeO₃. Diet and individual milk samples were collected twice a week at -1, 1, 2, 3 and 4 weeks on treatment, and analyzed using ICP-MS. The average daily I and Se intakes were 41.7, 65.6, 87.3 mg/cow and 1.86, 4.06, 6.2 mg/cow, respectively in the CTR, T1 and T2 groups. Data were subjected to ANOVA using the repeated statement in the Mixed procedure of SAS. The statistical model included the fixed effect of diet, sampling time and diet \times sampling time interaction. The autoregressive order was the covariance structure that fit the model best. The milk CO of I and Se were significantly affected by the treatment ($P < 0.05$) and the sampling time ($P < 0.05$). The CO rate of I increased ($P < 0.001$) linearly and were 0.14 (CTR), 0.27 (T1) and 0.28 (T2). Milk I ($\mu\text{g/L}$) means (and standard deviations) were 245.2 (59) for CTR, 607.8 (119.1) for T1

and 970 (184) for T2. While, the CO rate of Se decreased ($P < 0.001$) linearly and were 0.22 (CTR), 0.12 (T1) and 0.09 (T2). Milk Se ($\mu\text{g/L}$) means (and standard deviations) were 16.4 (4.5) for CTR, 16.6 (4.1) for T1 and 23.6 (5.9) for T2. Considering a milk daily intake of 150 mL, the amount of I in milk from T1 cows would supply 76%, 61% and 46% of the recommended daily I allowance for children, adults and pregnant women respectively.

Key Words: Iodine, Selenium, Carry-Over

TH246 Corn silage versus alfalfa hay for dairy cows: Effects of dietary cations. R. A. Erdman*, L. S. Piperova, and R. A. Kohn, *University of Maryland, College Park.*

Corn silage (CS) is becoming the predominant forage used in the dairy industry because of its cost, DM yield/hectare, ease of harvest, and preservation characteristics. Previous milk production studies suggested that diets containing corn silage alone were inferior to those containing at least some alfalfa hay (AH) or alfalfa silage. We speculated that this could be due to differences in mineral and dietary cation-anion difference (DCAD) concentrations. The objective of this experiment was to test the effects of forage (CS v. AH) and mineral supplementation on production responses with 44 lactating Holstein cows during the first 20 wk postpartum. Treatments included: 1) CS-AH (50:50 forage DM basis); 2) CS as the sole forage; and 3) CS fortified with mineral supplements (CS-DCAD) (limestone and K₂CO₃) to match the mineral and DCAD content of the CS-AH diet. Milk production, fat and protein percentage, and 3.5% FCM of cows fed CS-DCAD was equivalent or greater to that of cows fed the CS-AH. There was a trend ($P = 0.08$) for increased feed efficiency with CS-DCAD as compared to CS-AH and CS. These results suggest that differences in mineral and DCAD levels might explain previously reported negative effects of all corn silage diets as compared to alfalfa-corn silage mixtures.

Table 1. Corn silage-alfalfa hay (CS-AH) vs. corn silage (CS) and corn silage plus minerals (CS-DCAD) effects on intake and milk production

Item	CS-AH	CS	CS-DCAD	SEM
DMI, kg/d	21.6	22.2	20.9	0.48
Milk, kg/d	34.2	33.8	35.4	1.19
Fat, %	3.84	4.20	3.97	0.115
Protein, %	3.09	3.16	3.14	0.053
3.5% FCM, kg/d	36.8	38.6	38.9	1.46
FCM/DMI	1.75	1.75	1.90	0.055

Key Words: DCAD, Corn Silage, Alfalfa Hay

Ruminant Nutrition: Proteins and Amino Acids - Dairy

TH247 Influence of concentrate and protein levels on milk production by Holstein cows. R. P. Lana^{*1,2}, G. F. Sobreira¹, M. I. Leão¹, J. A. Freitas³, D. C. Abreu¹, W. C. Lopes¹, and G. Guimarães¹, ¹Universidade Federal de Viçosa, Viçosa, MG, Brazil, ²CNPq, Brasília, DF, Brazil, ³Universidade Federal do Paraná, Palotina, PR, Brazil.

According to the Biotechnology and Biological Sciences Research Council (1998), formerly AFRC, all existing feeding systems are designed to balance nutrients to meet the animals' requirements, but the authors recognize that in practice, the farmer has no obligation to do that if it is contrary to the economic profitability. An experiment was developed to evaluate the effect of four levels of concentrate - CON (30, 40, 50 and 60%) and four of crude protein - CP (12, 14, 16 and 18%) in the total dry matter (DM) on milk production and composition in confined Holstein cows. Forty-eight animals (640 kg LW) were allotted in two 4 x 4 Latin squares (six cows/pen), in four periods of 28 days, divided in four sub periods of seven days. The CON was distributed in the plots and the CP in the subplots. The forage was corn silage and the CON constituted of corn meal, soybean meal, urea, and mineral supplements. There were no effects ($P > 0.05$) of CP and CP*CON on animal body weight, feed intake (forage, CON, and total DM), milk production and composition, showing that 12% CP was as effective as 18% in the cows performance. The 30% CON diet presented DMI, CON intake and milk production of 17.5, 5.3 and 19.1 kg, respectively. The CON level increased ($P < 0.01$) DM and CON intake, and decreased ($P < 0.01$) forage intake by 0.188 kg, 0.288 kg, and 0.093 kg, and increased ($P < 0.05$) milk production by 0.151 kg per unit (%) of CON level, with no effect on milk composition ($P > 0.05$). Although milk production increased, the marginal response reduced ($P < 0.05$) with increasing CON (0.88, 0.43, and 0.58 kg of milk/kg of CON DM, for the levels of 40, 50 and 60% versus 30% CON). Relation lesser than 1 kg of milk/kg of CON can compromise the profitability, and then diet formulation should consider the cost-benefit ratio and not the balance of nutrients to meet the nutritional requirements of the animals, especially after breeding.

Key Words: Concentrate, Milk, Protein

TH248 Blood and ruminal metabolites of early lactating Iranian Holstein cows fed raw or roasted whole soybean. M. H. Fathi Nasri^{*1}, M. Danesh Mesgaran², R. Valizadeh², and H. Farhangfar¹, ¹The University of Birjand, Birjand, Iran, ²Ferdowsi University of Mashad, Mashad, Iran.

This study evaluated responses of early lactation Iranian Holstein cows to feeding roasted whole soybean (SB) or raw SB in diets with lucerne hay and corn silage as the primary forage source. Treatments consisted of a total mixed ration that included 387 g/kg forage supplemented with 1) 120 g/kg of roasted SB and 82 g/kg of cottonseed meal (CSM), 2) 120 g/kg of raw SB and 82 g/kg of CSM or 3) 120 g/kg of soybean meal (SBM) and 82 g/kg of cottonseed (CS), on a dry matter (DM) basis. The diets which were formulated to be iso-nitrogenous and iso-caloric were offered to fourteen multiparous Holstein cows (body weight = 617.0 kg, days in milk = 16.9) that were assigned randomly to one of three experimental diets for a 45-d trial. Roasted SB were obtained by roasting seeds for 1.5 to 2 min in a commercial roaster (exit temperature of seeds was about 140-145°C) and immediately placing, without cooling, in covered wooden barrels for 45 min. A dietary effect on rumen pH

values, glucose and beta-hydroxy butyrate (BHB) concentrations were not detected among cows fed different diets (Table 1). Rumen ammonia N concentration were significantly lower for the cows fed roasted SB compared with those fed raw SB. The lower ruminal ammonia concentration in cows fed roasted SB diet compared with raw SB diet, possibly arose as a consequence of lower ruminal protein degradability of roasted SB. Plasma urea nitrogen (PUN) concentrations were also significantly ($p < 0.031$) lower in cows fed roasted SB than in cows fed raw SB that confirms the reducing of ruminal protein degradability of roasted SB.

Table 1.

Item	SBM plus CS	Raw SB plus CSM	Roasted SB plus CSM	SEM	Contrast ¹	
pH	6.22	6.18	6.20	0.08	NS ²	NS
Ammonia N	13.7	14.3	12.8	0.30	0.024	NS
Glucose	57.3	59.0	59.3	2.86	NS	NS
Beta-hydroxy-butyrate	8.97	9.95	9.16	1.88	NS	NS
Plasma urea N	18.3	18.8	16.5	0.68	0.031	NS

¹ Contrast includes 1) roasted SB vs. raw SB and 2) SB plus CSM vs. SBM plus CS. ² $P > 0.05$.

Key Words: Whole Soybean, Early Lactation, Iranian Holstein Cow

TH249 Endogenous nitrogen (EN) flows: Effects of metabolizable protein (MP) supply in lactating dairy cows. D. Valkeners¹, H. Lapiere¹, U. Schönhusen², P. Junghans², C. C. Metges², and D. R. Ouellet^{*1}, ¹Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada, ²Research Unit Nutritional Physiology, Dummerstorf, Germany.

The current NRC model (2001) estimates EN at the duodenum as 1.9 g per d per kg DMI, with no allowance for differences in diet quality. The current study used 4 lactating cows in a replicated incomplete 3x3 Latin square to study the effect of MP supply on EN flows. Cows were fed every 2h a TMR. Three concentrates were formulated to provide NE_L according to requirements (126 MJ/d) and to supply incremental amounts of MP: 1430 (Low), 1920 (Medium) and 2160 (High) g MP/d, which corresponded to 72, 98 and 111% of estimated MP requirements. From d 27 to 35, cows were infused into a jugular vein with L-[¹⁵N] leucine (0.45 mmol/h). On d 34 and 35, rumen and intestinal mucosa, duodenal digesta and feces were sampled (4 samples/d) to determine EN flows (see Table), as previously described (Ouellet et al., 2002; JDS 85:3013). The N flows across the gut are presented in the Table. Total duodenal N flow increased from Low to High MP as did the flow of undigested feed. The duodenal flow of free EN and of total EN increased linearly with increased MP supply, although, contribution of EN to bacteria protein was unaffected by treatments. The EN loss in feces did not vary with treatments and represented 2.1 g/kg of DMI. Overall, total EN varied ($P = 0.03$; linear) with increasing MP supply (4.2, 4.7 and 4.8 ± 0.2 g/kg of DMI), representing 16% of duodenal N flow. Contribution of EN to bacteria flow is about equal to free EN and needs to be included in EN duodenal flows. Fecal EN flow provides a direct estimation of metabolic fecal loss.

Table 1. Duodenal and fecal nitrogen flow in dairy lactating cows fed different level of metabolizable protein

Item	Treatment			SEM	P	
	Low MP	Medium MP	High MP		Linear	Quadratic
Intake	356	468	516	7.8	0.001	NS
Total	383	510	574	9.5	0.001	NS
Undigested feed	60	123	170	7.4	0.001	NS
Free endogenous N	19	26	27	2.1	0.04	NS
Bacterial N from endogenous	51	55	55	2.6	NS	NS
Bacterial N from feed	215	256	276	7.2	0.01	NS
Bacterial N from urea	39	49	46	3.5	0.06	NS
Total fecal N	140	156	159	6.6	0.06	NS
Fecal endogenous N	36	36	35	2.6	NS	NS

Key Words: Endogenous, Gastrointestinal Tract, Metabolizable Protein

TH250 Is D-methionine (Met) used by the dairy cow? H. Lapierre^{*1}, G. Holtrop², A. G. Calder³, J. Renaud¹, and G. E. Lobley³, ¹Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada, ²BioSS, Rowett Research Institute, Aberdeen, UK, ³Rowett Research Institute, Aberdeen, UK.

Rumen-protected forms of Met are an equimolar mixture of the two isomers, D and L. Only L-Met can be used for protein synthesis, but it is unclear if the D isomer can be transformed into L in ruminants. Four lactating dairy cows averaging 675 kg BW and 32.5 kg/d of milk received a basal diet (12.0%CP) in twelve equal meals per day plus an abomasal infusion of AA (590 g/d, casein profile without Met). In a first study, they received portal infusions of 5, 10 or 15 g/d of DL-Met, in two incomplete Latin squares. On the last d, six arterial samples were collected at 45 min intervals. Concentrations of L- and D-Met were determined by gas-chromatography-mass spectrometry. Increasing infusion rates of DL-Met increased total Met plasma concentrations (19.7, 25.0 and 34.4 ± 0.6 µM, P<0.001) and the proportion of D (19.4, 30.5 and 37.3 ± 0.7 %, P<0.001). The fractional removal of D-Met from plasma (infusion rate/plasma pool of D-Met) decreased (P=0.02) at the highest infusion rate, averaging 5.6, 5.5 and 5.0 ± 0.1 /h, approximately 7-8 times slower than removal of L-Met (44/h). A second study determined if the removed D-Met was transformed into L-Met. The same cows were infused for 8 h with L-[²H₃]Met (1.3 mmol/h) to determine whole body irreversible loss rate (ILR; 21.2 ± 2.6 mmol/h) based on plasma [²H₃]Met enrichment. At 2h cows received a bolus venous injection of D-[¹³C]Met (6.8 mmol) and arterial samples were collected after 10, 20, 30, 40, 60, 90, 120, 150, 180, 240, 300, 360, 420 and 480 min. The ¹³C enrichments of the D and L isomers were expressed relative to L-[¹²C]Met. Enrichment of L-[¹³C]Met averaged 14.4 ± 3.7 mole percent excess 10 min after the bolus injection and declined exponentially thereafter. The minimum proportion of D-Met transformed into L-Met, calculated from (ILR × area under curve of L-[¹³C]Met enrichment/dose D-Met)

averaged 75 ± 6%. In conclusion, D-Met is transformed into L-Met in dairy cows, but with the rate of removal of the D-isomer much slower than the L form.

Key Words: Methionine, Isomer, Ruminant

TH251 Response in feed intake, blood metabolites, and milk production to varying ruminal protein undegradability in early lactation Holstein cows. M. Jahani-Moghadam¹, H. Amanlou², and A. Nikkiah^{*2,3}, ¹Islamic Azad University, Karaj, Iran, ²Zanjan University, Zanjan, Iran, ³University of Illinois, Urbana.

Effects of different dietary ratios of rumen undegradable (RUP) to degradable (RDP) protein on ruminal digestion, feed intake, blood metabolites, and milk yield were determined in early-lactation cows. Four multiparous (43 ± 5 days in milk) and four primiparous (40 ± 6 days in milk) tie-stall-housed Holstein cows were used in a duplicated 4 × 4 Latin square design trial with four 21-d periods. Each period had 14-d of adaptation. Diets contained, on a dry matter (DM) basis, 23.3% alfalfa hay, 20% corn silage, and 56.7% concentrate. Cows were first offered alfalfa hay at 0700, 1500, and 2300 h, and 30 min after each alfalfa hay delivery were offered a mixture of corn silage and concentrate. Treatments were diets with RUP:RDP ratios of 1) 5.2:11.6% (CO), 2) 6.1:10.6%, 3) 7.1:9.5%, and 4) 8.1:8.5%. Different RUP:RDP ratios were obtained by partial and total replacement of untreated soybean meal (SBM) with xylose-treated SBM. An in situ study showed that DM (27.1 vs 21.3%) and crude protein (CP, 20.4 vs 3.6%) of untreated SBM had greater rapidly degradable fractions. The slowly degradable CP was degraded more quickly in xylose-treated SBM than in untreated SBM (5.8 vs 2.0%/h). Treatment cows produced more milk (32 vs 29 kg/d) and had greater yields of milk protein, lactose, solids-non-fat and total solids than cows fed untreated SBM. Increasing dietary RUP:RDP ratio reduced blood urea N linearly (22.5 vs 18.4, 17.6, 16.7 mg/dL). Feed costs dropped at RUP:RDP ratios of 6.1:10.6 and 7.1:9.5 but not at the ratio of 8.1:8.5%, compared to the control 5.2:11.6% ratio. Intake of DM and CP, rumen pH, blood glucose, albumin and total protein, fecal and urine pH, changes in body weight and body condition score, and milk lactose and solids-non-fat percents did not differ among treatments. Therefore, increasing dietary RUP:RDP ratio from 5.2:11.6% up to 7.1:9.5% improved milk production and reduced feed costs in early lactation cows fed diets based on barley and corn grain, SBM, alfalfa hay and corn silage. Reduced blood urea may suggest reproductive benefits.

Key Words: Rumen Degradability, Soybean Protein, Early Lactation Cow

TH252 Effect of rumen degraded and rumen undegraded protein on microbial protein synthesis in mid-lactation cows. S. K. Ivan-Dinh^{*1}, R. L. Baldwin, VI², and R. A. Kohn¹, ¹University of Maryland, College Park, ²USDA-ARS, Bovine Functional Genomics Laboratory, Beltsville, MD.

The objective of this study was to determine the effect of rumen degraded protein (RDP) and rumen undegraded protein (RUP) on microbial protein synthesis in lactating dairy cattle, and evaluate the ability of the

National Research Council (NRC) 1989 and the NRC 2001 models to predict these flows. Eight mid-lactation Holstein cows were assigned to a repeated 4 × 4 Latin square, balanced for carryover effects. The isoenergetic diets were arranged in a factorial design (RDP at 10.0 and 12.5% and RUP at 5.6 and 8.0% of ration dry matter). The 8.0% RUP diets tended to increase liquid flow out of the rumen (P = 0.06), N flowing with the liquid fraction (P = 0.09), and liquid-associated bacterial N flow (P = 0.10). Potential transfer of excess RUP to the rumen in the form of urea-N did not increase microbial N flow out of the rumen. Rumen degradable protein did not affect flow of total N or microbial N out of the rumen. The NRC 1989 model predicted MN flow, total N flow, and rumen N balance more accurately than the NRC 2001 model. The NRC 1989 model predicted a negative rumen N balance across all four diets with no mean or linear bias, while the NRC 2001 predicted positive rumen N balance for all diets with a significant mean bias. The low estimate of MN flow by the NRC 2001 model resulted in an overestimate of rumen N balance, which could lead to inaccuracies in prediction of RDP and RUP requirements. The NRC 2001 underestimate of MN flow from the rumen resulted because the model does not account for the potential of urea-N recycling to be greater than ammonia absorption from the rumen, which would provide additional N for microbial protein synthesis. An accurate prediction of the RDP and RUP requirements is necessary given the potential negative environmental impact of over-feeding either one of these protein sources. Since MN is an integral part of the RDP prediction equations, model predicted MN flow needs to match actual flow, and currently the NRC 1989 prediction reflects the actual flow better than the NRC 2001 prediction.

Key Words: Rumen Degraded Protein, Rumen Undegraded Protein, Microbial Protein Synthesis

TH253 Nitrogen balance and excretion from grazing lactating cows supplemented with conjugated linoleic acid (CLA). D. E. de Oliveira^{*1}, S. R. de Medeiros², and D. P. D. Lanna³, ¹*Centro de Educação Superior do Oeste, Universidade Estadual de Santa Catarina/CEO, Chapecó, Santa Catarina, Brasil,* ²*Centro Nacional de Pesquisa de Gado de Corte, Campo Grande, Mato Grosso do Sul, Brasil,* ³*Universidade de São Paulo/ESALQ, Piracicaba, São Paulo, Brasil.*

The synthetic conjugated linoleic acid (CLA) has been used to alter milk composition, improve reproductive performance and increase CLA content of bovine milk with potential benefits to human health. Although CLA has been extensively studied, few reports have evaluated the changes in nutrient excretion of CLA-treated cows. The objective of this study was to measure the nitrogen (N) secretion in milk and estimate the excretion of N in cows receiving CLA. Twenty six lactating Holstein × Gir cows (28 to 84 DIM) were used in a complete randomized design, eleven cows were individually fed 150g of CLA (30.5% c9t11, 33.1% t10c12) and the remaining fifteen cows were fed 150 g of Megalac (MEG), mixed in the concentrate (4 kg/day, as fed). All cows grazed a pasture of Stargrass that contained, on average, 14.6% CP, 2.1% fat, 65.8% NDF, 44.0% NDFIP, 29.2% ADF, 13.6% ADFIP, 4.9% lignin, and 9.7% ash on DM basis. The mean chemical composition of the concentrate was 25.1% CP, 5.6% fat, 11.0% NDF, 6.6% NDFIP, 3.9% ADF, 2.5% ADFIP, 3.3% lignin, 16.1% ash. The n-alkanes C₃₂, C₃₁ and C₃₃ were used to estimate individual forage intake. The CNCPS v. 5.04 was used with the inputs above to estimate N balance for each individual cow and the data were analyzed using SAS PROC GLM.

CLA supplementation had no effect on milk yield (CLA = 15.9, MEG = 14.6 kg/day; P=0.25), decreased milk fat content (CLA = 2.1, MEG = 3.1%; P=0.0001) and increased milk protein content (CLA = 3.1, MEG = 2.8%; P=0.005). The DM intakes of forage (CLA = 11.5, MEG = 12.1 kg/day; P=0.46) and concentrate (CLA = 3.5, MEG = 3.4 kg/day; P=0.81) were similar between treatments. There was no effect of treatment on CP intake (CLA = 2.5, MEG = 2.5 kg/day; P=0.68), total N excretion (CLA = 330, MEG = 340 g/day; P=0.49), and N digestibility (CLA = 88.3, MEG = 88.3%; P=0.97). The CLA supplementation affected N distribution (% of total N intake) in milk (CLA = 19.4, MEG = 15.7%; P=0.006), reduced the N excretion as a function of daily milk protein yield (CLA = 647, MEG = 847 g/kg; P=0.009). CLA treatment decrease in N excretion per unit of milk protein produced.

Key Words: Nitrogen Balance, Nitrogen Excretion, Conjugated Linoleic Acid

TH254 Effects of an extruder-expelled soybean meal product on milk production and components for Holstein dairy cows. Y.-H. Chung^{*}, K. S. Heyler, J. A. Hartzell, V. A. Ishler, and G. A. Varga, *The Pennsylvania State University, University Park.*

Soybean meal (SBM) has been treated in various ways to enhance the quantity of rumen undegradable protein, and several commercial sources of treated SBM are available for use in the diets for dairy cattle. An extruder-expeller processed SBM product (SoyChoice; Wenger's Feed Mill, Inc., Rheems, PA) is produced by mechanically pressing the oil out of the meal and its effects on milk yield and components for Holstein dairy cows were evaluated. This extruder-expelled SBM product was fed at 4% ration DM for 17 d. A similar SBM product (Turbomeal; J. L. Moyer and Sons Inc., Turbotville, PA) was fed at 3.6% ration DM and served as the control. Both rations were formulated to a similar nutrient composition and contained 15% CP and 33% NDF (DM basis). Cows were fed once and milked twice daily. Milk yield for individual cows was recorded at each milking, and individual milk was sampled weekly from two consecutive milkings and analyzed for components. In situ degradability of this SBM product was conducted. Milk yield for the treatment group (cow=32, first-calf heifer=26; DIM=132±109 SD) was similar before (41.2 kg/d) and after (42.7 kg/d) the 17-d treatment period and did not differ from the control group (41.4 kg/d) (cow=34, first-calf heifer=26; DIM=126±102 SD). Percentages and yields of milk components were not affected by treatment and were similar before and after treatments. Percentages of milk fat and protein were 3.5 and 3.1% and 3.7 and 3.1% for the treatment and control groups, respectively. The calculated income over feed costs was 3.9% greater for the treatment compared with the control. In situ DM disappearance for this SBM product was 60, 68, and 84% and in situ CP disappearance was 43, 54, and 75% at 12, 16, and 24 hours of rumen incubation. The estimated effective ruminal degradability for this SBM product was 67.8% and fractional degradation rate was 8.5%/h. Based on similar production results, it is concluded that this extruder-expelled SBM product is comparable to a similar SBM product evaluated and offers another source of protein in dairy cow rations.

Key Words: Extruder-Expelled Soybean Meal, Milk Yield and Component, Rumen Degradation Kinetic

TH255 Increasing methionine, lysine or both does not increase milk protein percent in either high producing or low producing dairy cows. H. F. Bucholtz¹, J. S. Liesman¹, P. N. Naaz², M. J. Stevenson³, W. H. Heimbeck³, and R. A. Patton⁴, ¹Michigan State University, East Lansing, ²Upper Peninsula Experiment Station, Chatham, MI, ³Evonik-Degussa AG, Hanau, Germany, ⁴Nittany Dairy Nutrition, Mifflinburg, PA.

The objective was to determine the interaction between production level and predicted levels of lysine (LYS) and methionine (MET) on milk yield and milk protein. Forty midlactation Holstein cows (16 primiparous and 24 multiparous) were randomly assigned within parity to either high or low production blocks and within each block were assigned to 1 of 4 dietary treatments, designed to be isonitrogenous but varying in content of MET and LYS. Diets were: low MET and low LYS (LL); high MET and low LYS (HL); low MET and high LYS (LH); or high MET and high LYS (HH). MET and LYS were increased by adding a RPMet (Mepron[®], Evonik-Degussa Corp.) or by replacing corn gluten meal with blood meal. Mean analyzed nutrient content of diets was 17.1% CP, 18.7% ADF, 28.5% NDF and 27.48% starch. Calculated MET and LYS as % of MP were: LL, 1.88 and 6.07; HL, 2.22 and 6.05; LH, 1.82 and 6.38; HH, 2.11 and 6.37 according to the NRC model. Experiment was for 3 periods of 21 d. Statistical analysis was by the Proc Mixed of SAS. Model included terms for parity (primiparous or multiparous), production level (high or low), block, period and diet. Production data is presented below. Diet had no effect on any production variable, nor were there any diet*parity or diet*production interactions. This may have been due to failure to reach levels of MET and LYS as recommended by NRC. We conclude from this study that increasing MET and LYS as % MP to cows in midlactation does not increase kg milk protein regardless of production levels. This may be due to preset homeostatic regulation.

Table 1.

Variable	High Production				Low Production				SEM
	LL	HL	LH	HH	LL	HL	LH	HH	
Diets									
DMI kg	26.0	25.8	26.9	25.7	23.7	24.3	23.7	23.5	1.02
Milk kg	39.4	39.1	39.3	36.6	29.8	27.2	32.0	28.2	2.54
Fat %	3.26	3.39	3.30	3.66	3.58	3.89	3.58	3.71	0.18
Fat kg	1.28	1.32	1.28	1.32	1.06	1.04	1.14	1.04	0.09
Protein %	2.91	3.06	3.02	3.19	3.25	3.51	3.26	3.31	0.13
Protein kg	1.14	1.20	1.18	1.16	0.95	0.95	1.04	0.93	0.07
Lactose %	5.02	4.79	5.03	4.80	4.99	4.98	4.98	4.98	0.10
Lactose kg	1.98	1.88	1.97	1.76	1.49	1.35	1.60	1.40	0.14
MUN mg-dl	12.62	13.09	14.84	13.61	13.90	11.98	11.98	13.39	0.62

Key Words: Methionine, Lysine, Milk Protein

TH256 Ammonia emissions and olfactometry analysis of limit fed high and low concentrate diets with different forage quality in dairy heifers. G. J. Lascano*, P. A. Topper, A. Adviento-Borbe, D. Topper, R. C. Brandt, E. F. Wheeler, and A. J. Heinrichs, *The Pennsylvania State University, University Park.*

Ammonia emissions and odor are being used to regulate animal production. The objectives of this study were to observe the effects of restricted feeding dairy heifers high concentrate (HC) and low concentrate (LC) diets with different forage quality on NH₃ emissions and odor. A split

plot design with diet type as the whole plot and forage quality as subplot was administered in a 4-period (21 d) 4 × 4 Latin square using 8 Holstein heifers (321 ± 21 kg initial BW). Periods consisted of 17 d adaptation and 4 d total fecal and urine collection. Corn silage-based diets containing either 80 or 20% forage (DM basis) with 0, 20, 40 or 60% of forage provided by corn stover (CS; quality denominator) were evaluated. NH₃ concentration was determined using an infrared photoacoustic gas analyzer over a 24-h period and urine:feces as-collected from first 2 d of total collection. Odor was evaluated by a certified panel of human assessors utilizing a triangular forced-choice dynamic olfactometer (EN 13725: 2003). NH₃ emissions were different between HC and LC (6.98 vs. 10.57 ± 0.44 mgNH₃/g manure; *P* < 0.01), and decreasing quality of forage linearly increased NH₃ emission rate on HC diets (*P* < 0.01). Total daily NH₃ emissions were not different between quality or diet type. Feces:urine was lower for the HC diet (0.48 vs. 2.44 ± 0.44; *P* < 0.01). More feces relative to urine (g/g) was produced as quality of forage decreased (*P* < 0.01). Total manure (kg/d) was significantly higher as forage quality increased (*P* < 0.01), and decreased linearly with the addition of CS in the diets (*P* < 0.01). Results suggest that odor was less offensive as forage quality decreased. We conclude that NH₃ emissions were higher for the LC diets on a unit of manure basis, likely due to a shift in feces:urine. Lower quality forages increased these emissions linearly. Finally, forage quality seemed to have an effect on odor in this study.

Key Words: Ammonia Emissions, Odor, Forage Quality

TH257 Effect of abomasal glucose infusion on splanchnic amino acid metabolism in freshening dairy cows. M. Larsen* and N. B. Kristensen, *University of Aarhus, Tjele, Denmark.*

Six Holstein cows implanted with ruminal cannulas and permanent indwelling catheters in the major splanchnic blood vessels were used to investigate the effect of post ruminal glucose supply on splanchnic metabolism of amino acids. Cows were assigned to one of two treatments: Continuous abomasal infusion (INF) of 1500 g glucose/d (via the rumen) or no infusion (control; CON). Treatments were initiated at the day of second calving. Cows were fed ad libitum and the ration was offered in equal meals with 8 hour intervals. Eight hourly sets of arterial, portal vein, and hepatic vein (n = 2 for CON) samples were collected simultaneously starting 30 min before the morning feeding on 4, 15, and 29 days in milk (DIM). Plasma flows were measured by pAH dilution. Essential amino acids (EAA) analyzed in blood plasma were VAL, LEU, ILE, MET, LYS, THR, PHE and HIS; non-EAA analyzed were ASP, ALA, CYS, GLN, GLU, GLY, PRO, SER and TYR. Data was analyzed as a split-plot design, with cows as whole plots (random factor), treatments as whole plot factor and DIM as sub plot factor. Dry matter intake decreased (*P* = 0.05) with INF compared with CON (11 and 17 ± 1 kg/d, respectively). Net portal fluxes of EAA and non-EAA tended to decrease (*P* < 0.10) with INF compared with CON (EAA: 67 and 139 ± 22 mmol/h, respectively; non-EAA: 41 and 121 ± 23 mmol/h, respectively). However, net portal flux of EAA and non-EAA per kg DMI were not affected (*P* > 0.10) by treatment. Net hepatic fluxes of EAA and non-EAA were not affected (*P* > 0.10) by treatment (EAA: 4 and -7 ± 27 mmol/h, respectively; non-EAA: -52 and -99 ± 33 mmol/h, respectively). Net hepatic fluxes of EAA and non-EAA per kg DMI were not affected (*P* > 0.10) by treatment. Net portal and net hepatic fluxes of EAA and non-EAA increased (*P* < 0.05) with DIM for both treatments. In conclusion, abomasal infusion of 1500 g glucose/d did not increase the amount of amino acids available for peripheral tissues

in freshening dairy cows and an amino acid sparing effect of glucose could not be detected.

Key Words: Amino Acids, Glucose, Metabolism

TH258 The performance of calves fed a milk replacer containing wheat protein. A. B. Chestnut* and D. L. Carr, *Vigortone Ag Products, Hiawatha, IA.*

The value of wheat protein as a 50% replacement of milk protein in a calf milk replacer was evaluated. The experimental milk replacer (WP) containing wheat protein was formulated to contain 22% crude protein and 18% fat. The control milk replacer (MP) contained 22% crude protein and 20% fat with all the protein derived from milk ingredients. The milk replacers were formulated with similar levels of minerals and vitamins. Both milk replacers were medicated with neomycin (400g/ton) and oxytetracycline (200 g/ton). The trial was conducted with a group of Holstein bull calves that were 10 ± 4 d of age. Calves were randomly assigned to milk replacer treatments. Individual calf weights were recorded on days 1, 21 and 35 of the study. Each calf received 284 g of milk replacer twice daily from d 1 to 28 and once daily from d 29 to 35. Starter feed (18% crude protein) was offered ad libitum beginning d 1 and starter feed intakes were recorded for each calf. Data were analyzed as a completely randomized design using analysis of variance. Differences between means were tested using the least significant difference method. Calves fed WP had similar weight gains as calves fed MP (Table 1). In this study calves fed WP tended ($P < 0.10$) to eat more starter feed than calves fed MP.

Table 1. Effect of wheat protein in milk replacer on calf performance

	Wheat Protein (WP)	All Milk Protein (MP)	P value
No. head	36	34	
Initial age, d	9.9	10.0	ns
Initial wt, kg	46.9	46.3	ns
21 d gain, kg	8.51	8.29	ns
35 d gain, kg	19.29	18.38	ns
Total starter intake, kg	22.9	19.6	< 0.10

Key Words: Calves, Milk Replacer, Wheat Protein

TH259 Effect of Optigen® and ruminally degradable protein level on fermentation, digestion, and N flow in rumen-simulating fermenters. G. A. Harrison*, M. D. Meyer, and K. A. Dawson, *Alltech Biotechnology, Nicholasville, KY.*

Replacing plant protein with non-protein nitrogen (NPN) from urea or Optigen® (blended, controlled-release urea) increases ruminally degradable protein (RDP) but effects of RDP source on ruminal metabolism are not well defined. Effects of N source in diets and RDP level were investigated in single-flow rumen-simulating fermenter cultures. Cultures were fed diets with 3 N sources (plant protein, Optigen, urea) and

4 levels of RDP (2.1, 2.3, 2.5, 2.7 g/d). Twelve cultures were used in a 3 × 4 factorial design with 12 dietary treatments and 3 experimental runs. RDP was increased by N from plant protein, urea, or Optigen. Cultures were fed 12.5 g as fed of experimental diets twice daily for 6 days. Samples were collected immediately prior to morning feeding during the last 3 days of the experiment for fermentation analysis. A composite effluent sample from each fermenter was used for DM and NDF disappearance. Nitrogen flow measures were estimated by purine to N ratios for effluent and bacteria. Data were analyzed for effects of dietary treatment using the GLM procedure of SAS. Orthogonal contrasts were used to estimate effects of N source and RDP level (linear). N source affected fermentation with isoacids (mM) being higher in plant protein cultures ($P < 0.0001$) and ammonia concentration lower in urea cultures ($P < 0.10$). CP degradability was greater in urea cultures ($P < 0.10$). RDP level affected culture fermentation with linear increases in A:P ratio and ammonia as RDP increased ($P < 0.0001$). True DM digestion, CP degraded, bacterial N yield, and efficiency (g bacterial N/kg DM truly digested) increased in a linear fashion with higher RDP ($P < 0.001$). Nitrogen source did affect fermentation and N partitioning but not digestion and bacterial N yield. Increasing RDP level shifted fermentation and improved digestion and bacterial yield. Interactions between N source and RDP level on suggest that ruminal microbes respond differently to RDP depending on N source.

Key Words: Ruminally Degradable Protein, Non-Protein Nitrogen, Optigen

TH260 Effect of Optigen® and dietary neutral detergent fiber level on fermentation, digestion, and N flow in rumen-simulating fermenters. G. A. Harrison*, M. D. Meyer, and K. A. Dawson, *Alltech Biotechnology, Nicholasville, KY.*

The sustained release of N from Optigen® (blended, controlled-release urea) may be advantageous in diets containing higher neutral detergent fiber (NDF) and lower fermentable carbohydrate. Effects of NPN source and NDF level were investigated in single-flow rumen-simulating fermenter cultures. Cultures were fed diets with 2 NPN sources (urea, 0.58%; Optigen, 0.66% DM) and 3 NDF levels (low=36.5, mid=43.8, high=51.1% DM). Twelve cultures were used in a 2 × 3 factorial design with 6 dietary treatments and 2 experimental runs. Diets were formulated at 16% CP, 75% forage (DM basis) and NDF was increased by changing ratios of corn silage, hay, and straw. Cultures were fed 12.5 g as fed of experimental diets twice daily for 6 days. Samples were collected immediately prior to morning feeding during the last 3 days of the experiment for fermentation analysis. A composite effluent sample from each fermenter was used for DM and NDF disappearance. Nitrogen flow measures were estimated using purine to N ratios for effluent and bacteria. Data were analyzed for effects of dietary treatment using the GLM procedure of SAS. Orthogonal contrasts were used to determine effects of NPN source and NDF level. NPN source did affect culture pH with Optigen cultures being higher (6.40 vs. 6.50, ($P < 0.01$). Compared to low NDF, high NDF cultures had higher pH (6.32 vs. 6.58, ($P < 0.0001$), more ammonia (4.4 vs. 6.5 mg/dl, ($P < 0.05$), lower true DM digestion (65.2 vs. 54.2%, ($P < 0.001$), and lower CP degradability (75.8 vs. 70.1% CP, ($P < 0.05$). Mid NDF cultures had intermediate values. Bacterial N yield tended to be greater in low compared to high NDF cultures (0.350 vs. 0.314 g/d, ($P = 0.11$). On low NDF and high diets, Optigen-fed cultures produced less bacterial N than did urea-fed cultures (-4.8 and -3.3%, respectively). However, on mid NDF diets, Optigen-fed cultures produced 9.7% more bacterial N than their urea-

fed counterparts. Optigen inclusion may be more advantageous when not at dietary extremes.

Key Words: Neutral Detergent Fiber, Non-Protein Nitrogen, Optigen

TH261 Diet formulation strategy and Optigen® effects on fermentation, digestion, and N flow in rumen-simulating fermenters. G. A. Harrison, M. D. Meyer*, and K. A. Dawson, *Alltech Biotechnology, Nicholasville, KY.*

Inclusion of Optigen® (blended, controlled-release urea) in ruminant diets allows for formulation changes due to space created with a condensed N source. Effects of two dietary formulation strategies, increasing degradable protein (RDP) or increasing forage, were investigated in single-flow rumen-simulating fermenter cultures. Twelve cultures were used in a completely randomized design with 6 dietary treatments and two experimental runs. Six diets were formulated at 18% CP (DM basis): control (62.5% RDP, 50% forage), urea (65% RDP, 50% forage), Optigen G1 (65% RDP, 50% forage), Optigen G2 (62.5% RDP, 50% forage), Optigen F1 (65% RDP, 53% forage), and Optigen F2 (62.5% RDP as % of CP, 53% forage). NPN from urea (0.48%) and Optigen (0.55%) primarily replaced N from soybean meal. Cultures were fed 12.5 g as fed of experimental diets twice daily for 6 days. Samples were collected from all cultures immediately prior to morning feeding during last 3 days of experiment for fermentation analysis. A composite effluent sample from each fermenter was used for DM and NDF disappearance. Nitrogen flow measures were estimated using purine to N ratios for effluent and bacteria. Data were analyzed for effects of dietary treatment using the GLM procedure of SAS. Orthogonal contrasts were used to determine effects of RDP and forage level (Optigen diets). Dietary treatment did not affect pH, ammonia, digestion, or N flow measures. Cultures fed higher RDP diets degraded more protein (64.3 vs. 67.1% CP, $P < 0.05$) and had less undegraded feed N (0.251 vs. 0.231, $P < 0.05$). Forage level in Optigen diets did not affect fermentation, digestion, or N flow. Allowing RDP to increase from 62.5 to 65% of CP as Optigen replaced plant protein did not have any negative effects on fermentation or digestion. The formulation strategy of increasing forage (in this case, corn silage) in diets containing Optigen does not appear to have a negative impact on performance in rumen-simulating fermenters.

Key Words: Diet Formulation, Non-Protein Nitrogen, Optigen

TH262 Response of lactating cows to the partial replacement of soybean meal by Optigen® II or urea. J. F. dos Santos¹, M. N. Pereira*¹, G. S. Dias Júnior¹, L. L. Bitencourt¹, N. M. Lopes¹, S. Siécola Júnior¹, and J. R. M. Silva², ¹Universidade Federal de Lavras, Lavras, MG, Brazil, ²Centro Federal de Educação Tecnológica, Januária, MG, Brazil.

Performance and nutrient utilization response of cows to the substitution of soybean meal by two sources of non-protein nitrogen was evaluated. Eighteen Holsteins, 150±82 DIM at the beginning of the trial, were randomly assigned to a sequence of three treatments, in six concurrently run 3x3 Latin Squares, with 21-day periods. The crude protein content of the consumed diet was 16.4% for Optigen® II (Alltech Inc., Nicholasville, USA) and Control and 16.5% for urea. Diet crude protein from Optigen® II was 1.59% of DM and from urea 1.57%. Dietary content of

Optigen® II and urea were 0.61% and 0.56% of DM, respectively. The composition of the Control TMR was (% of DM): Corn silage (41.9), tifton hay (1.8), mature ground corn (14.2), whole cottonseed (7.6), buffer-fat premix (3.9), citrus pulp (12.6), soybean meal (18.0). For the Optigen® II and urea diets, content of soybean meal was 14.1% and citrus pulp was 15.9 and 16.0%, respectively. Data was analyzed with a model containing the effects of square, cow within square, period and treatment. Two orthogonal contrasts were evaluated: 1) Urea vs. soybean meal and 2) Optigen® II vs. soybean meal. The partial replacement of soybean meal by non-protein nitrogen sources reduced intake with no effect on milk yield, there was a tendency for increased milk to intake ratio on these diets. Optigen® II induced excretion of milk urea similar to soybean meal and lower than urea

Table 1. Performance and total tract diet digestibility

	Optigen® II	Control	Urea	SEM	Contrast 1	Contrast 2
Milk yield (kg)	31.6	31.5	31.5	.36	.97	.87
Fat yield (g)	1044	1062	1039	15.9	.31	.44
Protein yield (g)	941	944	942	9.1	.87	.77
MUN (mg dl ⁻¹)	15.5	15.4	16.6	.27	<.01	.68
DMI (kg)	22.4	23.2	22.4	.26	.04	.04
Milk/DMI	1.396	1.344	1.398	.0212	.07	.09
Energy/DOMI ¹	1.327	1.304	1.317	.0330	.77	.61
OM digestibility	71.1	71.3	71.6	1.07	.87	.89
NDF digestibility	45.0	46.6	47.5	2.45	.79	.64

¹ Milk energy over digestible organic matter intake (Mcal kg⁻¹)

Key Words: Optigen® II, Urea, Milk Urea

TH263 The effects of reducing dietary nitrogen on ammonia emissions from dairy housing. J. Cyriac*, L. Li, K. F. Knowlton, L. C. Marr, J. A. Ogejo, J. Ligon, M. Reed, and M. D. Hanigan, *Virginia Polytechnic Institute and State University, Blacksburg.*

This study investigated the potential of reducing NH₃ emissions from dairy housing by reducing the nitrogen (N) content in lactating dairy cow diets. A replicated crossover design was used with 2 pens per treatment, 2 periods (18 d each) per replicate, and 2 replicates. Forty eight mid-lactation Holstein cows were randomly assigned to one of 4 pens. Pens were randomly assigned to one of the treatment diets. The diets contained 15% or 18% crude protein (CP) which differed in rumen-degradable protein content. Feed intake and milk yield were recorded on d 11 through 18. Milk samples were analyzed for 4 d in the final week of each period. On each of d 11 through 18, manure was allowed to accumulate on the floor of one pen for 8 h, and NH₃ volatilization from the floor was measured for 10 h. Subsequent pens were measured on succeeding days resulting in 2 volatilization rate measurements for each pen during the 8 d period. Manure samples were collected for analysis of N and phosphorus. The Proc Mixed procedure of SAS was used to analyze the data. Dry matter intake was significantly increased for the 15% CP vs the 18% CP diets fed cows (23.2 and 25.4 kg/cow/d,

respectively; $P < 0.0001$) but there were no significant changes in milk yield (35.7 vs 37.2 kg/cow/d, respectively). Milk compositional analysis indicated that milk urea N increased significantly ($P < 0.0001$) as the CP content of the diets increased averaging 17.3 and 21.5 mg/dl, respectively, for the 15 and 18% CP diets. Consistent with the level of protein feeding, the N content of fresh manure samples from the 15% CP diet was significantly lower than from the 18% CP diet (3814 vs 4140 mg N/L; $P = 0.03$). However, the measured gaseous NH₃ loss from the barn floor was not significantly different between 15% CP and the 18% CP diets (116 vs 107 mg/h-m², respectively; $P = 0.75$). This study indicated that reducing N in the diet reduced milk urea N and manure total Kjeldahl N excreted into the environment but did not alter NH₃ emissions from the barn floor.

Key Words: Nitrogen, Manure, Ammonia

TH264 Characterization of wheat-based distiller's dried grain with solubles (DDGS) for ruminants. M Undi*, J. C. Plaizier, K. H. Ominski, and K. M. Wittenberg, *University of Manitoba, Winnipeg, MB, Canada.*

Advanced processing technology in the ethanol industry has improved DDGS quality for when corn is the primary feedstock. This study was designed to characterize wheat-based DDGS from western Canadian processing plants. Chemical analyses were carried out on wheat DDGS obtained from multiple runs of a plant using advanced processing technology and a plant using old processing technologies. For comparative purposes corn-based DDGS was obtained from three US plants. As well, rumen-fistulated animals were used to determine in situ dry matter and nutrient degradability of wheat and corn DDGS. Fistulated animals were fed two diets; a 50:50 concentrate:forage diet and a 95:5 grass forage:DDGS diet. Dacron bags containing 5 g of DDGS were incubated for 0, 2, 4, 6, 12, 18, 24, 48, and 72 h. Chemical analysis of DDGS samples from plants using advanced processing technologies showed that crude fat and starch were low and CP high in wheat DDGS relative to corn DDGS, averaging 66 and 148 g fat kg⁻¹ fat, and 7 and 48 g starch kg⁻¹, and 435 and 323 g CP kg⁻¹, DM basis, respectively. Wheat DDGS advanced processing technologies contained, g kg⁻¹ DM basis, 1.2 Ca, 1.1 P, 4.1 Mg, 10.1 K, and 4.1 S. New-generation wheat DDGS had an effective DM degradability of 65.6% (5% h⁻¹ flow rate), with a, b, and c fractions being 46.3%, 50.6%, and 0.03% h⁻¹, respectively. Diet type did not affect degradation parameters, however, effective DM degradability was higher in the old versus new technology wheat-based DDGS.

Key Words: Wheat, Corn, DDGS

TH265 Digestibility of corn distillers protein treated with glutamic acid fermentation solubles or not and exposed to heat damage. P. Summer*, *Ajinomoto USA, Inc., Eddyville, IA.*

The objective of this trial was to evaluate the effects of glutamic acid fermentation solubles (GAFS) and heat upon the enzymatic digestibility of protein in corn distillers grains plus solubles (DGS). A coproduct from glutamic acid production, GAFS was obtained from Ajinomoto Food Ingredients, Eddyville, Iowa. The trial was a 2 × 2 factorial with GAFS added to DGS to equal either 0 or 10% of the dry weight of DGS and heated at either 50 or 140°C in a forced air oven for 4 hours

followed by drying at 30°C. All treatments were applied in triplicate. Dried samples were rinsed to remove all soluble nitrogen and the water insoluble feed was dried gently (30°C). Samples within treatment were pooled and analyzed for Kjeldahl nitrogen (TKN) and ammonia nitrogen (AN). Intestinal protein digestibility of rinsed samples was estimated by incubating 15mg of nitrogen from each treatment (n=6) with pepsin (1g/L, Sigma P-7012) for one hour followed by pancreatin (3g/L, Sigma P-7545) and thymol (50mg/L) for 24 hours in 50ml polypropylene tubes. Trichloroacetic acid was added to stop digestion and precipitate proteins and large peptides. Three blanks were included. The tubes were centrifuged (3,200 X g) and the supernatant was analyzed for total nitrogen. Protein digestibility of the feed was calculated as the mg of nitrogen in the digest supernatant divided by the original mg of nitrogen in each tube. The TKN (% of DM), AN (% of DM), and protein digestibility of rinsed treatments were 5.16, 0.51, 48.1; 5.06, 0.53, 41.2; 5.16, 0.46, 47.2; and 5.26, 0.48, 48.3 for DGS-50, DGS-140, DGS+GAFS-50 and DGS+GAFS-140, respectively. Treatments were similar in TKN and AN. The main effects of GAFS ($P = 0.13$) and temperature ($P = 0.15$) upon protein digestibility were not significant. There was a significant interaction between GAFS and temperature ($P = 0.05$) as protein digestibility decreased in DGS but not in DGS+GAFS at high temperature. These data suggest GAFS or a component within GAFS protects protein in DGS from heat damage.

Key Words: Distillers Grains, Protein, Digestibility

TH266 Influence of Optigen® on nitrogen behavior in lactating dairy cows. R. L. Stewart, Jr.*¹, J. M. Tricarico¹, D. L. Harmon², W. Chalupa³, K. R. McLeod², G. A. Harrison¹, L. M. Clark², M. D. Meyer¹, R. Garcia-Gonzalez¹, and K. A. Dawson¹, ¹Alltech, Inc., Nicholasville, KY, ²University of Kentucky, Lexington, ³Global Dairy Consultancy Co. Ltd., Holderness, NH.

A study was conducted to compare N balance (Exp. 1) and in situ degradation (Exp. 2) of diets formulated for lactating dairy cows containing Optigen®, a controlled release NPN source, vs. soybean meal. Treatments (isonitrogenous, 16.7 % CP) consisted of: 1) soybean meal (SBM) vs. 2) NPN fed as 150 g/h•d⁻¹ Optigen® to replace a portion of the CP provided by SBM (OPT). In Exp. 1, six mid-lactation, multiparous Holstein cows (BW = 550 kg) were utilized in a crossover design to investigate N balance. Each period consisted of 14-d adaptation and 7-d N balance. In Exp. 2, two 600-kg ruminally cannulated steers were utilized in a crossover design to compare in situ degradation characteristics of DM, N and NDF of the diets above. Incubation times included 0, 2, 4, 6, 8, 16, 24, and 48 h. Dry matter and N disappearance data were fitted to the equation where $y = A + B(1 - e^{-Ct})$; y = disappearance (%), A = fraction available at time 0, B = fraction degraded at a measurable rate, and C = fractional rate of disappearance of fraction B. In Exp. 1, N intake was similar ($P < 0.23$: 518 g/d). Total N output (feces, urine, and milk) did not differ ($P > 0.49$) between the diets (483 g/d) and the resulting N balance was similar ($P > 0.91$; 36 g/d). Nitrogen efficiency (7.9 kg/kg), measured as kg of milk per kg of CP intake, did not differ ($P > 0.91$). In Exp. 2, the A (33.0 %) and B fractions (52.5 %) and the disappearance rate of B (8.0 %/h) for DM were similar between OPT and SBM ($P > 0.21$). Likewise, the A, B, and C fractions of N were similar ($P > 0.33$) between OPT and SBM diets (28.3 %; 61.3 %; and 9.3 %/h, respectively). However, the total degradable fraction of DM (A + B fractions) tended to be higher ($P < 0.06$) in the OPT diet compared to the SBM diet (86.5 and 83.3 %). Neutral detergent fiber digestibility tended ($P < 0.14$) to be higher for OPT at 24h (48.7 vs. 39.9%) but was

similar ($P > 0.24$) at 48 h (61.1 %). These results demonstrate Optigen® can be utilized to provide a portion of the CP without negatively affecting N balance or DM, N and NDF behavior in the rumen.

Key Words: Optigen, NPN, Nitrogen Balance

TH267 Meta-analysis of milk protein yield response data to lysine and methionine supplementation. D. Vyas* and R. A. Erdman, *University of Maryland, College Park.*

Previous reports on milk protein responses to metabolizable amino acid (MAA) supplementation focused on lysine (LYS) and methionine (MET) expressed as a percentage of metabolizable protein and not to the actual amounts of MAA supplemented. The objective of this study was to determine the milk protein yield (g/d, MPG) responses to the amounts of LYS and MET supplemented. Meta-analysis was performed on results from 21 published articles involving 36 treatment comparisons of post-ruminal LYS and MET supplementation in lactating dairy cows. A broken-line regression model using the NLmixed procedure in SAS 9.1 (Robbins et al., 2006, *J. Anim. Sci.* 84(Suppl E):E155–E165) was used. The following statistical model was used: $MPG \sim \text{Normal}(L + (U \times z1) + E + (E \times z1) + \text{lvar}, \text{errvar})$, where: $z1 = (\text{MAA (g/d)} < R) \times (R - \text{MAA (g/d)})$; R is the abscissa of breakpoint; L is maximal milk protein. Slope = 0; U is the slope and lvar and errvar are the variance components of L and error term, respectively.

Experiment (E) effects were removed by designation as random effects within the model. With MET and LYS supplementation, the breakpoints (R) were 121 and 275 g/d, the maximum protein yields (L) were 1212 and 1160 g/d, and the slopes were -3.50 and -2.49, respectively. Assuming MET and LYS concentration of 2.71 and 7.63 g/100g milk protein, this implies only 9.5 % and 19 % efficiency of use of these supplemental MAA for protein synthesis. It should be recognized that overall efficiencies of MAA utilization tends to be underestimated when amino acid supply is close to the animal's needs.

Table 1. Parameter estimates for lysine and methionine

Amino acids	L	U	R	SEM	Adj. R ²
Methionine	1212	-3.50	121	30.75	0.96
Lysine	1160	-2.49	275	47.29	0.89

SEM= Standard error of Mean

Key Words: Metabolizable Amino Acids, Milk Protein

TH268 Do feedstuffs contain a constant protein fraction that is both undegradable in the rumen and indigestible in the small intestine? S. E. Boucher*¹, C. M. Parsons², and C. G. Schwab¹, ¹*University of New Hampshire, Durham*, ²*University of Illinois, Urbana.*

To evaluate differences in intestinal digestibility of rumen undegraded amino acids (AA) within feeds and to determine if feeds contain a constant protein fraction that is both undegradable in the rumen and indigestible in the intestine, as is assumed in the AAT/PBV Protein System (1995), samples of soybean meal (SBM), SoyPlus® (SP), dried distillers grains with solubles (DDGS), and fishmeal (FM) were obtained from FeedAC, Inc. Feeds were analyzed for AA and incubated in situ

for 16 h in the rumen of 4 lactating cows. After incubation, bags were rinsed, washed in methylcellulose solution, and dried. Rumen undegraded residues (RUR) were pooled by sample, analyzed for AA, and ruminal degradation of AA (RDAA) was calculated as disappearance from the bags. Sub-samples of the intact feeds (IF) and RUR were tube fed to 4 cecectomized roosters each, and total excreta were collected for 48 h and analyzed for AA. Endogenous AA losses were estimated from fasted birds, and standardized intestinal AA digestibility (SDAA) of the IF and RUR was calculated. Indigestibility coefficients of the IF were calculated as $100 - \% \text{SDAA}$ and indigestibility of RUR was calculated as $((100 - \% \text{RDAA}) * (100 - \% \text{SDAA})) / 100$. The results indicate that SDAA in RUR differs within feeds, and SDAA coefficients were most often lowest for Lys, His, Cys, and Pro and highest for Trp, Leu, and Met. The observed ranges of SDAA in the RUR of SBM, SP, DDGS, and FM were 88-99, 85-99, 63-100, and 55-99%, respectively. The indigestibility coefficients of the IF and RUR also differed within all feeds and were lower for the RUR than for the IF. It appears that SBM, SP, DDGS, and FM do not contain a constant protein fraction that is both undegradable in the rumen and indigestible in the small intestine, but rather they contain a protein fraction that is indigestible in the intestine but partly degradable in the rumen and/or digestible in the intestine after rumen incubation.

Key Words: Amino Acid Digestibility, Rumen Undegraded Protein, AAT/PBV System

TH269 Effects of 2-hydroxy 4-(methylthio) butanoic acid isopropyl ester (HMBi) on the organic matter digestibility (OMD) and energy value of corn dried distillers grains with solubles (DDGS). E. Devillard*, L. Ducrocq, C. Richard, and P. A. Geraert, *Adisseo, Commeny, France.*

HMBi used in dairy cow rations is a source a metabolisable methionine for the animal. In addition, HMBi presents the particularity to enhance rumen function. Indeed, HMBi was shown to increase the rumen fermentations and consequently the energy value of different feedstuffs (Robert et al. 2002). Corn DDGS being largely available through the biofuel production, the potential of using HMBi to improve energy values of such feedstuffs was investigated. This was carried out using the rumen fermentation simulation technique (HFT gas test) where 4 different corn DDGS with different compositions were incubated with rumen fluid, and HMBi at 2 different doses. Gas production was measured and allowed to calculate OMD, and energy values of corn DDGS. Using a dose of 2.5% HMBi of the substrate dry matter (DM), the OMD of the 4 different DDGS was increased significantly. The increase varied between 2.1 to 3.2 % compared to the untreated control, depending on the DDGS. This corresponded to at least 2.9 % increase of the energy value of the corn DDGS. When the dose of HMBi added to the incubation was lowered to 0.1% HMBi of the substrate DM, OMD and energy values were also improved, numerically for 2 DDGS and significantly for the 2 others. With such a dose, the increase of energy value of DDGS could reach 1.5%. In order to further investigate the results obtained with the HFT technique, batch incubations were performed using the DDGS having exhibited the highest response. Its NDF and ADF digestibilities were improved with 0.1% HMBi supplementation and did not increase further when this dose was increased. These results show that i) HMBi can improve energy values of corn DDGS, ii) the effects of HMBi on corn DDGS vary with their type and composition, iii) improvement observed

at low dose could mainly be due to the increase in fibre degradation, iv) increasing dose of HMBi would not lead to a further improvement of fibre degradation, but could favour other fermentation processes.

Key Words: HMBi, Energy Value, Corn DDGS

TH270 Effects of feeding a controlled rumen release urea on productivity of Holstein cows. A. Highstreet*¹, J. Robison¹, P. H. Robinson², and J. G. Garrett³, ¹California State University, Fresno, ²University of California, Davis, ³Balchem Encapsulates, New Hampton, NY.

While urea is often added to rations of lactating dairy cattle, it is solubilized and converted to ammonia rapidly in the rumen which could lead to inefficient use of dietary N. Our objective was to determine if a controlled rumen release urea (Nitroshure (NS) Balchem, New Hampton, NY), increases performance, and efficiency of capture of dietary N in milk, when it replaced urea in diets of lactating dairy cows. NS was determined to be 45.0% N and 9.9% fatty acids that were 80% C18:0, 17% C16:0 and 3% others. Ruminal in sacco incubation, with hand washing of bags, showed 72, 89 and 99% rumen N solubilization (includes loss at t=0 h) at 0.5, 4 and 12 h respectively. Pens of multiparous lactating cows (2 early and 2 mid-lactation) on a California dairy were fed one of 2 TMR formulated to supply 5% of ration CP as urea or NS. The study was 2 experiments (early and mid-lactation) in 2x2 factorials within switchover designs with 2 experimental periods of 4 weeks. All pens were fed twice daily to appetite with daily intakes recorded by pen. TMR and TMR ingredients were sampled twice in the final week of each period for chemical analysis. Cows were milked thrice daily with milk yield and components measured at the end of each period. Urine samples were collected from 20 cows/pen voluntarily urinating at the end of each period with fecal collections from these same cows 24 h later. There were no differences among TMR in nutrient analyses, with average CP and NDF of 17.9 and 33.4% respectively. DM intakes did not differ due to treatment in either early or mid-lactation. In mid-lactation, there were no differences in milk production, or component levels or outputs, due to replacement of urea with NS in the TMR, while early lactation cows had increased (P<0.01) milk fat and protein %, as well as milk fat, protein and energy outputs. Neither early or mid-lactation cows had different urinary or fecal N output due to treatment, capture of dietary N in milk was not impacted, and whole tract NDF digestibility was unaffected. Feeding a controlled rumen release urea in replacement for urea at about 5% of dietary CP improved performance of early lactation high producing dairy cows.

Key Words: Urea, Dairy, Rumen

TH271 In vitro ruminal protein degradation and microbial protein formation of seed legumes. S. Colombini¹ and G. A. Broderick*², ¹University of Milan, Milano, Italy, ²U.S. Dairy Forage Research Center, Madison, WI.

Seed legumes such as peas, lupins and faba bean are important feeds for dairy cows in Europe and other regions. Ruminal protein degradability was quantified using the inhibitor in vitro (IIV) system for samples of 5 seed legumes: 2 peas (cv. Alembo and Helena), 1 white lupin (*Lupinus albus*, cv. Multitalia), 1 blue lupin (cv. Quilinok), and 1 faba bean (*Vicia*

faba minor, cv. Chiaro). Incubations were stopped by adding acid at 0, 2, 4 and 6 h; ruminal escape was computed assuming a passage rate of 0.06/h. Five standard proteins were included. Additional incubations were conducted without growth inhibitors in an attempt to correct for N incorporation by bacteria. These were conducted for 2, 4 and 6 h with ruminal inoculum containing ammonium sulfate enriched with N-15. Net microbial growth (growth above blank) was estimated from total non-ammonia N (NAN) plus N-15 enrichment of total NAN and isolated bacterial NAN. Significant differences were observed among protein sources in IIV degradation traits (Table 1). Typical estimates of degradation rate and rumen-undegraded protein (RUP) were obtained for the standard proteins. The 2 pea sources had slower degradation rates and greater RUP than the lupins and faba bean. The IIV system ranked the RUP contents of the 5 legumes differently from the Cornell model. Excessive variation prevented reliable estimates of degradability in uninhibited inoculum. However, there was a trend (P = 0.15) for an effect of seed legume on microbial NAN formation; greater content of starch and water soluble carbohydrate may have supported greater formation of bacterial NAN for Alembo peas and Chiaro faba beans. Both microbial growth and protein escape should be considered when evaluating feeds rich in protein and fermentable energy.

Table 1. In vitro ruminal protein degradability and microbial NAN formation

Source	Cultivar	N (%)	Inhibitor in vitro			Cornell model		Uninhibited Microbial NAN [mg/(h*100 ml)]
			Rate (/h)	RUP (%)	Rank	RUP (%)	Rank	
Casein		14.07	0.230	18				
Solvent SBM		7.16	0.106	35				
Expeller SBM		7.07	0.031	67				
Alfalfa hay		2.74	0.039	59				
Alfalfa silage		2.98	0.057	45				
Pea	Alembo	3.40	0.088	39	2	16	4	3.5
Pea	Helena	4.17	0.078	42	1	20	3	2.3
White lupin	Multitalia	5.62	0.137	29	5	11	5	1.9
Blue lupin	Quilinok	5.11	0.124	30	4	20	2	2.0
Faba bean	Chiaro	4.41	0.095	38	3	24	1	2.7
SE			0.008	2.3				0.7
P > F			< 0.01	< 0.01				0.15

Key Words: Seed Legumes, Protein Degradation, Rumen-Undegraded Protein

TH272 In situ ruminal degradation of nitrogen fractions of cottonseed and canola meals. T. Tashakkori, M. Danesh Mesgaran*, A. R. Heravi Mousavi, and H. Nasri Moghaddam, Ferdowsi University of Mashhad, Mashhad, Iran.

The experiment was investigated to determine ruminal degradation of nitrogen fractions [true protein (TP), buffer insoluble protein (BIP), neutral detergent insoluble protein (NDIP) and acid detergent insoluble protein (ADIP)] of cottonseed meal (CP= 280 g/kg DM) and canola meal (CP= 420 g/kg DM) using nylon bag technique. Two Holstein steers (450±50kg body weight) fitted with ruminal fistula were used.

Samples were weighed into nylon bags (19×12 cm, pore size= 48µm, n= 8) and incubated in the rumen for 0, 8, 24, 48 and 72 h. Nitrogen fraction concentrations were determined in intact and incubated samples using standard procedures. Data were applied to the equation of $P = a + b(1 - e^{-ct})$; P= degradability potential, a= rapidly degradable fraction, b= slowly degradable fraction, c= degradable constant, t= time. True protein degradation of cottonseed meal (a= 0.35±0.059, b= 0.49±0.394, c= 0.018±0.028) was markedly different from those of canola meal (a= 0.24±0.041, b= 0.71±0.046, c= 0.08±0.013). BIP degradation of cottonseed meal (a= 0.42±0.031, b= 0.89±0.723, c= 0.01±0.011) was higher than canola meal (a= 0.35±0.035, b= 0.63±0.047, c= 0.06±0.012).

NDIP degradation coefficients of cottonseed meal and canola meal were a= 0.45±0.063 and 0.16±0.086, b= 0.66±1.46 and 0.71±0.01, c= 0.008±0.026, 0.056±0.023, respectively. Ruminal degradation of ADIP of canola meal and cottonseed meal were a= 0.15±0.175 and 0.29±0.102, b= 0.29±0.226 and 0.17±0.126, c= 0.086±0.179 and 0.04±0.114, respectively. Results of the present study indicate that the nitrogen fractions of cottonseed meal and canola meals were degraded in the rumen with different kinetics.

Key Words: In Situ, Nitrogen Fraction, Degradation

Small Ruminant: Sheep

TH273 Influence of production traits on the sheep enterprise profitability: A modeling approach. V. Demers Caron*¹, D. Pellerin¹, and F. W. Castonguay^{1,2}, ¹Université Laval, Québec, Québec, Canada, ²Agriculture and Agri-Food Canada, Sherbrooke, Québec, Canada.

Many production traits have an impact on the net income in sheep production systems. Because these traits are all interconnected, it is difficult to quantify their relative impact on the enterprise profitability. A deterministic model, *SimulOvins*, has been developed to simulate the operation of a sheep flock, either in extensive or intensive production systems (3 lambings in 2 years). This discrete events simulation, built on a daily basis, takes into account the following criteria: production structure (number of breeding groups, interval between matings), herd size, breeds, crossbreeding system, parity, ewe fertility and prolificacy at each mating group depending on the breeding season and the out-of-season breeding techniques used, lamb growth and carcass quality adjusted for litter size, culling and mortality rates, production costs (feed, out-of-season breeding techniques, management...) and revenues from lambs sold (new crop, light or heavy lambs), culled animals and wool. Some of the outputs that could be obtained are: flock fertility and prolificacy, number of lambings attained per ewe per year, number of lambs of each type sold per week, labor and space requirement, revenues, variable costs and gross margin. Productivity can be calculated for each mating group, year, breed or parity. By conducting simulations, it is possible to assess the impact of farm-level management decisions on the flock performances. Then, the conversion of the technical data in economic data allows the estimation of the effects of these changes on the profitability. Special efforts were made to build a user friendly tool so that it can be not only used for research, but also for teaching purposes and, ultimately, to help experts in supporting farmers in their management decisions.

Key Words: Sheep, Model, Profitability

TH274 Estimating average fiber diameter and variability of wool fleeces using Optical Fibre Diameter Analysers (OFDA 100 and 2000). F. A. Pfeiffer*, C. J. Lupton, and D. F. Waldron, *Texas AgriLife Research, San Angelo, TX.*

Average fiber diameter (AFD) and variability (CV) of wool fleeces are important value determining traits that are measured and used to make animal selection decisions. The traits are accurately determined for individual animals by shearing the whole fleece and measuring a representative (cored) sample using standard methodology. Such procedures are time consuming and expensive. Consequently, faster, less expensive methods have been investigated. Mid-side samples shorn from 729 rams participating in central performance tests between 2004 and 2007 were measured as-is with an OFDA2000 instrument (BSC Electronics, Ardross, Australia) to obtain AFD2 and CV2. The samples were also guillotined close to the base of the staple, and sub-samples were cleaned and measured with an OFDA 100 to obtain AFD1 and CV1. Subsequently, the rams were shorn and whole fleeces were sampled and measured (OFDA 100) in a standard manner to obtain AFD and CV. Data were analyzed using MEANS, TTEST, and REG procedures of SAS. AFD1 > AFD > AFD2 (22.5, 21.8, and 21.6 μm , respectively, $P < 0.01$) and CV > CV1 ($P < 0.0001$) = CV2 ($P = 0.56$; 20.2, 16.0, and 16.1%, respectively). Regression analyses are summarized in Table 1.

In conclusion, the r^2 and slope values indicate the faster methods were not capable of accurately estimating AFD or CV of whole fleeces. Estimates of AFD were more accurate and precise than those of CV. In the absence of standard whole fleece measurements, AFD1 and AFD2 would provide useful guidance for selection purposes.

Table 1. Regression analyses

y	x	r^2	SEy	Slope
AFD	AFD1	0.79	0.63	0.76
AFD	AFD2	0.73	0.70	0.73
AFD1	AFD2	0.78	0.75	0.87
CV	CV1	0.16	2.40	0.59
CV	CV2	0.21	2.32	0.69
CV1	CV2	0.56	1.18	0.77

Key Words: Fiber Measurement, Sheep, Wool

TH275 Performance of F₁ crossbred lambs from Dorper and Katahdin rams and Pelibuey and Barbados Blackbelly ewes. G. M. Pérez, F. A. Rodríguez-Almeida*, M. A. Levario, J. C. Ontiveros, J. A. Villareal, B. Piña, O. G. Núñez, J. R. Peña, and J. A. Ortega, *Universidad Autónoma de Chihuahua, Chihuahua, Chihuahua, México.*

The objective was to compare growth performance and carcass traits of F₁ crossbred lambs sired by Dorper (Dp) and Katahdin (KH) rams mated to Barbados Blackbelly (BB) and Pelibuey (PB) ewes. Fifty six male lambs from five DP rams and 43 from three KH rams were used. Ewe numbers were 52 for BB and 32 for PB. Lambs were from three different lots according to date of lambing. Weights were recorded at birth (LW), weaning (WW; 90 d of age) and slaughter (SW; after 56 d on feedlot). Feed intake (FI) was calculated as the difference between the daily amount of feed offered and the amount rejected. The feedlot diet was balanced according to NRC requirements, with 13 % CP and 3.15 Mcal of ME/kg of DM through an average of 28 kg of BW, and 11 % CP and 3.17 Mcal of ME/kg thereafter. Carcass traits analyzed were yield (CY), weight (CW), length (CL), depth (CD), ribeye area, back fat depth, and weights of kidney fat (KF), rear leg, thorax and loin. Data were analyzed with PROC MIXED of SAS. The model included fixed effects of sire breed, dam breed, number of lambs born (1, 2 or 3), lot, and the interaction of sire breed by lot, and random effects of sire and dam within their respective breeds. Breed of sire was important for LW ($P < 0.03$), CY ($P < 0.07$), and weights of rear leg ($P < 0.03$) and thorax ($P < 0.06$). Lambs from KH rams were heavier than lambs from DP rams (2.73 ± 0.08 vs 2.19 ± 0.08 kg) at birth, but not thereafter. Lambs sired by DP rams had carcasses with greater CY (53.8 ± 0.5 vs 52.5 ± 0.6 %) and heavier rear leg (2.36 ± 0.05 vs 2.19 ± 0.06 kg) and thorax (2.60 ± 0.06 vs 2.39 ± 0.07 kg) than lambs sired by KH rams. Breed of dam was significant ($P < 0.01$) only for ADG, with a larger mean for lambs from PB than from BB ewes (0.298 ± 0.005 vs 0.275 ± 0.006 kg/d). In conclusion, lambs sired by DP rams had similar growth performance than lambs sired by KH rams, but resulted in larger carcass yield and weight of a high value cut: the rear leg.

Key Words: Growth, Carcass Traits, Hair Sheep Crosses

TH276 Productive performance and carcass characteristics of hair sheep of different genotypes in feedlot. F. G. Rios*, P. Hernandez, J. F. Obregon, D. C. Acosta, R. Cortina, J. J. Ortiz, and J. J. Portillo, *FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico.*

To determinate the productive performance and carcass characteristics of hair sheep of different genotypes in the feedlot, 48 ram lambs, 16 Dorper × Pelibuey (D×P), 16 Katahdin × Pelibuey (K×P), and 16 Pelibuey (P), (BW=38.97 ± 1.56 kg) were used in a randomized complete block experiment where block was initial weight. The lambs were assigned to consume a diet fed ad libitum with 15.5 % CP and 2.89 Mcal of DE/kg, consisting of 66 % whole corn grain, 12 % Sudan hay grass, 11.7 % soybean meal, 7.0 % molasses cane, 2.7 % mineral premix, and 0.6 % sodium bicarbonate, during 45 d. Feed intake (FI), average daily gain (ADG), feed efficiency (FE) and carcass traits, were recorded. The data were analyzed with ANOVA for randomized blocks design; Tukey test were utilized to examine the effect of genotype. The harvest weight, FI, ADG and FE were similar (P>0.05) among the breed types. Hot carcass weight were heavier (P<0.05) for D×P and K×P (30.58, and 29.01 vs. 28.40 kg; 0.481 SEM), than genotype P; and *Longissimus thoracis* area was largest (P<0.01) for P and D×P carcasses than genotype K×P (12.68, and 12.30 vs. 10.94 cm²; 0.256 SEM). Carcasses of D×P and K×P had greater (P<0.05) fat thickness measurements than P carcasses, and marbling score was greater (P<0.01) in P carcasses than D×P and K×P types. Length of leg was largest (P<0.01) for P carcasses than D×P and K×P. Depth of leg and compact leg index were higher (P<0.05) for D×P and K×P carcasses than genotype P. Carcasses from type P had higher (P<0.01) mesenteric fat and retail product yield than D×P and K×P lambs. Chilled carcass weight (29.07 kg), dressing percentage (58.25 %), body wall thickness (14.28 mm), compact carcass index (0.385), and empty body weight (46.22 kg), were similar (P>0.05) among the breed types. It is concluded that Dorper × Pelibuey hair sheep had superior carcass characteristics but similar productive performance to Pelibuey and Kathadin × Pelibuey types in the feedlot.

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Key Words: Hair Sheep, Carcass Traits, Genotypes

TH277 Comparative reproduction characterization among four crossbred groups of hair sheep: Prolificacy. W. R. Getz*, S. Mobini, and S. Gelaye, *Fort Valley State University, Fort Valley, GA.*

The use of hair or shedding breeds of sheep in commercial lamb production systems appears to be increasing in Georgia and the Southeast. Profitability from these enterprises is influenced to a large degree by the number of lambs born and sold. Reproductive rates have been shown to be influenced by breed and type of sheep. Over a six-year period, prolificacy data were collected from 145 ewes in four breed groups. A total of 248 parturitions were recorded including 103 parturitions from crossbred ewes composed of Dorset, Hampshire, Suffolk or western dual-purpose heritage; and three groups of ewes of hair sheep heritage. The hair sheep data included 28 parturitions from halfbred or ¾-bred Katahdin ewes, 26 parturitions from halfbred or ¾-bred Dorper ewes, and 91 parturitions from 50% white Dorper × 50% Katahdin composite ewes. Number of lambs born per ewe across all breed groups was 1.71±.0359. Wool crossbred ewes = 1.67±.0607 lambs; Dorper-cross ewes = 1.69±.0923 lambs; Katahdin-cross ewes = 1.71±.0869 lambs; and Dorper × Katahdin composite = 1.76±.0592 lambs per parturition.

Differences among the individual breed groups were minimal. These data suggest that either of the breed groups would be equally prolific in commercial lamb production systems in middle Georgia.

Key Words: Sheep, Breeds, Prolificacy

TH278 Male effect on heat distribution and pregnancy rate to timed AI and throughout the breeding season in postpartum Santa Ines ewes. M. V. Biehl¹, A. V. Pires*¹, I. Susin¹, C. Q. Mendes¹, F. S. Urano¹, R. S. Gentil¹, E. M. Ferreira¹, G. H. Rodrigues¹, and M. L. Day², ¹*Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, SP, Brazil.*, ²*The Ohio State University, Columbus.*

Objectives were to evaluate the effect of presence of the male on distribution of estrus after synchronization and pregnancy rate to timed AI and through the breeding season. Santa Ines ewes (n=270; 45 to 60 days postpartum) were blocked according to parity, lambing date, body weight and body condition score (BCS) and assigned to either: Treatment I (control, n=93) no ram exposure; Treatment II (n=97) presence of teaser rams with lateral deviation of the penis; Treatment III (n=80) presence of vasectomized teaser rams. Rams were introduced into the respective treatments (1 ram:30 ewes) 20 days before the application of an intravaginal progesterone releasing device (Eazi-Breed CIDR[®] with 33 mg of progesterone). The CIDR was withdrawn after 7 days, an injection containing 300 IU of eCG (Folligon[®]) and 5 mg of dinoprost (Lutalyse[®]) was given at that time. Estrous detection was performed continuously from CIDR withdrawal until intracervical timed AI (TAI) 55 hours later. Ewes were exposed to intact rams (3 rams/treatment) for 45 days; beginning 10 days after TAI. Pregnancy status was determined by US at 45 days after TAI and 30 days after the breeding season. Mean BCS was 3.0 ± 0.2. Estrus was detected in 140 (52%) at a mean of 45 ± 13 hours after CIDR withdrawal (21 and 41% between 24-36 and 37-48 hours, respectively), and did not differ between treatments. There was no differences among treatments for pregnancy rate to TAI (34.5%, 93/270) to the first natural mating after TAI (37%, 100/270), or at the end of the breeding season (89.6%, 242/270). These data suggest that TAI approximately 10 hours before recommended by the CIDR manufacturer would coincide with onset of estrus in a greater proportion of ewes. Neither exposure to rams or type of teaser ram used influenced pregnancy rate to TAI or during the breeding season.

Key Words: Male Effect, Hair Sheep, TAI

TH279 Retention of sperm motility, viability and fertility in ram semen after liquid storage at 4°C for up to 96 hours. J. L. Mook, J. R. Collins, and S. Wildeus*, *Virginia State University, Petersburg.*

The availability of reliable overnight shipping has provided new opportunities for the use of sheep semen stored at refrigerated temperatures prior to insemination. This experiment evaluated sperm motility and viability, as well as fertility, of ram semen stored at 4°C for up to 96 h. Semen was collected on 7 consecutive days by artificial vagina from 6 hair sheep rams during the breeding season (November), and 4 ejaculates with the highest initial motility were pooled each day. Pooled semen was diluted in a Tris-egg yolk (2.5%) extender with antibiotics, but without glycerol to a concentration of 400 million sperm/ml, pack-

aged in 0.25 ml straws, and stored horizontally at 4°C. Straws were evaluated in triplicate for motility (Minitube SpermVision CASA) and viability (Giesma staining) at 24 h intervals for 96 h immediately after warming and after incubation at 37°C for 6 h. Fertility was assessed in 0 and 72 h-liquid stored semen using 64 post-pubertal ewes. Ewes were estrus synchronized with flurogestone acetate sponges (40 mg, 12-14 d), and 500 IU eCG at sponge removal, and were inseminated in 4 timed, intrauterine artificial insemination sessions on successive days. Data were analyzed for the effect of day of collection, length of storage and incubation on sperm quality, and for the effect of 72 h-storage on fertility. Day of collection affected ($P<0.01$) total (Tmot) and progression of motility, but had no effect on sperm velocity or viability. There was a linear decline ($P<0.001$) from 0 to 96 h in motility (Tmot 76.4 to 56.6%), curvilinear velocity (218.8 to 176.6 $\mu\text{m/s}$) and viability (79.1% to 68.1%). Incubation had no effect on sperm motility at any stage of storage, but viability and velocity declined ($P<0.01$) following incubation. Fertility was not different between fresh and 72 h-stored semen (45.2 vs. 41.9%, respectively), but fluctuated between insemination sessions (31.3 to 60.0%). Data suggest that liquid ram semen experienced only a moderate decline in motility and viability after extended cooled storage, but further research is needed to account for the variability observed in individual collections.

Key Words: Semen, Ram, Fertility

TH280 Meat characteristics of crossbred lambs fed normal or heated whole cottonseed¹. R. R. P. S. Corte*², P. R. Leme², G. Aferr², A. S. C. Pereira², and S. L. Silva², ¹FAPESP, São Paulo, São Paulo, Brazil, ²Universidade de São Paulo, Pirassununga, São Paulo, Brazil.

Thirty-two crossbred lambs, sixteen males and sixteen females, with average weight and age of 20 kg and 75 days were fed for 63 days to evaluate the effects on the meat characteristics of lambs when there was an inclusion in their diets, in different levels, of normal or heated whole cottonseed. The animals were fed four different experimental diets: CA0, with 0% of cottonseed, CA10, with 10% of cottonseed, CA20, with 20% of cottonseed and CA20H, with 20% of heated cottonseed. For shear force, sensory panel and cholesterol analysis, samples of *Longissimus* muscle were used. Shear force was evaluated with a Warner Bratzler in samples aged 1 or 7 days, trained sensory panel was performed with samples aged 7 days, and cholesterol for enzymatic method was performed with spectrophotometric reading. The animals were assigned to a randomized block design by crossbred type ($\frac{1}{2}$ Dorper $\frac{1}{2}$ \times Santa Inês and $\frac{1}{2}$ Dorper \times $\frac{1}{2}$ Texel). Effects of treatments were evaluated by analysis of variance using the *MIXED* procedure of SAS software. There was no blocked effect and gender effect on objective tenderness characteristics, sensory panel or cholesterol. Meat characteristics, such as objective tenderness, were not affected by treatments and aging, with values for CA0 of 3.74, CA10 2.77, CA20 3.77 and CA20H 3.24 kg. Samples which were aged for 1 day had a mean shear force value of 3.46 kg and those aged 7 days had a mean value of 3.01 kg. Sensory qualities (characteristic flavor, off-flavor, juiciness, texture, characteristic taste and strange flavor) were not affected by the experimental diets. Off-flavor was classified as very weak indicating that the meat did not present any unpleasant characteristics. Grades given by the panelists have suggested that the analyzed lamb meat had an excellent acceptance regardless of gender or treatment. Meat cholesterol was not affected by the diets with a mean value of 90 mg/100g.

Key Words: Sub Product, Small Ruminant, Meat Attributes

TH281 Fatty acid composition of meat from crossbred lambs fed normal or heated whole cottonseed¹. R. R. P. S. Corte*², P. R. Leme², A. S. C. Pereira², G. Aferr², and J. C. C. Balieiro², ¹FAPESP, São Paulo, São Paulo, Brazil, ²Universidade de São Paulo, Pirassununga, São Paulo, Brazil.

To assess the effects of whole cottonseed (at different levels) or heated cottonseed in the diet on fatty acid composition in the meat of lambs, thirty-two crossbred lambs (16 males and 16 females with mean weight and age of 20 kg and 75 d) were fed for 63 days four diets: CA0, with 0% cottonseed, CA10, with 10% cottonseed, CA20, with 20% cottonseed and CA20H, with 20% heated cottonseed. At slaughter, a sample of the *Longissimus* muscle was taken for analysis of fatty acid composition. Lipids were extracted for fatty acid composition, and fatty acids methyl esters were determined by gas chromatography. The experiment had a randomized block design by crossbred type ($\frac{1}{2}$ Dorper $\frac{1}{2}$ \times Santa Inês (D-SI) and $\frac{1}{2}$ Dorper \times $\frac{1}{2}$ Texel (D-T)). Effects of treatments were evaluated by analysis of variance using the *MIXED* procedure of SAS software. The block and the diets had an effect on total saturated fatty acids (SFA) ($P=0.001$, $P=0.03$), monounsaturated fatty acids (MUFA) ($P=0.017$, $P=0.002$) and on the ration of unsaturated/saturated fatty acids (UFA/SFA) ($P=0.002$, $P=0.03$) and monounsaturated/saturated fatty acids (MUFA/SFA) ($P=0.002$, $P=0.002$). The meat of D-SI crossbred type had a higher proportion of SFA (48.30%), lower proportion of MUFA (43.66%) and lower ratio of UFA/SFA (1.08%) and MUFA/SFA (0.91%) when compared to the D-T (SFA=45.62, MUFA=45.14, UFA/SFA=1.20, MUFA/SFA=0.99%). The meat of animals fed diets with whole cottonseed (CA10, CA20 and CA20H) had a higher proportion of SFA (46.96, 48.17 and 47.58%), lower proportion of MUFA (44.23, 43.52 and 43.27%) and consequently lower ratio of UFA/SFA (1.13, 1.08 and 1.11%) and MUFA/SFA (0.94, 0.90 and 0.91%) when compared with the control diet CA0 (SFA=45.12, MUFA=46.58, UFA/SFA=1.22 and MUFA/SFA=1.04%). Whole cottonseed supplementation increased meat SFA and decreased MUFA. The effect of gender was significant for total polyunsaturated fatty acids (PUFA) ($P=0.007$), omega 6 ($\omega 6$) ($P=0.004$) and for the ratio of PUFA/SFA ($P=0.008$) in the animals meat. The male meat presented a higher proportion of PUFA (9.71%) and $\omega 6$ (8.24%) and a higher ratio of PUFA/SFA (0.21%) when compared to the female meat (PUFA=7.57, $\omega 6$ =5.83, PUFA/SFA=0.16).

Key Words: Sub Product, Small Ruminant, Fat Acid Profile

TH282 Effects of added protein and dietary fat on lamb performance and carcass characteristics when fed differing levels of dried distiller's grains with solubles. M. L. Van Emon*, A. F. Musselman, P. J. Gunn, M. K. Neary, R. P. Lemenager, and S. L. Lake, *Purdue University, West Lafayette, IN.*

The objective of this study was to evaluate the influence of dietary protein and fat in dried distiller's grains with solubles (DDGS) on feedlot performance and carcass characteristics in finishing lambs. Sixty crossbred lambs were allotted (33.17 ± 4.67 kg) into pairs (ewe and wether) and fed one of five isocaloric dietary treatments: 1) a corn based diet with DDGS included to meet CP requirements (25% of DM; CON), 2) CON with DDGS included at twice the amount of CON (50% of DM; 50DDGS), 3) CON with added protein to equal the CP in the 50DDGS diet (CON+CP), 4) CON with added vegetable oil to equal the fat in the 50DDGS diet (CON+VO), and 5) CON with protein and fat added to equal the CP and fat in the 50DDGS diet (CON+CPVO). Lambs were harvested when they obtained an approximate 12th rib fat

depth of 0.51 cm. Average number of days on study did not differ ($P = 0.78$) between treatments. Average daily gain ($P = 0.48$) and final BW ($P = 0.69$) were not influenced by treatments. However, G:F tended ($P = 0.13$) to be lower in CON (0.0480 ± 0.0042), CON+CP (0.0448 ± 0.0053), and CON+VO (0.0476 ± 0.0064) than 50DDGS (0.0732 ± 0.0374) and DMI tended ($P = 0.14$) to be higher in CON (4.92 ± 0.90 kg/pen/d) and CON+VO (4.82 ± 0.66 kg/pen/d) than 50DDGS (3.62 ± 1.34 kg/pen/d). Dietary treatment did not affect HCW ($P = 0.79$), dressing percentage ($P = 0.34$), 12th rib fat depth ($P = 0.71$), LM area ($P = 0.67$), body wall thickness ($P = 0.57$), yield grade ($P = 0.71$), flank streaking ($P = 0.62$), leg score ($P = 0.96$), or ether extract ($P = 0.36$). Although DMI tended to decrease and G:F tended to increase in the 50DDGS treatment, added CP or fat from DDGS had no overall effect on lamb performance or carcass characteristics. Therefore, these data indicate that DDGS can be included in feedlot lamb diets at levels up to 50% of DM without affecting overall performance or carcass quality.

Key Words: Distiller's Grains with Solubles, Lamb, Performance

TH283 Two levels of dried distillers grains with solubles on growth performance and carcass characteristics of Pelibuey sheep. A. Estrada-Angulo*, E. J. Lopez, G. Contreras, B. I. Castro, J. F. Obregon, and A. B. Perez, *CA-205-FMVZ-UAS, Culiacan, Sinaloa, Mexico.*

To determine the effect of two levels of dried distillers grains with solubles (DDGS) substituting partially at whole corn grain on growth performance and carcass characteristics of Pelibuey sheep. 20 Pelibuey ram lambs (BW= 33.1 kg) were fed for 70 days in a randomized block experiment design. The animals were weighed and blocked by weight in 10 groups of two, placed into 10 (2 × 3 m) floor pens, and assigned to one of two diets: 1) DDG25 had 17.3% CP and 3.53 Mcal DE/kg, and contained 25% dry distillers grains with solubles, 12.5% Sudan hay, 52% whole corn grain, without soybean meal, 8% sugarcane molasses, and 2.5% mineral premix; 2) like Control, DDG40 had 18.4% CP and 3.53 Mcal of DE/kg, but contained 40% DDGS and 37% whole corn grain. Feed was offered twice daily under free access conditions. In the first 35 days of the experiment, diet had no effect on ADG (265 and 255 g/day), DMI (1.109 and 1.149 kg/day), or feed/gain (4.132 and 4.556) for DDG25 and DDG40 respectively. Also, for the entire 70-d period, ADG (267 and 263 g/d), final weight (51.69 and 51.65 kg), and feed/gain (4.61 and 4.68) were similar ($P > 0.05$) for DDG25 and DDG40 respectively. Hot carcass weight (29.8 and 29.83 kg), dressing percent (57.6 and 57.7%), fat thickness (0.24 and 0.24 inches), rib eye area (15.74 and 15.23 square centimeters), carcass length (114 and 115.6 cm), leg circumference (45.4 and 46.8 cm), were not affected by DDGS level. It is concluded, that dry distillers grain with solubles can substitute partially in 25 or 40 % at whole corn grain in complete diets for Pelibuey sheep.

Key Words: Dried Distillers Grains, Whole Corn Grain, Pelibuey Sheep

TH284 Dried distillers grains as a supplement for grazing ewe lambs. I. Susin*¹, D. D. Clevenger², G. D. Lowe², P. A. Tirabasso², and S. C. Loerch², ¹*Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo(USP), Piracicaba, SP, Brazil,* ²*The Ohio State University, Wooster.*

Dried distillers grains plus solubles (DDGS) is a by-product of ethanol production and is a good source of protein and energy for ruminants. Frequently, weaned ewe lambs do not meet their nutritional requirements when pasture is the sole source of feed. When nutritional requirements are not met, growth rate is reduced and animals may be more vulnerable to parasite infection. Sixty-two ewe lambs (24.5 ± 0.5 kg BW and 2 mo. old) were used to determine the effects of supplementing DDGS on grazing performance and parasite status. Four orchardgrass paddocks were used with 15 or 16 lambs each. Ewe lambs in each paddock were randomly assigned to one of two experimental treatments: 1) control (only pasture), or 2) DDGS =1.3% BW of DDGS supplementation on pasture. Paddock was considered the experimental unit and a totally randomized design was used. Supplementation of DDGS started one week before weaning and continued throughout the grazing period. Weight and anemia status (via eye scoring=FAMACHA) were recorded for all lambs weekly during the grazing period. An anthelmintic dose was administered orally to ewe lambs that had FAMACHA score of 3 or more. Blood packed cell volume (PCV) and fecal egg count (FEC) were determined for all lambs on d 21, 49 and 69 post-weaning, as well as for those that required deworming based on FAMACHA score. A logarithmic transformation was used for the FEC data. ADG was greater ($P < 0.08$) for DDGS supplemented lambs (147 ± 23 vs. 252 ± 23 g) during the grazing period. Percentage of lambs treated with anthelmintic was greater ($P < 0.07$) for control (65.6 ± 5) compared to DDGS groups (40.0 ± 5). However, there was no effect of supplementation on FEC or PCV. For the ewe lambs not treated with anthelmintic, ADG was greater ($P < 0.03$) for those supplemented with DDGS (249 ± 14 g) compared to controls (132 ± 14 g). On day 21 post weaning, control lambs had a greater ($P = 0.037$) FEC compared to the DDGS group. Supplementation of grazing lambs with DDGS increased ADG and reduced post weaning susceptibility to internal parasite infection.

Key Words: Distillers Grains, Parasite, Sheep

TH285 Dried distillers grains as a supplement for finishing ewe lambs. I. Susin*¹, A. Radunz², D. D. Clevenger², G. D. Lowe², P. A. Tirabasso², and S. C. Loerch², ¹*Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo(USP), Piracicaba, SP, Brazil,* ²*The Ohio State University, Wooster.*

Dried distillers grain plus solubles (DDGS) have a high amount of fat. Fat supplementation can affect performance and ruminant carcass composition. Sixty-two ewe lambs were used in a feedlot experiment to determine the effects of supplementation with DDGS on performance, carcass characteristics and meat quality of lambs fed corn or DDGS based diets. During a preceding 10 wk grazing period lambs were housed in four separate orchardgrass paddocks. Half of the lambs (2 paddocks) were supplemented with DDGS at 1.3% of BW. After the grazing period, lambs were placed in four feedlot pens (maintaining integrity of the groups) for the finishing experiment. Ewe lambs were fed either a corn-based finishing diet (control=CT) or a finishing diet containing 30% DDGS (DDGS) on a DM basis. The DDGS replaced corn and soybean meal in the control diet. A 14d adaptation period was used, at the beginning of the feedlot phase, to gradually adjust lambs to the feedlot diets. When the final average target weight (52kg) was reached, 16 lambs from each feeding regimen were slaughtered. Initial BW in the feedlot was 35.0 and 41.3 kg for CT and DDGS lambs, respectively. There was no difference ($P = 0.70$) in ADG (268 vs. 274 g for the control and DDGS group, respectively). However, total DMI was higher ($P = 0.001$) for control (106.9 kg/head) than DDGS (71.9

kg/head) ewe lambs, because control lambs needed 3 additional weeks to attain the targeted slaughter weight. There were no differences in carcass wt (26.6 vs. 26.4 kg), dressing percentage (53.7 vs. 53.5), back fat depth (0.63 vs. 0.64 cm), body wall thickness (1.83 vs. 1.79 cm), LM area (14.7 vs. 15.2 cm²), slice shear force (14.1 vs. 9.9 kg), cooking losses (17.5 vs. 19.2%), total fat (4.1 vs. 4.2%), color or quality grade due to feeding regimen. However, lambs fed DDGS showed a tendency ($P < 0.10$) to accumulate more soft back fat compared to the control group (6.25 vs. 25%). Supplementing DDGS to grazing and finishing ewe lambs decreased days on feed during the finishing phase. However, DDGS supplementation may change characteristics of the back fat deposited.

Key Words: DDGS, Feedlot, Sheep

TH286 Effects of barley straw treated with different levels of urea and elemental sulfur in diets of late gestation ewes: effects on lambing and dietary In vitro digestibility. K. RezaYazdi*, H. Khalilvandi, and N. Vahdani, *University of Tehran, Karaj, Tehran, Iran.*

The various cereals extensively cultivated for grain production also generate large amounts of straw with a high cell wall content of poor digestibility. Urea ammoniation makes polysaccharides more available to enzymatic hydrolysis. However this treatment may result in additional sulfur needs of the animal for synthesis of sulfur containing amino acids by rumen microorganism, considering that straws have low levels of sulfur. The purpose of the present trial was to assess the sulfur supplementation of urea-treated barley straw on performance of late gestation ewes. This was done using 72 Varamini late pregnant (90 days) ewes until parturition, with 9 dietary levels of urea (5% solution) treated barley straw (UTBS) and elemental sulfur (ES), in 3×3 factorial design in a CRD (3 levels of UTBS: 0, 20 and 40 percent and 3 levels of ES: 0, 0.1 and 0.2 percent). The lambs were fed 9 isocaloric and isonitrogenous diets for 60 days according to NRC. Lambs were weighed immediately after parturition. The method of Tilley and Terry was used for In vitro digestibility.

The results indicated that ewes that received 40% UTBS and 0.2% ES had highest lamb birth weight (4.82 kg). Animals that consumed 67.66 % barley straw without any treatment had lowest lamb birth weight (3.76kg) and DMI. Differences among treatments in the case of DMI and feed conversion ratio (FCR) were not statistically significant. TMRs containing 40% UTBS and 0.2% ES had highest in vitro digestibility of dry matter and organic matter.

Results showed that sulfur supplemented urea treated barley straw improved lamb birth weight and DM and OM digestibility values.

Table 1. Differences of LBW and IVDMD, between dietary treatments

	1	2	3	4	5	6	7	8	9
LBW	3.7 ^a	4.0 ^{ab}	3.9 ^a	4.0 ^a	4.3 ^{abc}	4.7 ^c	4.2 ^{ab}	4.7 ^{bc}	4.8 ^c
IVDMD	61.0 ^a	66.0 ^b	67.5 ^{bc}	65.9 ^b	69.8 ^{cd}	70.9 ^d	71.8 ^d	74.8 ^e	75.4 ^e

1: 0% UTBS, 0% ES, 2: 0% UTBS, 0.1% ES, 3: 0% UTBS, 0.2% ES, 4: 20% UTBS, 0% ES, 5: 20% UTBS, 0.1% ES, 6: 20% UTBS, 0.2% ES, 7: 40% UTBS, 0% ES, 8: 40% UTBS, 0.1% ES, 9: 40% UTBS, 0.2% ES. Means within a row with different superscripts differ. ($p < 0.05$).

Key Words: Barley Straw, Urea, Sulfur

TH287 Effects of urea treated barely straw and inorganic sulfur inclusion on in vitro digestibility of TMR and performance of fattening Varanini lambs. K. RezaYazdi*, N. Vahdani, and H. Khalilvandi, *University of Tehran, Karaj, Tehran, Iran.*

Winter small grains, especially wheat and barley, are an important part of the typical crop rotation system. Providing N requirement of ruminants partly with NPN sources, leading to increase in sulfur requirements for maximizing microbial protein synthesis. It is anticipated that sulfur addition in rations contain different level of urea treated barely straw (UTBS), improved ruminant productivity. An experiment carried out to study effects of different levels of UTBS (5% solution) and elemental sulfur (ES) in fattening lambs, using 72 Varamini lambs (38.38±3.91), in 3×3 factorial method in a CRD. (First factor: 3 levels of UTBS 0, 15 and 30 percent and second factor 3 levels of ES 0, 0.1 and 0.2 percent). The lambs were fed 9 isocaloric and isonitrogenous diets for 90 days according to NRC recommendations. Method of Tilley and Terry was used for In vitro digestibility. The results showed significant ($p < 0.05$) differences among lambs in daily live weight gain, DMI, and feed conversion ratio. The lambs received diets containing 30 % UTBS supplemented with 0.2 % ES, had highest live weight gain (LWG), while control group that consumed 21 % untreated barely straw had lowest LWG (173.3 g/d vs. 126.5 g/d, respectively). No statistically significant interaction among dietary levels of UTBS and ES was observed. Results of In vitro digestibility trial showed that total mixed rations contained 30% UTBS and 0.2 % ES had highest dry matter and organic matter digestibility values than other treatments.

As results showed, dietary levels of 30% UTBS supplemented with 0.2% ES can be used in order to improve live weight gains in lambs.

Key Words: Barley Straw, Urea, Sulfur

TH288 Effects of protein sources on performance and carcass characteristics of feedlot lambs and Small Ruminant Nutrition System estimates evaluation. M. A. A. Queiroz, I. Susin, A. V. Pires, C. Q. Mendes*, O. C. Almeida, R. S. Gentil, R. C. Amaral, A. L. Gastaldello Jr., and G. H. Rodrigues, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, SP, Brazil.*

Mathematical models have been developed to assess sheep nutritional requirements; however, the challenge in these systems has been to accurately predict dry matter intake. Twenty-eight Santa Ines ram lambs (initial BW 20 ± 2 kg and 75 ± 5 d old) were used to determine the effects of protein sources in high grain diets on performance and carcass characteristics and to evaluate the Small Ruminant Nutrition System (SRNS) performance data estimates. Lambs were assigned to a complete randomized block design according to body weight and age at beginning of the trial and were penned individually. Lambs were fed an isonitrogen, total mixed ration, composed by 90% concentrate and 10% coarstcross hay (*Cynodon* spp) during 56 days. Experimental diets were formulated according to the Small Ruminant Nutrition System (version 1.8.1) and differed on protein source: soybean meal (SM), peanut meal (PM), canola meal (CM) or cottonseed meal (CSM), corresponding to the experimental treatments SM, PM, CM and CSM, respectively. There were no differences ($P > 0.05$) among treatments for dry matter intake (DMI), average daily gain (ADG) and feed conversion (FC). Daily DMI averaged 1.2, 1.1, 1.0 and 1.2 kg, ADG results were 330, 316, 284 and 311 g and FC were 3.5, 3.4, 3.7 and 3.8 kg MS/kg gain for the SM, PM, CM and CSM, respectively. In addition, carcass characteristics were not affected ($P > 0.05$) by protein source. SRNS predicted values for daily

DMI (1.3, 1.2, 1.0 and 1.3 kg) were greater ($P < 0.01$) than observed values. However, ADG estimates (319, 313, 280 and 304 g) were similar ($P > 0.05$) compared to observed experimental data. SRNS evaluation for feedlot lambs, based in these experimental data, showed good estimates for ADG and overestimated values for DMI.

Key Words: Canola, Cottonseed, Peanut

TH289 Total replacement of soybean meal by urea in high grain diets for feedlot lambs. C. Q. Mendes*, I. Susin, A. V. Pires, M. A. A. Queiroz, F. S. Urano, G. H. Rodrigues, R. S. Gentil, E. M. Ferreira, and M. V. Biehl, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, SP, Brazil.*

Dietary crude protein source for animals fed high grain diets influences ruminal nitrogen and energy utilization as well as small intestine flow of nutrients. Twenty-eight Santa Ines ram lambs (initial BW 21.7 ± 3.0 kg and 93 ± 4.0 d old) were used to evaluate the effects of replacing soybean meal by urea in high grain diets on performance and carcass characteristics. Lambs were assigned to a complete randomized block design according to BW and age at beginning of the trial and were penned individually. Lambs were fed a TMR composed by 90% concentrate and 10% coastcross hay during 56 d. Soybean meal in the control diet (UR0) was replaced by urea at 0.7; 1.4 and 2.1% on a DM basis, corresponding to the experimental treatments UR0.7; UR1.4 and UR2.1, respectively. A 9 d adaptation period was used at the beginning of the feedlot to gradually adjust lambs to the experimental diets with high level of urea. When the final targeted weight (40kg) was attained, lambs were slaughtered and carcass characteristics were recorded. There were no differences ($P > 0.05$) among treatments for dry matter intake (1.11, 1.11, 0.96 and 1.05 kg/d for the UR0, UR0.7, UR1.4 and UR2.1, respectively). However, ADG ($P < 0.02$) and feed efficiency ($P < 0.06$) decreased linearly with higher levels of urea (ADG: 0.296, 0.303, 0.246 and 0.257 g and G:F: 0.27, 0.27, 0.25 and 0.24 for the UR0, UR0.7, UR1.4 and UR2.1, respectively). Carcass parameters (dressing percentage, chilling losses, cooking losses, back fat depth, Longissimus muscle area and shear force) were not affected ($P > 0.10$) when urea was added to the diet. Replacing soybean meal by urea in high grain diets fed to feedlot lambs decreased ADG and G:F with no change on dry matter intake. Although total replacement of soybean meal by urea decreased ADG by 14.3%, its inclusion in the diet provided satisfactory feedlot lamb performance and carcass characteristic.

Key Words: Hair Sheep, NPN, Urea

TH290 Effects of replacing corn by soybean hulls on apparent digestibility of nutrients and ruminal parameters in lambs. E. M. Ferreira, A. V. Pires, I. Susin, C. Q. Mendes*, R. C. Araujo, M. A. A. Queiroz, F. S. Urano, R. S. Gentil, R. C. Amaral, and S. Gilaverte, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, SP, Brazil.*

Soybean hulls (SH) are an alternative feed source for ruminants and, due to its high level of digestible fiber and energy value, it can partly or totally replace forages or energetic ingredients. Sixteen Santa Ines ram lambs (BW 44.0 ± 5.0 kg), housed in individual metabolism crates were used to evaluate the effects of partial replacement of corn by SH

on apparent digestibility of nutrients and ruminal parameters. Lambs were assigned to one of four treatments in a complete randomized block design. The control treatment (SH0) was a diet containing 70% of corn on a DM basis. On the others diets, corn was replaced by SH at 15, 30 and 45%, corresponding to the experimental treatments SH15, SH30 and SH45, respectively. All diets were isonitrogen, containing 90% of concentrate and 10% coastcross hay (*Cynodon* spp). There was no effect on apparent digestibility of DM, NFC, CP, EE, ruminal ammonia and total VFA concentrations. However, NDF digestibility (55.5; 62.5; 66.6 and 68.1%), acetate concentration (26.0; 30.4; 37.1 and 41.9 mM) and ruminal pH (6.0; 6.0; 6.1 and 6.2) increased linearly ($P < 0.10$), while TDN values (84.5; 83.4; 80.2 and 78.9 % of DM) and digestible energy concentration (3.72; 3.68; 3.54 and 3.48 Mcal/kg of DM) reduced linearly ($P < 0.10$) for the SH0, SH15, SH30 and SH45 treatments, respectively. Propionate concentration (21.9; 29.4; 16.0 and 7.6 mM) showed a quadratic response ($P < 0.05$) for the SH0, SH15, SH30 and SH45 treatments, respectively. Soybean hulls added at 31.5% on DM basis (SH45) improved NDF digestibility, acetate production and ruminal pH. In addition, soybean hulls may reduce ruminal acidosis occurrence in high grain diets for lambs.

Key Words: By-Products, High Grain Diet, Hair Sheep

TH291 Performance and carcass characteristics of lambs fed wet low pectin citrus pulp in partial replacement of dried citrus pulp. G. H. Rodrigues, I. Susin, A. V. Pires, L. G. Nussio, C. Q. Mendes*, R. S. Gentil, E. M. Ferreira, M. V. Biehl, and F. S. Urano, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, SP, Brazil.*

Dried citrus pulp (DCP) is a co-product with a high pectin concentration. Pectin is used as a gelling and thickening agent and can be obtained by partial extraction from citrus peels. This partial extraction results in a residue containing: 15% DM, 7.5% CP, 69% NDF, and 22% pectin and, in this trial, it was named wet low pectin citrus pulp (WLPCP). The objective of this study was to evaluate the effects of partial replacement of DCP by wet low pectin citrus pulp (WLPCP), wet low pectin citrus pulp silage (WLPCPS) or wet low pectin citrus pulp silage with sodium benzoate (WLPCPS+B) on performance and carcass characteristics of Santa Ines ram lambs. Sixty-four lambs (initial BW 17 ± 2 kg and 75 ± 5 d old) were used to determine average daily gain (ADG), dry matter intake (DMI), gain:feed (G:F). Lambs were allotted in a complete randomized block design according to BW and age at beginning of the trial. Lambs were fed 95% concentrate and 5% sugarcane bagasse diets with 16% CP for 56 days. The control diet contained 69.5% DCP while in the other treatments fresh or ensiled WLPCP replaced DCP by 30% on a DM basis. Diets were fed once a day as a TMR. At the end of the performance trial, 40 animals were slaughtered (BW 36 ± 1.6 kg) to evaluate carcass characteristics. There were no differences ($P > 0.05$) in daily DMI (960, 828, 880, and 889 g) and ADG (226, 216, 218, and 224 g) for DCP, WLPCP, WLPCPS and WLPCPS+B, respectively. However, G:F was greater for lambs fed WLPCP compared to lambs fed DCP (0.265 vs 0.235, $P = 0.03$). Dressing percentage, chilling losses, back fat depth and Longissimus muscle area averaged 49%, 3.7%, 1.7 mm and 13.4 cm^2 , respectively and were unaffected ($P > 0.05$) by experimental diets. Partial replacement of dried citrus pulp by wet low pectin citrus pulp residue can be an interesting alternative for feedlot lambs, without affecting carcass characteristics.

Key Words: Hair Sheep, Pectin, Co-Product

TH292 Apparent digestibility and ruminal parameters of diets containing sugarcane silage with or without additives or fresh sugarcane fed to lambs. R. C. Amaral, A. V. Pires, I. Susin, C. Q. Mendes*, E. M. Ferreira, R. S. Gentil, M. V. Biehl, M. A. A. Queiroz, and G. H. Rodrigues, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, SP, Brazil.*

Objectives of this experiment were to evaluate the effects of chemical additives in sugarcane silage on dry matter intake, apparent digestibility, and ruminal parameters of cannulated ram lambs fed diets containing experimental silages (50% dietary dry matter). A diet containing fresh sugarcane was also assessed. Sixteen Santa Ines ram lambs, kept in metabolism crates, were distributed in a complete randomized block design. The experimental period was 15 days. Lambs were adapted to the experimental diets for 10 days and feces were sampled in the next 4 days. Ruminal fluid samples were taken at 0,2,4,6,8,10 and 12 hours after feeding in the last day of experimental period. Four experimental diets were used: fresh sugarcane, sugarcane silage without additive, sugarcane silage containing calcium oxide (1% on as-fed basis), and sugarcane silage containing limestone (1% on as-fed basis). There was no difference ($P>0.05$) among treatments for dry matter intake (mean DMI = 0.85 kg/day). Differences ($P<0.05$) were observed for dry matter digestibility, with the highest value (74.6%) observed for diets containing fresh sugarcane. Differences ($P<0.05$) also were observed for digestible NDF intake and the highest value (0.12 kg/day) was observed for diets containing 1% calcium oxide treated silage. There were no differences for treatment, hour after feeding, and treatment x hour interaction ($P>0.05$) effects on total volatile fatty acids, acetate and propionate concentrations, with mean values of 74.4, 42.6 and 18.6 mM, respectively. Butyrate concentration (11.9 mM) was highest for animals fed 1% calcium oxide treated silage. Mean acetate:propionate ratio was 2.4. Ruminal pH was not affected ($P>0.05$) by treatment, with mean value of 6.3. Addition of 1% of calcium oxide and limestone during sugarcane ensilage did not affect intake and digestibilities of diets fed to ram lambs when compared with the diet containing the non-treated silage. Sugarcane silages showed similar ruminal fermentation compared to fresh sugarcane.

Key Words: Calcium Oxide, Limestone, Hair Sheep

TH293 Effects of monensin, sodium bicarbonate and limestone sources on nutrient digestibilities in high grain diets fed to lambs. A. L. Gastaldello Jr., A. V. Pires, I. Susin, C. Q. Mendes*, G. H. Rodrigues, F. S. Urano, M. V. Biehl, R. S. Gentil, and G. B. Mourão, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, SP, Brazil.*

This trial was performed to evaluate the apparent digestibility and ruminal parameters (pH, total volatile fatty acids and N-NH₃) of diets containing two sources of limestone and sodium bicarbonate (NaHCO₃), with or without monensin (30 mg/kg on a DM basis). Twenty-four lambs were assigned to a complete randomized block design in a 3 x 2 factorial arrangement. Treatments were: L=1.3% limestone; FL = 1.3% Filler limestone; L + SB = 1.3% limestone + 1% NaHCO₃; with or without monensin. Diets contained 90% concentrate and 10% coastcross hay (*Cynodon* spp). FL treatments had greater ($P<0.05$) dry matter (DM=82.6%), organic matter (OM=83.2%) and crude protein

(CP=72.8%) digestibilities compared to the other buffers average (DM=76.9; OM=77.6 and CP=63.4%). Neutral detergent fiber digestibility was higher (59.2%) for monensin treatments compared to treatments without monensin (34.4%). There were no differences ($P>0.05$) in nitrogen metabolism, ruminal pH, water intake, acetate:propionate ratio and butyrate concentration among treatments. There was an interaction between FL and monensin. When monensin was added, there was a reduction of 45.4; 25.8; 19.4 and 34.3% for N-NH₃, total volatile fatty acid, acetate and propionate concentrations, respectively. There was also interaction between L + SB and monensin showing an increase in total volatile fatty acids (18.5%), acetate (16.1%) and propionate (27.9%) concentration. FL did not show benefits on ruminal parameters, however increased DM and CP digestibility and in combination with monensin there was an associative negative effect on ruminal parameters. Sodium bicarbonate showed positive associations in presence of monensin, increasing ruminal total volatile fatty acids concentration, however, had no detrimental effects on nutrient digestibility.

Key Words: Buffer, Ionophor, Hair Sheep

TH294 Use of salt for limiting supplement intake for hair sheep fed buffel grass (*Cenchrus ciliaris* L.). H. Morales-Treviño^{*1}, M. Mireles¹, E. Gutierrez-Ornelas^{1,2}, H. Bernal-Barragan¹, J. Colin-Negrete¹, F. Sanchez-Dávila¹, and C. Rodriguez-Alvarado³, ¹Facultad de Agronomía, Universidad Autónoma de Nuevo León, Marín, Nuevo León, México., ²Consortio Técnico del Noreste de México, Guadalupe, Nuevo León, México, ³Instituto Tecnológico de Altamira, Altamira, Tamaulipas, México.

Intake regulation of supplement by sheep can be a useful practice for semi-intensive production systems. The objective of this study was to estimate the maximum amount of salt intake by hair sheep fed with buffel grass. Five levels of salt in concentrate (1, 6, 11, 16 and 21%) were used in order to allow sheep to consume up to 600 g/d of supplement. Twenty five Saint Croix ewes (BW: 23.6 ± 1.7 kg) were individually fed with ground buffel grass hay (8 cm long) during 63 d. Intake of salt+supplement and buffel hay were recorded daily. Changes in live body weight and daily water consumption were estimated every 14 d. A regression analysis was performed to describe the maximum intake of salt by sheep, and the effect of treatments was analyzed by ANOVA using a completely random design. A substitution effect for DMI was found ($P<0.05$) when lower levels of salt were included in the concentrate. Highest ($P<0.05$) DMI from buffel grass (318.5 g/day) was registered when ewes received supplements with 21% of salt, whereas the least DMI of buffel grass (176.0 g/day) was obtained by 1% salt in the supplement. Dry matter supplement intake (DMSI) and salt intake (SI) were quadratically affected ($P<0.05$; $r^2=0.86$ and $r^2=0.93$, respectively) by salt level (SL), with prediction equations as follows: DMSI, $g = 514.8 - 10.29SL - 0.968SL^2$; SI, $g = -7.75 + 10.17SL - 0.261SL^2$. Maximum daily salt intake in hair sheep was predicted as 91.3 g when salt is included as 19% of the supplement. Ewes receiving supplements added with up to 16% salt had similar ($P>0.05$) ADG (89.6 g) but different ($P<0.05$) than those consuming supplement with 21% salt (37.0 g). Daily water intake was not affected ($P>0.05$) by SL. Hair sheep limited their daily supplement intake when salt consumption was 91.3 g.

Key Words: Salt, Hair Sheep, Buffel Grass

SYMPOSIA AND ORAL SESSIONS

Dairy Foods: Dairy Products and Processing II

509 ADSA Pioneer: Collegiate dairy products evaluation-past and future. R. T. Marshall*, *University of Missouri, Columbia.*

Collegiate Dairy products evaluation was initiated to help train students on the attributes of dairy products and to set standards for good products. Soon team were formed and competitions were initiated. Both regional and national events were organized to increase team participation and training. Over the years milk quality and product quality has improved, thus some defect that were common in the early days of evaluation are no longer a problem. However, as modern technology improved manufacturing other problems became apparent. Thus, collegiate evaluations are as important today as they were 5 decades ago.

510 Performance comparison of ceramic and polymeric microfiltration (MF) membranes for separation of casein and serum protein (SP) from skim milk at 50°C. J. Zulewska*¹, M. W. Newbold², and D. M. Barbano², ¹*University of Warmia and Mazury, Olsztyn, Poland,* ²*Cornell University, Ithaca, NY.*

Skim milk was pasteurized (72°C for 16 s), cooled and split into 3 batches for processing with different MF membranes: 0.1 micron ceramic uniform transmembrane pressure (UTP) 763 kg of milk in 342 min with 1.7 m² of membrane, 0.1 micron ceramic gradient porosity (GP) 780 kg of milk in 264 min with 1.7 m² of membrane, and 0.3 micron polymeric (polyvinylidene fluoride) spiral wound (SW) 1167 kg of milk in 130 min with 20.5 m² of membrane. For all membranes, a bleed and feed filtration was applied for continuous production of 3X MF retentate at 50°C and replicated 3 times. Flux was recorded every 10 or 15 min during the process run and mean flux (\pm SD) for UTP, GP, and SW were significantly different: 54.1 \pm 1.52, 71.8 \pm 1.68 and 16.2 \pm 4.75 (kg/m²/h), respectively. The mean SP content in the MF permeate portion of the skim milk was 0.62%. The true protein content (Kjeldahl total nitrogen minus nonprotein nitrogen multiplied by 6.38) of the MF permeates from UTP, GP and SW were 0.57, 0.56, and 0.38% respectively, with both UTP and GP significantly higher than SW. Therefore, the coefficients

of rejection for milk SP by the 3 membranes were 0.074, 0.090, and 0.383 and mean SP removal was 64.4, 61.0 and 38.6% of the original total weight of SP in the milk for UTP, GP and SW, respectively, with all means being significantly different. The UTP membranes produced a 64 to 65% SP reduced 3X MF retentate in one stage. The SW membranes would require a second stage with diafiltration using UF permeate to produce an MF retentate with about 65% SP reduction and the same background concentration of lactose and soluble minerals. The relative proportions of different SP may differ among the MF permeates and retentates with different systems. The MF permeate opacity increased with increasing L value: UTP 19.4, GP 19.9, and SW 20.5, with all permeates being significantly different from each other. MF permeate clarity may be important when the SP concentrates are used for clear nondairy beverage fortification.

Key Words: Microfiltration, Serum Proteins, Separation

511 Functional properties of whey proteins affected by heat and high pressure shearing. M. Dissanayake and T. Vasiljevic*, *Victoria University, Melbourne, VIC, Australia.*

Whey proteins (WP) are a functionally excellent food ingredient extensively used in various food applications. The major challenge affecting their functionality and applicability is the heat-induced destabilization during WP concentration, processing and preservation of food products containing WP.

The main objective of this study was to examine the effects of complete protein denaturation and extent of dynamic high-pressure shearing on colloidal and surface properties of microparticulated WP to produce novel ingredients with improved heat stability and modulated functionalities.

The study was carried out using randomised full factorial design with heat and high pressure as the major factors. Two different batches of WP retentates (10% protein content, pH 7) were subjected to complete heat denaturation and pressure sheared using different number of passes

at 140Mpa. Microparticulated WP were then spray dried. All powders were assessed for their solubility, heat stability and coagulation time, emulsifying and foaming properties. Effects of denaturation and shearing were also examined using SDS-PAGE and size exclusion HPLC. Heat treatment significantly decreased the solubility of treated samples while the number of passes markedly improved it. The combined effect of heat and pressure significantly improved the heat stability as depicted by the heat coagulation time. The emulsifying activity index also significantly increased upon heat denaturation, which was even further enhanced by pressure. The emulsion stability appeared unaffected by the combined treatment, but the concentration of adsorbed protein on the surface of fat droplets increased significantly. Foaming properties (overrun and foam stability) were detrimentally affected by heating. SDS-PAGE and SE-HPLC revealed disappearance of major WP and creation of high molecular weight aggregates and smaller molecular weight species as a result of heat and shearing. The study showed that this approach could be used to stabilize WP against heat by producing various microparticulated species, which also have different surface and colloidal properties from native WP.

Key Words: Whey Proteins, Microparticulation, Functionality

512 Production of whey protein concentrate 80 with improved clarity and flavor. I. Jarto^{*1}, J. A. Lucey¹, S. Damodaran¹, S. A. Rankin¹, and K. E. Smith², ¹*University of Wisconsin, Madison*, ²*Wisconsin Center for Dairy Research, Madison, WI*.

The objective of our study was to develop a pilot-scale whey pretreatment process that reduced the residual lipids in whey protein concentrate 80 (WPC80) to < 1% by employing chitosan to selectively precipitate lipids (US Patent# 5,436,014). Our hypothesis was that a reduction in the concentration of residual lipids in WPC80 would improve WPC clarity and flavor by removing small fat globules and phospholipids which are prone to oxidation. The process used a low concentration of chitosan (0.01% wt/wt), which formed a complex with membrane lipids at pH 4.5. The chitosan-lipid complex was allowed to settle and a 0.3 µm polymeric microfiltration (MF) membrane was utilized to process the supernatant from this reaction. There were 2 treatments and a control: WPC80 treated with chitosan and followed by MF (WPCC); WPC80 treated with MF only (WPCB); and WPC80 without chitosan or MF (WPCA). Treatments were done in duplicate. No significant differences were observed in flux during processing runs up to 4 hours with final retentate concentration factor of 12X. Fat content of the WPCC, WPCB, and WPCA was 0.46±0.07%, 0.46±0.02%, and 6.56±1.31%, respectively. The turbidity was measured by absorbance at 500 nm (5% protein solution). The absorbance values for the WPCC, WPCB, and WPCA were 0.05±0.01, 0.08±0.01, and 2.61±0.20, respectively. Commercial samples of WPC80 (WPCG) and whey protein isolate had absorbance values of 2.91±0.10 and 0.08±0.02, respectively. Samples were subjected to an accelerated storage (4 d at 60°C). WPCG and the WPCA browned considerably and developed intense off-flavors. WPCC remained white and WPCB underwent slight browning; both exhibited low levels of off-flavor development. Gas Chromatography-Mass Spectrometry was used to evaluate volatiles in WPC samples. Our study showed that chitosan pretreatment in the production of WPC80 resulted in greatly improved clarity and suppressed off-flavor and color development during accelerated storage, which suggested that this ingredient could be used to fortify clear beverages or be used in baking applications where browning was not desired.

Key Words: Whey Protein Concentrate, Chitosan, Clarity

513 Production of structured lipids containing palmitic acid for infant milk formulation and characterization of their oxidative stability. C. O. Maduko¹, C. C. Akoh¹, R. R. Eitenmiller¹, and Y. W. Park^{*2,1}, ¹*University of Georgia, Athens*, ²*Fort Valley State University, Fort Valley, GA*.

Developing infant milk fat similar to human milk fat (HMF) is of great interest and challenge to food processors. The sn-1,3 positions of the triacylglycerols of most vegetable oils are occupied mainly by saturated fatty acids, while these positions of human milk contain mainly unsaturated fatty acids. Structured lipids containing similar fatty acid structure as HMF can be produced by interesterification reactions using an sn-1,3-specific lipase that gives high selectivity and mimics the natural pathways of metabolic processes. This study was to produce structured lipids (SLs) for infant milk formulation by enzymatic interesterification of tripalmitin with vegetable oil blends and fish oil, and characterize oxidative stability of the starting oils, and their SLs with and without tocopherol. SLs were synthesized in a bioreactor by enzymatic interesterification of a 1:3 molar ratio of tripalmitin to oil blends. The SLs were analyzed for fatty acid content and structure, melting profiles, oil stability index (OSI), free fatty acid (FFA) and tocopherol content. The OSIs of different lipid preparations were determined at 110 oC with an Oil Stability Instrument by AOCS method. Oxidative stability was determined by quantifying FFA, peroxides (peroxide value) and aldehydes (p-anisidine value) production. Total oxidation (TOTOX value) was calculated as 2 x (peroxide value) + (p-anisidine value). The structured lipids after purification by distillation had melting profiles, oil stability index, and initial FFA concentration that were similar to that of the starting oils, while the fatty acid composition and structure of the SLs were similar to that of human milk fat. Oxidative stability of the SLs was improved with tocopherol addition as antioxidants and was comparable to that of the vegetable oils and oil blends.

Key Words: Infant Milk Formulation, Structured Lipids, Oxidative Stability

514 The impact of fat globules' colloidal stability on the pre-gelation stages of rennet coagulation process. Z. Gaygadzhiev*, M. Alexander, A. Hill, and M. Corredig, *University of Guelph, Guelph, ON, Canada*.

The effect of the state of flocculation of fat globules on the early stages of rennet-induced gelation of model recombined milk was investigated. Fat globules differing in their degree of flocculation and with well defined sizes were prepared by emulsifying anhydrous milk fat in solution of whey protein isolate. Pre-gelation behaviour of recombined milks was studied in situ using diffusing wave spectroscopy (DWS). In addition, confocal microscopy and small deformation rheology were employed to observe the gel microstructure and viscoelastic properties, respectively. DWS experiments revealed dissimilarity in the structural organization of rennet-induced gels containing non-flocculated and mildly flocculated WPI-stabilized fat globules, as observed by the development of the turbidity parameter, $1/l^*$. The evolution of storage moduli, G' , of recombined milk during the gelation process confirmed the results from the light-scattering experiments. Results demonstrate the importance of the aggregation state of the oil droplets in the formation of rennet-induced gels: mildly flocculated fat globules contributed to the formation of much stiffer gels compared to non-flocculated fat globules.

Key Words: Fat Globules' Flocculation, Rheology, Rennet Coagulation

515 Impact of changing temperature after measurable gelation on the properties of fermented milk gels. Y. Peng^{*1}, D. S Horne², and J. A. Lucey¹, ¹University of Wisconsin, Madison, ²Formerly of Hannah Research Institute, Ayr, Scotland.

Incubation temperature (IT) is an important parameter that affects many properties of yogurt gels including growth rate of culture, aggregation of caseins and strength of protein interactions. We wanted to understand how IT impacted gel properties by altering IT after we could instrumentally detect gel formation had occurred. This approach would help us to understand how IT influences events up to the initial measurable point of gel development as well as during the subsequent development of the gel network. Gels were made at different IT (30, 33.5, 37, 40.5 and 44°C) until gelation, then they were heated or cooled to 37°C at 1°C/min and maintained at 37°C until pH 4.6. Gelation was defined as the point when gels had a storage modulus (G') of ≥ 5 Pa. Control gels were made at these IT (i.e., no IT change during gelation or gel development). A single strain of *Streptococcus thermophilus* was used to avoid variations in the ratios of strains that could have resulted from changes in IT. Dynamic low amplitude oscillatory rheology was performed to monitor the formation of gels. Microstructure at pH 4.6 was studied using fluorescence microscopy. Whey separation was analyzed at pH 4.6. The gelation pH decreased and gelation time increased with a decrease in the IT used up to measurable gelation. There were no significant differences ($P < 0.05$) in G' values at pH 4.6, maximum loss tangent, microstructure and whey separation in gels that were made with different IT up to measurable gelation but had the same IT after that point. There were significant differences in properties of gels where different ITs were used without any IT changes during fermentation. Altering IT after measurable gel formation resulted in a change in the rate of development of G' and loss tangent of gels, indicating that IT altered the rate of rearrangements/fusion of caseins in the network. The results of this study suggested that changing IT during yogurt fermentation might be another approach to modifying the physical properties of yogurt. High IT could be used to reduce the gelation time and lower IT could be used to produce gels with improved textural properties.

Key Words: Gel, Temperature, Gelation

516 Rheological properties of stirred yoghurts made with whey protein isolate-pectin complexes as stabilizing agent. M.-C. Gentés^{*1,2}, S. L. Turgeon¹, and D. St-Gelais², ¹STELA Dairy Research Centre and Institute of Nutraceuticals and Functional Foods (INAF), Quebec, QC, Canada, ²Food Research and Development Centre, Agriculture and Agri-Food Canada, Saint-Hyacinthe, QC, Canada.

Problems of syneresis and viscosity in stirred yoghurts remain despite of the use of stabilizers. Whey protein isolate-pectin complexes can be used as stabilizers. Complex formation could confer different functional properties than individual compounds. Complexes were formed under associative conditions via electrostatic interactions at pH 4.5. As complexes were added at standardization step, they must be stable at pH 6.7. Prior study showed that a heat treatment at 90°C for 2 minutes was sufficient to stabilize them. Syneresis, apparent viscosity, hardness and microstructure were determined in stirred yoghurts produced with

unheated complexes (UC), heated complexes (HC), pectin used in complex formation (PC) and commercial pectin (CP) at 3 concentrations (0.05, 0.1 and 0.2%). Analysis of variance, according to a factorial design, was applied to determine the effect of stabilizers on rheological properties. Significant differences were tested at $P \leq 0.05$. Measurements were made after 4 days of storage at 4°C. Syneresis was significantly lower in CP yoghurts than in other yoghurts. The use of UC at 0.1% gave significantly the greater values of hardness and apparent viscosity comparatively to the use of HC. Microstructure of HC yoghurts showed larger aggregates than UC yoghurts. Double heat treatments (stabilization of complexes and pasteurization step) undergone by HC was not beneficial probably because an extensive whey protein aggregation leading to disruption of the casein network. This work showed that UC can be used to improve rheological properties of stirred yogurt. The stability of complexes in UC after addition into milk should be evaluated.

Key Words: Yogurts, Complexes, Rheological Properties

517 Changes in relative percentages of fatty acids in raw goat milk, its yoghurt and salted yoghurt during manufacture. Z. Guler^{*1} and Y. W. Park², ¹Mustafa Kemal University, Antakya, Hatay, Turkey, ²Fort Valley State University, Fort Valley, GA.

In Mediterranean and Southern regions of Turkey, 'Salted yoghurt' or 'Winter yoghurt' is produced by boiling and salting yoghurt to prolong its storage life. The cooking and salting processes ensure microbiological safety and keeping its quality for smoother and whiter products. The objective of the study was to quantify the changes in fatty acids compositions of raw milk, yoghurt and salted yoghurt from Turkish indigenous milking goats. Fatty acid profiles were assayed using a GC-MS (Agilent model 6890; Palo Alto, CA, USA) with 5973 N (Agilent) mass selective detector. Mean relative percentages (%) for fatty acids of raw milk, yoghurt and salted yoghurt were: acetic acid (C2:0), 4.88, 2.03 and 1.17; butanoic acid (C4:0), 1.30, 0.27 and 1.69; hexanoic (C6:0), 4.28, 2.48 and 4.65; octanoic (C8:0), 1.23, 0.76 and 1.80; decanoic acid (C10:0), 4.91, 3.06 and 6.46; dodecanoic acid (C12:0), 2.26, 1.70 and 2.55; tetradecanoic acid, (C14:0), 8.48, 7.88 and 9.76; pentadecanoic (C15:0), 0.75, 0.21 and 0.18; hexadecanoic acid (C16:0), 37.5, 39.1 and 39.7; heptadecanoic acid (C17:0), 0.88, 0.99 and 0.93; octadecanoic acid (C18:0), 19.9, 23.2 and 17.8; 9-octadecanoic acid (C18:1), 13.6, 16.6 and 12.80, respectively. The highest amount of fatty acids in descending order of the three milk products were palmitic (C16:0), stearic (C18:0), oleic (C18:1), myristic (C14:0), and capric acid (C10:0). Decreases in C2:0 to C15:0 fatty acids were observed during yoghurt-making process, with the most marked reduction in C2:0 to C12:0 acids. This could be attributed to evaporation of these fatty acids during heating process of yogurt. The relative percentages of C4:0 to C14:0 acids increased during salted yoghurt processing procedures, probably due to the fat content increase in total solids. However, percentages of C2:0, C15:0, C18:0 and C18:1 decreased, while C16:0 and C17:0 acids were unchanged during the manufacture.

Key Words: Turkish Goat Milk, Salted Goat Yogurt, Fatty Acids Profile

Symposium: Animal Behavior and Well-Being: Animal Welfare Standards - Who Decides and How?

518 Animal welfare legislation in the European Union. D. Wilkins*, *WSPA, London, UK.*

The debate on animal welfare legislation began in the Council of Europe, not to be confused with the European Union. Between 1977 and 1992, 5 animal welfare Conventions came into force on farm animals, slaughter for food, transport, laboratory animals and companion animals. The first animal protection law in the European Union (then the Common Market) was a 1977 Directive on stunning food animals before slaughter. In the late 1980s and early 1990s many more European laws were agreed and these covered the keeping of pigs, calves and laying hens, animal transport, slaughter, animals used for research purposes, zoos and general farm animal welfare. The circumstances of how this raft of legislation came about make an interesting story. What will happen in the future now that the European Union has expanded to 27 member states and with the influence of international trade rules will also be explored.

Key Words: Well-Being, Legislation

519 Animal welfare assurance programs in food production: a framework for assessing the options. D. Fraser*, *Animal Welfare Program, Faculty of Land and Food Systems and W. Maurice Young Centre for Applied Ethics, University of British Columbia, Vancouver, Canada.*

A variety of animal welfare assurance programs are being used to encourage or require the adoption of animal welfare standards in food production, and to assure the public that such standards are followed. The programs involve five main formats. Non-mandatory codes/guidelines are relatively easy to institute and appear well supported by the industry, but provide only minimal assurance to the public unless measures are taken to ensure compliance. Programs based on government regulations and inter-governmental agreements are more challenging to institute; they are likely to generate less industry acceptance, but may provide more public confidence if enforcement is adequate. Product differentiation programs, and retailer policies requiring products to meet certain standards, serve a range of functions; these may generate public confidence but only for products covered. The programs include several types of requirements. Requirements

designed to maintain animal health and functioning have a widely accepted scientific basis, are often easy to incorporate into existing production systems, and often provide economic benefits, but do not fully address public concerns over animal welfare in some cultures. Requirements that address pain, distress and other affective states, and those that accommodate certain natural behaviour, have a growing but less traditional scientific rationale and seem likely to generate public confidence; however, they sometimes require significant changes to existing practices. Requirements for more natural surroundings (outdoor, free-range) seem to generate public confidence, but appear most likely to increase costs, least likely to be supported by the existing industry, and may involve trade-offs with productivity and with other aspects of animal welfare.

The various formats and requirements provide a range of policy options for addressing animal welfare concerns in different cultural, industry and market contexts.

Key Words: Animal Welfare, Assurance Programs, Options

520 Pressures to regulate animal welfare and food production in the USA. K. Johnson*, *Animal Agriculture Alliance, Arlington, VA.*

The USA faces increasing pressure to regulate animal welfare on America's farms and ranches. The primary drivers of this legislative pressure are animal rights groups. These groups have effectively co-opted the animal welfare issue and are using perceived animal welfare as a wedge to advance an animal rights agenda.

The legislative pressures are being faced at all levels of government, from international to national to state and local. Currently, the greatest concentration of legislative resources is being aimed at state governments.

But these groups' influence isn't just limited to legislation, they are devoting significant resources to legal actions and political campaigns. In 2006, just one group spent \$3.4 million on the elections, more money than ExxonMobil spent, according to *The Wall Street Journal*.

This presentation will cover the issues driving legislation, the groups promoting it, the strategies and tactics being used, and examples of specific legislative initiatives being advanced.

Key Words: Animal Welfare, Legislation, Legal

Breeding and Genetics: Computational Issues in Genomic Analysis

521 Genomic selection using low-density SNPs. D. Habier, J. C. M. Dekkers*, and R. L. Fernando, *Department of Animal Science and Center for Integrated Animal Genomics, Ames, IA.*

Genomic selection (GS) using high-density single nucleotide polymorphisms (HD-SNPs) is promising to improve response to selection. GS is based on estimating effects of HD-SNP alleles using phenotypes in a training data set and using these estimates to obtain GS-EBV for selection candidates based only on HD-SNP genotypes. Genotyping HD-SNPs for all selection candidates may not be cost effective in most livestock species. Thus, we propose to use low-density SNPs (LD-SNPs) to trace chromosomal segments from parents to progeny with sufficient accuracy and estimate GS-EBV of selection candidates. This approach requires inferring HD-SNP haplotypes of the training individuals using parental HD-SNPs. Given estimates of HD-SNP effects, effects of chromosomal segments are estimated as the sum of the HD-SNP effects on that haplotype. To estimate GS-EBV in subsequent generations, only LD-SNPs flanking each segment are utilized to follow the inheritance of segments by estimating the probability of descent of a segment (PDS). To test this approach, a training data set of 1000 individuals with 1000 SNP genotypes on a 10 Morgan genome and phenotypes for an additive trait controlled by 100 QTL with heritability 0.5 was simulated. HD-SNP haplotypes of training individuals were assumed known and divided into 100 segments of 10 cM, flanked by a total of 110 LD-SNPs that were genotyped in subsequent generations. HD-SNP allele effects were estimated by Bayes-B. An MCMC sampler was used to first obtain joint probabilities of segregation indicators for every flanking marker pair. These were then used to calculate the PDS as the probability of maternal origin at the midpoint of flanking LD-SNPs. The correlation between true breeding values and GS-EBVs was used to evaluate the loss in accuracy from using LD-SNPs vs. HD-SNPs in generations following training. The accuracy was 0.66 with HD-SNPs and 0.63 with LD-SNPs in the first generation, dropped to 0.63 and 0.60 in the second, and to 0.61 and 0.56 in the third generation following training. Thus, LD-SNPs can be used for selection candidates with limited loss of accuracy which, depending on the costs of LD-SNPs vs. HD-SNPs, can result in a substantial reduction in costs.

Key Words: Genomic Selection

522 Effects of allele frequency estimation on genomic predictions and inbreeding coefficients. P. M. VanRaden¹, M. E. Tooker*¹, and N. Gengler^{2,3}, ¹USDA Animal Improvement Programs Laboratory, Beltsville, MD, ²Gembloux Agricultural University, Gembloux, Belgium, ³National Fund for Scientific Research, Brussels, Belgium.

Genetic calculations often require estimating allele frequencies, which differ across time due to selection and drift. Data were 50,000 simulated markers and 39,985 actual markers for 2391 genotyped Holstein bulls. Gene content of relatives and gene frequencies in the base (founder) population were estimated using pedigrees and a linear model. Ancestors born since 1950 were included, for a total of 22,088 animals. Because pedigrees were very complete, only one unknown-parent group was used. Convergence to 5 digits of accuracy required about 1000 iterations. Total time was 2 processor days and proportional to number of animals times markers, but actual clock time was reduced by processing loci on separate chromosomes in parallel. Simple allele frequencies were obtained from only the known genotypes. True base frequencies were

correlated with estimated base frequencies by 0.98 versus 0.94 with simple frequencies. Genomic predictions and inbreeding coefficients were computed in four ways, using true or estimated base frequencies, simple frequencies, or an "estimate" of .5 for each marker. When allele frequencies estimates were used instead of 0.5 to assign mixed model coefficients, solutions converged more slowly but predictions were more accurate. From simulated data, realized reliabilities for young bulls were 62.8% using either true or estimated base frequencies, 62.6% using simple frequencies, and 62.0% using frequencies set to 0.5. Pedigree and genomic inbreeding coefficients were correlated by 0.73 using true base frequencies, 0.67 using estimated base frequencies, 0.12 using simple frequencies, and 0.72 when frequencies were set to 0.5. Genomic inbreeding coefficients were biased downward by 7% to 9% using either frequency estimate, upward by 31% using 0.5, but were reasonable when true frequencies were used. Frequency estimation had small effects on genomic predictions but large effects on genomic inbreeding coefficients in both simulated and real data.

Key Words: Genotype, Genomic Selection, Allele Frequency

523 Strategies to incorporate genomic prediction into population-wide genetic evaluations. N. Gengler*^{1,2} and P. M. VanRaden³, ¹Gembloux Agricultural University, Gembloux, Belgium, ²National Fund for Scientific Research, Brussels, Belgium, ³USDA Animal Improvement Programs Laboratory, Beltsville, MD.

Most current research on genomic selection is focusing on the accurate prediction of genomic breeding values. However selection solely based on genomic breeding values, despite being theoretically promising, is in practice only suboptimal for several reasons. The two most important are that only few animals are genotyped therefore having genomic prediction directly available and that rankings will change. With genomic breeding values potentially available in the near future, strategies are required to avoid any confusion in the mind of users. The aim of this study is to present three different strategies that could be used to incorporate genomic prediction into population-wide genetic evaluation. The three strategies are: 1) using selection index theory to combine both sources of information into a single set of breeding values; 2) for ungenotyped animals, compute conditional expectation of gene contents for SNP given molecular and pedigree data and use these predicted gene contents; and 3) integrate genomic breeding values as external information into genetic evaluation using a Bayesian framework. If strategy 1) is straight forward, additional steps have to be done to adjust breeding values for changes in those of relatives. A practical implementation is to use reliabilities of the genomic prediction, the population-wide genetic evaluation PA, and PA from the genotyped subset to set up a 3 x 3 matrix for each animal, with off-diagonal elements being functions of the 3 reliabilities. The use of strategy 2) is computationally much more challenging but leads directly to the needed covariance structures combining genomic relationship if known with pedigree relationships. Strategy 3) is potentially a good compromise because the theory is well established and has already been used in beef cattle to incorporate external breeding values. Also current genetic evaluation software can be easily modified to incorporate genomic breeding values.

Key Words: Genomic Prediction, Incorporation, Breeding Value Estimation

524 Selection of single nucleotide polymorphisms and genotype quality for genomic prediction of genetic merit in dairy cattle. G. R. Wiggans*¹, T. S. Sonstegard¹, P. M. VanRaden¹, L. K. Matukumalli^{1,2}, R. D. Schnabel³, J. F. Taylor³, F. S. Schenkel⁴, and C. P. Van Tassell¹, ¹ARS, USDA, Beltsville, MD, ²George Mason University, Manassas, VA, ³University of Missouri, Columbia, ⁴University of Guelph, Guelph, ON, Canada.

A process to prepare high-density genotypic data for use in genomic prediction was developed. Marker genotypes from >51,000 single nucleotide polymorphisms (SNP) were generated for 3,139 Holstein bulls on the Illumina Bovine SNP50 chip. The SNP were grouped by minor allele frequency (MAF); 10,249 SNP with a MAF of <5% were excluded. Number of SNP for each of 45 MAF categories was uniform (800 to 1,009). Hardy-Weinberg equilibrium was assessed by comparing observed to expected heterozygosity for each locus. For 6 SNP assigned to chromosome 7, no bulls were heterozygous, which confirms the latest assembly that places those SNP on the X chromosome. Observed heterozygosity was within 2% of that expected for 96% of SNP. Linkage between adjacent autosomal SNP was analyzed to determine if the data set could be reduced for downstream analysis. For 1,237 pairs of adjacent SNP, marker genotypes were either both homozygous or both heterozygous (<10 bulls differed for each pair), and the first SNP from each pair was excluded; mean physical distance between those SNP pairs was much smaller (37 kb) than between 39,386 autosomal SNP (64 kb). Sire and son data for 2,566 bulls with 204 genotyped sires were compared to validate sample identification and Mendelian inheritance. For those bulls with >100 inheritance errors, correct sire was determined through comparison with other sires of sons. For sons with the correct sire, 99.99% of SNP with genotypes did not conflict. Comparison of genomic and pedigree relationships detected 3 members of a clonal family, a set of identical twins, and some possible pedigree errors. Genotyping consistency was investigated for 9 bulls genotyped twice and for the twins and clones. Most differences were caused by an inability to determine the genotype for one of the paired SNP; however, one clone had 24 SNP conflicts (99.94% concordance). Although evaluation of the SNP set is ongoing, only minor changes are expected for the final set. This largest set of high-quality SNP data for Holsteins to date should provide the basis for successful genomic prediction.

Key Words: Genomic Prediction, Genotyping, Single Nucleotide Polymorphism

525 Analysis of high dimension marker data in the presence of gene interactions: A machine learning approach. K. R. Robbins, J. K. Bertrand, and R. Rekaya*, *The University of Georgia, Athens.*

In recent years there has been much focus on the use of single nucleotide polymorphisms (SNP) for the fine mapping of genomes in an effort to identify causative mutations and important genomic regions for traits of interest; however, many studies focus only on the marginal effects of markers, ignoring potential gene interactions. Simulation studies have shown that this approach may not be powerful enough to detect important loci when gene interactions are present. While several studies have examined potential gene interaction, they tend to focus on a small number of SNP markers. Given the prohibitive computational cost of modeling interactions in studies involving a large number of SNP, methods

need to be developed that can account for potential gene interactions in a computationally efficient manner. This study adopts a machine learning approach by adapting the ant colony optimization algorithm (ACA), coupled with logistic regression on haplotypes and genotypes, for association studies involving large numbers of SNP markers. The proposed method is compared to genotype (GA) and haplotype analysis, implemented using sliding windows (SW). Each algorithm was evaluated using a binary trait simulated using an epistatic model and HapMap ENCODE genotype data. Two simulation scenarios, varying the strength of the epistatic relationship, were replicated five times each. The ACA yielded increases in the power to detect genomic regions associated with the simulated trait of 66.7% over the next best method in both simulated scenarios. Based on these results it is clear that methods accounting for potential gene interactions are necessary to obtain good power for association studies examining complex traits under the control of interacting genes.

Key Words: Ant Colony Algorithm, Machine Learning, Single Nucleotide Polymorphism

526 Statistical design of validation studies for transcriptional profiling experiments. J. P. Steibel*¹, R. J. Tempelman¹, and G. J. M. Rosa², ¹Michigan State University, East Lansing, ²University of Wisconsin, Madison.

Microarrays and quantitative reverse transcription polymerase chain reaction (qRT-PCR) are the most commonly used techniques for transcriptional profiling in animal tissues. Microarrays are commonly used as a first stage screening step, followed by a qRT-PCR experiment intended to validate the results from the first stage. While the design of microarray experiments has been extensively studied, the design and analysis of qRT-PCR validation studies has not. We address this issue as it pertains to the qRT-PCR validation of genes that are concluded to be differentially expressed based on results from a previous microarray experiment. Required sample sizes and expected significance levels for the validation experiment were determined, assuming that biological replicates are independent from those used in the microarray experiments. The level of replication was set to the minimum necessary to control the false discovery rate (FDR) at a certain level while maximizing the power or sensitivity of the overall experiment. We show that the number of replicates depends on the ratios of the FDR and the sensitivity between the two experiments as they depend on the true effect sizes (true mean differences divided by standard deviations). Our results also indicate that the traditional P-value thresholds of 0.05 or 0.01 for statistical significance are potentially too stringent for a second-stage validation experiment. In particular, if the FDR of the microarray experiment was controlled at 30% and the effect sizes are moderately large (i.e., near 1.0), setting the significance level of the validation experiment to 0.1 can control FDR at 5% while attaining greater than 80% power. Additionally, we consider the case where the same samples are used for the validation and microarray experiments (technical validation). We conclude that re-using the same samples in both stages invariably leads to a reduced power and increased FDR compared to the use of independent biological replicates. This increase in FDR is particularly large when the correlation between the two tests is high.

Key Words: Microarrays, qRT-PCR, Experimental Design

527 Model selection in gene-specific mixed linear models for microarray data with application to joint analysis of multiple experiments. L. Qu, N. Bacciu*, D. Nettleton, and J. C. M. Dekkers, *Iowa State University, Ames.*

Detecting differential gene expression using microarrays often suffers from low statistical power and accuracy due to small sample sizes and/or high variation. Model selection is hence an important task to obtain accurate significance levels and to improve power, in particular for joint analysis of multiple datasets. We propose four methods that use information across all genes to select one mixed linear model to be fit separately to data from each gene in a microarray experiment. We compare the results of these model selection methods on the joint analysis of two related microarray experiments in pigs. Method 1 is based on the information criteria (e.g., AIC) averaged over all genes to select a model that balances complexity and fit. Method 2 is based on cross-validation which selects the model that minimizes squared best linear unbiased prediction (BLUP) residuals, standardized and averaged over all genes. Method 3 is a multi-gene graphical method that uses principle component analysis on the residuals/BLUPs to compare distributional differences for a candidate factor. Method 4 is similar to method 3, but uses the multiresponse permutation procedure to formally test differences in residuals/BLUPs, ignoring the dependency among subjects. These four methods were applied to joint analysis of two random block design experiments, where the primary question was whether the variances can be pooled across experiments to increase power. Results show that the model that pooled both block and error variances and the one that only pooled block variances performed similarly and were preferred by each method, whereas separate analysis and the model that only pooled error variances were disfavored by each method. Although the methods generally agreed well for this data set, simulations are needed to further investigate which method is preferred and under which situations. In summary, our proposed methods can be useful tools for model selection in microarray analysis, especially when joint analysis of multiple datasets is used to increase statistical power. (Supported by USDA-NRI-2005-3560415618.)

Key Words: Microarrays, Model Selection, Mixed Models

528 Reconstruction of metabolic pathways for the cattle genome. S. Seo* and H. A. Lewin, *Institute for Genomic Biology, University of Illinois, Urbana.*

Metabolic reconstruction of microbial, plant and animal genomes is a necessary step toward understanding the evolutionary origins of metabolism and species-specific adaptive traits. The aims of this study were to annotate the recently sequenced cattle genome using a metabolism-centered approach, to reconstruct conserved metabolic pathways, and to identify metabolic pathways with missing genes and proteins. The MetaCyc database and PathwayTools software suite were chosen for this work because they are widely used and easy to implement. An amalgamated cattle genome database was created using the NCBI and Ensembl cattle genome databases (based on build 3.1) as data sources. PathwayTools followed by comprehensive manual curation were implemented for reconstruction of metabolic pathways. The curated database, CattleCyc 1.0, consists of 217 metabolic pathways. A total of 64 mammalian-specific metabolic pathways were modified from the reference pathways in MetaCyc, and two pathways previously identified but missing from MetaCyc were added. Comparative analysis of metabolic pathways revealed the absence of mammalian genes for 22 metabolic enzymes whose activity was reported in the literature. We also identified six human metabolic protein coding genes for which the cattle ortholog is missing from the sequence assembly. CattleCyc is a powerful tool for understanding the biology of ruminants and other cetartiodactyl species. In addition, the approach used to develop CattleCyc provides a framework for the metabolic reconstruction of other newly sequenced mammalian genomes. Having multiple annotated mammalian genomes hosted in BioCyc will facilitate comparative analysis of metabolic pathways among different species and a systems approach to comparative physiology.

Key Words: Genomics, Systems Biology, Metabolic Reconstruction

Breeding and Genetics: Current Issues in Swine Breeding

529 Genetics of piglet survival: Additive, maternal and foster contributions. E. F. Knol*, M. J. M. Rutten, D. Roelofs-Prins, and J. W. M. Merks, *IPG, Institute for Pig Genetics B.V., Beuningen, The Netherlands.*

Phenotypic and genetic trends for litter size are clearly positive in most parts of the world, similar trends for number weaned are lower. As a consequence phenotypic trends in stillborn and pre-weaning mortality are positive. This is partly the result of reduced input of labor, and partly because of negative correlated genetic trends of litter size. To optimize selection for current markets, we re-addressed the two traditional survival traits: farrowing survival (FS: complement of stillborn) and pre-weaning survival (PWS).

FS was modeled by both additive-genetic and maternal-genetic effects; PWS was modeled including an extra genetic effect for foster-dam. The models log-likelihoods justified inclusion of the direct additive genetic effect. When the majority of the piglets are raised by their own dam, the genetic foster dam effects and genetic maternal effects are confounded. Therefore, sufficient cross-fostering of piglets in the data is required to be able to disentangle these effects.

The dataset consisted of 75,765 records of individually recorded piglets with known cross-fostering status on a closed TOPIGS multiplication farm with a pedigree of 78,572 animals. Variance estimates for FS: error 623.5, additive genetic 3.79, and maternal genetic 15.50; for PWS: error 819.8, additive genetic 7.29, maternal genetic 7.87 and foster dam genetic 30.09. Absolute genetic correlations were lower than 0.1 within traits and lower than 0.4 among traits. Heritabilities were low, but the sum of the genetic variance components of 19.3 for FS and 45.3 for PWS are very promising for selection.

Interpretation: 'maternal' is the influence of the uterine environment and partly of the first colostrum; 'foster' represents the mothering ability of the sow, behavior and quality of the udder, and 'additive' includes contribution of the sire, which is especially relevant in crossbred data. Large scale recording of birth weight, cross-fostering and survival data is necessary for a successful selection program against mortality.

Key Words: Pig, Survival, Mothering-Ability

530 Genetic parameters of farrowing survival in purebred and crossbred pigs. A. Cecchinato*¹, G. de los Campos², D. Gianola², L. Gallo¹, and P. Carnier¹, ¹*University of Padova, Legnaro, Padova, Italy,* ²*University of Wisconsin, Madison.*

In commercial swine production, an important breeding objective is to improve performance of crossbred animals. However, selection is largely carried out in nuclei of purebreds. A question is whether purebred performance (in the nucleus) predicts accurately outcomes in crossbreds (commercial tier). This can be investigated by considering the two performances as different traits in a model and by estimating the genetic correlation. The objective of this study was to infer (co)variance components for farrowing survival in purebred (P) and crossbred (C) pigs; the latter were from crosses between P boars and Large White-derived crossbred sows. If the genetic correlation between C and P traits is large enough, selection in P would produce a correlated response in

C. Data were from 13,643 (1,213 litters) C and 30,919 (3,162 litters) P pigs, produced by mating the same 168 P boars to 319 Large White derived crossbred females and 1,413 P sows, respectively. The outcome variable was pig survival at birth as a binary trait. A Bayesian bivariate threshold model was implemented via Gibbs sampling. Effects of sex, parity of the dam, litter size and year-month of birth were assigned flat priors; those of litters, dams and sires were given Gaussian prior distributions. Marginal posterior means (SD) of the sire, dam and litter variances in P were 0.018 (0.008), 0.077 (0.020), 0.347 (0.025), respectively in the liability scale. For C, corresponding estimates were 0.030 (0.018), 0.120 (0.034), and 0.189 (0.032), respectively. The posterior means (SD) of heritability of survival in P and C, and of the genetic correlation between these traits were 0.049 (0.023), 0.091 (0.054) and 0.248 (0.336), respectively. Heritability estimates were low and in agreement with previous reports. The genetic correlation was also low, and a 95% Bayesian confidence region (-0.406, 0.821) included zero. Even though variation of estimates is large, results suggest that genetic progress expected in C when selection is based on P may be nil.

Key Words: Threshold Models, Pigs, Heritability

531 Heritability of longevity in Yorkshire females. M. D. Hoge*¹ and R. O. Bates², ¹*Western Illinois University, Macomb,* ²*Michigan State University, East Lansing.*

The length of adult sow life is recognized as both an economical and welfare concern. However there are not consistent definitions to measure sow longevity. This study assessed the genetic variation described by six different descriptions of longevity. Heritability was estimated for four different descriptions of longevity using a proportional hazards model with an underlying Weibull distribution. The definitions included herd life (time from first farrowing to culling), lifespan (number of parities a female has accumulated before culling), lifetime prolificacy (the number of piglets born alive during the lifetime of the sow), and a combination of prolificacy and length of productive life (the number of pigs produced per day of life). Data consisted of 7,632 records of Yorkshire females with at least one farrowing record, from both nucleus and multiplication herds across 21 farms from four seedstock systems. A threshold model was used to estimate heritability for two descriptions of stayability (probability of producing 40 pigs or probability of reaching 4 parities) on a subset of the original data (n=5803) that did not include censored observations. Terms for both models included, first litter performance effects of; age at first farrowing, number born alive, number of stillborns, adjusted 21 day weaning weight, and length of lactation along with the number born alive at last recorded farrowing. Additionally, the number born alive, litter birth weight and percentage of gilts born in a female's birth litter and her growth and backfat records were included. These variables were treated as fixed and time-independent. A random effect of sire was included in all models. Heritability estimates ranged from 0.16 to 0.21 for the Weibull analyses and 0.52 for the threshold analyses. Sufficient genetic variation exists, regardless of definition, to improve sow longevity.

Key Words: Sow Longevity, Genetics, Heritability

532 Use of serial pig body weights for genetic improvement. B. Zumbach^{1,3}, I. Misztal^{*1}, C. Y. Chen¹, S. Tsuruta¹, W. O. Herring², T. Long², and M. Culbertson², ¹University of Georgia, Athens, ²Smithfield Premium Genetics Group, Rose Hill, NC, ³Norsvin, Hamar, Norway.

This study examined the utility of serial weights from FIRE (Feed Intake Recording Equipment, Osborne Industries, Inc., Osborne, KS) stations for a longitudinal analysis of body gain. Data included 884,132 body weight records from 3,888 purebred Duroc pigs. Pigs entered the feeder station at age 77-149 d and left at age 95-184 d. A substantial number of records were abnormal, showing weight close to 0 or up to twice the average weight. Plots of weights for some animals indicated two parallel growth curves. Data were cleaned using robust regression based on M-estimation (weight function: bisquare, $c=2$; scale parameter: median), with age used as both a linear and a quadratic covariable. In order to maintain variability in the data and discard outliers at the same time, a cutoff value of $k=1.5$ was chosen. After discarding the outliers detected by the M-estimation, 607,597 body weight records remained. Daily weight (170,443 records) was calculated as an average of cleaned body weight records for each animal in one day. Daily gain was calculated as the difference in body weight between consecutive days. The number of records for daily gain was 152,636, and the average daily gain was 0.85 kg (SD = 1.16 kg). As a second step of cleaning, only animals with ≥ 50 body weight records and a standard error of the residual ≤ 2 kg were included, reducing the data to 89,257 records. After removing records outside of 3 SD from the mean, the final data set included 69,068 records of daily gain from 1,921 animals. Daily gain based on daily, weekly and monthly records was analyzed using repeatability models. Heritability estimates were 0.02%, 3.3% and 13%, respectively. SE of the estimate on daily records was larger than the estimate. After extensive editing, weight records from automatic feeding stations are useful for genetic analyses of daily gain from weekly or monthly but not daily data.

Key Words: Body Weight, FIRE Feeder Station, Robust Regression

533 Estimates of genetic correlations among growth traits including competition effects. C. Y. Chen^{*1}, R. K. Johnson¹, S. D. Kachman¹, and L. D. Van Vleck^{1,2}, ¹University of Nebraska, Lincoln, ²ARS, USDA, U.S. Meat Animal Research Center, Clay Center, NE.

The objective was to estimate genetic parameters of direct and competition effects for traits measured at the end of a growth test utilizing multi-trait analyses. A total of 9,720 boars were tested with 15 boars per pen from about 71 to 161 d of age and weight from 31 to 120 kg. Traits analyzed with initial age on test as a covariate were average daily gain during test (ADG), days to 110 kg (D110), and daily feed intake (DFI). Backfat measured at the p2 point (BF) and muscle depth (MD) were analyzed with age off test as a covariate. Fixed effects of line and contemporary group, with random direct genetic, competition genetic, and competition environmental effects were also in the statistical model. For single-trait analyses, estimates of direct heritability were 0.30, 0.26, 0.20, 0.46, and 0.33 for ADG, D110, DFI, BF, and MD, respectively. Estimates of heritability for competition effects were near to zero for all traits. Estimates of genetic correlation between direct and competition effects were 0.06, -0.13, -0.32, 0.22, and 0.36 for ADG, D110, DFI, BF, and MD, respectively but these are based on very small estimates of variance of competition effects. For two-trait analyses, estimates of direct genetic correlations were -0.96, 0.15, 0.44, -0.14, -0.42, 0.38, 0.16, and 0.04 for ADG-D110, ADG-BF, ADG-MD, D110-BF, D110-MD, DFI-BF, DFI-MD, and BF-MD, respectively.

Estimates of direct genetic correlations for ADG-DFI and D110-DFI, however, could not be obtained because global convergence failed to be met. Estimates of competition genetic correlations among the five traits might have little meaning because estimates of variances of competition effects were close to zero for all five traits. Difficulty of analyses including competition effects with two-trait models was apparent when the average information matrix failed to provide reasonable information. Interpretation of antagonisms among traits associated with competition effects was limited in this study.

Key Words: Competition, Genetic Parameters, Swine

534 Associations between body structure and overall leg action in crossbred gilts. M. Nikkilä^{*1}, K. Stalder¹, B. Mote¹, J. Lampe², B. Thorn³, M. Rothschild¹, A. Johnson¹, L. Karriker¹, and T. Serenius⁴, ¹Iowa State University, Ames, ²Swine Graphics Enterprises, Webster City, IA, ³Newsham Genetics, West Des Moines, IA, ⁴FABA Breeding, Vantaa, Finland.

The goal of this study was to investigate genetic parameters of body structure traits and overall leg action. The study was conducted at a commercial farm and involved 1449 females. The gilts were from two genetic lines and were progeny of 58 known sires and 836 dams. Sire information from 52 animals was unavailable. Gilts averaged 190 ± 7 days of age and 124 ± 11 kg body weight at the time of evaluation. Body structure evaluation included both body size (length, depth, width) and body shape traits (top line, hip structure, rib shape). Structure traits and overall leg action were independently evaluated by two experienced scorers using a 9 point scale. Top line was divided into two traits (weak/high top line) prior to analyses. AI-REML and the DMU-package were used to estimate variance components using a multivariate animal model. The statistical model included gilt line, evaluation day and scorer as fixed effects, animal as a random effect and weight at evaluation as a linear covariate. Heritability estimates were moderate for body size traits ($h^2=0.25-0.34$), low to moderate for body shape traits ($h^2=0.11-0.26$), and relatively low for leg action ($h^2=0.12$). Body size traits were genetically highly correlated with each other ($r_g=-0.80-0.92$) and with top line and rib shape ($r_g=-0.93-0.88$). Among body shape traits, high top line was genetically correlated with hip structure and rib shape ($r_g=0.63-0.92$). Long and shallow body, high top line and steep hip structure were associated with inferior leg action ($r_g=0.56-0.75$). Since body structure has high favorable genetic correlations with overall leg action, genetic progress in leg action can be enhanced not only by selecting animals with superior feet and leg soundness, but also by utilizing information about body structure. Satisfactory leg action is crucial for increasing sow productive lifetime, since lameness is one of the primary causes of early culling.

Key Words: Gilts, Body Structure, Leg Action

535 Genetic parameters for longitudinal feed intake and weight gain in Durocs. C. Y. Chen^{*1}, I. Misztal¹, S. Tsuruta¹, W. O. Herring², T. Long², and M. Culbertson², ¹University of Georgia, Athens, ²Smithfield Premium Genetics Group, Rose Hill, NC.

The objective was to investigate the genetic parameters for daily feed intake (DFI, g) and daily gain (DG, g) with records obtained from elec-

tronic feeder stations. After editing, data included DFI and DG from 81 to 167 d of age of 1,921 Duroc boars. The boars were housed in 112 pens, each equipped with one feeder, and allowed ad libitum feeding; most animals were tested only for 7-8 weeks. Because of large variation in daily records, weekly averages were used. Six traits were defined as DG and DFI during 81-109 (period 1), 110-138 (period 2), and 139-160 d of age (period 3). A six-trait model included age as a covariate with fixed effect of year-week and random effects of pen-year-week, litter, animal, and permanent environment. Variance components were estimated by a Bayesian approach using Gibbs sampling algorithm. Estimates of heritability for respective periods were 10.3, 10.7, and 11.6% for DFI and 7.0, 5.0, and 7.2% for DG. For DFI, genetic correlations between periods 1-2 were 0.76, periods 2-3 were 0.61, and periods 1-3 were 0.08. For DG, the same correlations were 0.68, 0.72, and 0.33. The correlations between DFI in period 1 and DG in periods 1-3 were 0.80, 0.61, and 0.49. The correlations between DFI in period 2 and DG in periods 1-3 were 0.38, 0.52, and 0.33. The correlations between DFI in period 3 and DG in periods 1-3 were -0.24, -0.09, and -0.27. Standard errors of correlations varied from 0.14 to 0.23. Low correlations for DG and DFI between extreme periods suggests that DG and DFI in these periods are different traits. Negative correlations between DFI and DG may indicate compensatory growth, competition for feeders, or the data structure of few animals with records in periods 1 and 3.

Key Words: Daily Gain, Genetic Parameters, Swine

536 Relationship between feed intake during growth and lactation in a mouse model. W. M. Rauw^{*1}, S. Hermes², K. Bunter², and L. Gomez Raya¹, ¹University of Nevada, Reno, ²University of New England, Armidale, Australia.

The major part of selection pressure in pig breeding programs has been directed toward improvement of lean growth efficiency by selecting for

increased growth rate, reduced body fatness, and improved feed efficiency. However, because leanness and feed efficiency are negatively correlated with feed intake, selection for improvement in these traits has led to a decrease in voluntary feed intake. It has been argued that voluntary feed intake should be considered in breeding programs. This study investigated the phenotypic correlation between feed intake during growth, at maturity, and during lactation in a mouse model in a selection experiment for litter size at birth. Data were available on 42 control and 48 selection line dams and litters. Feed intake was recorded every 3 d between 21 and 69 d of age, and daily between littering and weaning. A linear function was fitted to relate individual data on cumulative feed intake to age in virgin females and to days in lactation in lactating females. Selection line females, but not those of the control line, with higher intake during growth and at maturity had higher lactation intakes ($r = 0.37$, $P < 0.05$, and $r = 0.46$, $P < 0.001$, respectively). As this relationship will be positive only when animals eat to their potential, the results suggest that selection line females have been genetically "programmed" to eat to their potential intake capacity as a correlated effect, allowing for maximum litter sizes. Commercial lean types of pigs can be expected to produce to their maximum potential as well. However, when food intake is insufficient to meet the energy requirements during lactation, sows mobilize body reserves. When food intake capacity is limited and increased milk production in lactating sows is accounted for by a considerable mobilization of body reserves, the relationship between feed intake during growth and during lactation may be reflected in the relationship between growth intake and body condition instead.

Key Words: Selection, Feed Intake, Lactation

Dairy Foods: Cheese II

537 ADSA Pioneer: White cheese development. R. Richter*, *Texas A&M University, College Station.*

White cheeses are universally accepted and are a major component of the diet in many cultures. They are manufactured in many cultures and have a wide variety of names but many are similar in texture and flavor. Most of the white cheese varieties are manufactured by rennet coagulation of the milk with little or no acid production in the process. A popular variation is the production of cheeses that melt and stretch. A rich Artisan background for the manufacture of these cheese varieties exists and provides a significant basis for the development of this cheese category. The high pH and high moisture content of many of the white cheese products have caused vigilance for the manufacturing and storage practices to prevent public health problems. Research of these cheeses in the United States has historically been minimal but interest in this area has increased with the changing demographics in the United States and the expansion of the market.

Key Words: Cheese

538 Impact of the type of milk protein used to prepare starter media on properties of Mozzarella cheese. S. Govindasamy Lucey*, B. Dosti, J. Jaeggi, M. Johnson, and J. Lucey, *University of Wisconsin, Madison.*

Reconstituted NDM is commonly used as bulk starter culture medium in cheesemaking although whey protein concentrate (WPC) or milk protein concentrate (MPC) are other possible milk proteins that could be used. We investigated the impact of using WPC34/NDM blend or MPC80 based starter media for the manufacture of Mozzarella cheese. Cheesemilks were produced by blending skim milk (fortified with 1.5% NDM) (10.5% TS, 2.9% casein, 0.7% fat), cream (42.7% TS, 1.5% casein, 36.8% fat). 3% (w/w) starter media made with MPC80 (0.2% fat, 7.8% casein, 10.3% TS) or a blend of 16.3% WPC34 and 3.8% NDM (0.5% fat, 5.5% casein, 19.6% TS) was also added. No bulk starter media was added to control cheesemilk. All cheesemilks were standardized to a similar casein:fat of 1.0. A direct-vat-set starter culture was added to cheesemilks. Three types of cheeses were produced; control and cheeses made with WPC34/NDM and MPC80. Cheese functionality was assessed using dynamic low-amplitude oscillatory rheology (DLAOR) and performance on pizza. Coagula were cut at the same firmness. Addition of WPC34/NDM or MPC80 based starter media resulted in shorter rennet coagulation time. Cheeses made with both types of bulk starter media had slightly higher moisture contents (46.4-46.8%) compared with control (45.7%) cheeses. Nitrogen and fat recoveries were highest in MPC80-fortified cheese compared to control or WPC34/NDM-fortified cheese. Moisture-adjusted cheese yield was significantly higher in cheeses fortified with bulk starter media. Maximum loss tangent (LTmax) values (meltability index from DLAOR) was significantly lower in WPC34/NDM-fortified cheese compared to control or MPC80-fortified cheeses and LTmax values increased during the first two wk of ripening, after which the LTmax decreased. Temperature of LTmax was similar in all three cheeses and decreased with age. TCA-soluble nitrogen levels were higher in cheeses made with bulk starter media compared to control. Performance on pizza was similar for all cheeses. The results of this study indicated that other

types of milk protein powders can be successfully used as starter media in cheesemaking.

Key Words: Cheese Yield, Starter Media, Functionality

539 Characterization of Sicilian Pecorino cheese by area of production. S. Carpino*¹, I. Schadt¹, S. La Terra¹, G. Belvedere¹, T. Rapisarda¹, and G. Licitra^{1,2}, ¹CoRFiLaC, Regione Siciliana, Ragusa, Italy, ²D.A.C.P.A., Catania University, Catania, Italy.

Pecorino Siciliano is a PDO ewes' milk cheese produced in Sicily. The aim of this study was to investigate aroma profile differences for traditional Pecorino Siciliano cheeses produced in different part of Sicily. Cheeses ripened at 2, 4 and 8 months were obtained from 21 farms, from throughout Sicily, that were classed into seven areas by geography: Iblean (A), Etna (B), South-center (C), North-center (D), Western (E), West-center (F), Peloritana (G). Botanical composition of the native pasture grazed were visually evaluated in all these involved farms. Traditional cheese making parameters were also detected and evaluated. A MS-based Electronic Nose (SMartNose) was used to detect organic volatiles components in the mass-to-charge (m/z) range of 10 to 160 amu. Results were statistically elaborated by Principal Components Analysis (PCA). Comparison of the cheeses at 2, 4 and 8 months of ripening, generally showed differences in volatile compounds among the different areas. Cheese samples at 2, 4 and 8 months of ripening showed marked differences, likely due to the increasing lipolytic and proteolytic processes releasing the aroma compounds that characterize the cheese with time. The 8 month cheeses, showed the best separation with PC1 (60%) and PC2 (22%). Comparing two areas per times all the areas showed a good separation, but no differences between the Iblean area (A) versus the South-center area (C) and the Iblean area (A) versus the North-center area (D) were detected, indicating that seven areas are probably too many and we might need to restrict it. These comparison were also related to both differences in botanical composition and cheese making parameters in order to define which kind of parameters might effect Pecorino Siciliano cheese volatile profiles linked to the area of production.

Key Words: Cheese, SMartNose, Volatile Compounds

540 Effect of brine composition on cheese physical properties in Ragusano cheese. N. Fucà*¹, L. Tuminello², S. La Terra², M. Caccamo², M. Manenti², G. Licitra^{1,2}, and D. J. McMahon³, ¹D.A.C.P.A., Catania University, Catania, Italy, ²CoRFiLaC, Regione Siciliana, Ragusa, Italy, ³Utah State University, Logan.

During cheese brining, brine temperature, salt and calcium concentration influence the composition as well as the physical properties of cheese. This study aimed to examine the influence of brine composition and temperature on the protein matrix structure in cheese and its role in salt uptake. Three experimental 3.4-kg blocks of Ragusano cheese were made. The cheeses were cut in 63 pieces (1.7×1.8×13 cm³). One piece from each was chemically analyzed at time 0. All other pieces were measured for weight and volume and then immersed in 4 different

brine solutions (2, 10, 18, and 26% salt; all with 0.1% Ca) at 3 different temperatures (4, 12, and 20°C). The 10%-salt treatment was also performed with brine calcium contents of 0, 0.1, 0.2, and 0.4% Ca. After 24 h brining, the cheese was analyzed for weight, volume, fat, moisture, protein, salt, and Ca content, and by scanning electron microscopy. Cheeses brined in 2 and 10% salt had an average increase in weight ($20.5 \pm 0.06\%$ and $7.3 \pm 0.05\%$, respectively) while the 18 and 26%-brined cheeses decreased in weight ($-7.9 \pm 0.04\%$ and $-15.2 \pm 0.04\%$). Similar changes occurred in volume and cheese protein matrix appeared to be more expanded with low salt concentration and more compact with high salt concentrations. Brining at 4 and 12 °C caused greater expansion when the salt concentration was $\leq 10\%$. At 20 °C, virtually no change in volume occurred in 10%-salt brined cheeses indicating that even though salt was absorbed (salt content after 24 h was 4.9%) there was virtually no change in the protein matrix. When cheeses were brined without added calcium there was an increase in cheese volume ($15.1 \pm 0.09\%$) and weight ($18.6 \pm 0.03\%$) at all temperatures. At high calcium levels (0.4%), syneresis occurred and there was a decrease in volume ($-7.2 \pm 0.08\%$), especially at 20 °C (-16.5%).

Key Words: Cheese, Calcium, Microstructure

541 Studies on various paneer based spreads. H. A. Kumar and H. G. R. Rao*, *Dairy Science College, KVAFSU, Hebbal, Bangalore, Karnataka, India.*

Paneer is a heat-acid coagulated Indian type of soft cheese, used mainly for making culinary dishes. Paneer was made by heating wholemilk to 90°C, cooled to 70-75°C and coagulated by addition of 1percent citric acid. The whey was then drained out through a stainless steel mesh to

obtain paneer curd. Paneer spread (control) was prepared by adding salt (1.5%) and stabilizer (0.5%) to paneer curd and mixture was subjected to grinding by using mixer-grinder.

Dairy spreads available in the world market are high in fat, saturated fatty acids and cholesterol. Hence an attempt has been made in this study to develop various types of paneer based spreads which are low in fat and cholesterol, besides having good spreadability. Incorporation of 10%WPC or 5 % sodium caseinate or 5% soy flour in product preparation resulted in higher yield, better functional (firmness, spreadability, stickiness and adhesiveness were determined by texture analyzer) and nutritional value (considering protein %) comparable to control. Replacement of milk fat with vegetable oils (soy, corn or sunflower) at 25% level was highly acceptable with improved body and texture (texture analyzer) and spreadability. Further, matured cheddar cheese was incorporated at 30% level to paneer curd along with tri-sodium citrate (0.5%) as stabilizer and salt (1.5%). The mixture of cheese, paneer curd, stabilizer and salt was blended and grounded to obtain paneer spread. Incorporation of matured cheddar cheese in paneer spread improved acceptability and received higher flavor scores than control. Incorporation of spices such as pepper, clove, cinnamon and their combinations in the form of powder at 1% resulted in better flavor scores. Pepper and mixture of pepper and clove-flavored paneer spreads recorded highest overall acceptance scores. Among various storage studies undertaken, mere vacuum treatment of paneer spreads resulted in extension of storage up to 35 days at 7°C, as against 14 days in control. Microwave treatment of spreads under similar conditions of temperature resulted in extension of keeping quality up to 63 days. Cheese spreads are not popular in India. Therefore paneer type of product with slight modifications with better functionality to improve their utilization was developed in this study.

Key Words: Paneer, Spreads, Spices

Food Safety Centennial Presentations

542 ASAS Centennial Presentation: Developments and future outlook for preharvest food safety. S. P. Oliver*¹, D. A. Patel¹, T. R. Callaway², and M. E. Torrence³, ¹*The University of Tennessee, Knoxville*, ²*USDA/ARS Southern Plains Agricultural Research Center, College Station, TX*, ³*National Program Leader, Food Safety, USDA/ARS, Beltsville, MD*.

While the United States food supply is one of the safest in the world, CDC estimates that 76 million people get sick, more than 300,000 are hospitalized, and 5,000 die each year from foodborne illness. Consequently, preventing foodborne illness and death remains a major public health concern. Challenges to providing a safe, abundant and nutritious food supply are complex because all aspects of food production from farm to fork must be considered. Given the national/international demand and expectations for food safety as well as the formidable challenges of producing and maintaining a safe food supply, food safety research and educational programs have taken on a new urgency. Remarkable progress has been made during the last century. Sagacious wisdom from a century of animal agriculture research now includes the realization that on-farm pathogens are intricately associated with animal health and well-being, production of high quality food, and profitability. In this review, developments that have occurred over the last few decades will be summarized including types, sources and levels of disease-causing pathogens encountered in food-producing animal environments and their association with food safety; current and future methods to control/reduce foodborne pathogens on the farm; and present and future preharvest food safety research directions. Future scientific breakthroughs will no doubt have a profound impact on animal agriculture and production of high quality food but we will also be faced with moral, ethical and societal dilemmas that must be reconciled. A strong science-based approach that addresses all the complex issues involved in continuing to improve food safety and public health is necessary to prevent foodborne illnesses. Not only must research be conducted to solve complex food safety issues, but results of that research must be communicated effectively to producers and consumers.

Key Words: Food Safety, Foodborne Pathogens, Food Safety Research

543 ASAS Centennial Presentation: Developments and future outlook for postharvest food safety. J. Sofos*, *Colorado State University*.

Humans have consumed meat for thousands of years and consumption has increased with agricultural advances and increases in disposable income. It is natural for raw meat and other foods to become contaminated with spoilage and pathogenic microorganisms during exposure to the environment. Following advances in microbiology in the 19th century, meat safety and quality became of public interest and led to federal inspection regulations early in the 20th century. However, food safety became a major public issue only in recent decades along with changes in animal production, product processing and distribution; increased international trade; consumer preference for minimally processed foods; increased worldwide meat consumption; higher numbers of consumers at-risk for infection; and, increased scrutiny by consumers and news media. The 1906 meat inspection regulation underwent a major revision in the 1990s, following intense public scrutiny of an outbreak of *Escherichia coli* O157 transmitted through undercooked ground beef. The new inspection regulations are based on the principles of hazard analysis critical control point (HACCP) and have as target the prevention of hazards before consumer exposure. In efforts to meet regulatory requirements and commercial specifications for lower contamination, and to provide safer products to consumers, the meat industry, which also expanded along with regulatory developments and scientific advances, has recently employed various decontamination and pathogen control interventions as multiple hurdles. Major current and future meat safety issues and challenges include the need to control pathogens which may be of increased virulence or resistant to antibiotics or other stresses, control of cross-contamination of foods and water with zoonotic pathogens, and manure treatment and disposal issues. Other issues include additives and chemical residues, organic and natural products, animal identification and traceability, rapid pathogen detection, regulatory harmonization at the national and international level, establishment of risk assessment based food safety objectives, and optimization of HACCP implementation based on food handler training and consumer education.

Key Words: Meat, Safety, Food

Forages and Pastures: Centennial Presentations

544 ASAS Centennial Presentation: Historical perspective on the advances in forage research. J. Burns*^{1,2}, ¹USDA-ARS, Raleigh, NC, ²North Carolina State University, Raleigh.

The objective of this presentation is to provide a historic overview from 1908 through the present on advances in forage and pasture evaluation as related to ruminant utilization. The nutrition of ruminants resides with the utilization of forages, either in the form of pasture, or if stored and preserved as hay or silage. The diet may be all forage or some ratio of forage to concentrate, but the former is the focus of this presentation. The assessment of nutrients contained in forages, including pasturage, were initially identified and described in the early (pre 1900) literature by proximate analyses (following the Weende System) procedures. Innovation has occurred since then regarding the methods of nutrient identification, including improved characterization and rapid assessment of nutrient concentration in forages. During this same period a number of plant attributes have been identified and recognized as having a potential role in ruminant nutrition. These attributes consist of differences among forage species, differences among cultivar within species, morphological characteristics, herbage mass characteristics (grazing management) and physiological processes, such as regrowth rates diurnal shifts and advancing stages of maturity. Techniques and management strategies including stocking methods, and flexible utilization strategies in grazing environments have emerged during this period and have benefitted ruminants through judicious use of these inherent plant attributes. The process of moving forage innovations into the ruminant domain has occurred through advancements in better understanding of antiquality constituents, importance of diet selection, forage fermentation, and particle breakdown and passage. These are all subsequently reflected in *in vivo* dry matter digestibility and dry matter intake and ultimately expressed in the daily performance of the ruminant.

Key Words: Methods, Utilization, Ruminants

545 ASAS Centennial Presentation: Research and extension needs in forage utilization in the future. F. M. Rouquette, Jr.*¹, L. A. Redmon², G. E. Aiken³, G. M. Hill⁴, L. E. Sollenberger⁵, and J. Andrae⁶, ¹Texas AgriLife Research, Texas A&M System, Overton, TX, ²Texas AgriLife Extension Service, Texas A&M System, College Station, TX, ³USDA-ARS Forage Animal Production Research Unit, Lexington, KY, ⁴University of Georgia, Tifton, ⁵University Florida, Gainesville, FL, USA, ⁶Clemson University, Clemson, SC, USA.

Research and extension activities in forage utilization imply multi-discipline efforts targeted at the plant-animal interface. Future need assessments require a multidimensional response surface to account for discipline emphases-direction, funding level erosion, discipline survival, and stakeholder-commodity group interests. Energy-related costs of fuel, fertilizer, feed grains, and seed production mandate that economic assessments become a regular component of addressing and reporting forage-animal responses. Production and utilization strategies for legumes and reduced-nitrogen requiring forages and forage systems will be required to meet stakeholder demands for economically-viable, sustainable livestock enterprises. Emerging issues include plant food nutrient management on pastures and grazed areas, environment-compatibility with urban encroachment and land-use restrictions, and alternative land use for pasture areas. Reduced allocation of state and federal funding has contributed to a reduction in number of full-time equivalent scientists engaged in forage utilization activities. Enhanced requirements for extramural funding to support agricultural research endeavors has reduced forage utilization emphases due to prioritizing and redirection of commodity and industry-based grant funds. Stakeholder interests and objectives will likely include smaller-sized properties, increased urban proximity, and objective-motive, economic-driven management. Research and extension scientists will encounter a shift in emphasis to accommodate changes in stakeholders and property ownership. States that experience forage utilization discipline disappearance may seek a regionalized effort for expertise and databases to accommodate technology transfer opportunities.

Key Words: Grazing, Animal Performance, Pasture Systems

Horse Species III

546 ASAS Centennial Presentation: History and future outlook of equine science teaching programs. C. H. Wood*, *University of Kentucky, Lexington.*

Many equine programs began shortly after the enactment of the Morrill Act of 1862 which led to the creation of the land grant university system. During that time horses and mules were used as the main means of transportation and work for agriculture production. Their value and worth were vital to business and the economy. The objectives of this paper are to discuss early equine undergraduate programs, the characteristics of current programs, and what factors will affect the future of equine undergraduate programs. Early equine teaching programs focused on husbandry management practices of horses and mules. As modern farming practice and machinery were developed, the role of the horses and mules in transportation and agriculture production diminished and horses were selected more for performance activities. Universities with equine teaching programs began to introduce minors or options in equine science. In the 1960s and 1970s, many equine teaching programs implemented equitation courses that turned out to be very popular with students but were subsequently eliminated due to the expense and the perceived lack of science involved in the courses. Equine teaching programs have enjoyed renewed invigoration in the late 1990s and early 2000s. Most current equine programs offer research and educational programs for undergraduate students and professional students. The emphasis of current horse programs is equine science and technology, combined with practical aspects of horsemanship, horse training, showing and judging. What factors have led to this increased interest in equine teaching programs? Why are so many land grant universities instituting or expanding their equine programs? Has the equine industry as a whole contributed to this renewed interest? What role will innovations in technology and social networks play in future equine programs? As instructors, how will we incorporate technologies in the classroom or in the extended classroom? Exploring the answers these questions and more will shed light on the future of equine teaching programs.

Key Words: Equine, Undergraduate, Teaching

547 Effect of ad libitum concentrate feeding on cribbing behavior in horses. T. R. Fenn*¹, C. A. McCall¹, C. E. Eckert¹, W. H. Brown¹, and W. H. McElhenney², ¹*Auburn University, Auburn, AL*, ²*Tuskegee University, Tuskegee, AL*.

Previous research indicates cribbing behavior in horses increases around concentrate meals. This study used 10 mature cribbing geldings to investigate effects of ad libitum concentrate feeding on cribbing behavior. Horses were randomly assigned to either ad libitum feeding (n=5) or control (n=5) groups and were maintained on Bermuda grass (*Cynodon dactylon*) pasture and free choice hay. Each horse was receiving a baseline ration of 1.8 kg of a commercially available pelleted concentrate twice daily at the start of the study (d 0). Control horses remained on this amount throughout the study. Feed for the ad libitum horses was increased to approximately 3.6 kg concentrate four times daily and maintained at this amount for 102 d. Ad libitum horses then were fed 0.9 kg concentrate four times daily (d 103-136) and finally returned to baseline ration (d 137-176). Number of crib bites and duration of crib bouts were recorded for all horses during six 24-h observation periods (d 0, 28, 66, 102, 136 and 170). Data were analyzed as a repeated measures

design which revealed a period by treatment interaction ($P<0.01$) for both total crib bites and total crib bout duration. Preplanned contrasts showed that controls performed 1222 ± 143 more crib bites ($P<0.01$) and spent 110.6 ± 22.7 min more time performing cribbing behavior ($P<0.01$) than ad libitum horses. When ad libitum horses were fed four times daily (d 103-136), their total crib bites and crib bout duration were not significantly different from control horses. Also, no significant residual effect of ad libitum feeding on cribbing behavior was found when ad libitum horses returned to baseline feeding levels. It is not clear from this study whether the decrease in cribbing behavior seen in the ad libitum horses was the result of additional feed or a change in other factors that accompany concentrate feed delivery in horses. Additionally, ad libitum feeding cannot be considered a viable method to reduce cribbing behavior because of possible negative effects, e.g., obesity, of this feeding regimen on horse health and usefulness.

Key Words: Horse, Ad Libitum Feeding, Cribbing Behavior

548 Epidemiologic and economic study of Hyperelastosis Cutis/HERDA in the quarter horse cutting industry. S. G. Tipton*¹, J. D. Anderson¹, T. S. Smith¹, N. J. Winand², P. R. Ryan¹, R. L. Linford¹, and A. M. Rashmir¹, ¹*Mississippi State University, Mississippi State*, ²*Cornell University, Ithaca, NY*.

Hyperelastosis Cutis (HC) is an autosomal recessive skin disorder in Quarter Horses. Homozygous (Hr/Hr) horses have fragile, hyperextensible skin with skin sloughing and scarring, and are often euthanized. Heterozygous (N/Hr) horses are carriers of the gene, but appear to be normal. The objectives of this study were to evaluate the economic impact of HC within the cutting horse industry and to determine the pedigree relationship of affected and carrier individuals, using SAS Proc Inbreed. Hr/Hr horses (n=194) were identified through DNA and urine testing, or clinical presentation. N/Hr status was then established for an additional 606 horses, including 285 stallions and 265 mares. Records were obtained on the top 100 cutting horses and lifetime earning (LTE) sires within the industry for 1985 through 2006 (Equistat), (N/Hr) horses from these groups were then identified. As of 2006, the cutting horse industry has paid \$388 million to the top 100 sires' offspring, with 23% of those earnings (\$88 million) attributed to the offspring of 12 N/Hr stallions (12%). From 1998 through 2006, these N/Hr sires' offspring earnings increased an average of 0.5% annually, indicating an upward trend. Of the top 100 LTE sires, N/Hr stallions account for 12% and N/N (wild type) for 88%. Thirty three percent of N/Hr sires' offspring earned money with average earnings of \$24,064, compared to N/N sires, with 27% of their offspring averaging \$19,187. In addition, 43% of N/Hr sires' offspring have performed, while only 39% of N/N sires' offspring have performed. Of the approximate 3,500 samples submitted for DNA testing from four continents, 18% of clinically normal cutting horses tested N/Hr. The true prevalence of Hr/Hr horses is difficult to estimate due to the limited number of homozygous horses tested thus far. The large number of heterozygous (N/Hr) horses and the financial impact of this disease on the cutting horse industry emphasize the importance of DNA testing for HC and appropriate breeding selection. This study was supported by AQHA grant number 05070672.

Key Words: Hyperelastosis Cutis, HERDA, Quarter Horses

549 Gastric ulcer incidence rate and relationship to other parameters in 40 Standardbred racehorses. R. E. Cate*, B. D. Nielsen, C. I. O'Connor-Robison, H. S. Spooner, J. L. Feldpausch, and H. C. Schott II, *Michigan State University, East Lansing.*

Many studies report incidence rates of gastric ulcers to be 60 to 90% in racehorses. This study was performed to determine the incidence rate in a population of Standardbred racehorses training in Michigan and to determine the relationship of ulcers to other factors that could be evaluated through a physical examination or by obtaining the horse's history from a trainer. The presence or absence of ulcers was confirmed by gastroscopic examination of 40 Standardbreds on two farms (22 horses on farm A, 18 horses on farm B) and given a grade of 0 to 4 where a grade 0 represents no ulceration found. Examinations were conducted during the last two weeks of December and the first week of January and the age of horses (as of January 1st) ranged from 3 to 12 years. Horses were body conditioned scored on a scale of 1 to 9 and trainers were asked to grade the current racing performance of each horse on a scale of A to F with A being best. For statistical purposes, horses were grouped by gender (15 females, 25 males), age (ages 3 and 4 or 5 years of age and older), body condition score (below a BCS of 4.5 or 4.5 and above), and performance (grades A and B or grade C and lower). The incidence rate of ulcers was similar between farms (50% and 56%) but the average (52.5%) was lower than has been typically reported. Ulcer score was not related to gender ($P = 0.72$), age ($P = 0.48$), body condition score ($P = 0.65$), or performance ($P = 0.55$). These findings suggest that the commonly cited incidence rate of ulcers may be too high to be used universally. Similarly, given that only 7 out of 40 horses (17.5%) had a grade 2 or higher ulcer, the impact that ulcers likely cause on performance or health is probably lower than what is commonly believed. This study also confirms a gastroscopic examination needs to be performed to confirm the presence of ulcers despite the belief by many that performance and body condition score can be indicative of their presence.

Key Words: Horse, Ulcer

550 Use of slow-release urea to facilitate composting of horse manure. S. C. Dilling* and L. K. Warren, *University of Florida, Gainesville.*

Manure and bedding removed from horse stalls often has a high C:N ratio, thus requiring additional N to facilitate composting. Yet, N loss through volatilization can be significant. This study investigated the use of slow-release N (SRN) sources to promote composting and mitigate N loss from horse stall materials. Materials were amended with urea ($n=3$) or one of two SRN sources: urea formaldehyde ($n=3$) or polymer sulfur coated urea ($n=3$). N-amended treatments were compared to materials that were unamended (CON; $n=3$). All materials were composted for 120 d using an on-farm multiple-bin system. Compost temperature, moisture and O_2 were monitored 3 d/wk. Compost samples were collected at 30 d intervals and analyzed for NDF, ADF, lignin, total N, NH_3 , NO_3 , total C, pH and microbial populations. Data were analyzed by ANOVA using proc mixed function of SAS (v 9.1) and pdiff for treatment means separation. Temperatures required to destroy parasites and weed seeds were reached within the first 2 wks of composting in all treatments.

Weight and total C of materials were reduced in response to composting ($P \leq 0.05$), but were not affected by N-amendment. Total N decreased during composting ($P \leq 0.05$) with a greater loss of N in all N-amended treatments compared to CON ($P \leq 0.01$). The largest loss of N occurred with urea ($56 \pm 3\%$) compared to SRN sources ($5 \pm 0.9\%$) ($P \leq 0.01$). NH_3 was affected by treatment ($P \leq 0.05$) with a loss occurring in urea, no change in CON and an increase in SRN sources. Composting resulted in an increase ($P \leq 0.05$) in NO_3 , with CON lower ($P \leq 0.01$) than N-amended materials. N-amendment reduced ($P \leq 0.05$) the pH of materials from 7.5 ± 0.1 to 6.3 ± 0.2 during composting. N-amendment had no effect on NDF, ADF, lignin or microbial populations. Collectively, these results indicate that SRN sources reduce the loss of N during composting of horse stall material, but did not necessarily enhance the decomposition process compared to urea. Use of SRN sources may decrease the risk of environmental pollution and increase the value of the composted horse stall material as a fertilizer source.

Key Words: Composted Horse Manure, Stall Waste, Nitrogen Amendment

551 Phosphorus contribution of six equine bedding types. A. D. Woodward*, B. D. Nielsen, C. I. Robison-O'Connor, and J. M. Witherspoon, *Michigan State University, East Lansing.*

The objective of this study was to determine differences in P contribution from different bedding materials used in an equine facility. A 6×6 Latin Square design was used with 6 horses and 6 bedding materials—shavings (SH), straw (ST), chopped straw (CS), wood pellets (WP), peat moss (PM), and corn cob hulls (CC). Each horse and bedding combination lasted 7 days. Before the commencement of the study, stalls were stripped of any previous bedding material and bedded to an average depth of 12.5 cm with each bedding type. Weight of bedding used was recorded. Waste was removed once daily by the same farm crew, weighed, mixed, and a 10% grab sample was saved. New bedding was weighed and replaced as needed to maintain 12.5 cm. At the end of each 7-d period, all grab samples were pooled, mixed, and a cumulative 10% sample was bagged and frozen at $-20^\circ C$ for further analysis of P. More CS, PM, SH, and ST were added daily compared to CC and WP (6.5, 4.9, 4.6, and 7.2 vs. 0.0 and 1.3 kg, respectively; $P < 0.01$). Removal of CS, SH, and ST was higher daily compared to CC and PM (17.8, 16.7, and 21.1 vs. 10.5 and 10.6 kg, respectively; $P < 0.05$). Concentration of P in the used bedding was higher in CC compared to SH and WP (2.4 vs. 1.1 and 1.1 g P/kg bedding, respectively; $P < 0.05$) and was higher in CS compared to SH (2.1 vs. 1.1 g P/kg bedding; $P < 0.05$). Concentration of P in the used bedding was also higher in PM compared to CS, ST, WP, and SH (3.1 vs. 2.1, 1.7, 1.1, and 1.1 g P/kg bedding; $P < 0.05$). On a DM basis, results were much the same. Concentration of P in the used bedding was higher in CC compared to SH and WP (5.7 vs. 2.5 and 2.4 g P/kg bedding, respectively; $P < 0.05$) and was higher in PM compared to CS and SH (8.1 vs. 4.2 and 2.5 g P/kg bedding, respectively; $P < 0.05$). These results reveal differences in P contribution of six typical bedding materials used in horse facilities. The knowledge gained from these results can be used to create improved nutrient management practices in horse facilities.

Key Words: Horse, Phosphorus, Bedding

Lactation Biology III

552 ASAS Centennial Presentation: Historical perspective on lactation biology. R. S. Kensinger*, *Oklahoma State University, Stillwater.*

Research over the past 100 years has revealed numerous exciting developments in our understanding of the biology of lactation. New assay technology combined with classical approaches to endocrinology contributed greatly to our knowledge of hormonal control of mammary function. The development of unconventional models of investigation (including suckling intensity, altered milking frequency, hemi-mastectomy, induced lactation, and transplantation of mammary glands) lead to greater understanding of factors that affect mammary function; as well as greater appreciation of the plasticity of the mammary gland. This era yielded papers on the characterization of the milk proteins and sequencing of the milk protein genes; elucidation of the complex array of milk lipids; and an appreciation for variation among species in oligosaccharides in milk. From a practical standpoint, this knowledge provided better management strategies to encourage passive transfer of immunity to neonates, and better selection tools for breeding females. Subtle benefits of colostrum and milk to neonates were described in recent years. The defense mechanisms of mammary glands were characterized in this era, and a greater appreciation of the impact of mastitis on livestock productivity was gained. This foundation knowledge lead to development of useful food animal practices and technologies like vaccination programs in pregnant females to enhance immunity in neonates, bST for dairy, and the development of Monensin for lactating cattle. This knowledge also encouraged the biomedical industry to use mammary glands in food animals to produce human pharmaceuticals.

Key Words: Centennial, Mammary, Lactation

553 ASAS Centennial Presentation: Lactation biology for the 21st century. J. J. Looor*¹ and W. Cohick², ¹*University of Illinois, Urbana,* ²*Rutgers, The State University of New Jersey, New Brunswick.*

Knowledge of general aspects of mammary gland function, including metabolic pathways and hormonal regulation of mammary gland development and lactation, in livestock species was obtained several decades ago. As basic biological information of growth factor action, apoptotic mechanisms, and signal transduction events has exploded, the mouse became the model of choice for studying fundamental mechanisms regulating mammary function. A complete sequenced genome also has made the mouse amenable for studies of mammary gene network expression. Advances in molecular biology techniques currently allow researchers to genetically modify mice to either overexpress or completely lack specific genes, thereby studying their function in an in vivo setting. Furthermore, the use of mammary specific promoters has allowed genes related to mammary gland function to be eliminated from the mammary gland in a developmental and tissue-specific manner. These studies have provided compelling evidence of the underlying complexity that must ultimately allow the ruminant or swine mammary gland to function in a coordinated fashion throughout puberty, pregnancy, lactation, and involution. The challenge for the researcher interested in understanding these complex

mechanisms to enhance the efficiency of milk production in domestic species is how to obtain similar information in much larger, expensive animals. One possible approach is to manipulate gene expression in vitro using mammary cell culture models derived from domestic animals, e.g. genes can be “knocked-down” using small interfering RNA approaches. Ultimately, major advances in understanding lactation biology may come from coupling basic mechanistic information with functional genomics, proteomics, and metabolomics approaches. A strong foundation in bioinformatics will also be required to optimize use of these new technologies. Additional areas that hold promise are stem cell biology and epigenetics. Strong training of our future scientists in these areas should facilitate livestock-focused mammary gland research that will allow basic information to be gained at unprecedented levels, ultimately leading to optimization of livestock production.

Key Words: Genomics, Gene Silencing, Stem Cells

554 The persistent milk yield response to frequent milking during early lactation is associated with persistent changes in mammary gene expression. E. H. Wall*, J. P. Bond, and T. B. McFadden, *University of Vermont, Burlington.*

Four-times daily milking during the first 3 weeks of lactation elicits an increase in milk yield, which persists through late lactation even after twice-daily milking is imposed. We hypothesized that this milk yield response would be associated with changes in mammary proliferation, apoptosis, and gene expression, which would persist throughout lactation. Six multiparous cows were assigned to unilateral frequent milking (UFM; twice daily milking of the left udder half (2X), four-times daily milking of the right udder half (4X)) on days 1 to 21 of lactation, followed by 2X thereafter. Udder halves initially milked 4X produced more milk than 2X glands during ($P < 0.001$), and after ($P < 0.05$) UFM treatment. To determine the mechanisms involved in the persistent milk yield response, we obtained mammary biopsies from both udder halves at 21, 23, and 40 days in milk (DIM). Rates of [³H]-thymidine incorporation into DNA in vitro and mammary cell apoptosis were not affected by UFM or DIM ($P > 0.30$). Using Affymetrix GeneChip® Bovine Genome Arrays, we identified a cluster of 16 genes with a similar temporal pattern of expression that differed between 2x and 4x udder halves ($P < 0.05$). Nine of the genes in the cluster remained differentially expressed at 40 DIM ($P < 0.05$), indicating that they may be involved in the persistent milk yield response. Among these genes were chitinase-like protein (CLP)-1, clusterin, early growth response (EGR)-1, sex determining region Y-box (SOX)-4, and -9. These genes have been associated with mammary development, differentiation and remodeling; all of which may be functionally related to the increase in milk yield. We conclude that frequent milking during early lactation does not alter mammary growth but is associated with coordinated changes in mammary expression of 16 genes. Future experiments will determine the function of these genes in the mammary gland, and will clarify their role in the autocrine regulation of milk production and long-term alteration of mammary function.

Key Words: Frequent Milking, Gene Expression, Mammary Gland

555 Gene network analysis in mammary and liver tissue of lactating mice fed trans10,cis12-CLA. A. K. G. Kadegowda*¹, A. Thatcher², L. S. Piperova¹, S. L. Rodriguez-Zas², R. A. Erdman¹, and J. J. Loo², ¹University of Maryland, College Park, ²University of Illinois, Urbana.

Exogenous trans10,cis12-CLA (10/12CLA) reduces mammary lipid synthesis in bovine and murine mammary tissue (MG). However, genome-wide alterations in MG and liver (LIV) associated with dietary 10/12CLA during lactation remain unknown. To better characterize MG and LIV tissue gene networks sensitive to 10/12CLA during lactation, we fed mice (n = 5/diet) control or control + 10/12CLA (37mg/day) between d 6 and d 10 post-partum. Tissues were harvested on d 10 after sacrifice. A 35,302 gene annotated murine exonic evidence-based oligo (MEEBO) microarray (70-mers) and quantitative PCR were used for transcript profiling. Cy3- and Cy5-labelled cDNA from MG or LIV and a reference standard were used for hybridizations (total of

20 microarrays). Milk fat concentration was 44% lower on d 10 vs. d 6 due to 10/12CLA. ANOVA (FDR-adjusted P = 0.20) identified 1,496 differentially expressed genes (DEG) in MG and 22 in LIV due to 10/12CLA. Among DEG in MG, we found 37 downregulated and 82 upregulated by 1.5-fold or greater. Gene network analysis of upregulated MG genes identified cell cycle (7 genes), cell growth/proliferation (10 genes), cell assembly/organization (27), and small molecule biochemistry (25) as modified families of related genes. Similar analysis of downregulated genes identified lipid metabolism (34 genes), cell death (29), and carbohydrate metabolism (23) as gene families most affected by 10/12CLA. The PPAR-signaling pathway was the most affected by 10/12CLA with a total of 77 DEG including Pparg and Pppard. Overall, results suggest that lower mammary lipid synthesis induced by dietary 10/12CLA in mice is associated with previously-unknown adaptations in gene networks in MG and to a lesser extent in LIV.

Key Words: Lactation, Genomics, t10c12 CLA

Symposium: Meat Science and Muscle Biology: Postmortem Changes in Myofibrillar Protein and the Associated Contribution to Meat Quality

556 Historical perspective of postmortem changes in myofibrillar proteins and their relationship to meat quality. F. C. Parrish*, Iowa State University, Ames.

Myofibrillar proteins make up the largest amount of muscle protein and they are largely responsible for postmortem changes in rigor mortis, tenderness and water holding capacity. The changes of myofibrillar proteins and the mechanism of these changes in the tenderization process have received much attention. Proteolysis has long been thought of as the mechanism of postmortem tenderization. The definitive proof of proteolysis and its relationship to tenderness, however, had eluded scientists until studies were initiated in the late 1960's. A series of innovative studies on the changes in molecular properties of myofibrillar proteins in postmortem muscle led to the discovery of Z disk degradation and myofibril fragmentation by a calcium activated endogenous protease. The protease was subsequently named calcium activated factor (CAF). Further extensive studies found CAF had a high requiring calcium form, m calpain, and a low calcium requiring form, μ calpain, and an inhibitor, calpastatin. Other studies on CAF showed myofibril fragmentation and the simultaneous disappearance of troponin T and appearance of a 30 kDa component were strongly related to beef steak tenderness. The 30 kDa component was only in tender beef steaks. The term "myofibril fragmentation tenderness" was introduced to describe a state of beef tenderness. The degradation of titin and nebulin in postmortem beef muscle was found to be due to CAF. Also, degradation of titin, nebulin, and troponin T was greater and more rapid in a tender than in a tough beef muscle. Titin was more rapidly degraded in muscle from steers, than it was in muscle from bulls and mature cows, too. Degradation of specific structural proteins (titin, nebulin, filamin, desmin, and troponin T) by μ calpain at low pH and temperature was similar to their degradation in postmortem muscle. Other studies on calpain activity and its inhibitor, calpastatin, and the affects of calcium infusion of carcasses and their relationship to tenderization have proven valuable. From these historical studies it can be concluded that limited and specific proteolysis of key structural proteins in the I band of the myofibril are caused by μ calpain and results in postmortem tenderization.

Key Words: Proteolysis, 30 kDa Component, Calpain

557 Calpain biology and postmortem meat tenderization. D. E. Goll*, J. P. Camou, J. A. Marchello, S. W. Novak, and V. F. Thompson, University of Arizona, Tucson.

It is now widely accepted that the calpains have an important role in the postmortem proteolysis that contributes to tenderization. It remains unclear, however, how the calpains function in postmortem muscle, where the temperature after 6-12 h is near 2-4°C, the pH is near 5.8, and the calpain inhibitor, calpastatin, is present. Studies have suggested that μ -calpain is the primary protease responsible for postmortem proteolysis, but μ -calpain has very little activity after 2-3 d postmortem, even when assayed at pH 7.5 and 25°C. It has been suggested that loss of μ -calpain activity during postmortem storage is an artifact caused by exposure to high ionic strength. We have partly purified calpastatin and both μ - and m-calpain from 11-d postmortem bovine muscle without exposing them to ionic strengths above 200 mM during purification.

Both calpains are nearly inactive after 11 d postmortem when assayed at pH 7.5 and 25°C; the inactive μ -calpain can be detected with antibodies. Western analysis shows that postmortem μ -calpain consists largely of 76- and 28-kDa subunits, so the small subunit of μ -calpain is not autolyzed to any appreciable extent during postmortem storage. Based on results of *in vitro* assays, this 28/76-kDa molecule would be expected to be proteolytically active, and it is unclear why it has no activity. *In vitro* assays done at 25°C and using purified calpains show that at-death m-calpain is nearly inactive proteolytically at pH 5.8 but that at-death μ -calpain has some activity at pH 5.8. Zymogram assays, however, show that 1-d postmortem μ -calpain is nearly inactive at pH 5.8, even when assayed at 25°C. After partial purification, calpastatin activity is detected in 11-d postmortem muscle, but this activity is less than the calpastatin activity in at-death muscle. Postmortem calpastatin polypeptides are smaller than 70-kDa and seem less effective (higher K_i values) than at-death calpastatin in inhibiting the calpains. The results thus far suggest that postmortem calpastatin may not be an effective calpain inhibitor, but they raise a number of questions about whether the calpains have any appreciable proteolytic activity after 2-3 days of postmortem storage.

Key Words: Calpain, Tenderness, Postmortem

558 Relationship of postmortem changes in myofibrillar protein to meat quality. E. Huff-Lonergan* and S. Lonergan, Iowa State University, Ames.

Variations in tenderness and water-holding capacity are major quality problems that significantly affect the profitability of the meat industry. It is clear that early postmortem biochemical and biophysical processes, including proteolysis, contribute to the development of water-holding capacity of pork and tenderness of both pork and beef. For decades, it has been known that tenderness of meat is improved by holding the product at refrigerated temperatures for periods of time ranging from 1-4 weeks postmortem. This process is referred to as postmortem aging or conditioning. During the aging period, major structural changes in the tissue occur. Many of these changes are associated with myofibrils and their linkages to the sarcolemma. Since myofibrils make up nearly 80% of the volume of the muscle cell, their disruption will greatly influence meat tenderness. Even prior to 24 hours postmortem, significant proteolysis of proteins linking myofibrils to the sarcolemma and to each other occurs. Other changes correlated with increased tenderness include breakages within the myofibrils leading to their increased fragility and fragmentation. The increase in myofibrillar fragmentation is indicative of the amount of proteolysis and subsequent tenderization that has taken place. Many proteins involved in meat quality are substrates of the protease μ -calpain. Microenvironmental factors such as pH and ionic strength and oxidative conditions influence the ability of calpain to degrade myofibrillar substrates. Both μ -calpain and m-calpain have slower rates of activity against myofibrillar protein substrates at pH values and ionic strengths similar to those found in postmortem muscle. Alterations in pH and/or ionic strengths may cause conformational changes that allow an increase in the hydrophobicity and aggregation of the enzyme. Likewise, pH/ionic strength changes may alter the conformation of substrate proteins and render them less susceptible to

cleavage by μ -calpain. In addition, post-translational modifications of the calpains and their myofibrillar substrates may also contribute to the development of meat quality attributes.

Key Words: Muscle, Meat Quality, Postmortem Changes

559 New methods to investigate changes in meat and myofibrillar proteins. E. Veiseth*, *Matforsk, Ås, Norway.*

Meat tenderness improves during postmortem cooler storage largely due to calpain-mediated proteolysis of key myofibrillar and associated proteins. This proteolysis does not appear to be random, and several studies have been undertaken to determine which specific proteins are degraded and what structural changes are associated with tenderisation. While most structural changes described until now occur at the ultrastructural level (e.g. fracturing of myofibrils), we have focused on changes occurring at the microstructural level (i.e. fracturing of muscle fibres and their detachment from connective tissue).

Our objective was to investigate relationships between microstructural changes, calpastatin activity, and Warner-Bratzler shear force (WBSF) in aged Longissimus dorsi (LD) muscle from fifty Norwegian Red bulls. The LD muscle was conditioned at 12°C for 10h, and then aged for 7 days at 4°C. Samples for calpastatin measurements were extracted between 24 and 31 hrs postmortem using a heated calpastatin procedure. After 7d, WBSF measurements and microstructural analyses (optical microscopy observations of plastic sections stained with toluidine blue) were performed. Before correlation analyses (SAS, 1999), the data were corrected for the fixed effects of age, batch, and pen within batch. The analysis showed a positive correlation (0.62; $P < 0.001$) between calpastatin and WBSF, while negative correlations were found between muscle fibre fractures and both WBSF (-0.33; $P = 0.02$) and calpastatin (-0.55; $P < 0.01$). These results indicate that muscle fibre fractures resulting from calpain-mediated proteolysis is a major microstructural change responsible for variation in WBSF of bovine LD muscle, while muscle fibre detachments from connective tissue have limited impact.

We have recently begun to investigate changes in muscle structural proteins using proteomics. A combination of protein fractionation, two-dimensional gel electrophoresis, image analysis, and mass spectrometry is used to quantify and identify changes in these proteins during post-mortem storage of beef LD muscle.

Key Words: Muscle, Microstructure, Proteomics

560 Post harvest processes that influence myofibrillar protein degradation and meat quality. M. N. Lund¹, R. Lametsch*¹, M. S. Hviid², and L. H. Skibsted¹, ¹*University of Copenhagen, Frederiksberg, Denmark,* ²*Danish Meat Research Institute, Roskilde, Denmark.*

Modified atmosphere retail packaging with a high level of oxygen (70-80%) finds an increasing use for fresh meat as high oxygen concentrations preserve the bright red colour of fresh meat and increase shelf-life by reducing microbial growth. However, packaging of fresh meat in high-oxygen atmospheres increases oxidation of meat lipids and proteins leading to undesirable off-flavour formation and reduced meat tenderness. Oxidation of meat lipids has been studied extensively during the last decades, while protein oxidation in fresh meat has not received much attention until recently. Oxidation of proteins includes formation of reactive radicals, amino acid derivatives, and cross-linked protein derivatives, which may cause changes in the functional properties like loss of protein solubility and enzyme activity.

Myosin, which constitutes approx. 50% of the myofibrillar proteins, is very susceptible to *in vitro* oxidation of both its cysteine and tyrosine residues and possibly also other amino acid residues (1). We found that *in vitro* myosin oxidation causes formation of long-lived tyrosyl radicals and intermolecular disulfide and dityrosine cross-links which result in polymerization and aggregation of the protein (1). In fresh meat stored in high-oxygen atmospheres, myosin was found mainly to cross-link through intermolecular disulfide formation, which was consistent with a reduction in meat tenderness. In comparison, storage of meat without oxygen resulted in more tender meat and no observable myosin cross-linking (2). Furthermore, we found that addition of antioxidants capable of inhibiting lipid oxidation like a rosemary extract containing phenolic compounds did not inhibit protein oxidation in meat (3).

It is concluded, that protein oxidation of key myofibrillar proteins is a major consequence for meat quality. Notably, the protection of proteins from oxidation by using antioxidants needs further attention.

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(2) Lund, MN *et al.* Meat Sci. 2007, 77, 295-303

(3) Lund, MN *et al.* Meat Sci. 2007, 76, 226-233

Key Words: Protein Oxidation, Tenderness, Myosin Cross-Linking

Nonruminant Nutrition: Distillers Grains for Swine

561 Digestible energy and metabolizable energy in distillers dried grains with solubles (DDGS) and enhanced DDGS. J. A. Soares*, H. H. Stein, V. Singh, and J. E. Pettigrew, *University of Illinois, Urbana.*

Distillers dried grains with solubles (DDGS) have a high fiber concentration. The elusieve process removes approximately 10% of the material, mostly fiber, yielding a product called enhanced DDGS (E-DDGS) that has a total dietary fiber concentration that is approximately 3.5 percentage units lower than DDGS. The objective of the experiment was to determine DE and ME in 2 sources of DDGS and in E-DDGS produced from each source of DDGS. Thirty growing pigs (average BW: 23kg) and 30 finishing pigs (average BW: 73kg) were used. Pigs were placed in metabolism cages and allotted to a randomized complete block design. Five diets were used at each stage of growth. The basal diet was based on corn and soybean meal and 4 additional diets were formulated by replacing 40% of the basal diet with 40% of each source of DDGS and E-DDGS. Pigs were fed their experimental diets for 14d, and urine and feces were collected during the final 5d. Overall, E-DDGS has greater DE ($P < 0.05$) and ME ($P < 0.05$) than DDGS. The DE and ME values were not different between growing and finishing pigs. In conclusion, removal of some of the fiber from DDGS by the elusieve process increases the energy concentration in the product. Overall, E-DDGS contains approximately 242 and 185 kcal/kg more DE and ME than DDGS.

Table 1. Daily energy balance for DDGS and E-DDGS

Item	Ingredient				SEM	P-value
	DDGS-1	DDGS-2	E-DDGS-1	E-DDGS-2		
Growing pigs						
DE, kcal/kg of DM	3,391 ^x	3,483 ^{xy}	3,703 ^y	3,670 ^y	147	0.001
ME, kcal/kg of DM	3,047	3,159	3,225	3,339	226	0.187
Finishing pigs						
DE, kcal/kg of DM	3,303 ^x	3,436 ^x	3,518 ^{xy}	3,691 ^y	209	0.027
ME, kcal/kg of DM	3,128 ^x	3,239 ^{xy}	3,293 ^{xy}	3,453 ^y	203	0.075

x,y Values within a row without a common superscript letter are different ($P < 0.05$).

Key Words: Pigs, Energy, Enhanced Distillers Dried Grain with Solubles

562 Effect of deoiled corn dried distillers grains with solubles (solvent extracted) on growth performance and carcass characteristics of growing and finishing pigs. J. Y. Jacela*¹, J. M. DeRouchey¹, S. S. Dritz¹, M. D. Tokach¹, R. D. Goodband¹, J. L. Nelssen¹, J. M. Benz¹, K. Prusa², R. C. Thaler³, and D. E. Little⁴, ¹Kansas State University, Manhattan, ²Iowa State University, Ames, ³South Dakota State University, Brookings, ⁴DairyNet Inc., Brookings, SD.

A total of 1,215 pigs (BW=29.6 kg) were used in a 99-d trial to determine the effect of deoiled corn dried distillers grains with solubles, solvent

extracted, (dDDGS) on growth and carcass characteristics. This product is dried distillers grains with a majority of the oil removed. Pigs were blocked on pen weight and randomly allotted to 1 of 5 dietary treatments (0, 5, 10, 20, or 30% dDDGS). Diets had equal ME and standardized ileal digestible (SID) lysine content based on a previous study at Kansas State University. Pen weights were obtained every 2 wk from d 0 to 99 and ADFI was recorded on a pen basis. Increasing dDDGS reduced (linear; $P < 0.01$) ADG and ADFI. The greatest reduction was in pigs fed over 20% dDDGS. Carcass weight and percent yield were reduced (linear; $P < 0.01$), loin depth tended to decrease ($P < 0.09$), and jowl and belly IV increased (linear; $P < 0.01$) as dDDGS was increased. There was no difference in backfat ($P > 0.26$), percent lean ($P > 0.16$), or FFLI ($P > 0.20$). In summary, feeding increasing levels of dDDGS reduced ADG, ADFI, yield, and carcass weight and increased IV, but did not affect G:F. These data confirm the accuracy of the previously determined ME (2,506 kcal/kg) and SID values for dDDGS; however, reasons for the reduced ADFI need further investigation.

Table 1.

Item	dDDGS, %					SEM
	0	5	10	20	30	
D 0 to 99						
Final wt, kg	121.4	119.3	118.8	118.2	116.2	0.9
ADG, g	909	893	887	887	873	8.2
ADFI, kg	2.16	2.17	2.10	2.11	2.04	0.03
G:F	2.38	2.43	2.37	2.38	2.33	0.03
Carcass wt, kg	91.1	89.0	89.1	87.7	86.3	1.8
Yield, %	75.5	75.0	75.0	74.7	74.3	0.3
Backfat, mm	16.46	16.54	16.54	16.38	16.97	0.25
Loin depth, mm	2.50	2.45	2.46	2.48	2.39	0.03
Lean, %	56.5	55.9	56.3	56.4	55.8	0.2
FFLI, %	50.4	50.4	50.4	50.5	50.2	0.1
Jowl iodine value, g/100g	67.5	68.1	69.0	71.1	73.3	0.5
Belly iodine value, g/100g	67.1	68.0	69.1	72.4	73.7	0.6

Key Words: Swine, Dried Distillers Grains, Growth

563 Effect of dried corn distillers grains with solubles (DDGS) on growth performance of growing-finishing gilts with previous exposure to DDGS in the nursery. T. E. Burkey*, R. Moreno, E. E. Carney, and P. S. Miller, *University of Nebraska, Lincoln.*

A study was conducted to evaluate the effects of DDGS on growth performance of gilts, during the growing-finishing phase, that were previously fed high concentrations of DDGS (30%) during the nursery phase. A total of 24 crossbred gilts (initial BW 28.09 ± 0.73 kg) were used in a 98-d experiment. Twelve gilts with no prior exposure to DDGS, and 12 gilts that were fed high concentrations of DDGS (30%) in the nursery phase, were used in the current experiment. Pigs were individually penned and had ad libitum access to feed and water. The pigs were randomly allotted to 1 of 4 dietary treatments: 1) 0% DDGS in the nursery + 0% DDGS during the growing-finishing period; 2) 0% DDGS in the nursery + 30% DDGS during the growing-finishing period; 3) 30% DDGS in the nursery + 0% DDGS during the growing-finishing period; and 4) 30% DDGS in the nursery + 30% DDGS during the

growing-finishing period. Body weight and feed disappearance were measured and ADG, ADFI, and G:F were calculated. Final BW were 122.6, 113.7, 112.6 and 106.9 ± 4.4 kg, respectively for treatments 1 through 4. There were no differences among treatments for final BW ($P = 0.13$). Overall, no treatment effects were observed for ADG and ADFI; however, among gilts that were fed DDGS in the nursery, the absence of DDGS in the growing-finishing period resulted in greater G:F compared to gilts that continued to receive DDGS (30%) during the growing-finishing period ($P < 0.03$). The results of this experiment indicate that the growth performance of gilts fed DDGS in the growing-finishing phase of production may not be affected by the feeding of high levels of DDGS during the nursery phase.

Key Words: DDGS, Gilts, Growth Performance

564 Alternating dietary inclusion of corn distillers' dried grains with solubles (DDGS) did not impact growth performance of finishing pigs. N. R. Augspurger^{*1}, G. I. Petersen², J. D. Spencer¹, and E. N. Parr¹, ¹*JBS United, Inc., Sheridan, IN*, ²*University of Illinois, Urbana*.

An experiment was done to compare continuous vs alternating inclusion of corn dried distiller's grains with solubles (DDGS) in growing-finishing swine diets. A total of 480 pigs (52.2 ± 2.9 kg, Monsanto EBX Ultra × GPK 35) were weighed by pen, blocked by weight and sex, and randomly allotted to one of six treatments. Pigs were allowed ad libitum access to their respective diet for a period of 88 d. A total of five dietary phases were fed with body weights and feed intakes recorded at the beginning and end of each phase (the first three phases lasted 3 wk each; the last two phases lasted 2 wk each). Following the final weigh date, pigs were shipped to a commercial packing plant (Tyson Fresh Meats, Columbus Junction, IA) for collection of carcass data. Dietary treatments consisted of 1) corn-SBM diet without added fat; 2) as 1 + 3 (phase 1-4) or 4% (phase 5) added fat (choice white grease); 3) corn-SBM + 15% DDGS; 4) corn-SBM + 30 (phase 1-3)/15 (phase 4)/7.5% (phase 5) DDGS; 5) corn-SBM + 15% DDGS alternated by phase with 4% added fat; and 6) corn-SBM with 0 and 4% added fat alternated by phase. Fat was added at 4% during the last phase for treatments 2-6. Diets were not formulated to be isocaloric. Neither growth rate (g/d) or feed intake (g/d) were affected ($P > 0.39$) by dietary treatment. Gain/feed ratio, however, was increased ($P = 0.008$) through addition of fat (treatments 2, 5, and 6), while DDGS supplementation (treatments 3-5) had no impact ($P = 0.268$). Constant fat supplementation (treatment 2) resulted in the greatest ($P < 0.05$) carcass yield and carcass weight

responses, with an advantage of approximately 3.2 kg over pigs in the other five treatments. Neither backfat depth (mm) or carcass lean (%) were affected ($P > 0.20$) by dietary treatment, but loin depth (mm) tended to be lower ($P = 0.067$) for pigs fed diets containing DDGS relative to the corn-SBM control. These data show that alternating the presence and absence of DDGS in diets for finishing pigs was not detrimental to growth performance.

Key Words: DDGS, Pigs, Fat

565 Effects of excess dietary crude protein from soybean meal and distillers dried grains with solubles in diets for finishing pigs. S. C. Williams^{*}, J. D. Hancock, C. Feoli, S. Issa, and T. L. Gugle, *Kansas State University, Manhattan*.

A total of 180 pigs (90 barrows and 90 gilts with an average initial BW of 67 kg) were used in a 67-d experiment to determine the effects of excess CP from soybean meal (SBM) and distillers dried grains with soluble (DDGS) on growth performance and carcass measurements in finishing pigs. The pigs were sorted by gender and ancestry and blocked by BW with 12 pigs/pen and five pens/treatment. Treatments were a control diet (corn-SBM with 12% CP), a corn-SBM diet formulated to 16% CP, and a corn-SBM-based diet with 40% DDGS that had 16% CP. Feed and water were consumed on an ad libitum basis until the pigs were slaughtered (average final BW of 128 kg) at a commercial abattoir. Pigs fed diets with excess CP had lower ($P < 0.001$) ADG and ADFI compared to those fed the control. However, the reduced ADG and ADFI were apparent only for pigs fed excess CP from DDGS (SBM vs DDGS, $P < 0.001$) and G:F for pigs fed the excess CP treatments was similar to that of pigs fed the control ($P > 0.18$). Final BW and hot carcass weight were lower ($P < 0.001$) for pigs fed excess CP but as with growth performance, the negative effects were apparent only for pigs fed the diet with DDGS ($P < 0.001$). Also, there was a trend ($P < 0.08$) for pigs fed the DDGS treatment to have reduced dressing percentage compared to pigs fed the diet with excess CP from SBM. Means for the control, SBM, and DDGS treatments were 0.96, 0.96, and 0.85 kg/d for ADG, 2.97, 2.91, and 2.64 kg/d for ADFI, 323, 329, and 324 g/kg for G:F, 97.6, 97.0, and 91.1 kg for hot carcass weight, 74.2, 74.2, and 73.3% for dressing percentage, and 54.3, 55.6, and 54.8 for percentage carcass lean. In conclusion, reductions in growth performance, carcass weight, and dressing percentage for pigs fed a diet with 40% DDGS could not be explained by the excess CP for that diet.

Key Words: Pig, Distillers Dried Grains, Excess Crude Protein

Physiology and Endocrinology: Enhancing Reproductive Efficiency

566 ASAS Centennial Presentation: Future research in physiology and endocrinology. G. E. Seidel*, *Colorado State University, Fort Collins.*

Over the next quarter century in North America, the following eventualities are likely for physiology/endocrinology research with agricultural animals.

1. Total funding adjusted for inflation will change little, but will continue to come less from public sources, and most of that will be in the context of human health. Much of the privately funded research will be herd-specific and remain proprietary.
2. Numbers of M.S., Ph.D. and postdoctoral students probably will decrease, but research in the context of credentialing will remain important.
3. Resources such as expanded data bases in genomics and proteomics, and remarkable new tools like small inhibitory RNA will continue to become available, likely at a faster rate than in the previous 25 years.
4. The huge amounts of data from production agriculture will make agricultural animals ideal models for some kinds of basic research such as studying fetal programming, resulting in synergy with more applied research. Most of these experimental animals will be in private, production herds and flocks, even when work is publicly funded.
5. The trend toward more interdisciplinary research will continue, especially considering interactions among reproduction, health, nutrition, selective breeding, management factors, and societal concerns; reductionist research probing deeper into cellular and molecular mechanisms will remain important as will whole animal approaches.
6. Agricultural animals are a product of evolution plus selective breeding. Insights of the former will aid progress in the latter. One focus of research in physiology and endocrinology will be understanding heterosis, inbreeding depression, and epigenetic effects, as it becomes possible to manipulate and identify the allelic structure of individual animals.
7. Additional insightful concepts will evolve that will simplify thinking in some respects, such as the maternal to embryonic shift in transcribed RNA in early embryos; however, animal biology will turn out to be even more complex than most of us currently imagine.

Key Words: Research, Physiology, Endocrinology

567 Effect of antioxidants on oxidative stress during maturation and in vitro culture of pig embryos. B. D. Whitaker* and J. W. Knight, *Virginia Tech, Blacksburg.*

This study evaluated the effects of different concentrations (0, 0.5, 1.0, 1.5, 2.0, 2.5, 5.0 mM) of N-acetyl-cysteine (NAC) supplemented to the oocyte maturation medium on embryo development. Embryo development was analyzed at 48 h and 144 h post-fertilization. There were no differences between cleavage rates for any of the treatment groups. Blastocyst formation in the 1.5 mM NAC ($56.5 \pm 9.2\%$) supplementation was higher ($P < 0.05$) than all other concentrations of NAC supplementation. Identical concentrations (1.5 mM) of NAC and N-acetyl-cysteine-amide (NACA) supplementation were compared by evaluating nuclear maturation, superoxide dismutase (SOD), glutathione (GSH) peroxidase, catalase and intracellular GSH concentrations, DNA fragmentation, fertilization success and embryo development. Supplementation of 1.5 mM NACA increased ($P < 0.05$) the levels of GSH peroxidase in the oocyte compared to the other treatment groups. The concentration of SOD was less ($P < 0.05$) with 1.5 mM NAC

supplementation compared to the control but SOD was higher ($P < 0.05$) with 1.5 mM NACA supplementation compared to the control. The concentration of catalase was less ($P < 0.05$) with 1.5 mM NACA supplementation compared to the control but catalase was higher ($P < 0.05$) with 1.5 mM NAC supplementation compared to the control. There were no differences in the length of DNA migration, intracellular GSH concentration, nuclear maturation or fertilization when comparing 1.5 mM NAC and 1.5 mM NACA supplementation to the maturation media. There was no difference between cleavage rates of 1.5 NAC and 1.5 mM NACA supplementation to the maturation media. Blastocyst formation for 1.5 mM NAC ($44.4 \pm 4.7\%$) and 1.5 mM NACA ($46.2 \pm 3.4\%$) supplementation were higher ($P < 0.05$) than the control ($32.1 \pm 6.2\%$) oocytes. These results indicate that supplementing 1.5 mM of NAC or NACA to the oocyte maturation medium increased the percentage of viable embryos reaching the blastocyst stage of development and antioxidant supplementation may alleviate the free radicals associated with oxidative stress in the maturing porcine oocyte.

Key Words: Swine, N-Acetyl-Cysteine, Antioxidant

568 Glycomic analysis of saccharides that bind porcine sperm. E. D. Collins, C. Korneli, and D. J. Miller*, *University of Illinois, Urbana.*

The objective of this work was to identify glycans that bound different maturation states of porcine sperm. Interactions between glycans and lectins on the cell surface and extracellular matrix are proposed to mediate many cell-cell interactions, including those between sperm and the oviduct and sperm and the egg coat. Immature (uncapacitated) sperm bind to the oviduct, which forms a reservoir and maintains viability. After a final maturation (capacitation), sperm bind to the egg coat (zona pellucida) and undergo the acrosome reaction before penetrating the zona. Studies using competitive inhibitors have identified candidates but the specific glycans in the oviduct or zona pellucida that bind sperm remain controversial. The goal of this work was to use an alternate and unbiased approach to identify the glycans capable of binding sperm. A glycan array, developed to characterize the specificity of lectins and antibodies to glycans, was adapted for use with live cells. An array containing over 300 glycans was used in an adhesion assay to pinpoint glycans possibly involved in sperm-oviduct and sperm-egg interactions. Live porcine sperm from pooled ejaculates of 4-6 boars were either used immediately after collection and washing (uncapacitated), after incubation to capacitate sperm, or after subsequent incubation with A23187 to induce the acrosome reaction. Sperm were stained with DiI or SYTO-16, were incubated with the array and fluorescence of bound sperm was assessed. Sperm binding was specific and depended on structure and charge of the glycans. Uncapacitated sperm bound to only 4 glycans, all of which contained the same trisaccharide motif. Capacitated sperm bound 7 glycans, the 4 that uncapacitated sperm bound and 3 additional glycans, which also contained the same complete or partial trisaccharide motif. Acrosome-reacted sperm did not bind glycans. Identification of these glycans may lead to discovery of the molecules that are important in forming the oviduct storage site and in zona pellucida binding and may underpin the development of more accurate laboratory fertility tests.

Key Words: Sperm, Fertility, Fertilization

569 The relationship between sperm nuclear shape and boar fertility using Fourier Harmonics. K. L. Willenburg*¹, K. J. Rozeboom², and J. J. Parrish¹, ¹University of Wisconsin, Madison, ²ReproQuest, LLC, Fitchburg, WI.

In this study, boar sperm nuclear shape was characterized using Fourier Harmonic analysis (FHA) and then related to boar fertility. Fertility was based on farrowing rates of 26 boars with at least 100 single sire matings and ranged from 88% to 37%. Boars were separated into two fertility groups, acceptable fertility (n=24, farrowing rate >60%) and unacceptable fertility (n=2, farrowing rate <60%). Harmonic amplitudes 0–5 (HA0–HA5), derived from FHA analysis, were previously shown to be an accurate, objective and repeatable measure of sperm nuclear shape. Ejaculates from each boar were evaluated for motility, viability, and FHA. Multivariate analysis of variance using HA0–HA5, found that fertility groups differed in sperm nuclear shape ($P < 0.05$). Univariate analysis found only HA2 and HA4 were different between the groups ($P < 0.05$). Fertility groups also did not differ in various measures of HA dispersion, motility or viability ($P > 0.05$). Discriminate analysis was used to produce the best method to separate the two groups based on nuclear shape, shape dispersion, motility or viability. Diagnostic statistics (DS) were used to determine the best discriminate model for predicting the fertility group membership of a particular boar. The DS evaluated were: true positive (TP, classifying an acceptable boar correctly) and true negative (TN, classifying an unacceptable boar correctly). Various approaches can be used to evaluate diagnostic statistics. We chose the model with the fewest parameters and highest TP + TN value. The best model included viability, motility, HA 2 and 4, skewness, kurtosis and variance of HA 0 with a TP + TN value of 1.95. This model correctly classified 96% of the boars, misclassifying 1 of the acceptable boars. In comparison, a model containing viability and motility had a TP + TN = 1.67, classifying 69% of the boars correctly. The data reveals that there are differences in sperm nuclear shape between boars with acceptable and unacceptable fertility. Further testing is needed on a new group of boars with known fertility to test the current diagnostic model.

Key Words: Boar, Fertility, Fourier Harmonics

570 Effect of number of motile, frozen-thawed boar sperm and number of inseminations on fertility in post-pubertal gilts. K. Spencer*¹, P. Purdy², H. Blackburn², S. Spiller², C. Welsh², T. Stewart³, S. Breen¹, J. Taibl¹, B. Yantis¹, and R. Knox¹, ¹University of Illinois, Urbana, ²National Animal Germplasm Program, ARS, USDA, Fort Collins, CO, ³Purdue University, West Lafayette, IN.

The potential for use of frozen-thawed boar sperm (FTS) as a tool for genetic preservation and advancement has far reaching implications for breeding herd management. Numerous research studies have been carried out with FTS but fertility results are often less than the potential with liquid semen using multiple AI. We hypothesized that pregnancy rates (PR) and litter sizes (LS) would be influenced by both sperm numbers and numbers of inseminations when AI with FTS was performed based on numbers of motile cells. We tested the effects of number of motile FTS and one or two AI. The FTS used was from PIC crossbred boars cryopreserved in 0.5 mL straws at 500 million cells/mL. Each boar was represented across all treatments. Gilts (n = 20) were treated with PG600 then fed a synthetic progestagen (MATRIX), for 14 d to synchronize estrus. Following last feeding of MATRIX (LMF), gilts were checked

once daily for estrus and upon expression of estrus on d 5-8 (n = 17) were inseminated with 1.0, 2.0, or 4.0 billion motile FTS once at 32 h, or twice at 24 h and 32 h. Ultrasound was performed at 12 h intervals to determine time of ovulation and pregnancy at d 24. Reproductive tracts were collected on d 32 following AI. In this first replicate, 90% of the gilts expressed estrus but only 17 were used for AI during d 6-9 following LMF. Estrus occurred at 153 ± 24 h following LMF and ovulation at 37.4 ± 8.4 h following onset of estrus. The interval from the 24 h AI to ovulation was -10.3 h and the interval from the 32 h AI to ovulation averaged -5.4 ± 8.4 h. The PR (76.5%) was not affected by treatment ($P > .10$) as all treatments established pregnancies (range: 50-100%). The LS at d 32 also was not affected by treatment ($P > .10$) and averaged 8.3 ± 4.8 (range: 2-17) fetuses. Further replicates are in progress to clarify the effects of treatment on fertility. Even with few observations, it is clear that a single AI using 1 billion FTS can establish pregnancy using conventional AI. Still, increased sperm numbers and numbers of inseminations may influence pregnancy rate and litter size.

Key Words: Frozen-Thawed Boar Semen, Number of Motile Sperm, Litter Size

571 Comparison of exogenous porcine FSH/LH to PMSG/hCG for inducing follicular development and fertility in prepubertal gilts. S. M. Breen* and R. V. Knox, University of Illinois, Urbana.

PMSG/hCG is commonly used for induction of estrus and ovulation for production of oocytes and embryos. However, inconsistency in fertility responses has been a concern when using this combination. While in many species porcine FSH (pFSH) is used for improved efficacy, little data is available to indicate its potential value for use in pigs. Therefore, the objective of this study was to compare pFSH-LH (Bioniche) treatment with PG600 for induction of follicular development, estrus, ovulation, and embryo production. Terminal line prepubertal gilts were allotted to receive 25 mg of FSH (25F, n=31) and 50 mg of FSH (50F, n=33) each with 5 mg added LH, PMSG/hCG (PG600, n=32), and saline (n=31). The 25F, 50F, and saline were each divided into 6 injections given s.c. every 8 h for 2 d. In addition, the 25F and 50F each received an ovulatory dose of LH (5 mg, Bioniche) in a single injection on d 4. Gilts received PG600 in a single s.c. injection on d 0. Ultrasound was performed to assess follicles and ovulation. Gilts receiving 25F and 50F were AI at d 4.5 and d 5 while saline and PG600 were AI at onset of estrus and 24 h later. Reproductive tracts were collected 10 d following AI for determining ovulation and embryo numbers. The percentage of gilts with large follicles on d 4-5 was similar for 25F, 50F, and PG600 (82%) and greater ($P < 0.01$) compared to saline (24%). A greater ($P < 0.01$) proportion of the 25F and 50F gilts expressed estrus (81%) compared to PG600 (62%) and saline (20%). The percentage of gilts that ovulated was similar for 25F, 50F (80%) and PG600 (68%) but greater ($P < 0.01$) than saline (26%). FSH treated gilts had increased ($P < 0.05$) ovulation rate (20 CL) compared to PG600 (10 CL) and saline (8 CL) but FSH increased ($P < 0.01$) the percentage of gilts with cysts (26-48%) compared to PG600 (15%) and saline (3%). The percentage of gilts pregnant (64%) was similar ($P > 0.1$) between treatments but 25F (8.4) and 50F (10.4) both increased ($P < 0.01$) the number of embryos compared to PG600 (5.4) and saline (4.2). These data suggest that with improved delivery methods, pFSH could be useful as an alternative exogenous gonadotropin for use in swine.

Key Words: Gilts, FSH, Ovulation

Physiology and Endocrinology: Health and Immunology

572 Energy-related metabolites and hormones as surrogate markers for chronic wasting disease in cervids. J. R. Olsen^{*1}, R. A. Bessen¹, T. Roche², S. D. Wright², J. D. Bailey¹, and J. G. Berardinelli¹, ¹Montana State University, Bozeman, ²USGS National Wildlife Health Center, Madison, WI.

Chronic wasting disease (CWD) is a fatal neurodegenerative disease of cervids that can affect neuroendocrine and endocrine function. Currently, detection of CWD requires post-mortem neural and lymph node tissue evaluation. The objective was to evaluate if oral administration of prion-infected brain tissues alters energy-related metabolites and hormones in elk (Elk; *Cervus canadensis*), mule deer (MD; *Odocoileus hemionus*), and white-tailed deer (WTD; *Odocoileus virginianus*) as a reliable and rapid pre-clinical diagnostic panel for CWD. The null hypotheses were that serum concentrations of glucose, NEFA, ghrelin, glucagon, leptin, cortisol, insulin, thyroxine (T4), and tri-iodothyronine (T3) do not change over a 24-mo interval after oral inoculation with prion-infected cervid brain tissues. Blood samples were collected at time 0, and for animals sacrificed for blood and tissue collection, at 6, 12, 18, and 24 mo after inoculation. Glucose and NEFA concentrations were determined by colorimetric assays. Ghrelin, glucagon, leptin, cortisol, T3, and T4 concentrations were determined using RIA. Insulin concentrations were determined by ELISA. After inoculation, all animals were immunohistochemically positive for PrP^{CWD} in neural and lymph node tissues. Glucose and NEFA concentrations decreased ($P < 0.05$) after inoculation for all species. Ghrelin and leptin concentrations tended to decrease ($P < 0.10$) and T4 concentrations increased ($P < 0.05$) after inoculation in Elk but not in MD or WTD. Glucagon concentrations tended to increase ($P < 0.10$) in WTD but not in Elk or MD. In conclusion, progression of CWD seems to have cervid-specific effects on energy metabolites and conspecific effects on certain hormones. Further research is necessary in order to develop a pre-clinical panel of metabolite and hormone markers leading to a reliable, rapid, and effective method for identifying CWD in cervids.

Key Words: Chronic Wasting Disease, Hormones, Cervids

573 Intrauterine detection and *in vitro* characterization of *Escherichia coli*-Xen14: A model for monitoring infections of the bovine reproductive tract. J. Curbelo^{*}, K. Moulton, S. Laird, D. Moore, S. Bowers, and S. Willard, Mississippi State University, Mississippi State.

Intrauterine infections in the bovine can have detrimental effects on reproductive performance, and *Escherichia coli* (*E. coli*) is a primary causative pathogen. Our objectives were to characterize the photonic properties of *E. coli*-Xen14 (a stably transformed *E. coli* containing the *lux* operon), and conduct photonic imaging of *E. coli*-Xen14 from within the excised bovine uterus. *E. coli*-Xen14 (Xenogen) was grown for 24 h in LB broth with or without Kanamycin (KAN; 30 μ g/mL) and placed in an incubated shaker at 37°C. Inoculums were placed in 96-well plates for imaging, and photonic emissions collected for 2 s. Following imaging, inoculums were sub-cultured over 7 d, and plated daily (on LB agar plates with or without KAN) to determine the CFU/ml and ratio of photonic emitters vs. non-emitters. Excised bovine reproductive tracts (n = 4 tracts; 3 replicates per tract) were acquired and *E. coli*-Xen14 placed in a 1 mL tube for photonic imaging (5 s) pre- and post-insertion into the uterine horns. The CFU/ml did not differ ($P > 0.05$) over time

with or without KAN presence; remaining stable with 99.93 and 99.98% photonic emitters, respectively. However, RLU/s were lower ($P < 0.0001$) in the presence of KAN than Controls (629.8 \pm 117.7 vs. 3,012.0 \pm 423.5 RLU/s, respectively). Photonic emissions from *E. coli*-Xen14 imaged within the uterine horns resulted in a 4,847.1 \pm 215.3 RLU/s loss ($P < 0.05$) through the uterine horns, or an efficiency of photonic detection of 3.98 \pm 0.007% of the original (pre-) emission intensity. The concentration of photonic *E. coli*-Xen14 detected through the uterine horns was 662.5 \times 10⁶ \pm 149.0 \times 10⁶ CFU/ml, with a uterine horn wall thickness of 6.2 \pm 4.2 mm. In summary, *E. coli*-Xen14 remained stable with respect to the percentage of photonic emitters with or without KAN (used to selectively culture *E. coli*-Xen14), however KAN presence suppressed photonic activity. Imaging of *E. coli*-Xen14 was feasible through the bovine uterine horns *ex vivo*, suggesting that further development of this model may facilitate the monitoring of pathogen presence within the reproductive tract of the bovine *in vivo*.

Key Words: Biophotonics, Uterus, *E. coli*

574 Stimulation of appetite and the growth, stress and immune axes of weanling pigs by syndyphalin-33. S. J. Jenkins^{*1}, T. A. Cooper¹, M. P. Roberts¹, J. A. Carroll², A. G. Mathew¹, H. G. Kattesh¹, and C. J. Kojima¹, ¹University of Tennessee, Knoxville, ²USDA-ARS Livestock Issues Research Unit, Lubbock, TX.

Parameters measuring growth, stress and immune response in weanling pigs given the opiate tripeptide syndyphalin-33 (SD) were investigated in three separate trials. In the first trial, 8 nursing pigs were given SD (0.5 μ mol/kg, n = 4) or vehicle (VEH; n = 4) in a single im injection at 13 d of age and weaned 6 d later. Feed intake (FI) was greater ($P < 0.05$) in SD compared to VEH pigs 3 d postweaning, and a numerical increase in BW was observed in SD pigs from d 3 to d 7 postweaning. In the second trial, 8 pigs (19 d of age) were weaned, fitted with jugular catheters, and placed in individual pens. The following day, blood was collected at 30-min intervals for 9 h. Immediately following the second blood sample, pigs received either SD (n = 4) or VEH (n = 4) as in trial one. Feed intake (FI) and body weight (BW) were recorded daily for 7 d. No differences in FI or BW were noted at any time. Plasma cortisol levels and the free cortisol index were elevated ($P < 0.05$) in SD compared to VEH pigs from 3 to 4 h post-injection. Plasma corticosteroid-binding globulin levels were unchanged. Serum growth hormone concentrations were increased ($P < 0.05$) in SD pigs at 2 h post-injection. In the third trial, 8 pigs (19 d of age) were weaned, cannulated, and placed in individual pens. The next day, immediately following blood collection, pigs received either SD or VEH as above, and all pigs received an oral gavage of live *Salmonella enterica*. Blood was collected every 24 h for 4 d. The immune challenge increased ($P < 0.05$) the numbers of neutrophils, lymphocytes and monocytes from 48 h post-challenge to the end of the sampling period. There was a further stimulatory effect of SD on circulating neutrophil and monocyte populations, resulting in an overall increase ($P < 0.05$) in total white blood cell number. Pigs given SD had similar FI and BW as VEH pigs as measured on d 19 to 23. A decrease ($P < 0.05$) in serum glucose levels was observed at 48 h in SD pigs. These results suggest that treatment with SD can affect many aspects of the physiology of weanling pigs, but the timing of injection relative to weaning may modulate the response.

Key Words: Swine, Weaning, Appetite

575 Early weaning alters the acute phase immune response to an endotoxin challenge in beef cattle. J. A. Carroll^{*1}, J. D. Arthington², and C. C. Chase, Jr.³, ¹*Livestock Issues Research Unit, USDA-ARS, Lubbock, TX*, ²*University of Florida-IFAS, Range Cattle Research and Education Center, Ona, FL*, ³*SubTropical Agricultural Research Station, USDA-ARS, Brooksville, FL*.

Previous research indicates that early weaning prior to shipment can reduce transportation-induced increases in acute phase proteins (APP), and can increase subsequent performance in the feedlot. These data suggest that the combination of weaning and transport stress may compromise the immune system of calves, thus hindering subsequent performance and health. Therefore, our objective was to determine if the innate immune response of early weaned calves (EW; 80 d of age) differed from normal weaned calves (NW; 250 d of age) in response to an endotoxin challenge. Eighteen EW (n = 8) and NW (n = 10) Brahman × Angus calves (233 ± 5 kg BW) were used. Prior to the study, calves were maintained on pasture with supplement. All calves were acclimated to their study pens for 1 wk prior to a lipopolysaccharide (LPS) challenge. One d prior to LPS challenge, calves were fitted with an indwelling jugular catheter. Blood samples were collected at 30-min intervals from -2 to 8 h. At 0 h, all calves received an i.v. infusion of LPS (1.0 µg/kg BW). Serum samples were stored at -80°C until analyzed for cortisol (CS), tumor necrosis factor-alpha (TNF), interleukin-1 beta (IL-1), IL-6, interferon-gamma (IFN), ceruloplasmin (Cp) and haptoglobin (Hp). While LPS increased serum CS ($P \leq 0.001$) no weaning effect ($P \geq 0.15$) was observed. A weaning group × time interaction ($P \leq 0.04$) was observed for TNF, IL-1, IL-6 and Cp such that concentrations of these indices were greater in the NW compared to EW calves. For Hp, a weaning effect ($P \leq 0.03$) was observed with NW having greater average Hp concentrations compared to EW calves. Interestingly, the weaning group × time interaction ($P \leq 0.001$) for IFN revealed greater IFN in EW opposed to NW calves. Based upon these data, the innate immune system of EW calves appears to be less naïve than that of NW calves. Additionally, the differential IFN responses indicate that the immune system of EW calves may be more effective at recognizing and eliminating endotoxin. These data suggest that an altered innate immune system may be responsible for the improved feedlot performance previously reported in EW calves.

Key Words: Cattle, Immunity, Early Weaning

576 Relationship of temperament and circulating concentrations of cortisol, total protein, and immunoglobulin G with growth in Angus crossbred calves. K. R. Parker^{*1}, S. T. Willard², A. N. Musselwhite², R. D. Randel³, T. H. Welsh⁴, and R. C. Vann¹, ¹*MAFES/Brown Loam Experiment Station, Raymond, MS*, ²*Mississippi State University, Starkville*, ³*Texas Agrilife Research, Overton, TX*, ⁴*Texas A & M University, College Station*.

The purpose of this study was to determine the relationships among cortisol, total protein (PRT), and immunoglobulin G (IgG) concentrations, temperament and growth in beef calves (n:bulls=114, heifers=82). Plasma was collected for determination of concentrations of IgG and PRT at 24 h, 48 h, 14 d, and 84 d after birth. Calves were classified by IgG as follows: calves with IgG concentrations 1 SD below the mean were considered low (L), those 1 SD above the mean were considered high (H), all others were considered moderate (M). Temperament testing consisted of pen score (PS) and exit velocity (EV: m/s) and was conducted at 28 d pre-weaning, weaning, 28 and 56 d post-weaning, and

yearling. Calves were assigned temperament groups (TPG=EV+PS/2) as follows: calves 1 SD below the mean were considered calm (C), calves 1 SD above the mean were considered temperamental (T), all others were considered intermediate (I). Serum concentrations of cortisol were determined at 28 d pre-weaning, weaning, 28 and 56 d post-weaning. Growth traits included: BW taken at all time periods, and ultrasound measurements; ribeye area (REA), intramuscular fat (IMF), rib fat thickness (FT), and rumpfat (RF), which were taken at weaning, 56 d post-weaning, and yearling. There was a day × TPG interaction for REA and REA/cwt with C and I calves increasing ($P < 0.05$ and $P < 0.08$, respectively) from 56 d post-weaning to yearling, whereas T calves decreased. IMF, FT and RF differed ($P < 0.05$) from 56 d post-weaning to yearling, but did not differ ($P > 0.10$) by TPG. PRT was higher ($P < 0.001$) for H than L IgG calves, and was positively correlated with concentrations of IgG ($r = 0.51$; $P < 0.001$); both PRT and IgG decreased ($P < 0.001$) over time from day 14 to 84. PRT did not differ ($P > 0.10$) among TPG classifications, however cortisol was greater ($P < 0.001$) for T than C calves. In summary, temperament influenced some growth traits (REA and REA/cwt), and secretions of cortisol. Plasma PRT was not influenced by temperament, but was positively correlated to concentrations of IgG. [USDA-NRI: 2005-35204-15737]

Key Words: Temperament, Total Protein, Beef Calves

577 Influence of bovine temperament, transportation, and lipopolysaccharide challenge on ultrasound body composition traits. R. C. Vann^{*1}, N. C. Burdick², J. A. Carroll³, R. D. Randel⁴, S. T. Willard⁵, L. C. Caldwell², J. W. Dailey³, L. E. Hulbert³, A. N. Loyd², and T. H. Welsh, Jr.², ¹*MAFES-Mississippi State University, Raymond*, ²*AgriLife Research, College Station, TX*, ³*USDA-ARS Livestock Issues Research Unit, Lubbock, TX*, ⁴*AgriLife Research, Overton, TX*, ⁵*Mississippi State University, Starkville*.

This study was designed to determine the influence of bovine temperament on ultrasound body composition traits in response to transportation and endotoxin challenge. Brahman bulls (10 mo of age) were selected based on temperament score which was an average of exit velocity (EV; objective measure) and pen score (PS; subjective behavior score). The bulls with the lowest (C; n = 8; 0.87 m/s EV and 1 PS), intermediate (I; n = 8; 1.59 m/s EV and 2.25 PS), and highest (T; n = 8; 3.70 m/s EV and 4.88 PS) scores were used for this study. Prior to transportation (departure), after transportation (770 km) and post-lipopolysaccharide (LPS) challenge BW and ultrasound body composition measurements for longissimus muscle area (LMA), percent intramuscular fat (%IMF), rib fat (FT) and rump fat (RFT) were collected. Data were analyzed using PROC Mixed of SAS for repeated measures where appropriate. Body weights decreased (average 18.6 ± 5.5 kg) for all temperament groups from date of departure through post-LPS challenge ($P < 0.001$). A temperament score × day interaction ($P < 0.05$) for LMA was evident with the T bulls (0.41 ± 0.22) having a greater change in LMA from departure to post-LPS challenge compared to C (0.24 ± 0.24) and I (0.25 ± 0.22) bulls. There was a numerical trend for bulls classified as T (-0.15 ± 0.11) to have the smallest decrease in %IMF compared to the C (-0.41 ± 0.11) or I (-0.43 ± 0.11) bulls due to transportation or post-LPS challenge. FT was reduced (average 0.015 ± 0.009 cm) due to transportation for bulls in all temperament classifications ($P < 0.03$). Bulls classified as T (0.005 ± 0.003) had the smallest reduction ($P < 0.07$) in FT compared to the C (-0.001 ± 0.003) or I (-0.004 ± 0.003) bulls post-LPS challenge. While many of the observed changes in ultrasound body composition traits due to transportation and post-LPS challenge in the present study were

minimal, we did observe some trends indicating a bovine temperament effect. Further research is needed with larger numbers of animals to fully elucidate these potential effects.

Key Words: Temperament, Ultrasound Body Composition, Transportation

578 Influence of temperament on behavioral, physiological and endocrine responses of cattle to a provocative challenge with lipopolysaccharide (LPS). L. H. Hulbert^{*1}, J. A. Carroll¹, J. W. Dailey¹, R. D. Randel², T. H. Welsh, Jr.³, L. C. Caldwell^{2,3}, N. C. Burdick³, R. C. Vann⁴, and S. T. Willard⁵, ¹*Livestock Issues Research Unit, USDA-ARS, Lubbock, Texas*, ²*Texas AgriLife Research and Extension Center, Texas A&M System, Overton*, ³*Texas AgriLife Research, Texas A&M System, College Station*, ⁴*MAFES, Mississippi State University, Raymond*, ⁵*MAFES, Mississippi State University, Mississippi State*.

Previous studies have indicated that an animal's temperament can influence its health and productivity. Therefore, our objective was to evaluate the effect of temperament on rectal temperature (RT), sickness score (SS) and adrenal function of yearling bulls in response to a LPS challenge. Brahman bulls (10 mo of age) were selected based on temperament score; an average of exit velocity (EV) and pen score (PS) determined

at 177.08 ± 3.23 d of age. Bulls were ranked into 3 groups: calm, lowest score (C; n=8; 0.87 m/s EV and 1 PS), intermediate (I; n=8; 1.59 m/s EV and 2.25 PS), and temperamental, highest score (T; n=8; 3.70 m/s EV and 4.88 PS). Bulls were fitted with indwelling jugular catheters and RT devices that recorded RT at 1-min intervals. The next day blood samples were collected at 30-min intervals from -2 to 8 h relative to an i.v. infusion of LPS (0.5 μ g/Kg BW) at 0 h. Serum was stored at -80°C until analyzed for cortisol and epinephrine. RT data were summed into 10-min intervals for statistical analysis. SS were defined as follows: (1) on side with labored breathing; (2) clinical signs, increase respiration; (3) calm, but head distended; (4) appeared normal; and (5) active/agitated. SS were obtained from 30 min post-LPS until all animals scored at least 4. Cortisol concentrations increased during the first 2 h post-LPS, and remained elevated for 6 h post-LPS ($P \leq 0.01$). LPS-induced cortisol concentrations were not affected by temperament ($P = 0.55$). Concentrations of epinephrine peaked 1 h post-LPS with C bulls having a greater peak epinephrine (849.2 ± 107.1 pg/mL) than I (352.5 ± 87.1 pg/mL) and T bulls (417.2 ± 90.7 pg/ml; $P \leq 0.01$). SS revealed that T bulls showed less signs of sickness 30 min to 3 h post-LPS than I and C bulls ($P \leq 0.01$). I bulls had the greatest increase ($P \leq 0.01$) in RT ($1.74 \pm 0.23^\circ\text{C}$ at 240 min) compared to C ($1.45 \pm 0.36^\circ\text{C}$ at 260 min) and T bulls ($0.86 \pm 0.13^\circ\text{C}$; at 230 min). Based on our data, temperamental bulls appear to be more resilient to immunological challenges and calm bulls appear to be more susceptible.

Key Words: Bovine Temperament, Behavior, Rectal Temperature

Ruminant Nutrition: Carbohydrate Byproducts - Dairy

579 Feeding two corn milling co-products to dairy cattle: Intake and milk production. A. M. Gehman* and P. J. Kononoff, *University of Nebraska, Lincoln*.

The objectives of this experiment were to examine the effects of feeding dairy cattle different types of corn milling co-products, modified wet distillers grains plus solubles (WDGS) and wet corn gluten feed (WCGF). Multiparous (n = 20) and primiparous (n = 20) cows averaging 93 ± 29 DIM were used in a replicated 5 × 5 Latin square in which cows were blocked by parity and milk production. During each 20-d period, cows were offered one of 5 rations: 1) CONT, 0% co-products; 2) 15WDGS, 15% DM WDGS; 3) 15WCGF, 15% DM WCGF; 4) 15MIX, 7.5% WDGS and 7.5% WCGF; and 5) 30MIX, 15% WDGS and 15% WCGF. Rations were formulated to be similar in crude protein and metabolizable energy and protein allowable milk. Milk production and DMI were averaged for d 14 – 20 of each period for each cow, and milk components were measured on d 19 – 20 of each period. Dry matter intake was greatest ($P < 0.01$) for cows consuming 30MIX (25.5 kg/d) and lowest for CONT and 15 WCGF (22.7 and 23.2 kg/d). Milk production tended ($P = 0.08$) to be higher for 15MIX and 30MIX as compared to CONT (41.9 and 41.8 vs. 39.9 kg/d). 4% fat corrected milk (40.6 kg/d), fat percent and yield (3.92% and 1.59 kg/d), and milk urea N (14.5 mg/dL) were not different among treatments. Milk protein percent was increased ($P < 0.01$) for all rations containing co-products as compared to CONT (3.03 vs. 2.95 %). Protein yield also tended ($P = 0.07$) to be higher for co-products rations as compared to CONT (1.26 vs. 1.20 kg/d). Cows consuming 30MIX were ($P = 0.02$) the least efficient in producing milk from feed consumed (1.64 kg milk/ kg DMI) while 15MIX was the most efficient (1.83). This research demonstrates that WDGS and WCGF can be fed in combination up to 30% DM with an improvement in DMI, milk production, and protein percent and yield and no negative effect on milk fat.

Key Words: Corn Milling Co-Product, Milk, Intake

580 Endosperm type of dry ground corn grain affects ruminal and total tract digestion of starch in lactating dairy cows. M. S. Allen*, R. A. Longuski, and Y. Ying, *Michigan State University, East Lansing*.

Our objective was to determine effects of dry corn grain varying in endosperm type and particle size on ruminal digestion kinetics and ruminal and total tract digestibility of starch in lactating cows. Eight ruminally and duodenally cannulated Holstein cows (132 ± 42 DIM; mean ± SD) were used in a duplicated 4 × 4 Latin square design with a 2 × 2 factorial arrangement of treatments. Main effects were corn grain vitreousness (floury or vitreous) and particle size (medium or fine). Endosperm was 25% vitreous for floury treatment and 66% vitreous for vitreous treatment. The fraction of ground corn passing through a 1.18 mm sieve was 43% for medium, vitreous; 42% for medium, floury; 57% for fine, vitreous; and 62% for fine, floury. Diets included alfalfa silage, corn treatments, protein supplement, minerals and vitamins and contained 29.2% starch, 27.6% neutral detergent fiber and 18.3% crude protein. Corn grain treatments supplied 86.2% of dietary starch. No

interactions were detected for any measure of starch digestion. Floury treatment increased rate of starch digestion (19.2 vs. 9.9 %/h, $P < 0.01$) and decreased rate of starch passage (16.1 vs. 25.7 %/h, $P < 0.001$), increasing apparent ruminal starch digestibility (53.7 vs. 24.6 %, $P < 0.001$). Total tract starch digestibility was increased by floury treatment (92.2 vs. 85.1 %, $P < 0.0001$) despite greater post-ruminal starch digestion (% of starch intake) for the vitreous treatment (60.7 vs. 38.4 %, $P < 0.01$). Fine grinding increased rate of starch digestion (19.5 vs. 9.51 %/h, $P < 0.01$), which increased apparent ruminal digestibility (47.2 vs. 31.1 %/h, $P = 0.03$) compared to medium treatment. However, total tract starch digestibility was not affected by fineness of grind (mean = 22.2 %/h) because of greater post-ruminal starch digestibility (% of starch intake) for medium compared to fine treatment (57.2 vs. 41.9 %, $P = 0.02$). Endosperm type greatly affects ruminal and total tract starch digestibility independent of corn grain grind size.

Key Words: Vitreous, Digestion Kinetics, Particle Size

581 Effects of two dietary non-fiber carbohydrate levels on ruminal fermentation and animal metabolism of lactating cows. M. Blanch*¹, S. Calsamiglia¹, M. Devant², and A. Bach^{2,3}, ¹*UAB, Spain*, ²*IRTA, Spain*, ³*ICREA, Spain*.

Sixty-two lactating Holstein cows (BW = 654 ± 14 kg, DIM = 186 ± 6.8, 40 multiparous and 22 primiparous), fitted with rumen cannulas (5 multiparous and 3 primiparous) were used to study the effects of two dietary NFC levels on ruminal fermentation and animal metabolism following a cross-over design with 2 periods of 30 d. Treatments were: a traditional ration (TR, 16.5% CP, 33.8% NDF, and 41.8% NFC, on a DM basis), and a high-NFC ration (HC, 17.6% CP, 27.1% NDF, and 47.9% NFC, on a DM basis). Milk yield and feed intake were recorded daily and milk composition biweekly. Animals were blood sampled to determine blood glucose, insulin, and urea concentrations within the first hour after the morning feeding in 2 separate days in each treatment. Fecal samples were taken 1 d in each treatment within the first hour after the morning feeding to determine total tract starch digestibility using lignin as an internal marker. Samples of ruminal contents were collected during 3 d in each treatment at 0, 4 and 8 h post-feeding to determine VFA and ammonia-N concentrations. Rumen pH was recorded electronically at 22-min intervals during 6 d in each treatment. Milk yield was greater (34.4 and 31.9 kg/d), milk fat % was lesser (3.03 and 3.64), and concentrate intake at the milking unit was lesser (2.63 and 3.72 kg/d) in HC compared with TR, respectively. Blood glucose concentration was lesser in TR compared with HC (61.8 and 67.2 mg/dL, respectively), and HC resulted in a lesser total tract starch digestibility (94.7 and 95.9% for HC and TR, respectively) and a greater blood urea level (33.3 and 30.1 mg/dL for HC and TR, respectively). Rumen pH of HC primiparous cows fell below 5.6 for longer periods of time than that of TR cows (6.76 and 0.812 h/d, respectively), but no changes in mean pH were observed (5.93 and 6.26 for HC and TR, respectively). These results indicate that feeding high NFC diets for short periods of time may increase milk yield without incurring in strong negative repercussions to the animal.

Key Words: Dairy Cows, Non-Fiber Carbohydrates

582 Effects of feeding three types of corn milling co-products on ruminal fermentation and digestibility in lactating Holstein dairy cattle. J. M. Kelzer^{*1}, P. J. Kononoff¹, A. M. Gehman¹, K. Karges², and M. L. Gibson², ¹University of Nebraska, Lincoln, ²Dakota Gold Research Association, Sioux Falls, SD.

Replacing traditional feed ingredients with corn milling co-products in total mixed rations may alter ruminal environments in dairy cattle. Three co-products were fed at 15% inclusion to 4 ruminally fistulated Holstein cows averaging (\pm SD) 677 ± 41 kg BW and 124 ± 5 DIM to determine effects on ruminal fermentation and total tract digestibility. Cows and treatments were randomly assigned in a 4×4 Latin square over four, 21-d periods. Treatments were formulated by replacing portions of forage and concentrate feeds with 15% co-product and included: 1) 0% co-product (**Control**), 2) dried distillers grains + solubles (**DDGS**), 3) dehydrated corn germ meal (**Germ**), and 4) high protein dried distillers grains (**HPDDG**). Diets were formulated to be isonitrogenous and similar in metabolizable energy and protein. Neutral detergent fiber (NDF) content was 34.4, 36.9, 37.0, and 38.8 %, and starch was 26.1, 21.9, 22.0, and 22.8 % for Control, DDGS, Germ, and HPDDG, respectively. On d 21, rumen fluid was collected at 10 time points over 24 h post-feeding. Dry matter intake and milk production were not different across treatments and averaged (\pm SEM) 26.1 ± 2.3 and 28.3 ± 3.9 kg/d. Rumenal pH (6.26 ± 0.08), rumen ammonia (14.1 ± 1.0 mg/dL), and total concentration of volatile fatty acids (125.3 ± 4.2 mM) were similar. Acetate concentration for Control was higher ($P < 0.05$) than DDGS, Germ, and HPDDG (81.7 vs. 75.8 , 75.0 , and 78.4 mM). Concentrations of propionate (27.8 ± 1.2 mM) and butyrate (14.3 ± 0.9 mM) were not different. The acetate:propionate ratios for Control, Germ, and HPDDG were higher ($P < 0.05$) than DDGS (3.02 , 2.88 , 2.91 vs. 2.62). Dry matter, organic matter, and NDF digestibilities were similar and averaged 63.5 ± 2.7 , 67.3 ± 2.2 , and 43.5 ± 4.2 %. Feeding corn milling co-products to dairy cows decreased acetate concentration in the rumen; however, total tract digestibility was not affected.

Key Words: Co-Product, Ruminal Fermentation, Digestibility

583 Evaluation of low starch diets for lactating Holstein dairy cattle. H. M. Dann^{*1}, K. W. Cotanch¹, P. D. Krawczel¹, C. S. Mooney¹, R. J. Grant¹, and T. Eguchi², ¹William H. Miner Agricultural Research Institute, Chazy, NY, ²Zen-Noh National Federation of Agricultural Cooperative Associations, Tokyo, Japan.

Proliferation of ethanol production in the US has increased price of corn grain and consequently feeding diets containing less than 20% starch may be economically advantageous. The objective of this experiment was to measure the ruminal and lactational responses of Holstein dairy cattle when fed diets containing 17.7 (LS), 21.0 (MS), or 24.6% (HS) starch (dry basis). Twelve multiparous cows (3 ruminally fistulated) were assigned randomly to these diets in a replicated 3×3 Latin square design with 3-wk periods (14-d adaptation, 7-d collection). Diets were fed as total mixed rations and contained approximately 30.2% corn silage, 18.5% grass silage, and 5.0% alfalfa hay (dry basis). Dietary starch was manipulated by reducing the amount of corn grain (16.9%, HS; 10.1%, MS; 3.4%, LS; dry basis) and increasing the amount of beet pulp (0%, HS; 3.4%, MS; 6.7%, LS), wheat midds (6.8%, HS; 10.1%, MS; 13.4%, LS) and distillers grains (7.8%, HS; 8.7%, MS; 9.7%, LS). In vitro 6-h

starch digestibility of the diet increased as byproducts replaced corn grain (73.6%, HS; 77.3%, MS; 82.5%, LS). Data were analyzed as a replicated Latin square design using the MIXED procedure of SAS. Dry matter intake (26.5 kg/d), solids-corrected milk (SCM) yield (40.8 kg/d), and efficiency of SCM production (1.54) were unaffected ($P > 0.05$) by diet. Diet also had no effect ($P > 0.05$) on total chewing (815 min/d), ruminal pH averaged over 24 h (6.06), or acetate to propionate ratio (2.4). Total tract organic matter digestibility was higher ($P \leq 0.05$) for HS (69.2%) compared with MS (67.3%) and LS (67.0%) diets, but crude protein, neutral detergent fiber, and starch digestibilities were unaffected ($P > 0.05$) by diet. Microbial N synthesized in the rumen (584 g/d) estimated using urinary excretion of purine derivatives was unaffected ($P > 0.05$) by diet. As dietary starch decreased in this study, ruminal fermentability increased and consequently the range between HS and LS in rumen fermentable starch (3.5%-units) was less than the range in starch content (6.9%-units). Under these conditions, dietary starch content had no measurable effect on ruminal microbial production or lactation performance.

Key Words: Starch, Lactation Performance, Dairy Cattle

584 Ground vs steam-rolled barley grain for lactating cows: A clarification into conventional beliefs. A. Soltani¹, G. R. Ghorbani¹, M. Alikhani¹, and A. Nikkhab^{*2}, ¹Isfahan University of Technology, Isfahan, Iran, ²University of Illinois, Urbana.

An optimum processing method of barley grain that controls its rumen degradation rate, synchronizes starch and protein fermentation, and avoids starch overflow into the small intestine and hindgut is one of priorities in managing lactating cows. Grinding is an easy-to-access technique traditionally believed to be a potential risk to feed intake and rumen health. Steam-rolling is thought to overcome such concerns, but it is expensive. Our main objective was to determine if ground barley grain (GB) is as effective in promoting feed intake and maintaining milk production as steam-rolled barley (SB). Eight multiparous Holstein cows (85 ± 9 days in milk) were used in a replicated Latin square design experiment with four 21-d periods. Each period had 14-d of adaptation and 7-d of sampling. Treatments included feeding GB or SB barley grains at either 35% or 30% of dietary dry matter. Diets were prepared as a totally mixed ration and fed twice daily at 0700 and 1600 h. Neither processing method nor barley grain inclusion rate affected dry matter intake, daily eating, ruminating and chewing times, total tract digestibility of dry matter, organic matter, and neutral and acid detergent fibers, milk yield, and milk percents and yields of fat, protein, and total solids. When barley grain was ground, increasing its inclusion from 30% to 35% of diet dry matter tended to reduce milk fat percent (3.7 vs. 3.3%, $P < 0.10$) and reduced milk fat yield (1.38 vs. 1.24 kg/d, $P < 0.05$). Changing dietary level of SB did not change these criteria. Dietary use of 35% instead of 30% barley grain increased percents but not yields of milk lactose and solids-non-fat. Feed efficiency was improved by feeding SB instead of GB (1.57 vs. 1.50, $P < 0.05$) but was unaffected by dietary levels of barley grain. Therefore, GB was as effective as SB in stimulating feed intake and maintaining rumen fermentation and milk production.

Key Words: Barley Grain, Processing, Lactating Cow

585 Replacement of starch from corn with non-forage fiber from distillers grains in diets of lactating dairy cows. S. D. Ranathunga*, K. F. Kalscheur, A. R. Hippen, and D. J. Schingoethe, *South Dakota State University, Brookings*.

Availability of larger quantities of dried distillers grains with solubles (DG) and its greater energy content indicate that one can replace high-priced corn with DG, in dairy cow diets, to lower feed costs. Therefore, this research was to evaluate the partial replacement of starch from corn in dairy cow diets with different amounts of a non-forage fiber source, DG, on lactation performance. Forty Holstein cows were used in completely randomized design with a 2-wk covariate period followed by a 6-wk treatment period. Four diets were formulated: 1) high starch (28% starch, 0% DG), 2) medium starch (24.5% starch, 7% DG), 3) low starch (21% starch, 14% DG), and 4) very low starch (17.5% starch, 21% DG). Diets contained 17% CP, 4.5% fat, a constant forage to concentrate ratio (49:51), and 21% forage NDF. As starch was replaced with DG, DMI linearly decreased ($P < 0.01$; Table 1). Milk production during the study (38.2 kg/d) was not affected by diets. There were no treatment effects on milk fat and protein percentages nor milk fat and protein yields. Other parameters including 4% fat-corrected milk (FCM), total solids (TS), and MUN were unaffected by dietary treatments. There was a linear

tendency to increase feed efficiency as starch was replaced by non-forage fiber ($P < 0.10$). Results from this research suggest that non-forage fiber from DG can partially substitute for starch from corn in dairy cow diets without affecting milk production and milk composition.

Table 1.

Item	High Starch	Medium Starch	Low Starch	Very low Starch	SEM	P ^a
DMI, kg/d	25.6	25.0	23.4	22.9	0.70	L
Milk, kg/d	39.4	37.4	37.7	38.3	1.03	NS
Fat, %	3.14	3.23	3.29	3.24	0.11	NS
Protein, %	2.97	2.96	3.01	2.94	0.04	NS
TS, kg/d	4.73	4.54	4.55	4.58	0.13	NS
MUN, mg/dL	11.7	12.2	11.6	12.2	0.38	NS
4% FCM, kg/d	34.3	33.6	33.6	33.4	1.04	NS
Feed eff. (FCM/DMI)	1.46	1.35	1.41	1.50	0.05	LT

^a L=linear effect ($P < 0.05$); LT=linear tendency ($P < 0.10$); and NS=non significant

Key Words: Distillers Grains, Starch, Non-Forage Fiber

Ruminant Nutrition: Nitrogen Sources and Utilization

586 Effects of feeding triticale dried distillers grains with solubles as a N source on productivity of lactating dairy cows. M. Oba* and T. D. Whyte, *University of Alberta, Edmonton, AB, Canada.*

The objective of this study was to evaluate the effects of replacing protein sources that are commonly used in North America with triticale dried distillers grains with solubles (TDDGS) as a source of dietary N on the productivity of lactating dairy cows. Experimental diets contained 17.1% TDDGS, 17.5% Corn DDGS (CDDGS), 13.1% canola meal (CM), or 10.2% soybean meal (SBM) on a DM basis so that each feedstuff supplied 30% of total dietary crude protein (CP). All diets, which were formulated to contain 17.2% CP and 21.2% forage neutral detergent fiber (NDF), were fed to twelve multiparous Holstein cows (130 ± 40 days in milk) in a replicated 4 × 4 Latin square design with 21-d periods. Plasma concentrations of arginine, lysine, and threonine were greater for cows fed CM or SBM compared to those fed TDDGS or CDDGS ($P < 0.01$) while plasma concentrations of leucine and phenylalanine were lower for cows fed CM or SBM compared to those fed TDDGS or CDDGS ($P < 0.05$). Dry matter intake and milk yield were not affected by treatment (25.5 and 35.5 kg/d, respectively). Cows fed CDDGS had a lower plasma glucose concentration ($P = 0.04$; 49.3 vs. 53.5 and 52.6 mg/dL, respectively), and decreased yields of milk CP ($P < 0.01$; 1.01 vs. 1.17 and 1.14 kg/d, respectively), and milk lactose ($P = 0.03$; 1.43 vs. 1.66 and 1.59 kg/d, respectively) compared to cows fed CM or SBM. Cows fed TDDGS had similar plasma glucose concentration (53.5 mg/dL), and milk CP (1.10 kg/d), and milk lactose (1.57 kg/d) yields as cows fed CM or SBM. Furthermore, cows fed TDDGS or SBM had a greater body weight gain compared to cows fed CDDGS ($P = 0.05$; 514 and 390 vs. -290 g/d, respectively). These data suggest that TDDGS can replace CM or SBM in the diets of lactating dairy cows without adverse effects on production, and may be better N source than CDDGS.

Key Words: Triticale, Dried Distillers Grains with Solubles, Milk Protein Production

587 Nutritional profile of distillers dried grains with solubles from 40 ethanol plants. Y. Zhang*, J. Sido, and B. Wrenn, *National Corn-to-Ethanol Research Center.*

One of the barriers to broader use of distillers dried grains with solubles (DDGS) in animal feed is concern regarding nutritional variability of materials produced by different plants and temporal variations within a single plant. The nutritional variability of DDGS was investigated in a broad-based study involving samples collected from 40 ethanol plants over a period of one year. These 40 plants represent one third of the dry-grind plants in the U.S., and their geographical distribution was similar to the national distribution. The moisture, crude protein (CP), crude fat (CF), neutral-detergent fiber (NDF) and fermentable sugars (FS) were measured using either American Feed Industry Association (AFIA) recommended methods or modified AOAC methods. The results are shown in Table 1.

The use of recommended analytical methods for DDGS reduced the variability caused by analytical testing. Plant processing conditions and the characteristics of the corn also contribute to variability among DDGS samples. The correlation between plant processing parameters, such as fermentation time, the fraction of thin stillage recycled to process

water, and dryer type, and the characteristics of DDGS were evaluated. These factors were most correlated with variations in the moisture and fermentable sugar concentrations of DDGS. Variations in crude protein, crude fat, and NDF were controlled primarily by corn composition, but two important performance metrics, the ratio of CP to NDF and CF to NDF, were not correlated with the geographical distribution of ethanol plants.

Table 1. Summary of Proximate Analysis of DDGS from 40 Ethanol Plants in the U.S. (% dry basis)

	Moisture	CP	CF	NDF	FS
Mean	10.8	30.8	10.5	29.4	8.9
Range	7.8 – 14.7	26.7 – 38.3	7.4 – 13.3	23.2 – 37.6	5.2 – 17.8

Key Words: Distillers Dried Grains with Solubles (DDGS), Nutritional Profile, Nutritional Variability

588 Digestibility of rumen undegraded amino acids estimated in cecectomized roosters and the modified three-step in vitro procedure. S. E. Boucher*¹, S. Calsamiglia², M. D. Stern³, C. M. Parsons⁴, and C. G. Schwab¹, ¹University of New Hampshire, Durham, ²Universitat Autònoma de Barcelona, Bellaterra, Spain, ³University of Minnesota, St. Paul, ⁴University of Illinois, Urbana.

Three soybean meal (SBM), 3 SoyPlus[®], 5 dried distillers grains with solubles (DDGS), and 5 fishmeal (FM) samples were obtained from FeedAC, Inc. to evaluate the modified three-step in vitro procedure (TSP) for estimating digestibility of rumen undegraded (RU) amino acids (AA). Each sample was incubated in situ for 16 h in the rumen of 4 cows averaging (mean ± SD) 48 ± 4 d in milk, fed a 55% forage, 45% concentrate diet. Rumen undegraded residues were collected and pooled by feed sample, and sub-samples were analyzed for AA. A sub-sample of each residue was also tube fed to cecectomized roosters (4 birds per sample), and endogenous AA losses were estimated from fasted birds. Total excreta were collected for 48 h post-intubation and analyzed for AA. Standardized digestibility (STD) of RUAA was calculated. Sub-samples of each residue were also analyzed via the modified TSP. Five g of residue was weighed in duplicate into polyester bags (pore size of 50 µm) which were then heat sealed and placed into Daisy^{II} incubator bottles. A pepsin/HCl solution was added, and the residues were incubated in constant rotation at 38°C for 1 h. The solution was drained from the bottles, and the bags were rinsed and returned to the bottles. A pancreatic solution was added, and the residues were incubated in constant rotation at 38°C for 24 h. Bags were rinsed, dried, weighed, and undigested residues were analyzed for AA. Digestibility of RUAA was calculated based on disappearance from the bags. Digestibility of RU lysine, methionine, total AA, and total essential AA were correlated to STD estimates measured in the roosters ($R^2 = 0.94, 0.83, 0.93, \text{ and } 0.92$, respectively). In conclusion, the modified TSP may be a good approach for predicting RUAA digestibility in SBM products, DDGS, and FM.

Key Words: Amino Acid Digestibility, Modified Three-Step In Vitro Procedure, Rumen Undegraded Protein

589 In situ degradation characteristics of extruded-expelled cottonseed meal-based supplements. S. J. Winterholler*, T. K. Dye, C. P. McMurphy, C. J. Richards, and D. L. Lalman, *Oklahoma State University, Stillwater.*

Eight ruminally cannulated steers (BW=753 ± 48) were used to evaluate in situ DM, N, and neutral detergent fiber (NDF) degradation characteristics of supplements for beef cows consuming low quality prairie hay. Experimental supplements included (DM basis) 1) extruded-expelled cottonseed meal (ECSM; 33% CP and 55% NDF), 2) extruded-expelled cottonseed meal with linters (ECSML; 25% CP and 59% NDF), 3) solvent extracted cottonseed meal (CSM; 44% CP and 40% NDF), and 4) a blend of 76% wheat middlings with 18% CSM (WMCSM; 22% CP and 40% NDF). Chopped prairie hay (5.8 % CP, 61 % NDF; DM basis) was provided *ad libitum* and steers received 0.38 kg/100kg BW WMCSM daily. Calculated N, NDF and DM fractions included A (immediately soluble), B (degradable at a measurable rate), and C (undegradable). The ECSML supplement had the highest concentration of C fraction N (10.4%; $P < 0.01$), a high concentration of B fraction N (82.7%; $P < 0.01$) and the slowest B fraction degradation rate (1.73%/hr; $P < 0.01$). These characteristics resulted in the lowest estimated RDP (39%; $P < 0.01$) for ECSML. In contrast, ECSM had the highest concentration of A fraction N (41%; $P < 0.01$), and the lowest percentage of N in the B fraction (52%; $P < 0.01$). Rate of B fraction degradation was intermediate for ECSM (2.76%/h; $P < 0.01$). These characteristics resulted in the highest RDP estimate (77%; $P < 0.01$) for ECSM. Extent of NDF disappearance was greatest for CSM (56%; $P < 0.01$), similar for ECSML and WMCSM (41%; $P = 0.63$) and lowest for ECSM (28%; $P < 0.01$). Dry matter disappearance was most extensive ($P < 0.01$) for CSM and WMCSM (64 and 59%, respectively) and lowest ($P < 0.01$) for ECSM (36%) and ECSML (40%). Ruminant N degradation characteristics of ECSM were similar to more traditional supplements containing CSM and CSM with wheat middlings. Rumen degradability of ECSML N was low, indicating this potential supplemental N source may need to be blended with other ingredients containing higher concentrations of degradable N, particularly in situations where forage RDP is low.

Key Words: Byproduct, In Situ, Nitrogen

590 Feeding two corn milling co-products to dairy cattle: Nutrient digestibility, purine derivatives excretion, and nitrogen utilization. A. M. Gehman* and P. J. Kononoff, *University of Nebraska, Lincoln.*

The objectives of this experiment were to examine effects of feeding dairy cattle different types of corn milling co-products, modified wet distillers grains plus solubles (WDGS) and wet corn gluten feed (WCGF). Multiparous ($n = 20$) and primiparous ($n = 20$) cows averaging 93 ± 29 DIM were used in a replicated 5×5 Latin square in which cows were blocked by parity and milk production. During each 20-d period, cows were offered one of 5 rations: 1) CONT, 0% co-products; 2) 15WDGS, 15% WDGS; 3) 15WCGF, 15% WCGF; 4) 15MIX, 7.5% WDGS and 7.5% WCGF; and 5) 30MIX, 15% WDGS and 15% WCGF. Rations were similar in crude protein and metabolizable energy and protein. Fecal and urine samples were collected on d 17–20. Nutrient digestibility was estimated using indigestible ADF, and urinary purine derivatives were used to indicate effects of treatments on microbial protein synthesis. Compared to other treatments, 30MIX had ($P < 0.01$) reduced digestibility of DM (54.6 vs. 63.3%), NDF (34.4 vs. 46.4%), N (58.0 vs. 65.8%), and OM (57.9 vs. 65.9%). Excretion of urinary purine derivatives was higher ($P = 0.04$) for 15WDGS, 15MIX, and 30MIX

than CONT and 15WCGF (396.8, 399.7, and 400.5 vs. 361.0 and 387.3 mmol/d). Fecal N was ($P = 0.02$) greater for 30MIX (295.0 g/d) than 15WCGF and 15MIX (260.3 and 237.1 g/d) but was not different from CONT or 15WDGS (267.1 and 269.4 g/d). Urinary N was ($P = 0.03$) higher for 30MIX (330.0 g/d) than for CONT and 15WDGS (308.5 and 312.2 g/d) but not different from 15WCGF and 15MIX (319.3 and 320.5 g/d). Total manure N was ($P < 0.01$) highest for 30MIX compared to other treatments. Results of this experiment suggest the inclusion of corn milling co-products in dairy rations may negatively affect total tract digestibility but have positive effects on microbial protein synthesis.

Key Words: Nitrogen, Digestibility, Purine Derivatives

591 Milk urea concentration as an indicator of ammonia emission from dairy cow houses in a situation with restricted grazing. G. van Duinkerken*¹, M. C. J. Smits¹, G. André¹, P. F. G. Vereijken², L. B. J. Sebek¹, A. Bannink¹, and J. Dijkstra¹, ¹Wageningen University and Research Center, Lelystad, The Netherlands, ²Wageningen University and Research Center, Wageningen, The Netherlands.

Milk urea concentration was evaluated to assess its potential as an indicator of ammonia emission from dairy cow houses in a situation with restricted grazing. An experiment was carried out with a herd of on average 52 Holstein–Friesian dairy cows. The herd was housed in a naturally ventilated barn with cubicles and a slatted floor and each day was allowed 8.5 hours grazing. The experiment was designed as a 1×3 factorial trial and repeated three times. The experimental factor was the bulk milk urea level which was adjusted to levels of 15, 35 and 55 mg urea per 100 g milk, respectively, by changing the level of N fertilization of the pasture, the herbage mass and grass regrowth age, and the level and type of feed supplement. Ammonia emission from the barn was measured using SF₆ as a tracer gas. A dynamic regression model was used to predict ammonia emission from bulk milk urea concentration, temperature and a slurry mixing index. The total model accounted for 66% of total variation in ammonia emission and showed that emission from the barn increased with 2.6% when temperature increased with 1°C. Furthermore, ammonia emission increased exponentially with increasing milk urea concentration. At a level of 20 mg urea per 100 g milk, ammonia emission increased with about 2.5% when milk urea concentration increased with 1 mg/100 g. At a level of 30 mg urea per 100 g milk ammonia emission increases with about 3.5% when milk urea concentration is increased with 1 mg/100 g. The study showed that bulk milk urea concentration is a useful indicator for ammonia emission reduction from dairy barns.

Key Words: Ammonia Emission, Milk Urea, Restricted Grazing

592 A meta-analysis of the effects of protein concentration and degradability on milk N efficiency in dairy cows. P. Huhtanen*¹, A. N. Hristov², and M. Rinne³, ¹Cornell University, Ithaca, NY, ²Pennsylvania State University, State College, ³MTT-Agrifood Finland, Jokioinen, Finland.

Data sets from North European (NE, 998 diets) and North American (NA, 739 diets) feeding trials with dairy cows were evaluated to investigate the effects of dietary CP concentration and ruminal degradability on the efficiency of milk N production (MNE). NE diets were

based mainly on grass silage, barley grain, and soybean and rapeseed meals. NA diets were based on corn silage, alfalfa silage and hay, corn and barley grains, and soybean meal. Diets were evaluated for RDP and RUP concentrations according to NRC (2001). The average DMI and milk yield (kg/d), dietary CP, RDP, RUP concentrations (g/kg DM), ruminal CP degradability and MNE (g/kg) were 17.9, 25.4, 165, 120, 45, 0.73 and 277 for NE diets. The corresponding values for NA diets were 22.0, 31.3, 178, 122, 56, 0.68 and 245, respectively. A mixed model regression analysis with random study effect was used to evaluate relationships between dietary CP concentration and degradability and MNE (milk N/N intake; g/kg). The following prediction models were derived: $MNE = 475 - 1.21CP$ (NE diets), and $MNE = 497 - 1.40CP$ (NA diets). Residual mean square errors were 9.1 and 14.9 g/kg, respectively. Effects of CP degradability and RDP/RUP on MNE were significant in both models, but the prediction errors were not decreased. Akaike's information criteria were moderately improved by

inclusion of CP degradability variables in the models. Mean prediction error of MNE in NE diets using NA CP model was 13.2 g/kg with bias, slope, and random errors proportionally accounting for 0.54, 0.10 and 0.36, respectively. The corresponding values for validating the NE CP model with NA diets were: 18.9 g/kg, 0.48, 0.06, and 0.46, respectively. Including CP degradability variables did not improve predictions. In conclusion, improved MNE and consequently decreases in N emissions can be obtained by decreasing diet CP concentration, while manipulation of CP degradability is less efficient.

Key Words: Meta-Analysis, N Efficiency, Crude Protein

593 WITHDRAWN

Symposium: Swine Species: Intestinal Barrier Function

594 Stress-induced intestinal barrier dysfunction and its effects. G. P. Lambert*, *Creighton University*.

The intestinal barrier is formed by enterocyte membranes, tight junctions, secreted mucus, and immunologic factors like tissue macrophages. Dysfunction of this barrier can be caused by different types of stress (e.g., physiological, pathological, psychological, pharmacological) and can lead to increased intestinal permeability. Increased permeability to endotoxin, a component of the walls of Gram-negative bacteria, causes local and/or systemic inflammatory reactions. The immune response(s) can then promote more serious conditions. Exertional heat stroke is an example of such a condition. During severe exercise-heat stress, possibly combined with other stresses, reductions in intestinal blood flow and/or direct thermal damage to the intestinal mucosa can cause intestinal barrier disruption and endotoxemia. The resulting inflammatory response is believed to be involved in altered thermoregulation and multiple-organ dysfunction. Possible means for preventing and/or attenuating many stress-induced intestinal barrier problems include environmental, pharmaceutical, and/or nutritional approaches.

Key Words: Intestine, Heat, Stress

595 Dietary plasma proteins and the barrier functions of the intestinal mucosa. M. Moretó* and A. Pérez-Bosque, *Universitat de Barcelona, Barcelona, Spain*.

The intestinal mucosa contributes to homeostasis by preventing the passage of biological and chemical agents across the epithelium, which could alter the stability of the system. This protective function is important at weaning, when animals are exposed to infectious agents and to stresses such as changes in diet composition. Diets supplemented with spray dried plasma or immunoglobulin concentrates improve growth and performance of farm animals and have been proposed as an alternative to antibiotics. We summarize our findings on the mechanism of action of dietary plasma proteins. We used a rat model of intestinal inflammation based on the administration of *Staphylococcus aureus* enterotoxin B (SEB). SEB activates the gut-associated lymphoid tissue (GALT), increasing T-lymphocytes in Peyer's patches and the number of activated T lymphocytes in mesenteric lymph nodes (organized GALT). In the lamina propria SEB increased cytotoxic $T\gamma\delta$ and NK cells populations of the diffuse GALT. SEB significantly increased IFN- γ , TNF- α , IL-6 and LTB4 concentration in both Peyer's patches and mucosa. Plasma protein supplements modulated the mucosal immune response in both organized and diffuse GALT, protecting GALT from excessive activation by the SEB challenge. These effects were accompanied by a reduction of pro-inflammatory cytokine production and increased expression of IL-10 in the mucosa, supporting the view that changes in cytokine production mediate the effects of dietary plasma proteins during intestinal inflammation. The increase in mucosal permeability and intestinal

secretion induced by SEB was associated with decreased expression of mucosal tight-junction and adherent-junction proteins. Both plasma and immunoglobulin supplements could prevent the effects of SEB on intestinal permeability, thus reducing the probability of microbial and food antigens entering the interstitial space. These findings indicate that dietary plasma proteins modulate both functional and structural properties of the intestinal mucosa.

Key Words: Barrier function, Intestinal inflammation, Spray-dried animal plasma

596 Strategies to minimize inflammatory taxation on animal performance. M. E. Cook*, *University of Wisconsin, Madison*.

Collateral damage of inflammatory activation is measured as decreased gain, product production, reproduction, feed efficiency, and increased mortality. A decline in efficient animal performance (>10%) associated with microbial colonization or after vaccination of an animal suggests that current management systems fail to realize the animal's genetic potential for performance. The mechanisms by which pro-inflammatory cytokines redirect nutrient use at the expense of performance have been extensively studied. At least three strategies are available for improving efficient performance of the conventional (as opposed to germ-free) animal: 1. Minimize exposure to environmental immune stimulants: 2. Suppress the immune/inflammatory response: and/or 3. Erect barriers against inflammation-induced collateral damage. The success of a strategy employed may be case dependent, but is likely additive when used in combination. Traditional and successful methods to minimize immune stimulants and hence inflammation of the epithelial surfaces have included the use of antibiotics, pre- or pro-biotics and sanitation. Suppression of the inflammatory response, while seemingly problematic, has long been a pharmacological approach in human medicine. Since the domestic animal maintains the immune capacity of its wild ancestor, but is housed in an environment where diseases are well managed, an acute inflammatory reaction, even to benign agents, is often counterproductive. Barriers to the collateral damage caused by inflammatory responses constitute well-defined and novel approaches to improve efficient animal performance. Barriers erected are designed to target key biochemical or physiological responses to pro-inflammatory mediators in an attempt to assure resources are maintained for efficient animal performance. In this latter approach, neither the animal's environment nor its inflammatory response to the environment is the focus of improving efficient animal performance. Barrier examples to be presented include orally delivered egg antibodies to key targets in the gastrointestinal tract and conjugated linoleic acids that systemically reduce the collateral damage of inflammatory responses.

Key Words: Inflammation, Immunity, Growth

Forages and Pastures III

597 Performance by spring and fall-calving cows grazing with full access, limited access, or no access to endophyte-infected tall fescue. J. Caldwell*¹, K. Coffey¹, D. Philipp¹, J. Jennings³, D. Hubbell, III¹, T. Hess¹, D. Kreider¹, M. Looper², M. Popp¹, M. Savin¹, and C. Rosenkrans, Jr.¹, ¹University of Arkansas, Fayetteville, ²USDA-ARS, Booneville, AR, ³Cooperative Extension Service, Little Rock, AR.

Although performance by cows is improved greatly when toxic *Neotyphodium coenophialum*-infected tall fescue (E+) is replaced with a non-toxic endophyte-infected fescue (NE+), acceptance of NE+ by producers has been slow. Our objective was to compare performance by spring (S) and fall-calving (F) cows grazing either E+ or NE+ at different percentages of the total pasture area to determine to what extent having limited access to NE+ will enhance cow BW and BCS and calf weaning weights. Gelbvieh by Angus crossbred cows (n=144) were stratified by weight and age within calving season and allocated randomly to 1 of 14 groups representing 5 treatments: 1) F on 100% E+ (F100); 2) S on 100% E+ (S100); 3) F on 75% E+ and 25% NE+ (F75); 4) S on 75% E+ and 25% NE+ (S75); and 5) S on 100% NE+ (NE100; 2 replications). Cow BW and BCS at breeding and BCS at weaning were greater (P<0.05) for F vs. S. Cow BCS at breeding and BW at weaning were greater (P<0.05) for NE100 vs. S75, and cow BCS at weaning was higher (P<0.05) for the mean of F75 and S75 vs. that of F100 and S100. Calf gain, actual and adjusted weaning weight, ADG, and calf value at weaning were higher (P<0.05) from F vs. S. When compared with S75, NE100 calves tended (P<0.10) to have higher actual and adjusted weaning weight, ADG, and calf value, and had higher (P<0.05) preweaning gain. Weaning age did not differ (P>0.19) among treatments. Therefore, a fall calving season may be more desirable for cows grazing E+ pastures, resulting in better BW and BCS at critical times as well as heavier calves with higher value at weaning. Limited use of NE+ during the grazing season may improve cow BW at later stages of lactation. This project was supported by the National Research Initiative of the Cooperative State Research, Education and Extension Service, USDA, grant # 2006-55618-17114.

Key Words: Tall Fescue, Novel Endophyte, Cows

598 Warm-season legume haylage or soybean meal supplementation effects on the performance of lambs. J. L. Foster*¹, A. T. Adesogan¹, J. N. Carter¹, L. E. Sollenberger¹, A. R. Blount¹, R. O. Myer¹, S. C. Phatak², S. C. Kim¹, T. Kang¹, M. Brew¹, and K. G. Arriola¹, ¹University of Florida, Gainesville, ²University of Georgia, Athens.

This study determined how supplementing bahiagrass haylage (BGH, *Paspalum notatum*) with soybean (*Glycine max*) meal (SBM) or warm-season legume haylages affected the performance of lambs. Forty-two Dorper x Katadhin lambs (27.5 ± 5 kg) were fed *ad libitum* BGH (67.8% NDF, 8.9% CP) alone, or supplemented with SBM (18.8% NDF, 51.4% CP) or haylages of annual peanut (*Arachis hypogaea*; 39.6% NDF, 17.1% CP), cowpea (*Vigna unguiculata*; 44.1% NDF, 14.6% CP), perennial peanut (*Arachis glabrata*; 40.0% NDF, 14.3% CP) or pigeonpea (*Cajanus cajan*; 65.0% NDF, 12.6% CP). Legumes were supplemented at 50% of the diet and SBM fed to the average CP concentration (12.0%) of legume diets. Haylages were harvested, wilted to 45% DM, baled, wrapped in polyethylene and ensiled for 180 d. Each diet was fed to 7 lambs for 21 d, and then to 4 lambs for 21 d.

Intake of DM and OM (g/d) was greatest (P<0.01) in lambs fed annual peanut or SBM (819-748 and 723-668), and least (P<0.01) in lambs fed pigeonpea (421-400). Digestibility of DM was greatest (P<0.01) in sheep fed SBM (69%) and digestibility of OM was greater (P<0.01) in sheep fed BGH, SBM, peanuts, or cowpea (68-71%). Digestibility of NDF was greatest (P<0.05) in sheep fed BGH or SBM (70-72%). Intake of N (g/d) was greatest (P<0.01) in sheep fed annual peanut (18) followed (P<0.01) by SBM and perennial peanut (14-15), and least (P<0.01) in sheep fed pigeonpea (9). Digestibility of N was greatest (P<0.01) when SBM, annual or perennial peanut (67-70%) was fed and least (P<0.01) when pigeonpea (59.2%) was fed. Retention of N (g/d) was greatest (P<0.01) when sheep were fed annual peanut (7), followed (P<0.05) by perennial peanut, SBM and cowpea (4-5). Microbial N production was greater (P<0.05) when sheep were fed peanuts, SBM or BGH (10-12 g/d). Efficiency of microbial N production was not affected (P>0.10) by dietary treatment. The peanut haylages were the most promising legume haylage supplements for the lambs.

Key Words: Legume, Haylage, Digestibility

599 Forage species alters animal performance, carcass quality, and fatty acid composition of forage-finished beef produced in summer months. J. Schmidt*, J. Andrae, S. Duckett, M. Miller, and S. Ellis, *Clemson University, Clemson, SC.*

Thirty Angus-cross steers were finished on either alfalfa (AL), bermudagrass (BG), chicory (CH), cowpea (CO), or pearl millet (PM), to assess the effects of these forages on animal performance, carcass quality and longissimus fatty acid composition. Using a complete randomized block design, ten 5-acre paddocks were blocked and assigned forage species (2 reps per species). Steers (n=3) were randomly assigned to paddocks and grazing began when adequate forage growth for individual species was present. Put and take grazing techniques were utilized. Steers were slaughtered when sufficient forage mass for individual forage species was no longer present to support animal gains or when average steer weight exceeded 568 kg. Data were analyzed using PROC MIXED of SAS. Average daily gains tended to be higher (P = 0.10) for AL than BG. Total grazing days (GD) ha⁻¹ were greatest (P = 0.02) for PM, with BG having more GD than CH. Average forage mass was highest (P = 0.02) for PM. Carcass weight tended to be higher (P = 0.08) for AL and CO than CH and PM. Dressing percentage was higher (P < 0.01) for AL, CH, and CO than BG and PM. Marbling scores were higher (P = 0.03) for CO than BG, CH and PM. Postmortem aging increased tenderness (P < 0.01). Shear force tenderness scores did not differ (P = 0.24) among treatments. Oleic acid concentrations tended to be greater (P = 0.08) for CO than AL and BG. Concentrations of trans-11 vaccenic acid were greater (P = 0.004) in BG and PM than in CH and AL, and CO was greater than AL. Concentrations of linolenic acid were greater (P < 0.01) in CH and CO than AL, BG, and PM. Conjugated linoleic acid (CLA cis-9 trans-11) concentrations were greatest (P < 0.01) in BG and PM. Concentrations of monounsaturated fatty acids were greater (P = 0.04) in AL and BG than CO. Omega-6 to Omega ratio was higher (P < 0.05) in PM than CO. Forage species utilized during the summer finishing period altered animal performance, carcass quality and fatty acid composition in beef cattle.

Key Words: Beef, Forages, Fatty Acid

600 Performance of finishing steers on corn silage or low grain sorghum silage with corn oil supplementation. V. A. Corriher*, G. M. Hill, and B. G. Mullinix, Jr., *University of Georgia, Tifton.*

Beef steers (n=32; initial BW 524.9 ± 63.3 kg; age 24 mo.; Angus-X) were fed a free-choice TMR consisting of 55% corn silage (CS) or low-grain sorghum silage (SS) and 45% concentrate mix (88% ground corn, 10% SBM, 0.019% mineral/Rumensin/vitamin premix) on DM basis, without and with corn oil (7% of DMI). Low grain sorghum silage was used to simulate a grazing environment compared with high corn grain silage diet. Steers were ranked by BW, randomly assigned to dietary treatments and fed with Calan[®] gates for 78d. Steers were implanted with Component[®] on d1 of experiment. Steer BW were means of consecutive daily unshrunk BW. Steers were shipped to Cargill Taylor Beef (PA) and slaughtered at the end of the experimental period. Rib sections and subcutaneous fat samples were retained for fatty acid composition. Steer 78-d ADG had a silage × treatment interaction, ADG was higher for corn silage without corn oil (1.98 vs. 1.51 kg) and sorghum silage with oil (1.54 vs. 1.29 kg). Total DMI was higher for sorghum silage treatments; however, corn oil supplementation was not different (Table). Despite increased DMI for steers on sorghum silage treatments, 78-d ADG was higher for corn silage treatments. Steers on corn oil supplementation had higher concentrations of CLA isomer cis-9 trans-11 in longissimus dorsi and subcutaneous fat samples. A silage × treatment interaction occurred for the concentration of CLA isomer

trans-10, cis-12 in subcutaneous fat samples. Steers on corn silage with oil supplementation diets had higher concentrations of trans-10, cis-12. Steer HCW and QG (12=US Choice-) were higher for steers on corn silage. Corn oil supplementation increased QG however it decreased HCW of steers. Corn oil supplementation had no effect on steer performance; however, it increased CLA isomer concentrations.

Table 1.

	Corn	Sorghum	Oil	No Oil	SE	P<	
						Silage	Oil
Total DMI, kg	22.10	25.99	23.61	24.47	0.94	0.05	0.65
Total DMI/gain, kg	6.07	8.63	7.34	7.35	0.53	0.002	0.98
(LD) c9t11, g/100g	1.87	1.70	2.07	1.49	0.14	0.41	0.006
(LD) t10c12, g/100 g	0.079	0.097	0.094	0.082	0.024	0.61	0.75
(s.c.) c9t11, g/100 g	2.13	2.17	2.39	1.92	0.014	0.84	0.02
HCW, kg	370.21	354.25	354.34	370.13	11.48	0.33	0.34
QG	9.44	11.13	10.94	9.63	0.63	0.07	0.15

Key Words: Steer, Corn Oil, Fatty Acids

Symposium: ADSA Production Division Symposium: Dairy Replacement Heifers: Cost Effective Strategies from Weaning to Calving

601 Potential and limitations associated with manipulating dairy replacement heifer nutrition programs. P. C. Hoffman*, *University of Wisconsin, Madison.*

Goals of a dairy replacement heifer management program are to rear heifers at a low economic and environmental cost without compromising future lactation performance. To meet this objective, heifers are reared to 23-24 months of age and fed diets containing high fiber forages. Historically, research focused on feeding heifers higher energy diets to shorten the rearing period and reduce feed cost. This nutritional manipulation has potential to reduce feed cost but decreasing rearing time frequently results in decreased lactation performance. Decreases in lactation performance are often attributed to suppression of mammary development but some evidence suggest rearing time itself may play a role in mammary development and future milk yield. Another nutritional manipulation is to feed higher energy diets but limit the amount of the diet fed, controlling growth rate, which yields calving ages and body compositions similar to feeding high forage diets. This nutritional manipulation, (limit feeding) also has potential to reduce feed cost and decrease fecal excretion. In recent experiments, limit feeding heifers high energy diets has resulted in 20-25% improvements in feed efficiency and decreased manure excretion 20-30%. To date, negative effects on milk yield have not been observed. Unexplainably, when designed limit feeding experiments are combined with ancillary limit feeding experiments there appears to be a trend in improved milk yield when dairy heifers are limit fed. No biological mechanism is available to support these observations. Limit feeding dairy heifers does however result in behavior changes and interactions between bedding material, bunk space and heifer housing systems have yet to be defined. Finally, precision feeding heifers dietary P is another nutritional manipulation that could reduce economic and environmental cost without compromising future lactation performance. Recent research demonstrates supplementing P above the NRC requirement, results in a primary excretion of P and does not result in improvement of growth, bone or frame development in dairy heifers.

Key Words: Limit Feeding, Heifers, Phosphorus

602 Using growth monitoring in heifer management and research. A. Bach*^{1,2}, J. Ahedo³, and A. Kertz⁴, ¹*IRTA-Unitat de Remugants, Barcelona, Spain*, ²*ICREA, Barcelona, Spain*, ³*Rancho Las Nieves, Mallen, Spain*, ⁴*ANDHILL, LLC, St. Louis, MO.*

The ultimate goal of heifer rearing is to grow animals to their maximal production potential using the least amount of resources. Raising dairy heifers properly is a difficult endeavor by itself, but it is even more difficult in the absence of data and records. The main aspects that should be monitored include growth, reproduction, nutrition, wellbeing, and health. This paper will illustrate how to construct a database to monitor heifer performance, as well as the use of statistical and graphing tools to monitor performance. A proper database in combination with adequate analytical tools should allow setting management objectives, target performances, and correct deviations of individual animals. In addition, such a database could generate inferential answers to various aspects of heifer rearing. For instance, it could be utilized to forecast future milk production of an animal based on its up-to-date performance.

However, predicting future performance cannot be accomplished with much precision. Future performance is a random variable, and thus it is only by coincidence that its value will actually be exactly the same as the predicted one. In addition, the prediction of future performance may suffer from a considerable bias due to the omission of one or more variables that should have been included in the model and were omitted. For example, omission of individual intake data, body condition, etc., may deviate the predicted estimate of future milk yield. In addition, such an attempt is likely to also suffer from a relatively large lag due to the time span from birth to the day that milk records become available. The analysis of an existing database involving close to 500 heifers revealed that BW at first-calving was positively and linearly correlated with milk production during the first 150 DIM. No differences were found between AFC (ranging from 21.8 to 29.2 mo) and milk production. A positive relationship was found between ADG during the first 60 d of life and future milk production, whereas this relationship was negative from breeding time to calving. No negative relationship was found between ADG (ranging from 750 to 1100 g/d) during the prepubertal period and future milk yield.

Key Words: Heifer, Analysis, Record

603 Strategies for reproductive success in replacement heifers. R. L. Nebel*¹, J. M. DeJarnette¹, K. E. Hall², I. D. Peeler², and C. E. Marshall¹, ¹*Select Sires, Inc., Plain City, OH*, ²*Virginia Polytechnic Institute and State University, Blacksburg.*

Heifer rearing or replacement cost accounts for ~20% of the operational cost and represent the second largest expense for most dairy operations; therefore, proactive reproductive management of heifers to shorten the interval between birth and parturition is essential to reduce these costs. Puberty in heifers is a function of breed, age, and weight. Recommended body weight for first service is when heifers reach ~55% of the expected mature body weight (250 kg for Jersey and 350 kg for Holstein heifers). Initial rise in weekly blood P4 concentrations as the indicator of first cyclic activity for Holstein heifers occurs at 11 mo of age, 300 kg, and 122 cm withers height. A longer duration of estrus combined with more sexual activity makes the detection of estrus in heifers easier than in lactating cows. A variety of systems for AI will be discussed ranging from visual detection of estrus and PGF based programs to TAI using CIDR inserts in combination with PGF and GnRH. Comparable reproductive performance (number of heifers pregnant within a given time interval) can be obtained with most of the programs that will be reviewed. Development of fluorescence activated cell sorting has made X-bearing sex sorted semen available with conception rates ~80% of conventional semen with a resulting 90% heifer gender bias. The overall goal of a heifer program is to raise heifers to attain a desired age and body weight so that they initiate puberty, establish pregnancy, and calve easily. Sex sorted semen provides an effective method to accelerate genetic progress and maximize dairy profitability. Use of estrous detection aids and controlled breeding programs can improve the success of a heifer AI breeding program by improving estrous detection efficiency and labor associated with an AI program.

Key Words: Heifer, AI, Sexed Semen

604 Raising healthy dairy replacements: How we get the job done. G. Goodell*, *The Dairy Authority, LLC, Greeley, CO.*

One of the biggest expenses in maintaining a profitable dairy is providing for an adequate supply of dairy heifers to meet the demands of culling on the dairy. The science of raising replacement dairy heifers has come a long way in the past decade and this paper describes how some of these things are accomplished in a true farm setting.

Discussion for this paper comes from data accumulated from a 4000 head dairy heifer replacement facility in northern Colorado. This facility receives heifers at 4 to 5 months of age and returns them to the owners as springing heifers. Three diets are fed to heifers on this facility; 5-10 month diet, 11-16 month diet and a bred heifer diet. Diets are fed ad libitum to all heifers. Breeding is accomplished using once per day heat detection, chalk and the utilization of headlocks. Individual weights are collected the week of arrival, pre-breeding and 2-4 days before being shipped home. The breeding program has averaged 55-65% FSCR and 1.8 SPC even with the use of sexed semen.

Feeding heifers for optimal growth has long been identified as one of the top influencers of profitable heifer-raising. ADG was monitored for heifers returning home from this facility where the mean ADG was 2.0 lbs/day. Mean peak milk and peak DIM for these heifers back on their respective dairies were just 88 lbs and 110 DIM.

Monitoring for heifer health remains one of the biggest challenges on a heifer replacement facility of this size with multiple clients. This facility tries to involve the owner monthly by sending out reports on the owners' heifers that include everything from health to performance. This includes a "Poor Doer" report that lists heifers whose ADG was less than 1.25 lbs/day for longer than a 90 day period. Usually this list sparks discussion between the owner and the manager of the feedlot.

Vaccinology in youngstock continues to evolve. The use of an aggressive vaccine program in conjunction with mandatory (individual) BVD testing for persistently infected heifers as well as a recommended vaccine program prior to arrival gives this heifer raising program added performance.

Key Words: Dairy Replacements, Heifer Replacement

Animal Health VI

605 ASAS Centennial Presentation: The promise of proteomics in animal science. J. D. Lippolis* and T. A. Reinhardt, *National Animal Disease Center, USDA-ARS, Ames, IA.*

Proteomics holds significant promise as a method for advancing animal science research. The use of this technology in animal science is still in its infancy. The ability of proteomics to simultaneously identify and quantify potentially thousands of proteins is unparalleled. In this review, we will discuss the current state of proteomic technology and cover basic principles of its experimental design. In addition, challenges and limitations of proteomics will be considered, stressing those that are unique to animal sciences. The current proteomic research in animal sciences will be discussed and the potential uses for this technology will be highlighted.

Key Words: Proteomic, Animal Science, Genomics

606 Periparturient liver and mammary tissue-explant gene expression is responsive to bacterial lipopolysaccharide (LPS) in vitro: a model to study tissue-specific genomic responses to infection. M. Mukesh*, D. E. Graugnard, M. Bionaz, and J. J. Loor, *University of Illinois, Urbana.*

Periparturient cows experience a state of immunosuppression after parturition that renders them highly susceptible to mastitis pathogens. Objectives were to evaluate the suitability of an in-vitro mammary (MG) and liver (LIV) tissue explant model to study dose and temporal effects of bacterial LPS on gene expression profiles. Percutaneous biopsies of MG and LIV were obtained simultaneously from Holstein cows (7 DIM) that were bacteriologically negative in all mammary quarters. Explants (50-100 mg) were cultured in parallel in DMEM-F12 (MG) or RPMI-1640 (LIV) media at 37 °C and 5% CO₂. In a first study, MG explants were cultured for 2 h with 0 or 20 µg LPS/mL. Similarly, LIV explants were cultured for 2 h with 0, 0.2, 2.0, and 20 µg LPS/mL. In order to evaluate temporal changes in mRNA expression in response to LPS, LIV tissue was cultured with 20 µg LPS/mL and harvested after 2, 4, 6, and 8 h. Genes evaluated included serum amyloid A1 (*SAA1*), tumor necrosis factor-alpha (*TNFA*), complement component 9 (*C9*), haptoglobin (*HP*), and interleukin-6 (*IL6*). LPS challenge of MG resulted in greater ($P < 0.05$) *HP* (2.6-fold), *IL6* (3.9-fold), *SAA1* (3.5-fold), and *TNFA* (22-fold) relative to control. In LIV both *IL6* and *TNFA* increased ($P < 0.05$) markedly in response to incremental LPS, averaging ~5- and 3.5-fold greater expression with 20 than 0 µg LPS/mL. In the time course experiment, an 11-fold increase ($P < 0.05$) in *IL6* mRNA was observed at 4 h post-LPS challenge relative to 2 h, and it continued to increase through 8 h. In contrast, *HP*, *C9*, and *TNFA* mRNA decreased ($P < 0.05$) substantially between 2 and 8 h post-LPS. The present results indicate that mammary and liver tissue explants are suitable to study changes in mRNA expression due to infection. This approach holds promise in terms of allowing researchers to understand transcriptional responses in mammary and liver when stimulated by infectious pathogens. Funded by NRI-USDA project #2007-35204-17758.

Key Words: Nutrition, Immune Response, Inflammation

607 Effects of long-chain fatty acids on concanavalin A-induced cytokine production by bovine peripheral blood mononuclear cells. C. Caldari-Torres*, M. Perdomo, and L. Badinga, *University of Florida, Gainesville.*

Fatty acids (FA) are known to modulate immune responses in several mammalian species, including the human, pig, and cow. The objective of this study was to examine the short-term effects of long-chain FAs on concanavalin A (ConA)-induced tumor necrosis factor alpha (TNF- α), interferon gamma (INF- γ) and interleukin-4 (IL-4) production by cultured bovine peripheral blood mononuclear cells (PBMCs). Peripheral blood mononuclear cells were isolated by density gradient centrifugation and then incubated with ConA alone (10 µg/mL) or with a combination of ConA and specific FAs for 48 h at 37 °C in a humidified atmosphere of 5% CO₂. Concentrations of cytokines in cell-conditioned media were determined by specific bovine enzyme-linked immunosorbent assays (ELISAs). Incubation of PBMCs with ConA increased ($P < 0.01$) TNF- α , INF- γ and IL-4 production by 8-, 24-, and 24-fold, respectively. Co-incubation with eicosapentaenoic acid (EPA, C_{20:5n-3}) completely abolished ($P < 0.01$) TNF- α , INF- γ and IL-4 responses to ConA. Alpha linolenic acid (ALA, C_{18:3n-3}) was less potent in attenuating TNF- α and IL-4 production in vitro. Docosahexaenoic acid (DHA, C_{22:6n-3}) and monounsaturated FAs (cis or trans-C_{9:1} and cis or trans-C_{11:1}) had minimal effects on ConA-induced cytokine production in cultured bovine PBMCs. Results indicate that ALA and EPA attenuate TNF- α , INF- γ and IL-4 production by bovine PBMCs challenged with ConA. The mechanisms by which these omega-3 FAs modulate cytokine production in bovine PBMCs warrant further investigation.

Key Words: Fatty Acids, PBMCs, Cytokines

608 ASAS Centennial Presentation: Contributions in the *Journal of Animal Science* to understanding cattle metabolic and digestive disorders. J. T. Vasconcelos and M. L. Galyean*, *Texas Tech University, Lubbock.*

Ruminal acidosis, bloat, liver abscesses, and polioencephalomalacia (PEM) were reviewed with respect to contributions published in the *Journal of Animal Science* (JAS) regarding these metabolic and digestive disorders in beef cattle. Increased grain feeding and expansion of the feedlot industry in the 1960s led to considerable research on acidosis. The concept of subacute acidosis was developed in the 1970s. Significant research was published during the 1980s and 1990s on adaptation to high-grain diets, effects of ionophores, and the development of model systems to study ruminal and metabolic changes in acidosis. Recent publications JAS on acidosis have largely focused on individual animal variability in response to acid loads and the role of management strategies in controlling acidosis. Increased grain feeding also was associated with an increase in the incidence of liver abscesses, which were quickly linked to insults to the ruminal epithelium associated with acidosis. The role of antibiotics, particularly tylosin, in decreasing the incidence and severity of liver abscesses was a significant contribution of JAS publications during the 1970s and 1980s. Papers on bloat were among the earliest published in JAS related to metabolic and digestive disorders

in cattle. Noteworthy accomplishments in bloat research chronicled in JAS include the nature of ruminal contents in legume and feedlot bloat, the efficacy of poloxalene, ionophores, and more recently, condensed tannins, in decreasing the incidence and severity of bloat. Although less has been published on PEM, early publications highlighting the association between PEM and ruminal acidity and the role of thiaminase in certain forms of the disorder, as well as more recent publications related to the role of S in the development of PEM, are noteworthy contributions. The JAS has played a significant role as a repository for information pertaining to metabolic and digestive disorders in cattle, particularly through the publication of ASAS-sponsored symposia, and it will no doubt continue to be a premier resource for information on these conditions.

Key Words: Acidosis, Bloat, Liver Abscesses

609 Neutrophil function in response to level of dietary energy pre-partum and post-partum inflammatory challenge in dairy cows.

D. E. Graunard*, M. Bionaz, M. Mukesh, K. M. Moyes, J. L. Salak-Johnson, J. K. Drackley, and J. J. Loo, *University of Illinois, Urbana.*

Dairy cattle experience a state of immunosuppression after parturition that renders them highly susceptible to mastitis pathogens as well as metabolic diseases. We hypothesized that plane of dietary energy pre-partum is a management tool that can affect neutrophil and metabolic tissue function and, thus, transition success. Thirty-two Holstein cows with average SCC of $\sim 128,000 \pm 108,000$ in the previous lactation were assigned (n = 16/diet) to a control (high-straw; $NE_L = 1.33$ Mcal/kg) or moderate-energy (ME; $NE_L = 1.58$ Mcal/kg) diet during the entire dry period. All cows were fed a common lactation diet post-partum. At 7 DIM, cows were assigned to receive an intramammary bacterial lipopolysaccharide (LPS) challenge (200 μ g; n = 8/pre-partum diet) or served as controls (n = 8/pre-partum diet). Cows used were bacteriologically-negative in all mammary quarters. Blood for neutrophil isolation was collected on -14, 7 (prior to LPS), 14, and 30 d relative to parturition. Neutrophils for RNA, phagocytosis, and chemotaxis were promptly isolated by centrifugation after lysis of erythrocytes. Neutrophil migration (3×10^6 isolated cells/mL) was assessed using IL-8 (100 ng/mL) and C5a (10^{-6} M) as chemoattractants. Phagocytic capacity of neutrophils (2×10^5 /mL isolated cells) was assessed with 1.75 μ m fluorescent microspheres followed by quantification via flow cytometry. Differentials for phagocytic cells were assessed by sorting via flow cytometry. Phagocytosis did not differ between late pre-partum (-14 d) and early post-partum (7 d) or due to pre-partum diet. Analysis of LPS-effects (d 7, 14, and 30) showed that phagocytosis in cows fed the control diet pre-partum

increased $\sim 22\%$ by d 14 compared to a $\sim 19\%$ decrease in cows fed ME pre-partum (interaction $P < 0.01$). At 30 d post-partum, phagocytosis was $\sim 30\%$ lower than 7 d (time $P < 0.01$). Results show that neutrophil activity during an infection challenge following parturition might be affected by pre-partum dietary energy intake. Funded by NRI-USDA project #2007-35204-17758.

Key Words: Periparturient, Mastitis, Metabolic Disease

610 An immuno-evaluation system for anti-inflammatory probiotics using originally established porcine epitheliocyte (PIE) cells.

T. Shimazu*, M. Tohno, M. Moue, H. Aso, T. Saito, and H. Kitazawa, *Tohoku University, Sendai, Japan.*

Intestinal epithelial cells (IECs) are exposed to a variety of antigens, such as pathogenic and commensal bacteria, and are involved in the regulation of the mucosal immune responses. Although probiotics are believed to protect the host from pathogenic inflammation of the IECs, the precise mechanism of the anti-inflammatory effect of probiotics is not well understood. IECs recognize bacterial components through pattern recognition receptors, such as Toll-like receptors (TLRs), to initiate immune responses for pathogen elimination. Despite the importance of swine as a human model for some disease, little is known about the regulation of the immune response of porcine IECs. In the present study, we established and characterized an original porcine intestinal epitheliocyte (PIE) cell line in order to develop a novel immuno-evaluation system for anti-inflammatory probiotics based on the pathogenic inflammatory response of PIE cells. First, we isolated and cloned PIE cells from an unsuckled neonatal swine. These PIE cells expressed TLR1-9 and MD-2 mRNAs, and preferentially expressed TLR4/MD-2. In addition, we confirmed that TLR4 was expressed at the protein level. Upon stimulation with LPS, an antagonist for TLR4, the PIE cells upregulated the expression of several TLRs (TLR2, 3, 4, 5 and 8), Th1 cytokines (IL-1 α , IL-6), and chemokine (MCP-1). Furthermore, Enterotoxigenic *Escherichia coli* (ETEC), a major pathogen of neonatal swine, induced severe inflammatory cytokines through the TLR4 on the PIE cells. Interestingly, pretreatment with several probiotics significantly reduced inflammatory cytokine expression (IL-6, TNF- α) without affecting the TLR4 expression level. These results indicate that PIE cells are a useful cell line for studying the anti-inflammatory mechanism of probiotics with a view to developing new physiologically functional foods with intestinal anti-inflammatory effects.

Key Words: Probiotics, Intestinal Epithelial Cells, Anti-inflammation

Breeding and Genetics: Breeding for Milk Quality and Test-Day Model Applications

611 Quantitative trait loci for milk-fat composition in Dutch Holstein Friesians. A. Schennink*¹, W.M. Stoop¹, H. Bovenhuis¹, J.M.L. Heck², P.D. Koks¹, M.H.P.W. Visker¹, and J.A.M. van Arendonk¹, ¹*Animal Breeding and Genomics Centre, Wageningen University, Wageningen, the Netherlands*, ²*Dairy Science and Technology Group, Wageningen University, Wageningen, the Netherlands*.

This study is part of the Dutch Milk Genomics Initiative and aims at the characterization of genes involved in milk-fat synthesis and milk-fat metabolism. Previous research has shown substantial genetic variation in milk-fat composition: heritabilities were high (0.42-0.71) for short- and medium-chain fatty acids (C4-C16) and moderate (0.22-0.42) for long-chain fatty acids (C18 and longer). A genome-wide scan was conducted to map quantitative trait loci (QTL) affecting milk-fat composition in Dutch Holstein Friesian dairy cattle. The mapping population consisted of 7 half-sib families containing 849 cows in a daughter design. A total of 1378 single nucleotide polymorphisms (SNP) were typed covering all 29 autosomes, to construct a 2829 cM genetic linkage map. The phenotypes under study were 56 milk-fat composition traits, including saturated, mono-unsaturated, poly-unsaturated, and conjugated fatty acids, unsaturation indices, fat percentage and fat yield. A regression interval mapping approach was used to estimate effects and positions of the QTL. In addition to QTL on chromosomes 14 and 26, at which the genes coding for diacylglycerol acyltransferase 1 (DGAT1) and stearoyl-CoA desaturase 1 (SCD1) are located, QTL were detected on several other chromosomes. QTL were detected for short- and medium-chain fatty acids, as well as for long-chain fatty acids. Our results will enable marker assisted differentiation and marker assisted selection, in order to optimize milk quality and to develop innovative dairy products. Prior to implementation of these QTL in breeding programs, additional work is needed to fine map the chromosomal locations and select positional candidate genes influencing milk-fat composition.

Key Words: Milk-Fat Composition, Dairy Cattle, Quantitative Trait Loci

612 Genetic parameters of saturated and monounsaturated fatty acids estimated by test-day model in Walloon dairy cattle. H. Soyeurt*¹, C. Bastin¹, P. Dardenne², F. Dehareng², and N. Gengler^{1,3}, ¹*Gembloux Agricultural University, Gembloux, Belgium*, ²*Agricultural Walloon Research Centre, Gembloux, Belgium*, ³*National Fund for Scientific Research, Brussels, Belgium*.

The contents of saturated (SAT) and monounsaturated (MONO) fatty acids in milk vary through the lactation. The aim of this research was to estimate the genetic parameters for these groups of fatty acids in bovine milk using multi-trait random regression test-day models. The relationship between these fatty acids and the milk production traits was also studied as well as the effects of season and stage of lactation. The model included as fixed effects: herd x date of test, class of 15 days in milk, class of age. Random effects were herd x year of calving, permanent environmental, additive genetic, and residual effects. Since October 2007, all spectra generated by milk recording in the Walloon part of Belgium were collected. The contents of SAT and MONO were estimated by mid-infrared spectrometry. First results were obtained from 100,841 test-day records from 11,626 Holstein heifers. The season and stage of lactation influenced the contents of SAT and MONO in milk

and milk fat. The heritability estimates of SAT and MONO in fat were higher at the beginning of the lactation. The negative energy balance of cows could explain this variation. The values of heritability were also higher at the end of lactation. The genetic and phenotypic correlations among studied traits varied also through the lactation. This study confirms the genetic variability of fatty acids and suggests a possible relation between the contents of SAT and MONO in milk fat and the energy balance of cows.

Key Words: Fatty Acid, Genetic Parameter, Dairy Cattle

613 Genetic parameters of stearoyl coenzyme-A desaturase 9 activity estimated by test-day model. V. M.-R. Arnould*¹, N. Gengler^{1,2}, and H. Soyeurt¹, ¹*Gembloux Agricultural University, Gembloux, Belgium*, ²*National Fund for Scientific Research, Brussels, Belgium*.

Dairy and beef products account for a large part of fat intake in human nutrition and therefore can be linked to dietary diseases. The stearoyl Coenzyme-A desaturase 9 (delta-9) gene was identified as a potential functional candidate gene affecting milk fat composition in dairy cattle. The objective of this research was to estimate the genetic parameters of delta-9 activity indicator traits and to study the relationship between delta-9 activity as described by these indicator traits and common milk production traits. A total of 126,331 test-day records were obtained from 14,259 Holstein (> 84% Holstein gene) heifers belonging to 105 herds. The studied traits were milk yield, percentages of fat and protein, content of monounsaturated fatty acids, and 3 ratios reflecting the delta-9 activity (C14:1/C14:0; C16:1/C16:0 and C18:1/C18). The used model was a multiple-trait random regressions test-day model and included as fixed effects: herd x date of test, class of age, and month x year. Random effects were herd x year of calving, permanent environmental, additive genetic, and residual effects. The fatty acid contents were estimated by mid-infrared spectrometry. Delta-9 activity varied within year and lactation. The obtained heritability estimates of delta-9 as well as the genetic and phenotypic correlation varied also through lactation. This study suggests potential improvements of delta-9 activity and subsequently milk fat composition can be achieved by animal management but also by breeding and animal selection.

Key Words: Delta-9 Desaturase, Genetic Parameters, Dairy Cattle

614 Relationship between lactoferrin, minerals, and somatic cells in bovine milk. H. Soyeurt*¹, V. M.-R. Arnould¹, D. Bruwier¹, P. Dardenne², J.-M. Romnee², and N. Gengler^{1,3}, ¹*Gembloux Agricultural University, Gembloux, Belgium*, ²*Agricultural Walloon Research Centre, Gembloux, Belgium*, ³*National Fund for Scientific Research, Brussels, Belgium*.

Selection for increased mastitis resistance is hampered by lack of available data. Currently, somatic cell count or score are proven indicators. However, it should be a priority to increase the number of available indicator traits for mastitis resistance. The aim of this research was to study the relationships among potential indicator traits as lactoferrin content, concentrations of major minerals in milk (calcium, Ca; sodium, Na; phosphore, P), and somatic cell count. First, 3 calibration equations

were developed using partial least squares regressions to predict the contents of Ca, Na, and P in milk by mid-infrared spectrometry. A total of 1,609 milk samples were collected between March 2005 and May 2006 for 475 cows from 6 dairy breeds. Based on their spectral variability, 100 samples were selected using a principal components approach. The contents of these minerals were estimated by emission spectrometry (ICP-AES). The ratio of standard deviation to standard error of cross validation obtained for the equations predicted the contents of Ca, Na, and P were superior to 2 suggesting the use of these equations in this research. Second, the relationship between lactoferrin, minerals and somatic cells was studied using a random regressions multi-trait animal test-day model. A total of 57,973 milk samples were collected from 94 herds between April 2005 and January 2008 during milk recording in the Walloon part of Belgium.

Key Words: Minerals, Lactoferrin, Bovine Milk

615 Genetic variation in milk protein composition and the effects of genetic variants on the concentration of individual proteins. J. M. L. Heck*¹, A. Schennink², G. C. B. Schopen², H. J. F. van Valenberg¹, H. Bovenhuis², M. H. P. W. Visser², J. A. M. van Arendonk², and A. C. M. van Hooijdonk¹, ¹*Dairy Science and Technology, Wageningen University, Wageningen, the Netherlands*, ²*Animal Breeding and Genomics Centre, Wageningen University, Wageningen, the Netherlands*.

Milk protein composition determines, to a large extent, the nutritional value and technological aspects of milk. To determine the variation in protein composition the concentration of the six major milk proteins, α -lactalbumin (α -LA), β -lactoglobulin (β -LG), α_{S1} -casein (α_{S1} -CN), α_{S2} -casein (α_{S2} -CN), β -casein (β -CN) and κ -casein (κ -CN) was determined by capillary zone electrophoresis in individual milk samples of 2000 cows. This population was especially selected to be able to determine which part of the variation is caused by genetic effects or by factors as herd, stage of lactation, season and cell count. Heritability of every milk protein was determined using an animal model. Genetic variants of the main milk proteins were identified by DNA analyses and their effect on milk protein composition was determined.

The results show large variation in concentration of all individual proteins and a large part of this variation was caused by genetic factors. Milk protein composition has a moderate to high heritability with heritabilities ranging between 0.3 and 0.8. Large variation in combination with high heritability offers great opportunities for changing milk protein composition. The screening of the main milk protein genes resulted, next to the detection of the common genetic variants (α -LA B, α_{S1} -CN B and C, α_{S2} -CN B, β -LG A and B, β -CN A1, A2, A3 and B, κ -CN A and B), into the detection of κ -CN E which was not previously detected in Dutch Holstein Friesian cows. We show that genotypes of β -LG, β -CN and κ -CN have major effects on the concentration of individual proteins and explain a considerable part of the genetic variation in milk protein composition.

This was likely the first study where the total and the genetic variation in detailed protein composition was determined on such a large amount of animals. The effect of genetic variants on all individual proteins, rather than on total protein or total casein, has not been reported frequently. The information resulting from this study shows the possibilities and limits of changing bovine milk protein composition.

Key Words: Milk Protein Composition, Heritability, Genetic Variants

616 Effect of casein genotypes on heritability of milk coagulation ability in Holstein Friesian cows. M. Cassandro*¹, R. Dal Zotto¹, M. De Marchi¹, A. Comin¹, S. Chessa², and G. Bittante¹, ¹*University of Padova, Legnaro, Padova, Italy*, ²*University of Milano, Italy*.

Cheese-making industry plays a fundamental role in Italy, where more than 75% of overall marketable milk is converted into cheese. Therefore, it is important to analyze the genetic aspects of milk coagulation properties (MCP) as coagulation time (RCT, min) and curd firmness (a30, mm). Aim of this study was to estimate the heritability for RCT and a30 estimated with or without the effect of casein genotypes (CSN2 and CNS3) included on the linear model. A total of 1.071 individual milk samples of Italian Holstein cows, daughters of 54 sires, reared in 34 dairy farms of Veneto region (Italy), were analysed for RCT and a30. Moreover, all cows were genotyped for CSN2 and CSN3 loci. Heritability of RCT and a30 traits were 0.25 and 0.15, respectively, without including the effects of CSN2 and CNS3 in the analysis. The use of casein genotypes effect in the model showed a lower heritability estimates (0.15 and 0.09, for RCT and a30, respectively). These results evidenced that MCP can be improved using genetic strategies and that casein genotypes might be considered as major genes for milk coagulation abilities.

Key Words: Milk Coagulation Ability, Genetic Parameters, Casein Genotypes

617 Modeling extended lactation curves in Italian Holsteins. R. Steri¹, F. Canavesi², E. Nicolazzi², G. Gaspa¹, and N.P.P. Macciotta*¹, ¹*Dipartimento di Scienze Zootecniche, Università di Sassari, Sassari, Italia*, ²*Associazione Nazionale Allevatori Frisone Italiana, Cremona, Italia*.

In several countries the average lactation length of dairy cattle has increased markedly in recent years, essentially due to reproductive failures but also to management strategies. The search for suitable mathematical models for extended lactations is of great importance both for genetic evaluations via Random regression Models, and for management decision, especially for the assessment of an economically convenient asymptotic level of production. In this work, 737,011 test day records for milk yield of 69,863 lactation of 45,521 Italian Holsteins (with about 46% of lactations >350 DIM) farmed in four provinces of the North of Italy, were modelled with six common lactation curve functions: Wood (WD), Wilmlink (WIL), Ali and Schaeffer (AS) multiple regression, fifth-order Legendre polynomials (LEG), quadratic (QSPL) and cubic splines (CSPL) with three knots. Moreover, data were modelled with the version of the Dijkstra model specifically suggested for extended lactations. As expected, functions with a larger number of parameters showed better fitting performances for individual patterns, with about 75% of curves showing an adjusted R-squared higher than 0.70 for AS, LEG, QSPL and CSPL. Moreover, fitting performances tend to increase with lactation length due to the larger number of data. Lactations curves exceeding 650 DIM and that showed adjusted R-squared greater than 0.75 when modelled by the modified Dijkstra function, separately by parity, in order to calculate some measures of technical importance. Days at peak were 75, 48 and 48 for first, second and third calving cows; peak yield were kg/d 32.7, 38.3, 39.9. Cumulative yield at 305 and 1000 DIM were different across parities: 9,177 vs 22,154 (1st parity), 9,846 vs 21,925 (2nd parity), 10,115 vs 21,875 (3rd parity). The estimated

asymptotic level of production in the tail of lactation was on average 10 kg/d but together with a marked variability.

Key Words: Dairy Cattle, Extended Lactations, Mathematical Models

618 Issues in modelling lactation curves with regression splines. N. P. P. Macciotta*¹, F. Miglior^{2,3}, A. Cappio-Borlino¹, and L. R. Schaeffer⁴, ¹*Università di Sassari, Sassari, Italia*, ²*Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada*, ³*Canadian Dairy Network, Guelph, ON, Canada*, ⁴*CGIL, University of Guelph, Guelph, ON, Canada*.

Regression splines are a type of segmented regressions in which the curve is divided into different segments of the independent variable, joined at points named knots, each fitted with different polynomials. Cubic splines are becoming a model of interest for fitting individual lactations in random regression test day models for dairy traits whereas linear and quadratic splines have been proposed to fit growth curves. The main objective in spline modelling is to optimize the number and placement of knots. Non linear procedures allow for the estimation of knot position, treated as parameter of the function. In this study, lactation curves of Canadian Holsteins were modelled with splines of different order by using non linear procedures. Data were 285,340 test day records of Canadian Holsteins each with 10 records. Average curves of different parities (1 to 3) were modelled with linear, quadratic and cubic splines. Models with one, two and three knots were tested. Estimated knots positions were used to model individual curves by linear spline regressions. Fitting of average curves was high for all models considered (adjusted R-square > 0.98). By and large, the increase of the number of knots resulted in convergence problems. Only quadratic splines converged in all the three parities and for all the number of knots considered. The order of splines affected the knot position: for example when only one knot was fitted, the position was between 30-37 days in milk (DIM) for linear, 40-46 DIM for quadratic and 53-62 DIM for cubic splines, respectively. For increasing number of knots, their positions appeared more consistent for quadratic and cubic splines. When three knots were fitted, the first knot was between 10 and 26 DIM, the second between 23 and 59 DIM, the third between 60 and 252 DIM. Finally, no substantial increases of adjusted R-square was observed when increasing the number of knots or moving from quadratic to cubic splines in individual fitting, with about 60% of curves having an adjusted R-square greater than 0.6.

Key Words: Lactation Curve Modeling, Regression Splines, Knots

619 Improving stability of test day model bull proofs. F. Canavesi, S. Biffani*, E.L. Nicolazzi, and R. Finocchiaro, *ANAFI, Cremona, Italy*.

Test days are used for the official genetic evaluation in Italy since November 2004. They are used in a multiple trait multiple lactation random regression test day model. Since its introduction a larger variation on average was observed in bull proofs in comparison to the old repeatability model based on 305 days ME lactation records. In order to

improve proof stability several areas were investigated from definition of fixed effects to estimation of genetic parameters. Critical moments in bull proofs variation were the arrival of second and third lactation into the system.

In Italy progeny testing daughter data are coming into the genetic evaluation system at different times depending on efficiency of AI studs in distributing semen, efficiency of farmers in using young bulls doses, age at calving heterogeneity across regions. Therefore young bulls add daughters at every run and this may cause variation in bull proofs. A bull gets its official proofs when there are at least 30 daughters at 120 DIM in 30 herds but there were not limits set for second and later parities daughters. In January 2008 a new procedure was applied and now second and third parity daughters data can be used for bull evaluation only if they meet the following criteria: 5 daughters at 120 DIM in second lactation and 3 daughters at 120 DIM for third lactation. This improved stability of proofs from run to run on average by 10% and moreover reduced the number of bulls that were decreasing one run and increasing the next or viceversa due to the arrival of early and scarce data on second and third parity daughters.

Key Words: Stability of Proofs, Test Day Model, Accuracy of Proofs

620 Genetic parameters for milk, fat and protein in Holsteins using a multiple-parity test day model that accounts for heat stress. I. Aguilar*^{1,2}, I. Misztal¹, and S. Tsuruta¹, ¹*University of Georgia, Athens, GA*, ²*Instituto Nacional de Investigación Agropecuaria, Las Brujas, Uruguay*.

Data included 585,119 test-days (TD) in first to third parity for milk (M), fat (F) and protein (P) from 38,608 Holsteins in GA. Daily temperature humidity indices (THI) were available from public weather stations. Models included a repeatability test-day model (MREP) with a random regression on heat stress index (HIS), and a test-day random regression model (MRRM) using linear splines with 4 knots and HSI, which was defined as THI over 22C from the 3rd day before the TD from a weather station closest to the farm. Knots for splines in MRRM were placed at 5, 50, 200, and 305 days-in-milk (DIM). Random effects were additive and permanent environment in MREP and additive, permanent environment and herd-year for MRRM. Additionally, models included herd test day, age, milking frequency and DIM classes as fixed effects. In MREP and for M, F and P, the phenotypic variance increased by 50-60% from 1st to 2nd parity and additionally by 12-15% in 3rd parity. The regular genetic variance increased by 30-40% from 1st to 2nd parity but slightly declined in 3rd parity for M and P. The heat stress variance doubled from 1st to 2nd parity, and additionally increased by 20-100% in 3rd parity. The genetic correlations between parities in the regular animal effect were ≥ 0.84 , but they were ≥ 0.96 between 2nd and 3rd. The genetic correlations between parities in the heat-stress effect were $\geq 0.56-0.79$. The genetic correlations between regular and heat stress effects across parities and traits were between -0.30 and -0.47. With MRRM, the variance of the heat stress effect was about half of that with MREP. The most negative (-0.42) genetic correlation for milk between regular and heat stress effects was at 50-200 DIM for 1st parity and at 200-305 DIM for parities 2-3. Genetic variance of heat stress strongly increases with parity. It is inflated with MREP due to timing of lactations to avoid the peak production during heat stress.

Key Words: Heat Stress, Variance Components, Multiple Lactations

621 An alternative model to accommodate very large numbers of traits in random regression test-day models. N. Gengler*^{1,2}, ¹*Gembloux Agricultural University, Gembloux, Belgium*, ²*National Fund for Scientific Research, Brussels, Belgium*.

Computing capability has continued to increase following Moore's law allowing the use of full multitrait models in many cases. However there are still situations where current computing algorithms need to be optimized. One of these is large scale multitrait random regression models (MT-RRM), the type suitable for type traits and milk components where potentially 30 and more traits are analyzed together using several random regression effects. An equivalent model to a MT-RRM can be defined as a complete repeated records model where the different traits are standardized according to residual variances or records are weighted accordingly. Trait-specific or across trait fixed effects can be defined. Trait-specific random effects need to be used; however definition of random effects does not need to be identical for all traits. This equivalent model is also an excellent base to use rank reduction as the

potentially large number of random effects (effects x number of traits x number of regressions) can be reduced dramatically based on (co)variance structures among them. Adapted variance component estimation strategies can be used based on REML and Gibbs sampling algorithms. Alternative solving algorithm such as the use of sequential estimation of regressions and effects on regressions can be easily adapted to this framework. This equivalent model has also the practical advantage that it allows for easier models where some traits have been recorded for a long period (e.g., stature, milk, fat, protein) and other traits are recent and have much more sparse data (e.g., rear legs rear view, different fatty acids in milk fat). This can be done by a full or partial transformation of records of different traits to repeated records. This alternative model approach should make MT-RRM practical for many traits and trait groups under selection in dairy populations, today and in the future.

Key Words: Mixed Model, Equivalent Model, Rank Reduction

Breeding and Genetics: Current Issues in Beef Cattle Breeding

622 ASAS Centennial Presentation: Animal breeding and the *Journal of Animal Science*: A century of co-evolution. W. Hohenboken*^{1,2}, ¹Virginia Polytechnic Institute and State University, Blacksburg, ²Oregon State University, Corvallis.

In this paper, I attempt to survey, categorize and characterize papers relevant to animal breeding and genetics that were published in the *Journal of Animal Science* between the initial issue in 1910 and 2008. Graphics and descriptive statistics will be presented that describe allocation of publication effort across species, space and time. I then endeavor to identify and describe the evolution of major themes in research, teaching and extension. When did they begin? How did they expand and contract? Did they mutate or metastasize? Which suffered extinction? Relationships and paths of influence among investigators and among institutions will also be examined. Finally, I will reflect upon changes during the century in the *Journal of Animal Science* and in the manner and style with which animal breeders and geneticists published their findings within its pages.

Key Words: Breeding and Genetics, History, *Journal of Animal Science*

623 Residual feed intake heritability and phenotypic correlations of central tested Simmental bulls. W. C. Rutherford*, L. A. Kriese-Anderson, S. V. Free, M. S. Hittle, and J. K. Grubbs, Auburn University, Auburn, AL.

Feed intake along with weights, hip height, ultrasound carcass traits and scrotal circumference were analyzed for 459 Simmental bulls consigned to the Auburn University BCIA Bull Test from the years 1981 to 2007. All bulls were housed at the Auburn University Beef Evaluation Center for a minimum of 70 days. Bulls were trained to individual Calan Gates® within 21 days of arriving. All bulls were consigned by individual Simmental breeders primarily from Alabama. Bulls were measured for weight and height either biweekly or monthly depending on year. SC and ultrasound measurements for carcass traits were taken at yearling age (330 to 400 days). Residual feed intake (RFI) was determined for each bull by regressing metabolic mid-weight and ADG on intake. Phenotypic correlations among traits were determined using SAS. RFI was positively correlated with total feed intake (Corr=.53211 P<.0001) and has a slight positive correlation with 12th rib fat thickness (Corr=.12117 P=.0125). A mixed model in SAS was used to analyze RFI and determine sire components of variance. Fixed effects included consignor (N=61), and percentage Simmental (7 levels). Sire (n=223) was included as a random effect. Consignor was found to be non-significant (P>.05). Percentage Simmental was found to be significant (P<.0001). LSMEANS separated differences between percentage Simmental for RFI. Bulls that were 37% Simmental had the highest RFI values. The second highest RFI values were with 25% Simmental bulls. The 25% Simmental bulls had greater RFI values than bulls of 50, 62, 75, 87, and 100% Simmental (P<.0105). Heritability of RFI was estimated to be 0.29 ± 0.02.

Key Words: Residual Feed Intake, Heritability, Beef

624 Estimates of genetic variation for feed intake and other characteristics in growing beef cattle. K. M. Rolfe*¹, M. K. Nielsen¹, C. L. Ferrell², and T. G. Jenkins², ¹University of Nebraska, Lincoln, ²US Meat Animal Research Center, Clay Center, NE.

Calves born between 2003 and 2006 at the U.S. Meat Animal Research Center provided data for estimation of genetic and phenotypic parameters for measures of body weight and gain and feed intake during the finishing phase. At average age 278 d, cattle were started on a high energy diet of corn, alfalfa hay, soybean meal, and supplement. They were individually fed for ~138 d in pens of 4 to 8 steers by use of Calan headgates. Cattle were fed to an average optimum end weight, but harvested in four groups per year at a commercial slaughter facility. Steers were produced by randomly mating F1-cross sires to straightbred and F1 females. Nine breeds were represented in various fractions in the steers. These were: Hereford, Angus, Simmental, Charolais, Limousin, Gelbvieh, Red Angus, Pinzgauer, and Red Poll. Fifty-nine sires produced half-sib families. A total of 820 crossbred steers were analyzed with a pedigree file of 4,051 animals. Traits analyzed were ADG, DMI, mid-period body weight (MBW), and residual feed intake (RFI; determined from DMI adjusted for MBW and ADG). Flight time (FT) was collected at least twice (separated by ~60 d) as a possible indicator trait for temperament; two sets of electronic eyes were placed 5.5 m and 10.8 m beyond a scale box where the animals were temporarily detained. REML methods were used in univariate models that accounted for the fixed effects of year, month for only FT, pen size, breed and breed heterozygosity; random effects were animal genetic, pen, permanent environmental for FT only and error. Heritability estimates for ADG, DMI, RFI, MBW, and FT were: 0.21 ± 0.09, 0.21 ± 0.07, 0.40 ± 0.11, 0.45 ± 0.12, and 0.25 ± 0.07, respectively. Repeatability of FT was 0.63. Pen size only had a significant effect on RFI (P<0.001). Month was significant for FT (P<0.001) with flight time increasing as the animal aged.

Key Words: Beef Cattle, Feed Intake, Flight Time

625 Analysis of beef cattle growth with a Kalman Filter. S. Forni*, D. Gianola, G. J. M. Rosa, G. de los Campos, and K. A. Weigel, University of Wisconsin, Madison.

A dynamic model known as Kalman Filter (KF) was embedded into a standard linear mixed model, to analyze longitudinal data. Growth data of Nelore cattle were used to compare a standard multiple trait model (MM) with the KF. A data set consisting of body weight records of 6,856 animals was used. Animals were weighed at 90 d intervals from birth to 540 d of age, and six equally-spaced records were used for each individual. Contemporary groups (CG) consisted of: sex, herd, year and season of birth (rain or dry) combinations. A six-variate mixed linear model with CG, additive genetic and maternal effects was employed. KF introduced a time-dependent association between additive genetic, maternal and residual effects, which were assumed to change over time according to a first order autoregressive process. Under KF, covariances between any two time points can be inferred from combinations of variances estimates. Thus, the (co)variance structure can be modeled with fewer parameters than in the MM. The KF and MM models were compared using the Deviance Information Criterion (DIC) and the Bayes

Factor (BF). Models where KF described additive genetic and maternal effects were favored by DIC. However, KF did not describe residual (co)variation adequately. According to the BF, there was not conclusive evidence in favor of a specific model. The KF allowed fitting additive and maternal effects with a meaningful lower number of parameters than the standard procedure. This reduction avoids problems associated with overparameterized models and makes efficient use of the data. Further, fitting KF to growth traits provides estimates of genetic merit for the entire range of time points and captures differences through time between and within individuals.

Key Words: Kalman Filter, Longitudinal Data, Mixed Model

626 Bayesian estimation of the covariance between permanent maternal and temporary environmental effects for weaning weight in beef cattle. R. Cantet^{*1,2}, ¹University of Buenos Aires, Buenos Aires, Argentina, ²CONICET, Aregentina.

The magnitude of the additive covariance between direct and maternal effects (CADM) in the presence of an environment covariance between direct and maternal effects (CEDM) for weaning weight in beef cattle is still an open issue. Inclusion of CEDM presents a challenging problem for fitting the model to data. An animal model with maternal effects is presented that includes random additive direct and maternal effects, as well as random permanent environmental effects (PE) that are correlated to a set of temporary environmental effects (TE) on the individual records through the CEDM parameter. In this model, error terms are independent and identically distributed. Two formulations of the covariance matrix for PE effects are studied. The first one accounts for the environmental influences from grand-dams to all her direct descendant dams. An alternative formulation is presented where the only non-zero covariance is between PE effects of a dam and her daughter dam. The covariance matrix for TE effects is modeled after the time elapsed among progeny records from the same dam. To estimate all dispersion parameters a Bayesian method using conjugate prior densities and Gibbs sampling is used. The inversion of the covariance matrix for the joint distribution of PE and TE is avoided by block sampling of all PE effects by line of dams and all TE of calves out of the same dam. A line of dam involves the records of an ancestor dam, their dam descendants and all their progeny, raised naturally (not by embryo transfer). The TE effects within any line of dam are correlated but are independent with those from the other lines. The number of animals involved in any line of dam is small for beef cattle data (for example, at most 20 in a data set of 80,000 Brangus records, or at most 25 in a 10,000 records from an Angus data set). The resulting means of the marginal conditionals densities for the fixed effects, breeding values, PE and TE effects are linear combinations of some matrices related to the MME and some matrices that are not functions of them.

Key Words: Maternal Effects, Environmental Covariance, Gibbs Sampling

627 ASAS Centennial Presentation: Future needs in animal breeding. R. D. Green*, Pfizer Animal Genetics, Sutton, NE.

The past century has seen animal breeding and genetics evolve and expand from definition and validation of basic population genetics

theory to development of selection index theory to today's relatively sophisticated genetic prediction systems enabling industry genetic improvement. The end of the first century of the ASAS also coincides with the rapid movement of the field into the era of genome-enabled genetic improvement and precision management systems. Led by recent research infrastructure investments by the US and international partners to develop chicken, bovine, swine, ovine, and equine "genome toolboxes", the animal breeding community is poised to play a crucial role in the century to come. These genome toolboxes provide the needed platforms for developing whole genome selection programs based on linkage disequilibrium for a wide spectrum of traits; allow the opportunity to re-define genetic prediction based on allele sharing as opposed to traditional pedigree relationships; and provide for the first time simultaneous information upon which to practice genetic selection and plan precision management of specific genotypes --all early in the life of the animal. An area of major focus will be mining of the genomes through systems biology approaches to better understand gene and metabolic networks --what has previously been lumped into poorly understood GxE, and GxG interactions. Perhaps the greatest obstacle to the successful merger of genomic and quantitative approaches will be the lack of necessary animal resource populations to appropriately define and measure phenotypes, i.e. the so-called "phenomic gap", for difficult to measure traits (e.g. resistance to disease and stress, adaptability, longevity, efficiency of nutrient utilization). Additionally, due to de-emphasis of quantitative genetics and animal breeding programs in academia over the past quarter century, a dearth of qualified young scientists to effectively mine the genomes must immediately be addressed. Whilst the motivating factors may have changed, the need for high quality animal breeding and genetics research and education has never been higher.

Key Words: Animal Breeding, Genomes

628 Genetic trends for production traits of the Montana Line 4 Hereford herd. J. M. Rumph^{*1}, D. D. Kress², K. C. Davis², D. C. Anderson^{2,3}, H. C. Van Wagoner³, and D. L. Boss³, ¹Michigan State University, Lake City, ²Montana State University, Bozeman, ³Montana State University, Havre.

To commemorate the centennial of the ASAS, the researchers thought it was fitting to analyze the genetic trends of the Montana Line 4 Hereford herd, a closed herd descended from the Miles City Line 1 which has also been maintained as a closed population for 74 years. The Line 4 herd has been managed at Montana State University's Northern Agricultural Research Center (NARC) in Havre, Montana since 1963 and has undergone various selection programs since its introduction to NARC. The herd is currently managed at approximately 100 females with an average inbreeding of 37.2% for the 2006 calf crop with individual animals ranging in inbreeding coefficient from 34.0 to 46.6%. The average inbreeding of the herd is increasing at a rate of 0.5% per year. Genetic parameters were analyzed for production traits routinely measured on this herd. All traits were analyzed using a univariate model. Estimates of direct heritability (and associated s.e.) were 0.52 (0.09), 0.24 (0.08), 0.32 (0.12), and 0.23 (0.09) for birth weight, weaning weight, weaning wither height, and weaning condition score, respectively. Estimates of maternal heritability were 0.08 (0.04), 0.09 (0.06), 0.12 (0.07), and 0.09 (0.07), respectively. The estimate of the direct-maternal genetic correlation was non-significant for most traits with estimates of 0.19 (0.27), -0.13 (0.34), 0.53 (0.22), and -0.41 (0.31), respectively. The proportion of variance due to maternal permanent environmental effects

was only significant for weaning weight and weaning condition score with estimates of 0.28 (0.04) and 0.12 (0.04), respectively. Birth weight direct breeding value (DBV), maternal breeding value (MBV), and phenotypic trends were estimated to be +0.008, 0.003, and -0.034 kg/yr, respectively. Weaning weight trends were estimated to be +0.346, +0.051, and +0.276 kg/yr, respectively. Weaning wither height trends were +0.033, +0.006, and -0.130 cm/yr, respectively. Weaning condition score trends were +0.0068, -0.0004, and +0.0040 score/yr. Trends for these traits are relatively flat for the period of time studied.

Key Words: Genetic Trends, Inbreeding, Weaning Weight

629 Clustering of herds to account for heterogeneous variance of docility scores in Limousin cattle. D. W. Beckman* and D. J. Garrick, *Iowa State University, Ames.*

Analyses of docility in Limousin cattle have shown the significance of random maternal and sire by herd interaction effects as artifacts of the data, resulting from heterogeneous variation. The objective of this study was to determine whether heterogeneous variance by herd stems from the subjective method used to allocate docility scores. Animals were assigned to a low (L) or high (H) variance cluster according to phenotypic variation estimated within-herd. Two univariate analyses examined clusters L and H as separate traits using ASReml. Animal models encompassed combinations of random factors: direct genetic, maternal genetic and sire by herd interaction effects. Models ranged from the most basic, containing direct genetic and residual effects (model D), to a model including all random factors. Likelihood ratio tests indicated model D best fit the data for both L and H. A bivariate model D further examined the genetic relationship between clusters. Direct heritability estimates from univariate analyses were 0.24 ± 0.05 and 0.38 ± 0.05 , and estimates of residual variance were 0.2 ± 0.01 and 0.35 ± 0.02 , for L and H, respectively. Similar estimates of direct heritability (0.22 ± 0.05 and 0.38 ± 0.05) and residual variance (0.21 ± 0.01 and 0.35 ± 0.02) were observed in the bivariate analysis for L and H, respectively. The genetic correlation between clusters was 0.8 ± 0.14 . Residual variance and heritability estimates were greatest in H, indicating herds that utilize a greater range of scores are a preferred environment for sire selection, as the accuracy of evaluation is greater. Results indicate variance of

docility scores between herds is not homogeneous, and is due to the subjective nature of scoring.

Key Words: Beef Cattle, Heterogeneous Variance, Temperament

630 Estimation of breed and heterosis effects for growth and carcass traits in cattle using published crossbreeding studies. J. L. Williams*, R. Rekaya, and J. K. Bertrand, *University of Georgia, Athens.*

Current genetic evaluations are performed separately for each breed. Multiple breed genetic evaluations, however, assume a common base among breeds enabling producers to compare cattle of different breed makeup. Breed and heterosis effects are needed in a multi-breed evaluation because databases maintained by breed associations include few crossbred animals which may not be enough to accurately estimate these effects. The objective of this study was to infer breed effects (BE), maternal effects (ME), direct heterosis effects, and maternal heterosis effects for growth and carcass traits using least square means estimates from crossbreeding studies published in the literature from 1976 to 1996. The data set was formed by recording each least square mean along with the breed composition, maternal breed composition, and direct and maternal heterozygosity. A Bayesian approach was implemented to analyze each trait with a fixed linear model which included study as a fixed effect and breed composition as a covariate. Breed solutions for each trait were expressed relative to the Angus breed. Direct BE for weaning weight ranged from -7.0 ± 0.67 kg (British Dairy) to 29.3 ± 0.74 kg (Simmental) and ME ranged from -11.7 ± 0.24 kg (Hereford) to 31.1 ± 2.22 kg (Gelbvieh). Direct BE for birth weight ranged from -0.6 ± 0.14 kg (British Dairy) to 10.1 ± 0.46 kg (Continental Beef) and ME ranged from -7.1 ± 0.13 kg (Brahman) to 5.8 ± 1.07 kg (Continental Beef). Direct BE ranged from -17.9 ± 1.59 kg (Brahman) to 21.7 ± 1.96 kg (Charolais), from -6.1 ± 1.29 kg (Brahman) to 55.1 ± 1.49 kg (Charolais), from -8.1 ± 0.47 cm² (Shorthorn) to 20.9 ± 0.48 cm² (Continental Beef), and from -1.1 ± 0.02 cm (Continental Beef) to -0.02 ± 0.03 cm (Shorthorn) for post weaning gain, carcass weight, rib eye area, and fat thickness, respectively. The use of literature estimates to predict breed and heterosis effects may be an alternative to their direct prediction in a multi-breed evaluation.

Key Words: Breed Effects, Multi-Breed Evaluation, Heterosis

Symposium: Companion Animals: Exotic Animal Nutrition

631 Zoo nutrition: In the beginning... D. E. Ullrey*, *Michigan State University, East Lansing.*

This is not a history of zoo nutrition but a personal retrospective on a career in Comparative Nutrition, beginning with life as a farm boy and a traditional undergraduate education in Animal Husbandry. Wise counsel by R.H. Nelson led to a useful MS degree in Pathology at MSU and a PhD in Animal Nutrition, with minors in Physiology and Biochemistry, at the Univ. of Illinois. Thesis research was conducted with cattle and swine, and my first faculty position in the Dept. of Physiol./Pharmacol. at Oklahoma State Univ. involved research with domestic species, as well. A faculty appointment in Animal Science at MSU in 1956 included responsibility for developing an analytical laboratory, and E.R. Miller and I collaborated on studies of swine for 37 years. Our faculty and graduate students were also interested in beef and dairy cattle, sheep, horses, and poultry, and several collaborative studies of their nutrient needs were published. When the Wildl. Div. of the Mich. Dept. of Natural Resources asked for assistance, research began on nutrition and physiology of white-tailed deer. The diets used in white-tailed deer studies, and concern for the welfare of other captive wild animals, ultimately led to development of diets for a number of wild species. A Comparative Nutrition Group was formed at MSU, and a small group of graduate students began on-site training at the Dallas Zoo. They were asked to gather quantitative data on food offered and consumed in all animal exhibits, to calculate nutrient intakes, and, when appropriate, make recommendations for change. Many decisions were founded on extrapolations from knowledge of needs of domestic animals with similar gastrointestinal physiology. Because specific nutrient guidelines were so limited, studies were initiated to develop research-based diet formulations. Over time, the physiology and nutrient needs of 77 species were investigated. These included marsupials (2), primates, including humans (5), rodents (1), whales (1), mammalian carnivores (10), perissodactyls (7), artiodactyls (19), birds (20), turtles & tortoises (2), snakes (3), frogs & lizards (3), fish (2), and insects (2). Examples and contributions of others are presented.

Key Words: Zoo, Nutrition, Comparative

632 Forty-plus years of exotic animal management - A director's perspective. L. Simmons*, *Omaha's Henry Doorly Zoo, Omaha, NE.*

In the beginning, a million years ago, zoo directors and curators formulated diets for exotic animals based on an empirical combination of extrapolations and questions that included:

1. How much was known about the target animal's natural history and diet?
2. What were the diets of the domestic species that the target species was most closely related to?
3. What was the traditional diet fed to the target species in captivity?
4. What did the animal readily eat when given a wide choice of food items?

Sometimes, developing diets based on the answers to these questions worked out well; however, in a substantial percentage of cases, a successful diet was arrived at only after much trial and error. "Successful diets"

were passed down from keeper to keeper, from zoo to zoo and even from country to country. Frequently, diets which were coined "successful" for a species were those diets which were fed to multiple species or genera within a single exhibit and therefore, the animals had access to a large number of foodstuffs to choose from. Anecdotally, there were many observations of species that preferred the "other guy's diets." Defining what was meant by a "successful diet" also was problematic. Did it mean that the animal ate the diet and survived? Did the animal grow up to be a healthy adult? Did the animal reproduce and if it did, how long had it been out of the wild when it reproduced and did it reproduce a second time? Diets were also defined "successful" by monitoring the texture and color of an animal's pelage? Over the past forty-plus years, there have been plenty of examples of diets that did work, diets that did not work, and diets that seemed to work but in fact were altogether wrong. Some of these examples include frog eating toucans, yellow brown bears, and drunk hummingbirds. Today, the field of exotic animal nutrition is applying a science based approach to the development and formulation of nutritious diets for captive exotic animals.

633 Amphibians and reptiles - Trials and tribulations. C. Dikeman*, *Omaha's Henry Doorly Zoo, Omaha, NE.*

Animal science research during the last century has given the field of exotic animal nutrition a knowledge base for extrapolation to exotic species. Unequivocal comparisons often are made between traditional animal science research and that conducted with exotics. For example, comparisons between the horse and zebra or the cat and leopard, seem obvious. However, when dealing with nutrition of endangered amphibians and reptiles, direct comparisons with animal science becomes ambiguous at best. Animal scientists have been improving the diets of domestic animals for decades to provide nutritious products for human consumption. Likewise, feeding captive amphibians and reptiles requires careful attention to the diet of the intended prey, typically live feeder crickets. Compounded with a lack of solid information regarding nutrient requirements for amphibians and reptiles, the successful rearing of these captive creatures becomes onerous. Metabolic bone disorders, caused by imbalances of calcium and phosphorus, have been the focus of feeder insect research for amphibians and reptiles over the past 4 decades. While it may seem irrelevant to animal scientists to consider the importance of feeding frogs, currently a crisis is affecting these bio-indicators that could result in the extinction of up to one-third of the World's amphibian species over the next 5-10 years. While many species of birds and mammals (approximately 12 and 23%, respectively) are threatened with extinction, nearly 50% of known amphibian species are threatened. As a result, many of these species are being brought into captivity for critical conservation efforts. As new species are brought into captivity, additional nutritional concerns are becoming apparent. Captive Wyoming and Puertorican Crested toads appear to have extraordinary dependency on Vitamin A concentrations that are largely misunderstood. While researchers are currently working on feeding regimes to improve the nutrient profile of feeder insects, gaps exist in the connection those vital nutrients play in the health and longevity of preying amphibians and reptiles. Dedicated nutritional and biochemical research is imperative to the conservation of these animals.

Key Words: Exotic species

634 Carnivores: From mouse to moose. E. S. Dierenfeld*, *Saint Louis Zoo, St. Louis, MO.*

Classic metabolic bone disease, diagnosed in the 1800s in lions at the London Zoo fed unsupplemented meat, is perhaps the first published nutritional problem identified in zoo carnivores. Since that time, enzyme studies with cheetahs, other large cats, carnivorous birds, and even crocodylians confirm that domestic felids are an appropriate physiologic model for many obligate carnivores. The unique metabolic adaptations of felids for high rates of protein catabolism and use of the carbon skeletons for gluconeogenesis, dietary requirements for specific amino acids, fatty acids, and both water- and fat-soluble vitamins can be applied with a variety of carnivorous/omnivorous zoo species to determine whether felids or canids may be more suitable models for evaluating nutritional status and dietary adequacy. Despite this wealth of comparative information, actual nutrient requirements are unknown, and physiologic data remain obscure for entire groups of mammalian carnivores (i.e. herpestids, mustelids, generalist insectivores as well as specialists like pangolins and anteaters). Information is even more limited when considering non-mammalian carnivores. Although whole vertebrate prey comprise nutritionally-balanced foodstuffs for a variety of carnivores, there are surprisingly few data on nutrient composition of whole prey, particularly vitamin and micronutrient information (fatty acids, amino acids, trace elements, carotenoids) × all of which may have significant impact on reproductive output, immune function, and overall health. Summarized data that do exist suggest important effects of diet on body composition of whole prey. For example, vitamin A concentrations in free-ranging rodents were found to be significantly and consistently lower (10,000 × 30,000 IU/kg DM) than values measured in laboratory-reared mice and rats of the same body size, likely due to captive diets upon which the feeder animals were raised. The use of domestic carnivore nutrient requirements, developed through controlled experimental studies, provide solid guidelines for development of balanced diets for a variety of exotic carnivores, even given the our current scope of knowledge and limitations.

Key Words: Carnivory, Nutrient Composition, Physiology

635 Comparative Avian Nutrition – Lessons learned from domesticated poultry. E. A. Koutsos*, *Mazuri Exotic Animal Nutrition/PMI Nutrition International LLC.*

There are over 9000 species of birds (more than twice as many as mammals), using virtually every wild type feeding strategy described. Due to limited research in most exotic avian species, captive feeding programs are often designed around the known nutrient requirements of domesticated poultry. Domesticated poultry are generally granivorous, consuming nutrient dense seeds in their native habitats. Their GI anatomy is equipped for such diets (e.g., a well-muscled gizzard), and commercial diets often include similar dietary inputs (e.g., grains from domesticated plant species). Many companion avian species are also granivorous (e.g., many finch species, budgerigar), and domestic poultry requirements may be an excellent starting point for these species. However, many avian species have evolved to eat prey (terrestrial vertebrates, insects, fish and plankton), grasses and other plant components, fruits (from wild rather than domesticated fruit species), nectar and pollen, and other components. For these species, poultry nutrient requirements may not be an adequate starting point for diet development. Further, an understanding of GI and beak morphology is critical to design nutrition programs that meet the requirements of the animal, but also promote

consumption, proper GI tract function, ideal excretion properties, and prevents stereotypic behaviors associated with boredom and malnutrition. For example, ratites, which are captively managed in zoos and for production purposes, have significant hindgut fermentation. Thus, these animals have much higher fiber digestion ability than domestic poultry, and as a result, ME values for chickens underestimate the amount of energy that is obtained by growing ratites (Angel, 1993).

Key Words: Avian Nutrition, Comparative

636 Ungulates: Are they cows with long necks? M. S. Edwards*, *California Polytechnic State University, San Luis Obispo.*

Ungulates refer to mammal groups that distribute their weight, while moving, over tips of usually hooved toes. The taxonomic significance of Superorder Ungulata is debatable; however, their shared traits and herbivorous feeding habits allow interesting comparisons. The Orders Perissodactyla (odd-toed ungulates) and Artiodactyla (even-toed ungulates) represent the majority of species with these traits. Although *in situ* work with a species offers insights to its biology, extrapolation to managed environments is often limited. Scientific advances established with domestic ungulates over the past 100 yrs, as well as training professional animal scientists, are a cornerstone of applied nondomestic ungulate management. Comparative nutritionists rely on research of animal scientists and others to support these species programs. A recent example: extrapolation of research on influences of dietary starch fermentation and resulting metabolic changes in dairy cattle. This scientific collaboration led to experimental diets that may address nonclinical, but persistent serum Ca:P below 1:1 ratio in captive giraffe, a physiological measurement inconsistent with observations among free-ranging herds (Koutsos et al., 2007). Opportunities for information transfer are not unidirectional. As modern domestic ungulates demonstrate improved growth and production, the physiological “distance” from their species of origin increases. Nondomestic ungulates, including mouflon, urial, and boar, afford us an opportunity to look back at nutrient requirements and physiology of genetic ancestors and answer questions related to modern breeds. Humans have maintained wildlife species since 2300 B.C., yet significant information gaps exist. Gaps will be filled with experience borne from controlled research and careful documentation of science-based management based on domestic ungulate foundations. Are ungulates cows with long necks? This group’s diversity exceeds a simplistic description. Sizes range from a 2.5 kg royal antelope to a 6000 kg African elephant. However, gastrointestinal tract similarities and resulting physiology allow us to compare and contrast species to advance our scientific understanding of all animals.

Key Words: Ungulate, Nondomestic, Nutrition

637 Omnivores – Models of metabolism. J. Williams*, *Indianapolis Zoological Society, Indianapolis, IN.*

Plant and animal biomass differs substantially in biochemical composition, with plant material greater in carbon than in nitrogen and phosphorus. Due to the carbon skeleton associated with the structural framework of plant fibers, herbivorous animals typically consume feed resources with greater carbon to nitrogen and carbon to phosphorus ratios than are contained within their own biomass. This makes phos-

phorus and nitrogen the principal growth limiting nutrients associated with herbivorous feeding strategies. Conversely, under a carnivorous feeding strategy animal matter is composed of elemental constituents that are similar to those of the animal that is consuming it. Due to the predator's utilization of organic carbon in physiologic processes such as protein synthesis, energy production and respiration, organic carbon as opposed to other metabolites becomes the limiting nutrient in the diet of the strict carnivore. The term omnivore can best be defined as any animal with the capacity to consume and digest feed resources from more than one ecologic trophic level and this unique ecological niche repre-

sents an evolutionary adaptation common to many taxonomic groups. Omnivorous animals are generalists that must possess the ability to not only catch and ingest fellow consumers but also consume and digest primary producers e.g. plant biomass. This feeding strategy enables the omnivore to exploit both the more plentiful but less nutrient dense and less plentiful but more nutrient dense environmental food resources. The factors involved with the development and maintenance of traits enabling omnivorous consumers to exploit food resources from multiple trophic levels will be discussed.

Key Words: Omnivore, Trophic, Feeding

Symposium: Contemporary and Emerging Issues: Healthfulness of Dairy and Meat Products

638 The current nutrition environment: Beef lipids in perspective. S. McNeill*, *National Cattlemen's Beef Association, Centennial, CO.*

Consumer beliefs about nutrition, health and wellness “that have for decades underpinned their decisions about what to eat” are rapidly evolving. Obesity is driving a number of trends, including food labeling, nutrition profiling and food bans. Today, pressure to define and promote healthier diets is coming from multiple angles. This presentation will explore this new nutrition environment and identify both the opportunities and potential challenges it presents for beef. Nearly sixty-five percent (65%) of all whole muscle cuts sold at retail and 15 of the top 20 most popular retail whole muscle cuts are “lean.” Additionally, beef is among the top four food sources of 10 essential nutrients in the American diet. Despite these positive nutrition contributions, health professionals and consumers still hold misperceptions about beef’s role in a healthy diet. Research on beef’s role in a healthy diet will be reviewed with a focus on research demonstrating the effects of lean beef on established and emerging cardiovascular disease risk factors.

Key Words: Beef, Nutrition Environment, Heart Health

639 Role of animal protein in optimal health. N. Rodriguez*, *University of Connecticut, Storrs.*

Research over the last decade suggests that higher protein intakes may impart some benefits with specific regard to various health outcomes such as weight management, diabetes, and cardiovascular disease. Further, emerging science based on newer, more sensitive methodologies, indicates that high quality, animal protein may convey particular benefits. This presentation will consider the scientific evidence for the role of animal protein in optimizing human health and identify areas of scientific consensus regarding the health benefits of high quality protein. Potential areas for future research to further delineate the importance of animal protein in optimal health will be highlighted. Special consideration will be given to recommending protein intake at levels approaching the higher end of the Dietary Reference Intakes (DRI) for the purpose of reducing the risk of certain diseases (i.e., obesity, diabetes) and delaying the onset or progression of muscle loss with aging (i.e., sarcopenia).

Key Words: Protein, Health, Nutrition

640 Milk fat and risk of cardiovascular disease. D. E. Bauman*¹ and A. L. Lock², ¹*Cornell University, Ithaca, NY,* ²*University of Vermont, Burlington.*

The last quarter-century has seen increased consumer interest in the link between diet and health. A major focus of this interest has been the effect of dietary fats and recognition that certain dietary fatty acids can impact human health. Both saturated (SFA) and *trans* (TFA) fatty acids in dairy products are significant challenges because of their perceived negative effects on human health, particularly in relation to cardiovascular disease (CVD) risk. This has led to the concept of eating healthy becoming synonymous with avoiding dietary fat, especially saturated

fat, with a low saturated fat diet at the heart of nutritional advice for lowering plasma cholesterol and reducing CVD risk. Furthermore, clinical and epidemiological studies have consistently demonstrated that diets containing TFA from partially-hydrogenated vegetable oils result in an increased risk of CVD. These results have been broadly extrapolated to imply that consumption of any and all TFA isomers is associated with an increased risk of CVD. Individuals do not consume fatty acids as a dietary entity, but rather as fats in foods. Investigations of the relationship of dairy product consumption to cholesterol and CVD in both children and adults challenge the appropriateness of these recommendations. In addition, a number of epidemiological studies have found no association or a slight beneficial association between intake of milk and dairy products with variables related to CVD risk. Likewise, recent animal model and human clinical studies indicate that milk fat-derived TFA show no pattern of negative effects on CVD risk. Overall, the available evidence does not provide support for the concept that consumption of dairy products adversely affects the risk of CVD. The growing body of scientific evidence that some of the fatty acids uniquely present in milk fat may have beneficial effects on human health and disease prevention (e.g. conjugated linoleic acid), and the recognition that not all SFA and TFA have the same biological effects, may ultimately challenge the recommendations and current public perception of dairy fats in human diets.

Key Words: Milk Fat, *Trans* Fatty Acids, Saturated Fatty Acids

641 Milk fat globule membrane components and their interactions with lactic acid bacteria. R. Jimenez-Flores*, *California Polytechnic State University, San Luis Obispo.*

Milk and dairy products are in a constant transition that obeys two forces. On the one hand the traditional view of the healthfulness of milk and its wholesome image, on the other the different nutritional trends of sectors of the population. Examples of the latter are obesity and saturated fats, lactose intolerance, preference for organic or raw milk and other emerging consumer issues. In addition, milk and dairy products as a business is subject to the added dimension of a highly political arena. However, this has been the case through most of the history of industrialized civilization. A big driver for innovation in dairy products has always been the ease in which products can address health issues and how technology has made possible production of valuable commodities. In this talk we will exemplify this trend by focusing on the underutilized milk fat globule membrane (MFGM), which is a component in milk with great health and value potential, and the rapidly growing pre- and pre-biotic arena. Several factors are of importance in this presentation: the biological origin of the membrane, the voluminous literature on its individual components and their relationship with health and wellness, the biological role of milk in nutrition to mammals (and their digestive flora) and the innovations in scientific tools being applied in many fields of chemistry and biology. Finally we will analyze the basic scientific information available or lacking for the judicious development of technology and products that fulfill the requirements of biological activity, flavor, and price.

Key Words: Milk Fat Globule Membrane, Lactic Acid Bacteria, Value Added

Symposium: Dairy Foods: Emerging Non-Thermal Food Processing Technologies- Their Potential in Dairy Systems

642 Introduction to non-thermal processing technologies and dairy systems. G. Smithers*, C. Versteeg, and J. Sellahewa, *Food Science Australia, Melbourne & Sydney, Australia.*

Gone are the days when dairy companies could rely exclusively on sales of milk, cheese, powder and butter to thrive. In the 21st century, innovation in the dairy industry will be essential in enhancing international competitiveness in a truly global market. Such innovation will also be critical in meeting consumer demands for 'miracle foods' that are not only safe and nutritious, but also natural, economical to manufacture, convenient, great tasting, environmentally-friendly, and enhance health and well-being – quite a challenge! In meeting these challenges, we must look beyond the norm and traditional, often to new and novel approaches that when adapted and applied in dairy systems will result in innovation together with consumer acceptability. Several non-thermal processing technologies, notably high pressure, power ultrasonics, and pulsed electric field, are creating an impact in food processing around the world. While these technologies have been largely viewed as alternative non-thermal techniques to enhance microbiological safety and quality, they are increasingly being developed for a range of other applications in dairy systems, including (a) improved processing effectiveness; (b) differentiation of ingredients and products including 'tailored' functionality; (c) preservation of heat-labile bioactives; (d) modulation of enzyme activity; (e) improved microstructure through component interactions; and (f) hypoallergenic products. Commercial exploitation of these developments will be dependent upon a sound understanding of the science and technology of the observed effects, suitably scaled equipment, and economic viability. The major non-thermal processing technologies will be introduced, together with an overview of their current and potential applications in dairy systems. This overview will set the scene for subsequent presentations exploring the science underpinning the observed effects, and how this science understanding can accelerate and strengthen commercialization of these non-thermal dairy processes.

Key Words: Non-Thermal Processes, Dairy Products, Functionality

643 Dairy proteins under pressure: Static high pressure processing to modulate the functionality of dairy proteins. P. Udabage*¹, M. A. Augustin¹, I. R. McKinnon², A. Kelly³, and C. Versteeg¹, ¹*CSIRO Food Futures Flagship, Food Science Australia, Werribee, Victoria, Australia*, ²*Monash University, Victoria, Australia*, ³*University College Cork, Cork, Ireland.*

The effects of high pressure processing (HPP; ≤ 400 MPa) at 25°C and at elevated temperatures ($\leq 90^\circ\text{C}$) on the (1) physico-chemical properties of skim milk (2) properties of stirred yoghurt made from pressure treated skim milk and (3) functional properties of other end products were examined. Changes in the calcium and phosphate equilibria and protein aggregates (composition and size) were observed with HPP, the extent of changes depending on the magnitude of the pressure and heat applied. The particle size of the casein micelles decreased with increasing applied pressure when pressure treated at 25°C, suggesting the disintegration of the micelles. When pressure treated at elevated temperatures, the particle size increased with increasing applied pressure, possibly due to aggregation of disintegrated micelles with eventual

precipitation at 400 MPa. These reformed new micelles are anticipated to have distinct physico-chemical and functional properties compared to the original micelles. When compared to stirred yoghurts made with milk given only a conventional heat treatment (90°C/10 min), the magnitude of the pressure applied at 25°C to milk did not affect the viscosity of the yoghurt when a subsequent conventional heat treatment was given to pressure treated milk prior to inoculation. When milk was pressure treated at elevated temperatures with no subsequent heat treatment prior to inoculation, yoghurts of lower viscosities were obtained. In other applications, pressure treatment of raw materials or end products resulted in products of different functionalities. Taken together, the results suggest the ability to promote physico-chemical changes through HPP of raw material or end products, translating to different degrees of changes in end-products. HPP is opening opportunities to control and create novel protein structuring capabilities, thereby potentially reducing the need for additives in formulations and opportunities for cleaner labels.

Key Words: Casein, High Pressure, Properties

644 High pressure treatment and bovine milk proteins. A. L. Kelly*¹, K. Kothari¹, A. Simpson², D. M. Mulvihill¹, P. M. Kelly², T. P. Guinee², and T. P. Beresford², ¹*University College Cork, Cork, Ireland*, ²*Moorepark Food Research Centre, Fermoy, Co. Cork, Ireland.*

High-pressure (HP) treatment of milk has significant effects on proteins. Casein micelles may aggregate or disintegrate and whey proteins denature, depending on the pressure applied. This may, in turn, alter the functional properties of products like cheese, yoghurt and protein-based ingredients. Milk protein co-precipitates, acid gels and microfiltration retentates made from HP-treated skim milk were studied. Protein co-precipitates were made from milks adjusted to two pH values (6.8 or 7.5) and unheated, heat-treated (HT, 90°C for 10 min) or treated at 250 MPa for 30 min, or 400 or 600 MPa for 10 min at 40°C. Co-precipitate recovery was highest from milks that were either HT or HP-treated at 600 MPa, followed by milk HP-treated at 400 or 250 MPa. Co-precipitates made from HP-treated milks had better emulsification properties and heat stability than those made from HT milk. Differences in the whey protein composition of co-precipitates made from either HT or HP treatment were also clear. In separate experiments, reconstituted skim milk subjected to either heat treatment (HT, 85°C for 10 min) or HP- treatment alone (250 MPa or 600 MPa for 30 min at 20°C) or combined HT and HP treatment was used for making stirred yoghurt using a commercial starter culture. Yoghurt made from milk HP-treated at 600 MPa exhibited significantly higher water-holding capacity and was less susceptible to shear-thinning than yoghurt made from HT milk. Scanning electron micrographs indicated that HP treatment at 600 MPa alone or in combination with HT resulted in a more compact gel network and lower porosity than HT. In separate studies, when phosphocasein (PC) was reconstituted in simulated milk ultrafiltrate, HP-treated, and processed through a laboratory scale micro-filtration (MF) plant using a 1.4-micron membrane with co-current permeate flow, quantitative but not qualitative differences in protein partition between permeate and retentate occurred.

Key Words: High Pressure, Milk, Functionality

645 Microstructural effects in thermo-sonicated yogurt and other dairy products: Understanding and exploiting the science.

G. V. Barbosa-Canovas* and D. Bermudez-Aguirre, *Washington State University, Pullman.*

One of the main goals of nonthermal technologies is to optimize the quality and safety of processed products minimizing the use of heat. Ultrasound has had positive effects on the final quality of milk and other dairy products where important improvements include enhanced color, appearance, texture, and stability. Scientifically speaking, these improvements are due to the homogenization effect in milk generated by ultrasonic waves. From a microstructural perspective, a new and fascinating universe emerges where important changes occur in the milk microstructure and size of fat globules, as reflected in macro scale, revealing whiter color, better appearance and physical properties. Fat globules (average size, 4 µm) in raw milk are disrupted by ultrasound and reduced in size (smaller than 1 µm); thousands are generated with similar volume and appearance. Ultrasound, combined or not with thermal treatments, could reduce specific quality problems in other dairy products like yogurt, a product highly consumed worldwide. Thermo-sonication involves two simultaneous processing steps: pasteurization and homogenization. As with milk, this dual process improves the quality of the yogurt characteristics, yielding a more homogeneous protein/fat matrix, better stability, whiter color, and improved texture, resulting from a reduction and regrouping of milk components and interaction with the yogurt remaining ingredients. Indeed thermo-sonication is a viable alternative for processing milk, yogurt, and other dairy products, with important cost/time savings as well.

Key Words: Ultrasound, Microstructure, Dairy Products

646 Membrane and other processing technologies for dairy fluids: Effectiveness of ultrasound in enhancing productivity. R. Mawson¹, S. Kentish², M. Ashokkumar², S. Udabage¹, and M. Golding*¹, ¹*Food Science Australia, Werribee, Victoria, Australia*, ²*University of Melbourne, Melbourne, Victoria, Australia.*

In water the interaction between (ultra) sound waves and dissolved gas nuclei results in acoustic cavitation, nuclei grow by rectified diffusion and inertial collapse of resonance-sized microbubbles. Acoustic cavitation generates physical effects, including agitation, microstreaming, and enhanced mass transport. In some conditions near adiabatic collapse generates very high temperatures and pressures within the cavitation bubbles leading to the formation of reactive radicals that can be managed or used for desired chemical transformations. Ultrasound use in the dairy industry includes cleaning plastic cheese moulds, and at low sub-cavitation intensity for monitoring product quality of Swiss cheeses, the presence of flat sour spoilage in aseptically packaged milk and levels in tanks. Ultrasonic spectroscopy is now an accepted laboratory tool for analysing molecular level transformations that can occur during processing dairy products.

Historically, the main impediment to applying ultrasound in dairy processing was the lack of suitable equipment for large scale application. Currently, equipment suitable for production scale exists, but the specific knowledge of application to dairy processing is lacking. Laboratory studies determine that ultrasound can be effective in reducing microbial counts in milk, inhibiting or enhancing enzymic activity, improving the quality of cheeses and yoghurts, incorporating nutraceuticals, raising the productivity of membrane processing, and reducing fouling of heated surfaces. Based on laboratory studies, the use of ultrasound for killing

microorganisms or inhibiting enzymes have been dismissed as being of little advantage in terms of effectiveness and high energy usage whilst adding to processing complexity. However, for other applications the ultrasonic energy required is low and scaling up to production scale with significant savings in processing cost is feasible.

Key Words: Ultrasound, Membranes, Enzymes

647 Microbial safety and bioactive efficacy: Effectiveness of pulsed electric field processing of dairy fluids. J. Wan*¹, K. Shamsi², Q. Sui³, D. Bermudez-Aguirre⁴, C. P. Dunne⁵, G. Barbosa-Canovas⁴, and C. Versteeg¹, ¹*Innovative Foods Center, Food Science Australia, Melbourne, Australia*, ²*RMIT University, Melbourne, Australia*, ³*University of Melbourne, Melbourne, Australia*, ⁴*Washington State University, Pullman*, ⁵*US Army Natick Soldier Center, MA.*

Value-added dairy ingredients with demonstrated biological properties, including lactoferrin (LF) and lactoperoxidase (LP), have attracted great attention in recent years due to applications in functional foods and nutraceuticals. Most of these bioactive dairy ingredients are proteins and their biological properties are often compromised during conventional heat processing. In the current study, the effect of pulsed electric field (PEF) in combination with moderate temperatures (30-70°C) on the survival of microorganisms and the activity of LF and LP in milk was evaluated.

PEF treatments were conducted using an OSU-4 system with a field intensity of 33 kV/cm, pulse width 2 µs, total treatment time 20 µs, and total specific energy input 120 kJ/L. For each temperature, controls were prepared by processing samples in the PEF unit without the electric pulses.

In the challenge experiments using inoculated (10⁶⁻⁷ CFU/ml) UHT milk, PEF resulted in >6 log reduction on *Pseudomonas fluorescens* ATCC 948 and *Salmonella* Typhimurium ATCC 14028 at 60°C. However, *Listeria monocytogenes* NCTC 11994 and *Enterococcus faecalis* ATCC 19433 required 65 and 70°C, respectively, to achieve a 6-log inactivation. The controls at the respective temperatures had less than 1 log reduction. PEF treatment at 5-10°C below the temperatures identified above resulted in only 1-2 log reduction on each of these target organisms.

PEF treatment at 65°C of cold stored raw milk (with an initial total plate count of 10⁶ CFU/ml) resulted in a 5 log reduction, and the count of enterobacteriaceae was reduced from 10² to <1 CFU/ml. Over 85% of the LF (by ELISA) and LP (by enzyme activity assay) were recovered after the PEF treatment.

These results suggest that PEF in combination with mild heat can be used for effective microbial inactivation in milk while preserving LF and LP activities.

Key Words: Pulsed Electric Field, Lactoferrin, Lactoperoxidase

648 High pressure processing of colostrum. T. Carroll*, *Fonterra Co-operative Group Ltd., Palmerston North, New Zealand.*

Bovine colostrum is rich in bioactive components, such as immunoglobulins and lactoferrin, that may provide health benefits to consumers. Delivering these bioactive components in a consumer-friendly format with a commercially-useful shelf-life is a challenge, because they are relatively sensitive to denaturing by traditional thermal preservation.

Colostrum consumer products are generally formulated dry, in formats such as powders, tablets or capsules or as a fresh pasteurised liquid with a shelf-life of several days. Immunoglobulins in particular can not withstand UHT or heat-sterilisation processes, although they do survive thermal pasteurisation well. Unfortunately immunoglobulin proteins are particularly heat-sensitive under acidic conditions, where microbial stability might be achieved by milder thermal processing than at near neutral pH. The effect of pressure on immunoglobulins as a function of pH is found to be the opposite of the effect of heat; specifically immunoglobulin proteins are less sensitive to pressure denaturation under acidic conditions than they are at near-neutral. This finding creates the possibility of using high pressure processing, a non-thermal food preservation technology, to produce a ready-to-drink colostrum beverage with a commercially-useful shelf-life. High pressure processing offers microbial stability in acidified dairy systems, as spoilage micro-organisms that can grow are inactivated by pressure (eg lactic acid bacteria, yeast and mold) and micro-organisms that are not inactivated by pressure cannot grow (eg bacterial spores). Immunoglobulins and other bioactive components in colostrum are well-retained under the high pressure processing conditions that are required to achieve microbial stability in an acidified colostrum beverage model.

Key Words: High Pressure Processing, Colostrum, Immunoglobulin

649 Enhancing the quality of whey protein functionality using high pressure. S. Clark*, X. Liu, S.-Y. Lim, J. Chauhan, and C. Padiernos, *Washington State University, Pullman*.

Four studies were designed to investigate the potential for high hydrostatic pressure (HHP) of whey protein concentrate (WPC) to improve the

quality of lowfat ice cream and lowfat whipping cream. The initial study investigated flavor-binding properties of WPC treated at 600 MPa for 30 min at an initial temperature of 50°C. The treatments enhanced binding of certain flavor compounds but not others, suggesting a need for follow-up studies in real food systems. Subsequent studies involved treatment of fresh, ultrafiltered Cheddar cheese whey (fresh WPC) at 300 MPa for 15 min at an initial temperature of 25°C. The treatment maintained fresh WPC solubility and demonstrated improved foaming properties of fresh WPC. A variety of lowfat ice cream mix and lowfat whipping cream products were formulated and evaluated using instrumental and sensory analysis tests. Headspace-SPME-GC demonstrated that lowfat ice cream with HHP-treated fresh WPC plus diacetyl exhibited higher concentration of diacetyl than untreated fresh WPC plus diacetyl after 1 day of storage, but the diacetyl binding was not maintained up to day 14. Additionally, sensory evaluation revealed that panelists could not distinguish between ice cream containing untreated or HHP-treated fresh WPC. Although flavor was minimally impacted, HHP treatment of fresh WPC enhanced overrun and foam stability of ice cream and whipped cream. Additionally, sensory panelists were able to distinguish some differences among ice creams and whipped creams. HHP can alter foaming properties of fresh WPC significantly enough for differences to be noted in a product even when the modified ingredient is used at levels as low as 10% in a formulation.

Key Words: Whey Protein, Ice Cream, High Pressure

Extension Education: All Species

650 A tool to optimize the length of time a boar is in an A.I. stud. J. S. Fix*¹, M. T. See¹, and D. S. Casey², ¹*North Carolina State University, Raleigh*, ²*Pig Improvement Company, Hendersonville, TN*.

The objective of this study was to develop a decision-tool that determines the optimum length of time a boar should be utilized in an AI program. The time in stud depends on two conflicting perspectives. The semen customer desires semen from genetically superior boars which tends to be the younger boars. The boar stud wants to increase profit margin by dividing costs over large quantities of quality semen. This typically occurs as boars become older. Since the two prefer to be on opposite ends of the boar's life an optimum situation must be determined. Every week the customer receives semen from a boar that could be replaced with a genetically superior boar, there is value lost by the customer. The total value lost per week per boar can be calculated using the following variables: difference in index points between a given boar and a potential replacement, value of an index point per marketed pig, pigs marketed per litter, doses per mating and doses of semen per week. To determine the weekly cost associated with maintaining a boar the following values are needed: boar purchase price (salvage value and % death loss), isolation cost, production cost per boar space (feed, building, etc.), collection labor per collection, post collection costs per dose (lab, shipping, etc.), royalty cost (if applicable), weeks in production and doses per week. These values are then used to determine value lost to the customer per week and a cost per week for the boar stud. The intersection of the two curves is where this optimum occurs. If we assume an average index for replacement boars then an index threshold at which a boar should be culled for a given age can be calculated. A spreadsheet was developed that allows for easy input of boar stud specific inputs and calculates the index level at which culling should occur. Average cull age and annual cull rate are also given based on an assumed index decline and non-index culling levels. This tool allows a boar stud manager to make important culling and management decisions that are balanced between the boar stud's and semen customer's perspectives.

Key Words: Boar Stud, Index Management

651 State funded genetic enhancement programs: An example from Tennessee. M. L. Spangler*¹ and D. Kirkpatrick², ¹*University of Nebraska, Lincoln*, ²*University of Tennessee, Knoxville*.

In 2005, the Tennessee Department of Agriculture started an Agricultural Enhancement program in an effort to provide funds to educate producers and increase their profitability. These funds are available for several areas of production including beef cattle genetics. The program allows producers who are residents of Tennessee and who own a minimum of 10 cows to apply for funds when purchasing or leasing a bull or for the cost of artificial insemination (AI). For the fiscal year 2007-2008, maximum cost share funds per producer are \$1,025 including \$175 for herd evaluations and 35% of the total cost of bull purchase/lease or AI up to \$850. If the producer has completed Tennessee's Master Beef Producer course then the cost share maximum increases to 50% of the cost for bull purchase/lease or AI up to \$1,000. For a producer to receive these funds, bulls must meet certain genetic criteria. Currently those criteria are for a bull to rank within the top 50% of their respective breed for two of four traits: Birth weight (BW), weaning weight (WW), maternal milk (MM), or yearling weight (YW). In the first two years of

the program, approximately 1,600 bulls qualified for cost share, 73% of which were Angus. Although the current system forces commercial producers to consider EPDs in the selection process, it inevitably leads them to single trait selection for growth, or even worse, to bulls who are below breed average for economically relevant traits. Currently, it would be possible for a bull to qualify by ranking in the top 50% of their respective breed for WW and YW, but be above breed average for BW and below breed average for MM. The current study proposes a three-category system including: Heifer safe, terminal, and balanced. The heifer safe category emphasizes low BW animals and places minimums on WW and YW. The terminal category places emphasis on WW and YW and maximums on BW. The balanced category places minimums for WW and YW, maximums for BW, and an acceptable window for MM. The new guidelines attempt to avoid the inevitable single trait selection that the current system allows and to emphasize the original goals of enhancing profitability and education.

Key Words: Beef Cattle, Extension, Genetics

652 Transferring technology to beef producers in Missouri to facilitate expanded use of estrus synchronization and AI. D. C. Busch*¹, N. R. Leitman¹, D. A. Mallory¹, J. F. Bader², D. J. Wilson¹, S. E. Pooch¹, M. F. Smith¹, and D. J. Patterson¹, ¹*University of Missouri, Columbia*, ²*Merial Limited, Fulton, MO*.

Limited transfer of existing and emerging reproductive technologies (estrus synchronization and AI) to beef enterprises precludes those enterprises from reaching their economic potential and places them at a competitive disadvantage relative to livestock enterprises where such technologies are being implemented more aggressively. However, pregnancy rates in postpartum beef cows in the range of 60% or higher resulting from AI performed at predetermined fixed times are now achievable. Since the spring of 2006, our extension group at the University of Missouri has worked directly with 23 different cow-calf producers in Missouri to demonstrate on farm use of estrus synchronization and fixed-time AI (FTAI). On those 23 farms, 1860/3107 (60%) cows conceived to a single FTAI (CO-Synch + CIDR with FTAI at 66 h) on the first day of the breeding season based on pregnancy diagnosis via transrectal ultrasonography. Current calving data following FTAI with the field demonstrations indicate an increase in calf age ranging from 6 to 22 days in comparison to the previous year's calving profiles resulting from performing AI based on detected estrus following estrus synchronization or using natural service. This results in older, heavier, and more uniform calves at weaning. In addition, seven educational meetings with approximately 400 people in attendance have been held in conjunction with field demonstrations to review results highlighting successes that are occurring with FTAI in cows in various regions in the state. Information is presented which reviews criteria for beef cows prior to initiation of a FTAI program, ways to implement specific estrus synchronization protocols that work effectively with FTAI, and the expected improvement in calving distribution, genetics, and carcass quality of calves that result from AI sires with high accuracies for various production and carcass traits. In summary, beef operations in Missouri are realizing improvements in reproductive management and genetics resulting from FTAI to genetically proven superior sires. This project is supported by USDA-NRI grant 2005-55203-15750.

Key Words: Artificial Insemination, Beef, Estrus Synchronization

653 Evaluation of on-farm pasteurization systems. J. A. Elizondo-Salazar*^{1,2}, C. F. Vargas-Rodríguez², S. C. Donaldson¹, B. M. Jayarao¹, and A. J. Heinrichs¹, ¹The Pennsylvania State University, University Park, ²Estación Experimental Alfredo Volio Mata, Costa Rica.

Waste milk has been fed to calves for many years but concerns with bacteria contamination as well as possible transmission of diseases through feeding waste milk have discouraged many producers from feeding calves with this milk. Pasteurization of waste milk is one option to reduce management risk while utilizing a valuable, low cost liquid feed source for calves. However, many farms lack a protocol to adequately monitor the efficiency of their pasteurizing system. A study was carried out to evaluate on-farm pasteurization systems using 6 farms with different pasteurization systems, including both HTST and batch pasteurizers. Milk samples were taken pre- and post pasteurization and immediately frozen to -20°C for later bacterial culture. Samples were taken for a period of approximately 15 d, twice daily. All milk samples were examined for standard plate count (SPC), coagulase-negative staphylococci (CNS) count, environmental streptococci (ES) count, coliform (CC) count, gram-negative noncoliform (NC) count, *Streptococcus agalactiae* (SAG) count, and *Staphylococcus aureus* (SA) count. The SPC from all farms in the pre-pasteurized samples ranged from 7,415 to 250,822 CFU/mL while in the post-pasteurized samples ranged from 461 to 30,625 CFU/mL. Pasteurization reduced the SPC to < 10% of the original count in 81% (range 53 to 100%) of the samples. CNS count was reduced to < 10% of the original count in 86% (range 52 to 100%), meanwhile CC was reduced in 83% (range 52 to 97%) of the samples, meaning that pasteurization systems effectively reduced the bacteria counts of waste milk. However, 2 farms did not reduce the bacterial population in approximately 50% of the samples, suggesting that incomplete pasteurization may be a common problem and monitoring pasteurizer performance is an important step in assuring the quality of waste milk after pasteurization.

Key Words: Pasteurization, Waste Milk, Bacteria

654 Managing the newly created livestock gross margin for dairy (LGM-Dairy) insurance under seasonal climate variability. V. E. Cabrera*¹ and D. Solis², ¹New Mexico State University, Clovis, ²University of Miami, Tallahassee, FL.

By July 2008, dairy farmers in 35 states will be able to lock-in their margins through the new livestock gross margin for dairy insurance (LGM-Dairy). LGM-Dairy is a risk management tool that allows farmers to hedge against loss of gross margin (market value of milk minus feed costs). LGM-Dairy gives farmers a way to control volatility in feed costs and milk prices. Farmers will estimate the volume of milk to be sold and the amount of feed (equivalents to corn and soybean) to be bought each month. Then, the expected gross margin (EGM) will be calculated using the Chicago Mercantile Exchange Class III milk futures and the Chicago Board of Trade corn and soybean futures. Prices for milk and corn (not soybeans) will be adjusted monthly by state. If the EGM is greater than the actual gross margin, the farmer will be paid an indemnity according to a selected deductible. Seasonal climate variability (e.g., El Niño Southern Oscillation) may impact feed costs and milk prices as well as milk production and feed consumption. Consequently, advancements in

climate forecasting could play an important role in assisting farmers to decide on the most appropriate risk management strategy. The goal of this study is to offer an analytical tool to help farmers select the optimum level of LGM-Dairy when accounting for seasonal climatic variability. This paper (1) characterizes the historical climate impacts on dairy profit margins; (2) systematizes the indemnity calculation of LGM-Dairy; (3) introduces climate uncertainties to the optimal selection of a LGM-Dairy contract; and (4) explores the potential economic outcomes of locking-in margins under uncertain climatic conditions. Preliminary results indicate that seasonal climate variability impacts feed costs, milk production, feed consumption and milk price. Dairy producers could use climate forecasting to decide if it is convenient to purchase LGM-Dairy and at what EGM level. Under El Niño climate forecast, with expected above average feed costs, LGM-Dairy purchase with low or no deductible would be advisable, whereas during La Niña climate forecast a low premium or no LGM-Dairy would be a better option.

Key Words: Risk, Uncertainty, Economics

655 A stochastic simulation model for assessment of investments in Precision Dairy Farming technologies: Model enhancements and utility demonstration. J. M. Bewley*¹, M. D. Boehlje¹, A. W. Gray¹, H. Hogeveen², S. D. Eicher³, and M. M. Schutz¹, ¹Purdue University, West Lafayette, IN, ²Utrecht University, Utrecht, The Netherlands, ³USDA-ARS, West Lafayette, IN.

A previously described stochastic simulation model of a dairy enterprise was modified for improved robustness. This model was developed to evaluate investments in Precision Dairy Farming technologies and was constructed to embody the biological and economic complexities of a dairy farm system within a partial budgeting framework. The @Risk add-in (Palisade Corp., Ithaca, NY) for Microsoft Excel was utilized to account for the stochastic nature of key variables by Monte Carlo simulation. The model comprised a series of modules, which synergistically provide the required inputs for profitability analysis. Model enhancements included addition of a retention pay-off (RPO) module to calculate cost of culling, an average cow simulation module, a body condition score module, a herd size control algorithm, a best management practice adherence factor, a technology stage adjustment factor, and updated, literature-based estimates for disease impact. Technology benefits are appraised from changes in disease incidence, disease impact, and reproductive performance. The influence of stochastic input and output prices on RPO, days open (DO), and disease was examined with 5000 iterations of a simulation of an average 1000-cow US dairy herd. For example, during the first month of the first lactation, increasing replacement price, slaughter price, milk price, or feed cost by 1 SD changed RPO by +\$196.39, -\$80.08, -\$9.02, and -\$2.16, respectively. As slaughter price, feed cost, milk price, and replacement price increased by 1 SD, the cost of a DO changed by -\$0.24, -\$0.23, +\$0.20, and +\$0.20, respectively. Sensitivity for costs of displaced abomasum, dystocia, ketosis, mastitis, metritis, retained placenta, and milk fever were also investigated. The RPO, DO costs, and disease costs were highly sensitive to stochastic prices and deterministic inputs.

Key Words: Investment Analysis, Precision Dairy Farming, Stochastic Simulation

656 Assessing the potential value of automated body condition scoring through stochastic simulation. J. M. Bewley*¹, M. D. Boehlje¹, A. W. Gray¹, H. Hogeveen², S. D. Eicher³, and M. M. Schutz¹, ¹Purdue University, West Lafayette, IN, ²Utrecht University, Utrecht, The Netherlands, ³USDA-ARS, West Lafayette, IN.

Automated body condition scoring (BCS) using digital images has been shown to be feasible. The primary objective of this research was to identify factors that influence the profitability of investment in an automated BCS system. An expert opinion survey was conducted to provide estimates of potential improvements arising from adoption of this technology. Experts indicated that the most important benefits would be disease reduction followed by nutritional cohort management, reproduction, animal well-being, energy efficiency, and genetics. A stochastic simulation model of a dairy farm was utilized to perform a Net Present Value (NPV) analysis. Benefits of automated BCS were estimated by assessing the impact of BCS on incidences of ketosis, milk fever, and metritis, conception rate at first service, and energy efficiency. Improved reproductive performance had the largest influence on revenues followed by energy efficiency and disease reduction. Stochastic variables having the most influence on NPV were: variable cost increases; odds ratios for incidences of ketosis and milk fever, and conception rates at first service; uncertainty of the impact of ketosis, milk fever, and metritis on days open, unrealized milk, veterinary costs, labor, and discarded milk; and change in the percentage of cows with BCS of ≤ 3.25 at calving before and after technology adoption. The deterministic inputs impacting NPV were herd size, management level, and milk production. Investment in this technology may be profitable, but results were herd-specific. A simulation modeling a deterministic 25% decrease in the percentage of cows with BCS of ≤ 3.25 at calving showed a positive NPV in 87.8% of 1000 iterations. Investment profitability was highly dependent on the current BCS distribution, the magnitude of negative impacts of extreme BCS, and management capacity to make changes necessary to achieve optimal BCS.

Key Words: Body Condition Scoring, Investment Analysis, Stochastic Simulation

657 Analysis of corn distillers grain for expansion of the FeedAC database to include pre-digestion fractionated high protein distillers' grains (HP-DG). T. R. Johnson*¹, J. Goodson², D. P. Casper³, T. J. Applegate⁴, K. E. Ilieji⁴, B. T. Ulrich⁵, F. P. Lundy, III⁶, and C. G. Schwab⁷, ¹Dairy Nutrient Management Systems, Noblesville, IN, ²Degussa, Inc., Kennesaw GA, ³Agri-King, Inc., Fulton, IL, ⁴Purdue University, West Lafayette, IN, ⁵Mor Technology, LLC., Metropolis, IL, ⁶FEED AC, Inc., Homer, NY, ⁷University of NH, Durham, NH.

The Feed Analysis Consortium (FeedAC) was incorporated in 2006 with the mission of creating a cooperatively shared, comprehensive and evolving database of feed analysis. The idea for creating FeedAC sprang from the last author's interaction with feed industry personnel as he helped in the preparation of Nutrient Requirements of Dairy Cattle (NRC, 2001). In this publication, Tables 15-1 to 15-4 were created to reflect the current knowledge of feedstuff composition. However, static tables that do not allow changes in composition or addition of new ingredients have limited usefulness. The web-based nature of the FeedAC database will allow it to follow the evolution of feed ingredients, processing, and analytical techniques and remain current. The rapid expansion of ethanol distilleries, implementation of new and different processing techniques and pre fermentation fractionation creates

challenges. The goal is to collect data using wet chemical analysis and NIRS analysis for creation of better predictive equations. Two specific challenges are grouping and analysis of diverse DG and DDGS products for NIRS derived prediction equations and the inclusion of values far from the mean with elimination of blatant outliers in calibration datasets. Study of statistical models used by plant scientists in the building of prediction models may assist animal scientists in forming models with greater utility and a low prediction error. Mean chemical composition of a sample of fractionated high protein distillers' grain (HP-DG) from S.E.M.O. Milling, (Mor Technology, LLC) is compared with NRC (2001) values for DDGS in the accompanying table.

Table 1. Mean Chemical Composition and HPLC Amino Acid Analysis¹

Item	DM, %	CP, %	ADF, %	EE, %	Ash, %	P, %	LYS, %	MET, %	CYS, %
HP-DG2 (n=2)	93.2	57.6	25.4	3.7	1.34	0.36	1.43	1.32	1.06
NRC 2001 (n=892)	90.2	29.7	19.7	10.0	5.2	0.83	0.67	0.54	0.55

¹Expressed as % of DM; ²Analysis from two FeedAC cooperating laboratories

Key Words: Distillers Grain, Corn Processing, Fractionation

658 Development of a software to calculate pollutant emissions, resources consumption and best available techniques effects from Spanish farms. C. Pineiro*¹, G. Montalvo², M. A. Garcia², M. Herero³, and M. Bigeriego⁴, ¹PigCHAMP Pro Europa, S.A., Segovia, Spain, ²Tragsega, S.A., Madrid, Spain, ³Feaspor, Segovia, Spain, ⁴Spanish Ministry of Agriculture, Fisheries and Food, Madrid, Spain.

The intensification of animal production has become a serious threat to the environment, mainly in the form of emissions into the air, the ground or the water. There are recent directives, such as the European Integrated Pollution Prevention and Control, or IPPC, which are aimed to decrease the emissions and to save the resources (water and energy) through the promotion of good agricultural practices and the so called Best Available Techniques, or BAT, at farm level. Since this directive considers the whole production chain, including the effects of nutrition, facilities design, slurry storage and spreading, it is not always easy to calculate overall farm emissions and the influence of every BAT applied. That is the reason why a software to integrate all of these factors and its influence in emissions and water and energy consumption has been developed. The data base used for the emission calculations was the same as for the National Emission Inventory. To calculate pollutant emission at each stage, the application used a mass-balance system. With this tool, farmers and technicians are able to calculate ammonia, methane and nitrous oxide emissions, considering the influence of the BAT used along all of the productive process. This information is requested by the European Pollutant Emission Register notifications for farms under European regulation (Council Directive 96/61/EC). Furthermore, it is possible to estimate water and energy savings when BAT are implemented. The software also provides to the user improvement proposals to be implemented at farm. The impact on change in agriculture sector will be that, as an add-on tool, farmers and technicians can achieve further information about the BAT effect in order to improve the environmental situation of their farms. As conclusion, this software

is an interesting tool to promote good environmental practices in farms, indispensable with current international policies.

Key Words: Pollutant, Emissions, Software

659 Using an iClicker audience response system to engage participants in extension programs. J. Andrae*, *Clemson University, Clemson, SC.*

Students, producers and Extension professionals are exposed to many Powerpoint presentations at educational events. While Powerpoint slide presentations can be effective, this passive education method can actually discourage audience discussion and interaction. An electronic audience response system (iClicker; <http://www.iClicker.com>) was field-tested to determine its acceptability and usefulness in forage Extension programs. The system was developed for use in college classrooms and is composed of a 915 MHz receiver with up to 1500 hand held transponders. It is compatible with both Windows and OS X operating systems. These remote control style transponders allow the audience to

answer multiple choice questions imbedded in Powerpoint presentations in a Who Wants to Be a Millionaire style. Audience answers are pooled and immediately displayed, allowing reinforcement of information or redirection of programs to fit audience needs. The system was tested in county, multi-county, statewide, and regional Extension programs across the southeastern U.S. Audience members were grouped by table during each presentation and assigned a common transponder (one shared transponder for 4-8 people and typically 20 groups per audience). Approximately 6-8 questions were delivered in each 45 minute presentation on topics including beef cattle management myths, forage species and grazing intensity information. Each group was allowed to debate answers for 30 seconds to 1 minute before responding. The group format encouraged discussion, particularly in large forums, and fostered interaction among audience members. Following each presentation, the audience was asked to "rate the iClicker system for effectiveness of teaching" on a scale of 1-5 (A-E) using the transponder. To date (n=178), over 90% have selected the highest ranking (A) with 9% assigning a rating of B. The iClicker system appears to be an effective tool for fostering audience interaction and improving the educational experience in traditional Extension presentations.

Key Words: Extension, Audience, Response

Growth and Development: General Topics

660 Ovariectomy alters myoepithelial cell populations in the prepubertal bovine mammary gland. K. E. Ballagh¹, N. Korn¹, L. Riggs², R. M. Akers³, and S. Ellis*¹, ¹Clemson University, Clemson, SC, ²Louisiana State University, Baton Rouge, ³Virginia Polytechnic Institute and State University, Blacksburg.

Allometric growth of the bovine mammary gland is stimulated by ovarian secretions in pre-weaning calves. Prepubertal ovariectomy inhibits mammary development, but the mechanism of inhibition is not well characterized. Holstein heifers (n=37) were ovariectomized at d40 and sacrificed at d55, 70, 85, 100, 130, and 160 to provide tissues for analysis of ovariectomy effects. Histologic analyses unexpectedly revealed that ovariectomy caused myoepithelial development and striking changes in basal epithelial cell morphology, compared to intact animals. Myoepithelial cells were identified by location, morphology, and positive staining for α -smooth muscle actin (SMA+). At least 1000 cells from 3-5 non-sequential sections and 15 or more randomly selected fields were counted per sample. Vascular smooth muscle staining served as an internal positive control for SMA staining. Z-tests and adjusted P-values (Bonferroni's) were used to compare the proportion of SMA+ basal cells between treatment groups. In d40 heifers, 80% (P<0.05) of basal epithelial cells were SMA+. Significant differences in SMA labeling were observed between ovariectomized (OVX) and intact (INT) animals at d55 (OVX 51% vs. INT 27%; P<0.05), d70 (OVX 59% vs. INT 0%; P<0.05), d85 (OVX 86% vs. INT 0.3%; P<0.05), d100 (OVX 44% vs. INT 0.6%; P<0.05), d130 (OVX 100% vs. INT 0.3%; P<0.05), and d160 (OVX 74% vs. 0%; P<0.05). We hypothesize that ovarian secretions block myoepithelial differentiation. Myoepithelial cells can limit parenchymal development through expression of growth factors, proteinase inhibitors and anti-angiogenic proteins and have been shown to inhibit tumor cell proliferation. Ovariectomy may therefore remove an estrogenic growth stimulus and permit emergence of myoepithelial cell populations that inhibit parenchymal development.

Key Words: Mammary, Myoepithelial Cells, Ovariectomy

661 Dihydroxy vitamin D affects the myogenic potential of porcine satellite cells. A. Qu¹, R. P. Rhoads², and C. H. Stahl*³, ¹Iowa State University, Ames, ²University of Arizona, Tucson, ³North Carolina State University, Raleigh.

Satellite cells are needed for the growth and development of muscle, but the strict commitment of satellite cells to a myogenic lineage has been challenged recently. Myogenic cultures have been diverted from their myogenic fate into an alternate mesenchymal differentiation pathway. We examined the impact of 1,25 (OH)₂ Vitamin D on porcine satellite cells in vitro. Satellite cells were isolated from the loin muscle of 14 d old pigs, placed in proliferative media (PM, DMEM + 10%FBS), incubated at 37°C in 5% CO₂, and media was changed daily until the cells reached 60-80% confluence. Cells were then harvested, counted, and seeded into poly-L-lysine and fibronectin coated 24-wells plate at 1,000 cells/well. Cells were given 24 h to attach and were then switched to their respective treatment media. The treatments were: control (PM), PM + 2×10⁻⁹ M 1,25 (OH)₂ vitamin D (1X VitD), and PM + 2×10⁻⁸ M 1,25 (OH)₂ vitamin D (10X VitD). Complete media changes were made daily. At 3, 6, and 9 days post treatment, cells were harvested for cytochemical staining and gene expression analysis. All experiments

were repeated as two independent studies. Within each study, n = 2 for cytochemical staining and n = 4 for gene expression analysis. Study, day, treatment and day*treatment were considered fixed effects. Statistical significance was set at P < 0.05.

After 6 days, the vast majority of the control cells (>95%) stained positive for desmin. However, after 6 days of Vit D treatment, only approximately 25% of the cells stained positive for desmin. Although there appeared to be fewer desmin-positive stained cells with the 10X VitD versus the 1X Vit D treatment, this difference was not statistically significant. The gene expression of both MyoD and Myogenin was significantly reduced (P < 0.05), in a dose dependant manner, after 6 and 9 d of treatment with VitD. Based on these data, we conclude that 1,25 (OH)₂ vitamin D inhibits the myogenic differentiation of satellite cells. Since circulating levels of 1,25 (OH)₂ vitamin D are seen with dietary P deficiency, this may help explain the molecular basis for reduced muscle growth seen with dietary P deficiency.

Key Words: Satellite Cells, Vitamin D, Pig

662 Calpain and calpastatin mRNA expressions in skeletal muscle are highly correlated with protein accretion activities in neonatal pigs. Z. Li*¹, B. Zhao¹, X. Yang², M. Z. Fan², and J. Yang¹, ¹University of Hawaii, Honolulu, ²University of Guelph, Guelph, ON, Canada.

The calpain-calpastatin system plays a significant role in the regulation of protein degradation in the skeletal muscle. Rapid gain in skeletal muscle mass during the neonatal period is one of the most significant physiological events in life. Little is known about protein degradation during the muscle gain. To understand the role of calpain-calpastatin system in muscle growth, we randomly selected 36 neonatal pigs from more than 10 litters. The piglets were divided into six groups and slaughtered at the age of 1, 4, 6, 12, 20 and 28 days. The expression patterns of calpain 1A, calpain 2, calpain 3A, calpastatin type 1, type 2, and type 3, obtained by quantitative real-time PCR analysis, and their correlations with the measurements of muscle protein accumulations such as protein content and RNA/protein ratio were studied. The mRNA levels of all the six genes at the age of 4 to 6 days showed a decrease by 2-4 folds compared with 1-day-old piglets. Then they were maintained at relatively low expression levels until 28 days of age. The expressions of the six calpain and calpastatin genes were highly correlated with each other, and showed significant correlations with muscle protein content, RNA/protein ratio and protein/DNA ratio. Expressions of calpain 1A, calpastatin type 1 and type 3 were also negatively correlated with birth weight and fractional rate of growth. Analysis of the expressions of calpain-calpastatin genes by quantitative real-time PCR method can be used for identifications of piglets with increased muscle protein accretion activities.

Key Words: Calpain and Calpastatin, Muscle Protein Deposition, Neonatal Pigs

663 A low-fat liquid diet decreases AMPK and increases mTOR phosphorylation in skeletal muscle of 10-day-old pigs. W. Oliver* and J. Miles, USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.

Previous research shows that neonatal pigs respond to decreases in energy density of liquid diets with increased feed intake, resulting in similar performance to pigs fed a more energy-dense diet. The objective of this experiment was to determine if a high- (25%, HF) or low-fat (2%, LF) liquid diet affects proteins involved in energy homeostasis and protein synthesis in early-weaned pigs. Forty-eight pigs, with an initial body weight of $3,637 \pm 85$ g, were weaned at 10 d of age and utilized in a randomized complete block design. Pigs were blocked by weight and gender, then assigned to pens (8 pigs/pen). Diets were formulated to provide a constant lysine:ME and were fed for 10 d, at which time blood and longissimus dorsi were collected. Blood was analyzed for plasma urea nitrogen (PUN) and NEFA. Longissimus dorsi was analyzed via western immunoblot for mammalian target of rapamycin (mTOR) and adenosine 5' monophosphate-activated protein kinase (AMPK) phosphorylation. Pigs gained 347 ± 11 g/d, which resulted in an ending body weight of $7,035 \pm 170$ g, regardless of dietary treatment ($P > 0.20$). Pigs fed a LF diet consumed approximately 24% more milk than pigs fed the HF diet ($2,853 \pm 23$ vs. $2,309 \pm 65$ g dry feed \cdot pen $^{-1}\cdot$ d $^{-1}$; $P < 0.01$), which resulted in similar calculated ME intakes between dietary treatments (9.9 ± 0.2 vs. 10.7 ± 0.5 Mcal \cdot pen $^{-1}\cdot$ d $^{-1}$; $P > 0.10$). Feed conversion (gain:feed) was 19% higher in HF compared to LF fed pigs ($P < 0.03$). Circulating NEFA (137 ± 37 vs. 39 ± 13 μ Eq/L; $P < 0.02$) and PUN (17.6 ± 0.8 vs. 3.0 ± 0.6 mM; $P < 0.01$) concentrations were higher in HF pigs compared to LF pigs. The AMPK phosphorylation was 29% higher ($P < 0.03$) in HF pigs compared to LF pigs, while mTOR phosphorylation was increased by 22% in LF pigs ($P < 0.02$). Thus, young pigs consuming a low-fat diet have lower activation of AMPK and higher activation of mTOR, which, considering the difference in PUN, may indicate an improved utilization of amino acids in young pigs consuming a low-fat diet.

Key Words: Energy Source, Skeletal Muscle, Swine

664 Media components including exogenous lipid and PPAR- γ agonists influence the differentiation of primary bovine adipocytes *in vitro*. A. J. Lengi and B. A. Corl*, *Virginia Polytechnic Institute and State University, Blacksburg.*

Our objectives were to isolate bovine stromal-vascular (SV) cells using explants and determine media components that promote differentiation into mature adipocytes for studies of lipogenic enzyme regulation. Three published differentiation protocols utilizing DMEM were evaluated initially: (A) 10% serum, 50 ng/mL insulin (INS), 0.25 μ M dexamethasone (DEX), 5 mM octanoate, 10 mM acetate; (B) 10 μ g/mL INS, 0.25 μ M DEX, 0.5 mM isobutylmethylxanthine (IBMX), 1 mM octanoate, 2% Intralipid; (C) 5% serum, 2.5 μ g/mL INS, 0.25 μ M DEX, 0.5 mM IBMX, 5 μ M troglitazone. DEX and IBMX were removed from media B and C after 48 h. SV cells were treated with differentiation media for 8 d after reaching confluence. Differentiation was assessed by measuring radiolabeled acetate incorporation into lipids, glycerol-3-phosphate dehydrogenase (G3PDH) activity, and the mRNA expression of aP2, PPAR- γ , and acetyl-CoA carboxylase- α (ACC). After 8 d of differentiation, medium B produced acetate incorporation and G3PDH activity that were 5- and 6-fold greater, respectively, compared with differentiation media A and C. Medium B increased mRNA expression of aP2 and PPAR- γ 180- and 7-fold, respectively, compared to undifferentiated control cells, but ACC mRNA expression was unaffected by differentiation media. Medium B was manipulated to further improve the differentiation protocol. Removal of 2% Intralipid did not improve any differentiation measures. Addition of rosiglitazone (1 μ M), a PPAR- γ

agonist, increased acetate incorporation, aP2 expression, and PPAR- γ expression. Troglitazone (5 μ M), another PPAR- γ agonist, increased acetate incorporation to a similar extent as rosiglitazone and produced the greatest expression levels of ACC, but was not superior for any other measures to media that included rosiglitazone. Cell seeding density influences the cell divisions required to reach confluence and increased plating density (2×10^4 cells/cm 2 vs. 6.7×10^3 cells/cm 2) increased acetate incorporation by 31%. We have developed a method to differentiate primary bovine adipocytes that will allow us to study the regulation of lipogenic enzymes by nutrient and endocrine factors.

Key Words: Adipocyte, Differentiation, Bovine

665 Basal expression of four SLC1 (Na $^+$ -dependent glutamate transporter) mRNA by small intestinal epithelia of beef cattle differs and is altered by ruminal and abomasal infusion of starch hydrolysate. S. F. Liao*, E. S. Vanzant, D. L. Harmon, K. R. McLeod, J. A. Boling, and J. C. Matthews, *University of Kentucky, Lexington.*

High-affinity glutamate uptake in the mammalian small intestine is mediated by SLC1 family members: system X $_{AG}^-$ (EAAC1, GLT-1) or ASC (ASCT1, ASCT2) activity. To determine if the expression of mRNA encoding SLC1 family members by duodenal (D), jejunal (J), and ileal (I) epithelia responds to increased luminal supply of rumen-derived microbes (hence, AA substrates), energy, or both, 18 ruminally and abomasally catheterized Angus steers (BW \approx 260 kg) were assigned (n = 6) to either water (basal), or ruminal or abomasal corn starch hydrolysate (SH, by α -amylase) infusion treatment (at 20% of ME intake) and fed an alfalfa-cube based diet at $1.3 \times$ NE $_m$ requirement. After a 14 or 16-d infusion, steers were killed, small intestinal epithelia harvested, and total RNA extracted. Real-time RT-PCR analysis was conducted to quantify the relative mRNA expression (SLC1 mRNA:18S rRNA). Basal expression patterns by D, J, and I differed ($P \leq 0.10$): EAAC1, D = J, D < I, J = I; GLT-1, D < J = I; ASCT1, I < D < J; ASCT2, D = J = I. Ruminal SH infusion decreased ($P = 0.05$) JAST1 mRNA expression by 46%, compared to basal expression. In contrast, abomasal SH infusion increased ($P = 0.07$) I basal expression of EAAC1 and ASCT1 mRNA, by 40 and 52%, respectively. GLT-1 and ASCT2 mRNA content was not affected by SH infusion. Discovery of ASCT1 mRNA expression by small intestinal epithelia is novel, and may represent a unique role for ASCT1 in the small intestinal epithelium of cattle, especially as ASCT2 mRNA content was insensitive to increased luminal substrate or energy supply while ASCT1 responded to both. The finding that I EAAC1 and ASCT1 mRNA content was increased in the presence of increased luminal SH suggests that their expression was sensitive to the energy status of I epithelia.

Key Words: Bovine, SLC1 Gene Expression, Small Intestine

666 Dry matter intake based on birth weight as weaning criterion in Brown Swiss calves. B. Saremi*, A. Foroughi, and A. Rahimi, *Education Center of Jihad-e Agriculture, Mashhad, Khorasan-e Razavi, Iran.*

Nineteen female Brown Swiss calves were placed randomly in treatments: 1) 1% BW 2) 1.5 % BW 3) 2 % BW dry matter intake as a weaning criterion. Calves were fed milk 8% BW two times daily and

weaned abruptly when aged at least 3 weeks, DMI equal or larger than treatments, total DMI more than 9% and body gain more than 12% of initial body weight. Calf starter (NRC 2001) fed from birth to 8 weeks post weaning ad lib. Blood and rumen liquid samples were taken each 15 days. Daily DMI, body weight and body characteristics include: Body length, wither height, hip height, pin width, hip width, pin to hip, stomach size, heart girth, metacarpus and metatarsus size were measured in 15 days intervals. Nutrient digestibility was determined 5 days at weaning and at the end of experiment. Repeated measurement analysis and a completely randomized design with unequal replicates by mixed procedure of SAS 9.1 were used for statistical analyses. Means were compared using Lsmean ($P < 0.05$). Data showed that milk fed period was increased from treat 1 to 3 ($P < 0.05$). Calf starter intake was significantly higher in treat 3 post weaning ($P < 0.05$). Feed to gain, body weight, average daily gain, stomach size, heart girth, metacarpus and metatarsus size and their increase pre and post weaning were equal pre and post weaning for all treatments. Calves in treat 3 had higher wither and hip height gain pre weaning ($P < 0.05$). This trend was observed nonsignificantly for body length. A reverse trend was observed post weaning with a significantly higher body length for treat 1 ($P < 0.05$). Pin to hip gain pre weaning and pin width at weaning showed significant different ($P < 0.05$). Plasma Glucose, PUN, rumen pH and N-NH₃ was equal between treatments. Nutrient digestibility had no differ pre weaning but reduced significantly for all nutrients post weaning as milk fed time increased ($P < 0.05$). Some data had not been shown in this summary saving brevity. In general, it seems that using DMI as a percent of BW could be used as a criterion for calves weaning at Iranian commercial farms management conditions.

Table 1. Effect of different weaning methods on some calves' measurements

Items	Treatments			SEM
	1%BW	1.5%BW	2%BW	
Milk fed days	42.67 ^b	50.71 ^{ab}	62.00 ^a	3.071
Starter intake prewean kg	15.15 ^b	16.50 ^{ab}	24.37 ^a	1.830
postwean kg	85.18 ^b	91.88 ^b	109.94 ^a	3.250
Wither Height prewean cm	3.67 ^b	4.29 ^b	8.83 ^a	0.672
postwean cm	21.17	16.71	18.17	0.974
OMD%	81.47 ^a	81.64 ^a	77.60 ^b	0.772
DMD%	93.72 ^a	93.79 ^a	91.95 ^b	0.329
CPD%	73.15 ^{ab}	77.77 ^a	69.43 ^b	1.532
ADFD%	66.11 ^a	61.61 ^{ab}	56.16 ^b	1.552
NDFD%	54.38 ^a	49.75 ^a	40.86 ^b	1.554

Key Words: Dry Matter Intake, Weaning, Dairy Calves

667 Effects of plane of nutrition and bioavailable trace minerals on growth of transported male dairy calves. J. S. Osorio^{*1}, J. K. Drackley¹, R. L. Wallace¹, D. Rincker¹, D. J. Tomlinson², and T. J. Earleywine³, ¹University of Illinois, Urbana, ²Zinpro Performance Minerals, Jeffersonton, VA, ³Land O'Lakes Animal Milk Products Inc., Madison, WI.

Effects of enhanced milk replacer on growth and health of transported calves are unresolved. Whether organic (bioavailable) trace minerals benefit transported calves also is unknown. Male Holstein calves <1 wk old (n=90) were purchased in 3 groups (blocks) from Wisconsin

and transported to the Illinois research facility. Calves were randomly assigned in a 2x2 factorial arrangement of plane of nutrition (PN) and trace mineral source (TM). Conventional PN received milk replacer (22% CP, 20% fat; 568 g/d) and starter (18% CP), were weaned at 6 wk, received ad libitum starter to wk 12 and 0.5 kg of mixed hay wk 10-12. In wk 13-20 calves received 2.75 kg/d of grower (16% CP) and hay ad libitum. Enhanced PN received milk replacer (28% CP, 20% fat; 810 g/d wk 1, 1136 g/d wk 2-6, 568 g/d wk 7) plus starter (22% CP), were weaned at 7 wk, received ad libitum starter through wk 12, and ad libitum grower + 0.5 kg/d hay wk 13-20. Feeds contained either inorganic salts of Fe, Cu, Zn, and Mn or bioavailable sources (Zinpro Performance Minerals, Eden Prairie, MN). Calves were housed in individual hutches bedded with straw through wk 9, group-housed by diet wk 10-12, and group-housed by diet wk 13-20. All calves had free access to water. Calves were weighed and measured (heart girth, body length, withers height (WH), hip height (HH), and hip width) weekly through wk 10 and then at wk 12, 15, and 20. Data were analyzed with the MIXED procedure of SAS with repeated measures and block as a random effect. Calves fed enhanced PN had greater ($P < 0.01$) body weight (BW) and WH tended ($P = 0.08$) to be greater. Significant interactions between TM and PN were found for WH ($P = 0.05$), HH ($P < 0.05$), and BW ($P = 0.08$). Bioavailable TM increased growth for calves fed enhanced PN, but had no effect in calves fed conventional PN. Transported calves responded to enhance PN, although improvements in growth were less than observed previously with locally born calves. Bioavailable TM may increase growth with enhance PN, at least for calves under transport stress.

Key Words: Trace Minerals, Milk Replacer, Dairy Calves

668 Relationship of ghrelin and leptin with growth performance and carcass composition of beef cattle. J. S. Jennings^{*1}, R. H. Pritchard¹, K. W. Bruns¹, A. Trenkle², D. H. Keisler³, J. A. Daniel⁴, and A. E. Wertz-Lutz¹, ¹South Dakota State University, Brookings, ²Iowa State University, Ames, ³University of Missouri, Columbia, ⁴Berry College, Rome, GA.

Angus steers (n=72) of similar age, weight (292±1.44 kg), and genetic background were used to determine the effects of growing phase diet on the relationship of plasma ghrelin and leptin concentrations with growth performance and carcass composition. At trial initiation (d 0), eight steers were harvested for initial carcass composition. The remaining 64 steers were allotted, by weight, to pen and treatment was assigned randomly. Treatments were 1) 60% forage; 40% concentrate diet fed during the growing period (112 d) followed by 10% forage; 90% concentrate diet during the finishing period (113-209 d) (GRW-FNSH) or 2) 10% forage; 90% concentrate diet fed for the duration of the trial (0-209 d) (FNSH-FNSH). Steers were allowed ad libitum consumption regardless of dietary treatment. Eight steers per treatment were harvested on d 88, 116, 165, and 209, and carcass characteristics were recorded. A blood sample was collected from each steer prior to harvest, and plasma was assayed for ghrelin and leptin concentrations. Hormone and carcass data were analyzed statistically using the MIXED procedure of SAS, and linear, quadratic, and cubic contrasts were performed with the hormone data. At the final harvest, carcass weight was not different between treatment groups, but FNSH-FNSH steers had more ($P < 0.01$) subcutaneous fat and higher ($P \leq 0.001$) marbling scores compared with GRW-FNSH steers. Plasma ghrelin concentrations were different ($P \leq 0.01$) as a result of dietary treatment. Plasma ghrelin concentrations for FNSH-FNSH steers increased quadratically ($P \leq 0.01$) over time, whereas plasma ghrelin concentrations were not different over time for GRW-FNSH. Plasma

leptin concentrations for FNSH-FNSH steers increased ($P \leq 0.001$) from d 0 to 84 and then plateaued whereas, plasma leptin concentrations increased linearly ($P \leq 0.001$) in the GRW-FNSH steers. These data are consistent with the hypothesis that plasma ghrelin and leptin concentrations differ as a result of nutritional status of the animal.

Key Words: Ghrelin, Leptin, Carcass Composition

669 Carcass quality and relative content of glutamate metabolizing enzymes and transporters differ in Polypay and percentage Polypay-White Dorper lambs. A. K. Lunsford*, K. R. Brown, S. F. Liao, D. K. Aaron, J. C. Matthews, M. M. Simpson, D. G. Ely, and J. A. Boling, *University of Kentucky, Lexington.*

L-Glutamate (Glu) transport and metabolism by liver, kidney, longissimus dorsi (LD), and subcutaneous fat (SCF) are essential to N and energy metabolism of growing animals. The effect ($n = 6$) of sheep genetic type [Polypay (PP), 1/2 White Dorper 1/2 Polypay (1/2 D), and 15/16 White Dorper 1/16 Polypay (15/16 D)] on expression of Glu transporters and enzymes by these tissues was evaluated in wether lambs that had grazed a mixed grass pasture and received a grain supplement (2% BW) for 36 to 78 d. All lambs were harvested at a common weight of 50.0 kg and tissues collected. Although age at slaughter did not differ, 15/16 D lambs had heavier rack weights and higher percentage of boneless closely trimmed retail cuts ($P < 0.05$) and tended ($P < 0.10$) to have greater DP, LEA, and leg weights than PP or 1/2 D lambs. The relative content of EAAC1 and GLT-1 (Glu transporters) and Glu synthetase (GS), Glu dehydrogenase (GDH), and alanine transaminase (ALT) in liver, kidney, LD, and SCF was determined by immunoblot analysis. ALT content was lower ($P < 0.05$) in liver (54%), LD (72%), and SCF (51%) and tended to be lower ($P < 0.10$) in kidney (34%), while EAAC1 was 89% lower ($P < 0.05$) in LD of 15/16 D than PP or 1/2 D lambs. In contrast, GS (99%) and GLT-1 (25%) content tended to be increased ($P < 0.10$) and GDH tended to be decreased ($P < 0.10$) 39 and 46% in SCF of 15/16 D and 1/2 D lambs. To determine if altered protein content was by transcriptional control, the relative mRNA content for GS, GDH, and ALT in LD and SCF was determined by real-time RT-PCR. GS mRNA (59%) was highest ($P < 0.05$) and ALT mRNA (44%) tended to be highest ($P < 0.10$) in LD of 1/2 D, indicating post-transcriptional regulation of protein content. These results reveal the increased carcass quality of 15/16 D lambs was concomitant with a reduced ALT protein content of tested tissues and SCF had an increased potential to produce glutamine from plasma Glu.

Key Words: Breed, Gene Expression, Glutamate

670 Sheep differing in exogenous adrenocorticotropin hormone induced cortisol responses are different in body composition and residual feed intake. S. A. Knott¹, L. J. Cummins², F. R. Dunshea³, and B. J. Leury³, ¹Charles Sturt University, Wagga Wagga, NSW, Australia, ²Ivanhoe, Cavendish, Victoria, Australia, ³The University of Melbourne, Parkville, Victoria, Australia.

The objective of this study was to determine whether there were differences in body composition (lean tissue mass, LTM; fat tissue mass,

FTM) and residual feed intake (RFI) in sheep that were identified to have either a low (LC) or high (HC) serum cortisol response to exogenous administration of adrenocorticotropin hormone (ACTH). One hundred maternal sire cross-bred rams (initial weight 52.9 ± 4 kg) received 2 $\mu\text{g}/\text{kg}$ ACTH intramuscularly. Two blood samples were collected, one immediately before and one 45 min after the injection of ACTH. Twenty two rams with low or high post ACTH serum cortisol concentrations were then selected; cortisol concentration post ACTH administration for LC ($n=11$) and HC ($n=11$) groups was 113.3 and 215.6 nmol/L, respectively, ($P < 0.05$). Body composition was measured using dual energy X-ray absorptiometry at the start and end of a 40-day measurement period where ad libitum feed intake and liveweight (LW) were measured for estimation of feed conversion ratio (FCR) and residual feed intake (RFI). LC sheep were significantly more efficient than HC sheep in terms of RFI (-0.49 v. 0.45 , LC v. HC, $P < 0.05$) but not for FCR. There were no significant differences between the HC and LC groups in body composition or LW at the start of the study whereas after 40 days there were significant differences ($P < 0.05$) in the proportion of LTM (0.72 v. 0.75 , HC v. LC) and FTM (0.16 v. 0.13 , HC v. LC) and absolute FTM (10.83 v. 8.91 kg, HC v. LC), but no difference in LW. These data indicate that animals that are more responsive to an ACTH challenge are less efficient and have increased adiposity, both of which may be related to an overall increase in stress responsiveness in these animals.

Key Words: Cortisol, Sheep, Efficiency

671 Wool growth is negatively related to exogenous adrenocorticotropin hormone induced cortisol responses in sheep with a low wool growth potential but not with a high potential. G. M. Butler¹, M. W. Robertson¹, A. J. Tilbrook², F. R. Dunshea¹, and B. J. Leury^{*1}, ¹The University of Melbourne, Parkville, Victoria, Australia, ²Monash University, Clayton, Victoria, Australia.

The objective of this study was to determine whether there were differences in serum cortisol response to exogenous administration of adrenocorticotropin hormone (ACTH) in Merino sheep with either high (HW) or low (LW) wool growth potential. Forty eight merino wethers (42.1 ± 4.8 kg) were selected for HW and LW from a larger grazing flock based on the previous season's greasy fleece weight (GWT). Sheep were yarded and fasted for 15 hours and then injected with 2 $\mu\text{g}/\text{kg}$ ACTH intramuscularly. Two blood samples were collected, one immediately before and one 45 min after the injection of ACTH and plasma cortisol measured. The wethers were then brought indoors and after acclimation to a pelleted ration commenced a study where feed intake, liveweight and mid-side wool growth were measured for up to 27 d. Ten wethers failed to adjust to the pellets and were removed. While there was no difference in basal plasma cortisol, both the incremental (62 v. 40 nmol/L) and the final (104 v. 91 nmol/L) post ACTH cortisol concentrations were greater ($P < 0.05$) in the HW than the LW sheep. As anticipated, mid-side wool growth was correlated ($R=0.46$, $P < 0.05$) with the previous season's GWT and was higher (0.39 v. 0.26 mg/cm² /kg, $P < 0.001$) in the HW sheep. Mid side wool growth was negatively related ($R=-0.55$, $P < 0.05$) to the ACTH increment in cortisol in LW sheep but not in HW sheep. This difference in cortisol response may allow HW sheep to maintain wool growth under a range of environmental conditions.

Key Words: Wool, Cortisol, Sheep

Symposium: International Animal Agriculture: Welfare in Animal Production, from Science to Practice

672 ASAS Centennial Presentation: The impact of current global challenges in the animal agricultural industry. A. Tewolde*¹ and T. Díaz², ¹*Inter American Institute for Cooperation on Agriculture - IICA, San José, Costa Rica*, ²*Food and Agriculture Organization - FAO, Santiago de Chile*.

The important contribution of animal agriculture to today's main challenges that the world faces is recognized. Globally, animal agriculture employs 1.3 billion people, accounts for almost 40 percent of agricultural gross domestic product, provides one third of total protein intake, and most rural people depend on livestock to survive, and the general contribution of livestock to the gross national product (GNP) will increase with time. It is estimated that almost 42% of the agricultural GNP will be attributable to the livestock sector by 2030, of which 39 and 50% correspond to the developing and developed countries, respectively. It is also expected that global animal production will increase in response to higher income and consumption in developing countries. However, rural poverty, climate change and natural resources degradation may become the main threats to the global animal agricultural industry. For example, it is estimated that in 25 years time meat and cereal production will have to increase by 85 and 50%, respectively, using the same currently available physical resources. Livestock can reduce poverty and food insecurity in most African and some Asian and Latin American countries. Also the different livestock regions can be threatened by the growing biofuel trends. Globalization is increasing sanitary risks and agriculture and livestock systems are becoming highly vulnerable to climate change. All these require collective efforts between the public and private sector and respective stakeholders in designing appropriate research, training and outreach services. Also, biotechnology applications to produce desired product traits are now seen as important tools. In conclusion, it is evident that animal production will continue to contribute to the wellbeing of the human kind, but it is also challenged by social, technological, biological, environmental and economic factors that should be dealt with integrally and via regional cooperation and technological and information sharing.

Key Words: Climate Change, Globalization, Biotechnology

673 Farm animal welfare: The science behind the standards. D. Fraser*, *University of British Columbia, Vancouver, BC, Canada*.

Three broad types of research have been used in the development of "science-based" animal welfare standards. One body of research focuses on the basic health and functioning of animals; it relies on measures such as freedom from disease and injury, indicators of "stress", and rates of survival and growth. Other research looks at the ability of animals to live in reasonably "natural" ways; it uses the performance of natural behavior (especially behavior that animals are highly motivated to perform) as indicating good welfare, and abnormal behavior as indicating the reverse. A third body of research focuses on the "affective states" of animals, especially states of pain and distress; it attempts to identify and quantify such states through a combination of behavioral and physiological responses, and to develop practical mitigative measures. All three of these types of science have been used in animal welfare standards, but they sometimes lead to different requirements because they involve the pursuit of different (although often overlapping) animal welfare

objectives. In order to prevent confusion arising from the conflicting requirements, we need to be clear about the specific animal welfare objectives that different standards are designed to address.

674 Strategies to improve animal welfare in poultry production: From science to practice. J. A. Mench*, *University of California, Davis*.

It is estimated that approximately 23 billion poultry are produced worldwide each year. The poultry industry is diverse and is involved with the production of eggs, meat, and byproducts (e.g. feathers) from a variety of species, including chickens, turkeys, ducks, ratites, and game birds. As consumer demand for poultry products has continued to grow, rearing practices have become increasingly intensive in most segments of the poultry industry in many countries. In turn, this has led to increasing concerns about poultry welfare among consumers and food retailers, and a concomitant attempt to eliminate or modify certain production practices via legislation, retailer purchasing specifications, labeling programs, and/or voluntary or audited guidelines. This has been paralleled by an explosion of research on poultry welfare, particularly on topics related to behavior and health. To what extent has science played a role in these regulations, standards and guidelines, and how has that science been translated into day-to-day practice in such a way as to improve poultry welfare? This question will be discussed with regard to three particularly controversial practices: housing laying hens in cages, the production of foie-grass from ducks and geese, and the use of electrical stunning in processing plants to induce insensibility prior to slaughter in broiler chickens and turkeys.

Key Words: Poultry, Welfare, Guidelines

675 Strategies to improve animal welfare in farm animals: From science to practice. X. Manteca*¹, A. Bach², S. Calsamiglia¹, A. Ferret¹, J. Gasa¹, and B. Jones³, ¹*School of Veterinary Science, UAB, Bellaterra, Barcelona, Spain*, ²*IRTA-Unitat de Remugants & ICREA, Barcelona, Spain*, ³*Animal Behaviour & Welfare Consultant, Edinburgh, Scotland*.

Concern about the welfare of farm animals has increased in many countries over the last decades and animal welfare is fast becoming a global issue. Strategies intended to improve farm animal welfare can be divided into three main categories: improving the quality of stockmanship, improved housing and husbandry, and genetic selection. Fear of human beings is often a major welfare problem in farm animals that has marked negative consequences for production. Fear of humans is largely determined by the behavior of the stockpersons, which normally reflect their beliefs, attitudes and skills. Therefore, training programmes aimed at improving stockmanship have a very positive impact on the welfare of animals. To be fully effective, these must be tailored to the production system and the characteristics of the producers in each country. Improved housing and husbandry is the most frequently used strategy for enhancing farm animal welfare. The range of strategies may vary substantially from those requiring significant changes in the production systems (such as replacing stalls for pregnant sows by group housing

systems) to very moderate alterations, such as increasing feeding space for beef cattle. Although enhanced housing and husbandry practices are undeniably effective in many circumstances, they may have a high economic cost that hampers uptake. Genetic selection is becoming an increasingly important tool for improving farm animal welfare. It can be applied with two different aims: firstly to prevent the negative consequences that selection for certain production traits may have on animal welfare (such as increased prevalence of lameness in broilers due to selection for rapid growth) and to select animals that are better able to cope with existing production systems and perhaps future developments. Examples of the latter include selection for reduced aggressiveness in pigs and for greater sociability in dairy cows.

The categories of welfare improvement strategies mentioned above will be illustrated with examples from work done in the research project Welfare Quality®.

Key Words: Animal Welfare, Farm Animals, Welfare Quality

676 On farm assessment of animal welfare: The ‘Welfare Quality’ experience in the EU. L. J. Keeling*, *Swedish University of Agricultural Sciences, Sweden.*

The project ‘Integration of animal welfare in the food quality chain: from public concern to improved welfare and transparent quality’ (Welfare Quality®) has become the largest piece of integrated work yet carried out in animal welfare in Europe, involving 44 research groups from 17 countries. The main aims are: to develop practical strategies/

measures to improve animal welfare, to develop a European standard for the assessment of animal welfare, to develop a European animal welfare information standard and, to integrate and interrelate the most appropriate specialist expertise in the multidisciplinary field of animal welfare in Europe. Effort is focused on three main species and their products: cattle (beef, dairy and veal), pigs and poultry (broiler chickens and laying hens).

A starting point was that animal welfare is an important part of an overall “food quality concept”. Analyses of public perceptions and attitudes were combined with existing knowledge from animal welfare science and 12 areas of concern that should be covered in measurement systems were identified. To address these areas of concern, 20-30 performance (animal-based) and design measures for each species were selected for inclusion in pilot systems being applied in practice this year. Further fine tuning of the systems will take place. Population surveys have explored the extent of social engagement in farm animal welfare issues and how this is reflected in everyday consumption practices and there have been studies of the supply chains for welfare-friendly products. Clear differences between countries were apparent so strategies to implement welfare schemes under specific conditions of consumer, distributor and producer expectations are being formulated. Work with a formal standard setting body to create the basis of future technical standard documents has also started and the potential importance of such harmonised standards in the setting of future European legislation has been recognised. Future work will focus on further development of the welfare measurements and improvement strategies and on establishing implementation strategies.

Key Words: Welfare, Wellbeing, Monitoring

Lactation Biology III

677 Inhibitory effect of unsaturated fatty acids on *de novo* fatty acid synthesis in bovine mammary epithelial cells. J. W. McFadden*, I. K. Mullarky, and B. A. Corl, *Virginia Polytechnic Institute and State University, Blacksburg.*

In vitro, unsaturated fatty acids (UFA) inhibit lipid synthesis in rat hepatocytes as well as goat and bovine mammary epithelial cells. A bovine mammary epithelial cell line (BME-UV) was used to determine the effect of saturated, monounsaturated, and polyunsaturated fatty acids (PUFA) on *de novo* fatty acid synthesis. Cells were grown to confluence in DMEM supplemented with 10% serum. Serum or increasing incubation time reduced radiolabeled acetate incorporation into lipids (pmol/ μ g DNA). Addition of insulin (0.1 μ g/ml) and prolactin (1.5 μ g/ml) serum-free media enhanced acetate incorporation (22%). Subsequent experiments included BME-UV cells cultured in the presence of hormones with BSA-complexed fatty acid in the absence of serum for 24 h starting at confluency. Treatment with 50 μ M oleic acid, linoleic acid (LA), *cis*-9, *trans*-11 conjugated linoleic acid (CLA), or *trans*-10, *cis*-12 CLA resulted in 40 to 50% reductions in acetate incorporation. A minor increase (14%) in acetate incorporation was observed with 50 μ M stearic acid (SA) treatment. Fatty acid synthase mRNA was reduced by 29, 9, and 22% for the LA, *cis*-9, *trans*-11 CLA, and *trans*-10, *cis*-12 CLA treatments, respectively. Acetyl-CoA carboxylase mRNA expression remained unaffected by treatment. Expression of peroxisome proliferator activated receptor- γ and liver X receptor (LXR)- α mRNA were unaffected by treatment; however, significant reductions in sterol response element-binding protein (SREBP)-1 mRNA and protein were observed for all PUFA treatments. Cells incubated with a LXR agonist, T0901317, resulted in enhanced acetate incorporation (21% at 1 μ M). Incubating BME-UV cells with LXR agonist rescued the suppressive effect of UFA on lipid synthesis. Presence of a LXR agonist had no effect on acetate incorporation in SA treated BME-UV cells. These results suggest, *in vitro*, that UFA decrease BME-UV cell lipid synthesis by inhibiting the expression of SREBP-1 and this effect may be mediated by suppressing LXR activity.

Key Words: LXR, SREBP-1, Unsaturated Fatty Acids

678 Lipogenic gene expression in MAC-T cells is affected differently by fatty acids and enhanced by PPAR- γ activation. A. K. G. Kadegowda*¹, M. Bionaz², L. S. Piperova¹, R. A. Erdman¹, and J. J. Loo², ¹University of Maryland, College Park, ²University of Illinois, Urbana.

Recent work has focused on *trans*10,*cis*12-CLA (t10c12CLA) and its effect on mammary lipogenic gene expression, while the effects of other fatty acids (FA) remain ill-defined. Objectives were to test individual FA effects on mRNA expression via qPCR of 19 genes with roles in *de novo* synthesis (ACACA, FASN), FA uptake (LPL, CD36), intracellular FA transport (FABP3, FABP4), desaturation (SCD), triacylglycerol synthesis (AGPAT6, DGAT1, GPAM, LPIN1), transcriptional regulation (SREBF1, SREBF2, INSIG1, THRSP), and nuclear receptor signaling (PPARG). A PPARG-specific agonist (Rosiglitazone, ROSI) was used to assess the role of this nuclear receptor on mammary lipogenesis. Lipid droplet (LD) formation was quantified with Oil Red O staining.

MAC-T cells were cultured in triplicate for 12 h with 50 $\hat{1}$ / μ M ROSI or 100 $\hat{1}$ / μ M t10-18:1, t10c12CLA, 16:0, 18:0, c9-18:1, 20:5, or ethanol (control). All FA increased ($P < 0.05$) CD36 expression (\sim 770%) and, except for 16:0 and 18:0, decreased LPL (\sim 150%) and FABP3 (\sim 200%) relative to control. 16:0 and 18:0 elicited greater mRNA of FABP3 (+500%) and FABP4 (+160%) over control. Responses common to 16:0 and 18:0 included greater THRSP (\sim 90%), INSIG1 (\sim 200%), AGPAT6 (\sim 150%), DGAT1 (\sim 60%), and LPIN1 (\sim 90%), coupled with greater LD formation with 16:0. T10-18:1 and t10c12CLA reduced expression of ACACA (\sim 60%), FASN (\sim 50%), SCD (\sim 240%), and LPIN1 (\sim 30%). SREBF1 was lower with t10c12-CLA (\sim 200%), c9-18:1 (150%), and EPA (\sim 140%) over control. C9-18:1 and EPA also decreased ACACA (\sim 40%) and SCD (\sim 300%). No effects were observed for PPARG but ROSI upregulated by $>40\%$ ACACA, FASN, SCD, LPIN1, AGPAT6, DGAT1, SREBF1, SREBF2, and INSIG1 without changes in LD formation over control. Results showed that FA regulate mammary lipogenic gene expression to different extents. Further, PPAR- γ activation of *de novo* lipogenesis coupled with exogenous FA availability might play a role in regulating milk fat synthesis.

Key Words: Mammary Cells, Gene Expression, Fatty Acids

679 Comparative MammOmics™ of milk fat synthesis in *Mus musculus* vs. *Bos taurus*. M. Bionaz* and J. J. Loo, *University of Illinois, Urbana.*

A sequenced genome and low cost are at the root of the preferential use of the mouse to study genome-wide mechanisms of mammary function. Whether mammary tissue from mouse and cow share similar gene expression patterns remains to be determined. We propose that the degree of similarity in relative % mRNA abundance coupled with temporal responses in both species is indicative of the importance of a gene in the process of mammary lipid and protein synthesis. Our objective was to compare temporal patterns and relative % mRNA abundance of lipid synthesis-related genes in mammary tissue from mice (FVB and C57B1) and Holstein cows during pregnancy and lactation. Published mouse mammary microarray data ($>20,000$ genes) and our bovine qPCR data were used in this comparison. Murine data encompassed pregnancy to 9-10 d post-partum, and bovine the last 30 d pre-partum through late lactation. With few exceptions, mouse strains had similar relative % mRNA abundance and temporal patterns across selected genes. Overall, mouse mammary had proportionally lower relative % mRNA abundance of *CD36*, *GPAM*, *AGPAT6*, *INSIG1*, and *LASS2* and larger % mRNA abundance of *ACSL1*, *ACBP*, *FADS1*, *OXCT1*, *SREBF1*, and *THRSP* compared with cow. Genes characterizing mammary tissue of both species included *ABCG2*, *ACSS1*, *ACSL1*, *FABP3*, *FASN*, *SCD*, *BTN1A1*, *XDH*, *OXCT1*, *LPIN1*, *SREBF1*, and *PPARGC1A*. In contrast, we observed lower up-regulation of genes involved in uptake of fatty acids (FA) from blood (e.g., *LPL*, *CD36*, and *VLDLR*) and desaturation (e.g., *SCD*) in murine vs. bovine. Thus, it appears that FA uptake from blood, relative to *SREBF1/THRSP*-regulated *de novo* FA synthesis (e.g., *FASN*), and delta-9 desaturation are more relevant processes in the cow. Intracellular FA trafficking also appears more important in bovine mammary as suggested by larger up-regulation of *FABP3*. Comparative analysis revealed unexpected findings such as down-regulation of

GPAM in lactating murine mammary. Murine mammary data might be partly confounded by the greater amount of adipocytes during pregnancy and the beginning of lactation. Care should be taken when inferring phenomena in bovine mammary using murine data.

Key Words: Genomics, Lactation, Metabolism

680 SREBP1 and Spot14 are acutely down-regulated in mammary tissue during abomasal infusion of *trans*-10, *cis*-12 conjugated linoleic acid (CLA) in the dairy cow. K. J. Harvatine*, Y. R. Boisclair, and D. E. Bauman, *Cornell University, Ithaca, NY.*

Trans-10, *cis*-12 CLA is a potent inhibitor of milk fat synthesis in the dairy cow. We have previously reported down-regulation of the mammary mRNA expression of sterol response element binding protein 1 (SREBP1), SREBP1 regulatory proteins, SREBP-regulated enzymes and thyroid hormone responsive spot 14 (S14) during chronic CLA- and diet-induced milk fat depression (MFD). This provides strong evidence for a central role of the transcription factor SREBP and the nuclear protein S14 in the regulation of milk fat synthesis. To distinguish between primary mechanisms regulating milk fat synthesis and secondary adaptations to the reduction in milk fat, we conducted a time-course experiment. An initial priming dose of 7.5 g of CLA was given at time-zero followed by steady state abomasal infusion of 2.5 g every 4 h for 36 h, and then by 3.75 g every 6 h until 120 h. In a separate previously reported experiment we characterized at high resolution the temporal production response to an identical infusion protocol by milking every 4 h with the aid of oxytocin. In the production experiment, milk fat percent progressively decreased over the first 24 h, although the ratio of *de novo* and preformed fatty acids was not modified until after 24-30 h. In the current experiment, mammary biopsies from 9 cows were obtained at -48, 12, 30, and 120 h relative to initiation of CLA infusion. Expression of fatty acid synthase and lipoprotein lipase were decreased at 30 and 120 h compared to control. Expression of SREBP1 and S14 were also decreased at 30 h and 120 h compared to control. Time course analysis during MFD demonstrates that CLA down-regulates master transcriptional regulators of lipid synthesis and their dependent enzymes during the onset of MFD. This provides additional support for SREBP1 and S14 as primary central regulators of MFD.

681 PPAR-gamma activation and *trans*10,*cis*12-CLA affect gene expression profiles and intracellular lipid droplet formation and secretion to different extents in MAC-T cells. A. K. G. Kade-gowda*¹, M. Bionaz², R. E. Everts², H. A. Lewin², L. S. Piperova¹, R. A. Erdman¹, and J. J. Loores², ¹*University of Maryland, College Park*, ²*University of Illinois, Urbana.*

We showed previously that PPAR-gamma activation induces lipogenic gene expression in MAC-T cells. To examine effects of PPAR-gamma activation on large-scale gene expression profiles, RNA from MAC-T cells cultured in triplicate for 12 h with 50 micro molar rosiglitazone (ROSI; PPAR-gamma agonist), 100 micro molar t10c12CLA (CLA; negative control), or ethanol (control) were hybridized to an annotated 13,257 bovine oligonucleotide (70-mers) microarray in a dye-swap design (i.e., 18 microarrays). Lipid droplet (LD) formation was quanti-

fied with Oil Red O staining and concentrations of triacylglycerol (TG) and glucose in culture media measured by commercial kits. ANOVA identified 769 differentially expressed ($P < 0.05$) genes due to treatment. Relative to control, CLA uniquely increased expression by ≥ 1.5 -fold of 47 genes associated with lipid transport (e.g., ADFP, VLDLR) and cellular proliferation (e.g., IGFBP3, SPP1), and decreased expression of 45 genes associated with TG synthesis (e.g., SCD, IDH1, FABP3) and cholesterol synthesis/transport (e.g., HMGCS, LDLR). Similarly, ROSI distinctively affected expression of 32 genes associated with amino acid (e.g., CTH, SLC7A1) and glucose metabolism (PCK2, PFKFB2), and decreased expression of 35 genes associated with cell morphology (e.g., MCAM, WPIF1, ACTN2). CLA resulted in substantially greater LD (350%) accumulation and 3.6-fold more TG in culture media compared with control. ROSI resulted in 1.6-fold more TG in culture media than control, and also lowered glucose relative to control or CLA. Responses to ROSI or CLA for several genes previously measured by qPCR (e.g., LPIN1, FASN, FABP3, SCD) on the same RNA were confirmed. The suggested increase in glucose utilization inferred by microarray data due to ROSI also was confirmed. Paradoxically, CLA promoted intracellular TG accumulation and secretion into culture media via mechanisms that remain to be determined.

Key Words: Genomics, Mammary Cell, PPAR-Gamma

682 *Trans*-10, *cis*-12 conjugated linoleic acid (CLA) induces a dose-dependent reduction in milk fat synthesis in C57BL6J mice. K. J. Harvatine*, M. M. Robblee, Y. R. Boisclair, and D. E. Bauman, *Cornell University, Ithaca, NY.*

Inhibition of milk fat synthesis by fatty acid intermediates originating from rumen biohydrogenation (e.g. *trans*- 10, *cis*- 12 CLA) has been extensively studied in the cow. Inhibition of milk fat synthesis by CLA has also been investigated in rodent models, but a dose response has never been reported. We determined the dose dependent effect of *trans*-10, *cis*- 12 CLA on milk fat synthesis using 24 wild type C57BLJ mice. Starting at 6-8 d of lactation, dams nursing 6-7 pups received daily doses of water (control) or 6, 18, or 54 mg/d of CLA for 5 d. CLA was orally administered in three equal doses. CLA caused a linear decrease in dam feed intake (up to -27%) and pup growth rate (up to -49%). Milk fat percent was progressively decreased up to 20% with the 18 mg/d dose, but the 54 mg dose did not differ from control. All CLA treatments caused a decrease in the concentration of short and medium chain fatty acids in milk fat similar to milk fat depression (MFD) in the dairy cow. In agreement, mammary tissue lipogenesis measured by in vitro tissue incorporation of C14 glucose into fatty acids was decreased at the 18 and 54 mg/d doses. Finally, gene expression was analyzed by real-time PCR for the control and 18 mg/d treatments. Expression of SREBP1, S14, and FASN was decreased by CLA treatment compared to control. We have previously reported decreased expression of SREBP1 and S14 during diet- and CLA-induced MFD in the dairy cow. Overall these data show that MFD can be experimentally induced in the mouse with 18 mg/d of *trans*- 10, *cis*- 12 CLA, although higher doses may cause a more generalized inhibition of milk synthesis. We conclude that the mouse can serve as an experimental model to investigate functional mechanisms mediating the effect of CLA on milk fat synthesis.

Key Words: Milk Fat, Mouse, CLA

683 MammOmics™ in *Sus scrofa*: Uncovering genomic adaptations underlying mammary development during pregnancy and lactation. S. Tramontana^{1,2}, W. L. Hurley², M. Bionaz^{*2}, A. Sharma², D. E. Graugnard², E. A. Cutler², R. E. Everts², P. Ajmone-Marsan¹, S. L. Rodriguez-Zas², and J. J. Loores¹, ¹Università Cattolica del Sacro Cuore, Piacenza, Italy, ²University of Illinois, Urbana.

Elucidating genes controlling growth, development, and metabolism of swine mammary glands can reveal potential metabolic or signaling pathways that might help improve efficiency of milk synthesis. A swine microarray consisting of 13,263 oligonucleotides (70 mer) was used for transcript profiling of mammary tissue from 4-5 sows at -34, -14, -4, 0, 7, 14, 21, and 28 d relative to parturition. Annotation of the microarray was based on similarity searches using BLASTN and TBLASTX against human, mouse, and pig UniGene databases, the human genome, and pig TIGR. Cy3- and Cy5-labelled cDNA from mammary tissue and a reference standard were used for hybridizations. ANOVA (false discovery rate ≤ 0.10) identified 2,664 differentially expressed genes (DEG) due to physiological state. Gene network/pathway analysis revealed that cell growth and proliferation ($n = 548$ genes) and cell signaling ($n = 612$) were among the most affected molecular functions due to physiological state in DEG. A clear switch in metabolic state of mammary gland from pregnancy to lactation was apparent, with up-regulation of genes involved in milk component synthesis (e.g., *LALBA*, *CSN3*, *BTN1A1*) and concomitant down-regulation of genes involved in catabolism and energy production (e.g., *ACOX1*, *NDUFA4*). Peak of lactation (21 d) was characterized by the largest number of DEG with ≥ 1.5 -fold expression (714 up-regulated, 791 down-regulated) relative to late pregnancy (-34 d). A total of 110 transcription regulators with ≥ 1.5 -fold in at least one time point relative to -34 d were identified via gene network analysis. Among these, 14 (e.g., *RARB*, *TP53BP1*) had ≥ 3 -fold up-regulation during lactation relative to pregnancy. The imminent onset of lactation elicited tremendous adaptations in mammary gene expression, including many novel molecular functions. Differential expression of novel transcription regulators might help explain long-term adaptations in mammary gland development and function.

Key Words: Genomics, Sow, Lactogenesis

684 Mammary fat pad but not parenchyma is affected by diet in pre-weaned Holstein heifers. K. M. Daniels^{*1}, S. R. Hill¹, K. F. Knowlton¹, R. E. James¹, M. L. McGilliard¹, A. V. Capuco², and R. M. Akers¹, ¹Virginia Polytechnic Institute and State University, Blacksburg, ²USDA-Agricultural Research Service, Beltsville, MD.

Overfeeding prepubertal heifers may impair mammary parenchymal growth and reduce milk production, but dietary impacts in pre-weaned calves are unknown. This study was to evaluate effects of milk replacer (MR) composition on mass and composition of mammary parenchyma and fat pad (MFP). Twenty-four newborn heifers were fed one of four MR diets ($n=6$ /diet): CON (20% CP, 21% fat MR fed at 441 g DM/d), HPLF (28% CP, 20% fat MR fed at 951 g DM/d), HPHF (27% CP, 28% fat MR fed at 951 g DM/d), and HPHF+ (27% CP, 28% fat MR fed at 1431 g DM/d). Water and starter (20% CP, 1.43% fat) were offered ad libitum. Animals were sacrificed and tissues were harvested on d 63 for analysis of protein, lipid, and DNA. Total mammary gland mass was lowest in CON (CON vs. others; 150 vs. 284 \pm 30 g). Increased feeding (HPHF vs. HPHF+; 288 vs. 379 \pm 30 g) as well as addition of fat to an

isonitrogenous diet (HPLF vs. HPHF; 185 vs. 288 \pm 30 g) increased gland mass. Parenchymal mass (CON, HPLF, HPHF, and HPHF+: 9.2, 11.7, 15.5, 15.1 \pm 3.3 g) was not affected by diet nor was parenchymal composition, or concentrations of protein (4.2 \pm 0.30%), lipid (13.8 \pm 2.2%), and DNA (0.21 \pm 0.02%). However, MFP was markedly affected by diet; MFP mass (CON vs. others; 140 vs. 270 \pm 30 g) and total MFP lipid (37 vs. 144 \pm 25 g) were lowest in CON, whereas total DNA content did not differ (60 vs. 54 \pm 12 mg). Added fat increased MFP mass (173 vs. 273 \pm 30 g), tended to increase total MFP lipid (64 vs. 132 \pm 25 g), but decreased total MFP DNA (84 vs. 42 \pm 12 mg). Increased intake of HPHF increased MFP mass (273 vs. 364 \pm 30 g) and MFP lipid (132 vs. 234 \pm 22 g), but did not affect MFP DNA (42 vs. 37 \pm 11 mg). Total protein in MFP was unaffected by diet, but protein concentration of MFP was highest in CON (CON vs. others; 20 vs. 11 \pm 3 mg/g MFP). Added fat decreased MFP protein concentration (20 vs. 9 \pm 3 mg/g), and increased intake of HPHF had no effect on MFP protein concentration (9 vs. 6 \pm 3 mg/g). In conclusion, diet had no effect on mammary parenchyma, but MFP mass and composition were affected. Implications with respect to future milk production remain to be determined.

Key Words: Heifer, Mammary, Milk Replacer

685 Hormone interactions modulate mammary growth, morphogenesis and local IGF expression in peripubertal gilts. K. C. Horigan¹, J. F. Trott^{1,2}, and R. C. Hovey^{*1,2}, ¹University of Vermont, Burlington, ²University of California, Davis.

Development of the mammary glands is coordinately regulated by hormone interactions during postnatal development. While responses by the mammary gland to the ovarian hormones estrogen (E) and progesterone (P) and pituitary-derived prolactin (PRL) have been characterized across various species, their combined effects have received limited investigation. We therefore determined the individual and combined effects of E, P and PRL on mammary gland growth, morphogenesis and hormone receptor expression in sham-operated and ovariectomized (OVX) peripubertal miniature swine ($n=36$). Females received bromocriptine (Bromo) for 9d after OVX surgery to suppress endogenous PRL. Thereafter females received daily injections comprising all possible combinations ($n=4$ /group) of E, P and/or haloperidol (HAL, to induce PRL secretion) for 5d. Sham-operated females received saline only. The incidence of cells proliferating (BrDU-positive) and expressing E and P receptors (ER and PR) was determined immunohistochemically. Total RNA from mammary glands was analyzed for IGF-I and IGFBP-3 expression by qRT-PCR. OVX plus Bromo blocked proliferation relative to that in Sham controls ($P<.05$) while it was restored by exogenous E. Hal alone failed to stimulate proliferation but positively interacted ($P<.001$) with the effects of E, where maximum proliferation was induced by E+P+Hal. The incidence of ER-positive cells was less when E, P and Hal were administered in combination compared to the individual hormone effects. While E increased PR incidence, this effect was blunted by treatment with P and/or Hal. Expression of IGF-I mRNA in the mammary glands was unaffected by ovariectomy but increased in response to E or Hal. Conversely, E and E+Hal suppressed IGFBP-3 levels, supporting the potential for local modulation of IGF bioavailability. These findings provide important details about the interactive effects of ovarian and pituitary hormones on mammary growth in swine.

Key Words: Mammary Growth, Prolactin, Estrogen and Progesterone

686 Possible involvement of connective tissue growth factor (CTGF) in insulin-like growth factor-I (IGF1) stimulation of proliferation of bovine mammary epithelial cells. Y. Zhou¹, A. V. Capuco², and H. Jiang*¹, ¹Virginia Polytechnic Institute and State University, Blacksburg, ²USDA-ARS, Beltsville, MD.

IGF1 plays an important role in mammary gland development and lactation in part by stimulating proliferation of the milk-producing epithelial cells. In this work, we used the bovine mammary epithelial cell line MAC-T as a model to study the mechanism by which IGF1 stimulates proliferation of the mammary epithelial cells. A microarray analysis revealed that 155 transcripts were up- or down-regulated at least twofold by IGF1 in MAC-T cells ($P < 0.05$). Among the most significantly down-regulated genes was CTGF, a secretory protein that has both proliferative and apoptotic effects, depending on cell type, and also a low-affinity binding protein of IGF1. Quantitative PCR confirmed IGF1 regulation of CTGF and eight other mRNAs in MAC-T cells. Using selective inhibitors of signaling pathways from the IGF1 receptor (IGF1R), it was found that IGF1 suppressed CTGF mRNA in MAC-T cells through the phosphatidylinositol 3-kinase pathway. Administration of growth hormone (GH), a major stimulator of IGF1 production in vivo, decreased mammary expression of CTGF mRNA in cows ($P = 0.07$). However, GH had no effect on CTGF mRNA expression in MAC-T cells, suggesting that IGF1 mediates the reduced expression of CTGF mRNA in the mammary gland. In the absence of IGF1, CTGF stimulated proliferation of MAC-T cells ($P < 0.05$), but in combination with IGF1 it attenuated the stimulation of IGF1 on proliferation of MAC-T cells ($P < 0.05$), and the attenuation was reversed by excess IGF1 ($P < 0.05$). Western blotting analyses indicated that despite being an IGF1 binding protein, CTGF did not affect IGF1-induced phosphorylation of IGF1R or total IGF1R expression in MAC-T cells, indicating that CTGF attenuation of IGF1-stimulated proliferation of MAC-T cells is not mediated by decreasing the ability of IGF1 to activate IGF1R or by decreasing IGF1R expression. Overall, these results suggest a novel biochemical and functional relationship between CTGF and IGF1 in the bovine mammary gland, where IGF1 may inhibit CTGF expression to reduce the attenuating effect of CTGF on IGF1 stimulation of epithelial cell proliferation.

Key Words: IGF1, CTGF, mRNA

687 Stromal changes in the bovine mammary gland during involution and mammogenesis. L. De Vries*, M. VandeHaar, T. Casey, T. Petzke, H. Dover, J. Liesman, and K. Plaut, *Michigan State University, East Lansing.*

The bovine mammary gland undergoes extensive remodeling during involution and mammogenesis between lactations. Changes in mammary epithelium have been well characterized during the dry period, but few studies in dairy cattle have characterized changes in stromal tissue. We hypothesized that stromal fibroblasts are activated and the amount of fibronectin is increased during the dry period to promote remodeling of the mammary gland for the subsequent lactation. Our objective was to determine if changes occur in the number of activated fibroblasts, the percent stromal area, and the expression of fibronectin in the stroma during involution and mammogenesis. Tissue was biopsied from 7 Holstein cows at 4 time points: late lactation, 7 d after dry-off, and at 21 d and 7 d before expected calving date. Smooth muscle α -actin, which is an indicator of activated fibroblasts, and fibronectin were measured by immunohistochemistry with image analysis software. Overall morphology of biopsied tissues was typical of involution and mammogenesis within each cow. The number of activated fibroblasts was similar for the first three time points but tended to increase from 20% to 33% of total fibroblasts between the last two time points ($P=0.04$). The intralobular stromal area decreased relative to the lumen and epithelial area from 48% to 32% between the last two time points ($P<0.01$). Fibronectin expression did not significantly change across time points ($P>0.2$). Based on these preliminary data, we suggest that fibroblast activation may indeed be important for stromal remodeling and that the major changes in the stroma occur in the late stages of the dry period.

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Key Words: Mammogenesis, Involution, Mammary Gland

Meat Science and Muscle Biology: Meat Science Research: Past, Present, and Future

688 ASAS Centennial Presentation: A century of pioneers and progress in meat science leads to new frontiers. D. H. Beermann*, *University of Nebraska, Lincoln.*

Discoveries, understanding and innovations in meat science led to revolutionary changes during the last century in meat and poultry production, processing, marketing and consumption. American Society of Animal Science members made key contributions in most, if not all, categories of advancement. The first U.S. university meat science program started in Minnesota in 1905. Use of mechanical refrigeration in the “meat packing industry”, improved transportation and packaging, and home refrigeration provided more flexibility, variety and consistency of meat and meat products in the early 1900s. Cooperative meat research was started by 27 universities in 1925, with focus on observational characterization of carcass traits and composition, meat quality attributes, and understanding the causes of wide variation in these variables. Scientific study of the genetic, nutritional, and environmental influences on growth, physiology and postmortem biochemistry of muscle often employed muscle-comparative investigations. Rigor mortis, cold shortening and thaw rigor, postmortem muscle metabolism, post mortem tenderization and tenderness variation, and postmortem myoglobin and lipid oxidation were vigorously studied in the 1960s and beyond, defining the biochemical bases for associated outcomes in fresh and processed products. Value-added benefits result from implementation of electrical stimulation, “boxed beef” and modified atmosphere packaging, restructuring technologies, collagen recovery and muscle profiling work. Isolation, purification and defining the primary structure and biophysical properties of the myofibrillar and cytoskeletal proteins in muscle aided understanding of contraction and postmortem changes. The role of calcium-dependent proteases in meat tenderness and muscle growth is being clarified. The chemistry of meat curing, meat emulsion formation, fermentation, and other processing methods led to new technologies, new meat products, and new benchmarks in product shelf-life and quality. Meat safety assurance and our ability to manage the microbiological causes of food-borne illness and spoilage are imminently important now and in the future.

689 Mapping quality attributes within the pork loin. R. M. Smith*¹, M. J. Anderson¹, J. Viguera², E. Huff-Loneragan¹, and S. M. Lonergan¹, ¹*Iowa State University, Ames,* ²*Company Imasde Agroalimentaria, S.L., Madrid, Spain.*

Muscle location has the potential to be a significant source of variation in fresh pork quality. The objective of this study was to investigate how location affects quality attributes within the longissimus dorsi. Forty pork loins aged 10-12 days postmortem were cut into chops from the blade end, center, and sirloin end. Quality attributes were measured on the longissimus dorsi at each location. Hunter L, a, and b values as well as drip loss were measured in duplicate. Intact desmin and pH were also measured in each location. Two instrumental methods used to determine texture were Warner-Bratzler shear (WBS) and star probe (SP). Measurements of SP of the blade were significantly lower ($P<0.01$) than both the center and the sirloin. WBS values of the center were significantly higher ($P<0.01$) than both the blade and the sirloin ($P<0.01$). pH of the sirloin tended to be higher ($P<0.06$) than the blade and was significantly higher ($P<0.01$) than the center. Hunter L and b values both exhibited location differences between the blade and center and between the blade

and sirloin end. There was significantly more intact desmin in blade ($P<0.05$) than in the center and sirloin. Location did not significantly affect drip loss values or Hunter a values. The differences observed between locations for some quality attributes reiterate the importance of sampling from the same location when examining pork quality.

	Blade	Center	Sirloin	Standard error	P-value
Star Probe (kg)	4.27 ^b	5.87 ^a	5.72 ^a	1.49	<0.01
Warner-Bratzler Shear (kg)	2.58 ^b	3.25 ^a	2.82 ^b	1.15	<0.01
pH	5.65 ^b	5.63 ^b	5.71 ^a	0.02	<0.05
Drip (%)	1.05	1.16	1.13	0.06	0.39
Hunter L	57.15 ^a	54.94 ^b	55.03 ^b	0.41	<0.01
Hunter a	7.03	6.94	7.15	0.28	0.88
Hunter b	12.57 ^a	11.75 ^b	11.82 ^b	0.15	<0.01
Intact Desmin	1.53 ^a	1.27 ^b	1.14 ^b	0.09	<0.01

Key Words: Pork Quality, Star Probe, Warner-Bratzler Shear Force

690 Nitrosylation affects the autolysis of μ -calpain. W. Zhang*, S. Lonergan, and E. Huff-Loneragan, *Iowa State University, Ames.*

Nitric oxide is a signaling compound that can interact with cysteine residues and induce protein nitrosylation to regulate protein function and enzyme activities. This study was designed to examine the hypothesis that S-nitrosoglutathione (GSNO) can induce the nitrosylation of the cysteine protease μ -calpain and regulate its autolysis. GSNO is a natural compound which releases nitric oxide (NO) under physiological conditions and is widely used as a NO donor. SDS-PAGE, western blotting and a nitrosylation assay were used to detect autolysis and nitrosylation of μ -calpain that was exposed to GSNO. The five treatments for autolysis were (in order of addition): 1) control: μ -calpain only; 2) μ -calpain+GSNO; 3) μ -calpain+CaCl₂; 4) μ -calpain+CaCl₂+GSNO; 5) μ -calpain+GSNO+CaCl₂. A sixth treatment in which purified μ -calpain was incubated with 10 volumes of 5 mM dithiothreitol (DTT) for 12 hours was also included in the nitrosylation assay. The final calcium concentrations for autolysis and nitrosylation were 0.5 and 1.0 mM respectively. μ -Calpain was purified from porcine skeletal muscle and 0.83 μ g μ -calpain was used for each treatment. GSNO was added at a ratio of 2:1 (w:w) GSNO to μ -calpain. All treatments were incubated with pH 6.5 HEPES on ice for 60 minutes. μ -Calpain autolysis of the 80 kDa subunit was slowed by GSNO especially when it was first exposed to GSNO before calcium. The calpain was less autolyzed in GSNO+calcium treatment after 5 and 10 minute incubations on ice compared with control treatment. Of particular interest was that native μ -calpain was shown to be nitrosylated. Less nitrosylation was detected in the DTT treated group compared with control group showing calpain may be endogenously nitrosylated. More μ -calpain was nitrosylated in both GSNO, calcium+GSNO and GSNO+calcium groups than control group, although the difference was less remarkable in the absence of calcium. These results indicate that μ -calpain could be further nitrosylated by GSNO. The nitrosylation may be involved in regulating the autolysis of μ -calpain.

Key Words: S-Nitrosoglutathione, μ -Calpain, Nitric Oxide

691 Myostatin is associated with marbling in beef cattle. K. R. Underwood*, J. Tong, M. J. Zhu, W. J. Means, and M. Du, *University of Wyoming, Laramie.*

Marbling, or intramuscular fat, is an important factor in beef quality. Myostatin is a member of the Transforming Growth Factor- β family which functions as a negative regulator of muscle growth. Myostatin mutation leads to double muscling cattle. Though the role of myostatin as a negative regulator of skeletal muscle development has been well-established, its role in adipose tissue deposition and adipogenesis is not well defined. Myostatin's role in marbling deposition of beef cattle is unclear. **HYPOTHESIS:** Myostatin is positively associated with marbling in beef cattle. **OBJECTIVE:** To evaluate the role of myostatin in marbling deposition in beef cattle through both *in vivo* study and *in vitro* 3T3-L1 cell culture study. 3T3-L1 cells are commonly used for studying adipogenesis *in vitro*.

Five steers with high intramuscular fat (High IMF, $5.71 \pm 0.36\%$) and five steers with low intramuscular fat (Low IMF, $2.09 \pm 0.19\%$) were selected from a highly uniform group to measure myostatin mRNA expression using RT-PCR and myostatin protein expression using immunoblotting. In addition, 3T3-L1 cells were incubated in DMEM medium with 10% fetal bovine serum. Adipogenesis in 3T3-L1 cells was induced using a standard adipogenic medium composed of DMEM with 10% Fetal bovine serum supplemented with insulin (20 mIU/ml), dexamethazone (0.1 μM), 3-isobutyl-1-methylxanthine (0.5 mM), and troglitazone (10 μM) for 10 days with 0, 2.5, 5.0, 10.0, and 20.0 μM myostatin. Adipogenesis was then assessed by Oil-Red-O staining ($n = 3$).

Myostatin mRNA expression and active myostatin content tended to be higher ($P < 0.10$) in the High IMF steers compared to Low IMF steers. Oil-Red-O staining showed that myostatin levels of 2.5, 5.0, and 10.0 μM increased ($P < 0.05$) adipocytes differentiated into mature 3T3 cells, but 20.0 μM myostatin did not. These data indicate that myostatin is associated with marbling in beef cattle. Therefore, myostatin may be a target that could control muscle growth and marbling deposition in beef cattle.

Key Words: Myostatin, Marbling, Beef

692 ASAS Centennial Presentation: Current and future meat science research needs. T. H. Powell*¹ and R. D. Huffman², ¹*American Meat Science Association, Savoy, IL*, ²*American Meat Institute, Washington, DC.*

Meat science research continues to evolve and adapt to the ever changing needs and resources of the agricultural research community and the livestock and meat processing industries. Recently, meat scientist from academia, government and industry convened to develop a comprehensive set of current research needs and relative priorities in meat science. The initial forum was convened by the American Meat Science Association and the American Meat Institute Foundation during a 1 day research priority symposium at the 2006 Meat Industry Research Conference. Sixty-five scientists from academia, industry and government heard presentations from key thought leaders in four broad research areas:

1. Product Quality
2. Food Safety
3. Processing, Packaging and Ingredients
4. Consumer Needs

Conference participants then worked in break-out groups for each research area. For each area, they brainstormed current research needs, assigned a relative priority score and identified the most urgent needs. Reports from each breakout group were presented at the conference and will be summarized in this presentation. The document was reviewed and updated during a reciprocation session at the 2007 Reciprocal Meat Conference. This presentation will also take a forward look at what challenges lay ahead for meat science research in the future given the changing dynamics of livestock production, meat consumption patterns, and ever increasing limits on available resources for research.

Nonruminant Nutrition: Energy Utilization

693 Effects of enzyme additions to diets with corn- and sorghum-based distillers dried grains with solubles on growth performance and nutrient digestibility in nursery and finishing pigs. C. Feoli¹, J. D. Hancock¹, T. L. Gugle¹, S. D. Carter², and N. A. Cole³, ¹Kansas State University, Manhattan, ²Oklahoma State University, Stillwater, ³USDA/ARS, Bushland, TX.

Two experiments were conducted to determine the effects of enzyme additions on the nutritional value of diets with corn- and sorghum-based distillers dried grains with solubles (DDGS). For Exp. 1, 180 weanling pigs were fed the same starter diet for 10 d and then used in a 27-d growth assay. There were six pigs/pen and six pens/treatment with an average initial BW of 7.5 kg. Treatments were a corn-soy-based control and diets with 30% corn-based (Hudson, SD) and sorghum-based DDGS (Russell, KS) without and with enzymes (a cocktail of beta-glucanase, xylanase, alpha-amylase, and pectinase to supply 150, 4,000, 1,000, and 25 units of activity, respectively, per kg of diet). Pigs fed the control diet had greater ADG and digestibility of DM, N, and GE ($P < 0.003$) than pigs fed the DDGS treatments. Addition of enzymes improved ADG and decreased ADFI for pigs fed corn-based DDGS (DDGS source \times enzyme interaction, $P < 0.08$). However, addition of enzymes improved G:F ($P < 0.08$) and digestibility of DM ($P < 0.04$) regardless of DDGS source. For Exp. 2, 330 finishing pigs (avg BW of 64 kg) were used in a 65-d growth assay. There were 11 pigs/pen and six pens/treatment. Treatments were the same as in Exp. 1 but 40% DDGS were used for the finishing experiment. Pigs fed the control diet had greater ADG and ADFI and digestibility of DM, N, and GE ($P < 0.008$) than pigs fed the DDGS treatments. Pigs fed the corn-based DDGS treatments had greater G:F, digestibility of DM, N, and GE, and iodine value of jowl fat than pigs fed the sorghum-based DDGS treatments ($P < 0.04$). Enzymes improved digestibility of DM, N, and GE ($P < 0.007$), especially for diets with sorghum-based DDGS (DDGS source \times enzyme interaction, $P < 0.10$). In conclusion, rate of gain and nutrient digestibility were decreased with addition of DDGS to diets for nursery and finishing pigs but adding enzymes partially restored those losses.

Key Words: Pig, Distillers Dried Grains, Enzyme Supplementation

694 A multi-substrate enzyme blend for weaned pigs fed corn- or wheat-barley-based diets and its relationship with water acidification. Y. Han¹, A. Humphreys², P. Lessard³, and M. Vignola⁴, ¹Nutreco Canada Agresearch, Guelph, ON, Canada, ²Nutreco Canada West, Winnipeg, MB, Canada, ³Nutreco Canada East, St. Hugues, QC, Canada, ⁴Nutreco Canada Agresearch, St-Roumuald, QC, Canada.

Different non-starch polysaccharides (NSP) exist in corn- or wheat-barley-based diets. This study evaluated the efficacy of a proprietary enzyme blend for both diet types. Two enzyme blends (A; B) targeting multiple NSP substrates were prepared based on *in vitro* studies. The blends were used in two pig studies conducted at two research locations. Exp. 1 used 900 weaned pigs (BW 6.2kg) allocated to 36 pens (25 pigs/pen, 9 pens/treatment, 4 treatments total) at a Manitoba facility. The same phase 1 (0.5kg/pig) and 2 (1.5kg/pig) diets were given to all pigs. In phases 3 and 4, a wheat-barley based control diet was supplemented with a commercial xylanase, Blend A, or Blend B at 0.75, 0.5, or 0.5 kg per tonne, respectively. The trial lasted for 46 days. Exp. 2 was conducted at a Quebec facility, with 918 weaned pigs (BW 5.6kg)

allocated to 54 pens (17 pigs /pen, 9 pens/treatment, 6 treatments total). The same phase 1 and 2 diets were given to all pigs. In phases 3 and 4, a factorial study of 3 (enzymes) \times 2 (with or without water acidification) was conducted. A corn-based control diet was supplemented with a commercial enzyme (xylanase/glucanase, 1.0kg/tonne) or Blend B (0.5kg/tonne). A water acidifier was used at 500ml per 1000kg water. The trial lasted for 42 days. In Exp. 1, Blend B improved overall feed efficiency (FE, $P < 0.03$) compared with the Control (4.7%), the commercial xylanase (5.7%) or Blend A (5.1%) respectively. In Exp. 2, both enzymes significantly improved ADG (7%, $P < 0.01$) and FE (4%, $P < 0.001$) at week 3. The overall performance was similar in all treatments ($P > 0.05$). The acidifier only improved FE (2%, $P < 0.046$) at week 5. There was no interaction between acidification and enzymes ($P > 0.05$). These results demonstrated the potential to use one common enzyme blend for both diet types in weaned pigs, and the response was more pronounced in wheat-barley based diets than in corn-based diets.

Key Words: Weaned Piglets, Enzymes, Multi-Substrate

695 Gastrointestinal ecology of piglets fed diets containing non-starch polysaccharide hydrolysis products and egg yolk antibodies upon challenge with *Escherichia coli* (K88). E. Kiarie*, B. A. Slominski, D. O. Krause, and C. M. Nyachoti, *University of Manitoba, Winnipeg, MB, Canada.*

Gastrointestinal ecology (GE) of piglets fed diets containing non-starch polysaccharide hydrolysis products (HP) and egg yolk antibodies (EYA) against K88 fimbriae upon oral challenge with enterotoxigenic *E. coli* K88 (ETEC) was studied. The HP were generated by incubating a mixture of ethanol-extracted wheat, soybean meal, canola meal and flax with a blend of carbohydrase enzymes. Forty, 21-d old pigs housed in pairs were assigned one of four diets: control (C; devoid of feedstuffs used to generate HP), C + 5 g of HP/kg (HP), C + 5 g of EYA/kg (EYA) or C + 5 g of EYA + 5 g of HP/kg (EYA + HP) in a completely randomized design to give 5 pens per diet. Piglets were fed the experimental diets for 9 d adaptation period. On d 10 all piglets were orally challenged with ETEC. The incidence and severity of diarrhea was determined on a pen basis using a fecal scoring system (1 = no diarrhea to 5 = liquid diarrhea) at 0 h (1 h before challenge), 6, 24, and 48 h post-challenge. At 24 and 48 h post-challenge pigs (1 pig/pen on each occasion) were sacrificed to collect digesta and intestinal tissue. Compared to pigs fed the C diet, pigs fed additives showed low ileal adherent ETEC counts (4.7 vs. 5.5 log₁₀ cfu/g; $P = 0.01$), low digesta ammonia concentration (104 vs. 132 mg/l; $P = 0.002$) and high villi height to crypt depth ratio (2.3 vs. 1.9; $P = 0.05$) which coincided with less (2 vs. 4; $P = 0.01$) scours within 48 h post-challenge. Feeding HP and EYA in combination resulted in higher ($P = 0.0001$) ileal lactic acid than when fed singly whilst pigs fed diets containing HP showed lower gastric pH ($P = 0.03$) and higher ileal adherent lactobacilli counts ($P = 0.01$) than pigs fed the C diet. In conclusion, the results show that HP and EYA modified piglet GE in the presence of ETEC which may explain the mechanisms through which these additives attenuate ETEC-induced secretory diarrhea in piglets.

Key Words: Egg Yolk Antibodies, Piglet Gastrointestinal Ecology, Non-Starch Polysaccharides Hydrolysis Products

696 Expression profiles of iron-related genes in the intestine and liver of young pigs fed three types of dietary inulin. K. Yasuda*¹, H. D. Dawson², E. Wasmuth¹, K. R. Roneker¹, K. Kohn², C. Chen², J. F. Urban², R. M. Welch³, D. D. Miller¹, and X. G. Lei¹, ¹Cornell University, Ithaca, NY, ²USDA-Beltsville Human Nutrition Research Center, Beltsville, MD, ³USDA-ARS U.S. Plant, Soil and Nutrition Laboratory, Cornell University, Ithaca, NY.

Dietary inulin has been shown to improve hemoglobin repletion efficiency in young anemic pigs. To elucidate the mechanism, we compared the expression of 27 Fe-related genes in intestine and liver of pigs fed three types of inulin (BENEO-Orafti, Tienen, Belgium): P95 (oligofructose), HP (long-chain), and Synergy 1 (50:50 mixture of P95 and HP). A total of 20 pigs (5-wk old) were fed a corn-soybean meal based diet (BD) without supplemental inorganic iron, or the BD plus 4% of Synergy 1, HP, or P95. After 5 wks, all pigs were killed to collect total RNA from the liver and mucosa of duodenum, ileum, cecum, and colon. Relative mRNA expression of the 27 genes was quantified using real-time qRT-PCR (ABI 7700, Applied Biosystems, Foster City, CA) and normalized with levels of four housekeeping genes. Dietary inulin affected ($P < 0.05$) 2 genes in the duodenum, 6 genes in the colon, and 7 genes each in the cecum and liver. An additional 1 or 2 genes were marginally affected ($P = 0.06$ to 0.09) by inulin in each of the five tissues. Gene expression of solute carrier family 11 member 1, lactoferrin, and ferritin showed similar responses to dietary inulin in multiple tissues. In conclusion, expression of Fe-related genes was affected by dietary inulin supplementation in young pigs not only in the large intestines but also in the small intestines and liver. The regulatory mechanism and physiological relevance of these responses need further exploration. This project was supported in part by Harvest-Plus, International Food Policy Research Institute (IFPRI) and Centro Internacional Agricultura Tropical (CIAT) and BENEO-Orafti (Tienen, Belgium).

Key Words: Inulin, mRNA, Gene Expression

697 Variation in chemical composition of soybean hulls. F. F. Barbosa*^{1,2}, M. D. Tokach², J. M. DeRouchey², R. D. Goodband², J. L. Nelssen², and S. S. Dritz², ¹Federal University of Viçosa, Viçosa, Minas Gerais, Brazil, ²Kansas State University, Manhattan.

The objective of this study was to examine the variation in chemical composition of soybean hulls. Our goal was to develop regression equations characterizing the nutritive value of soybean hulls for use in swine diets. Samples ($n=39$) were collected from different processing plants across the U.S. and analyzed for CP, GE, crude fiber (CF), ADF, NDF, fat, ash, Ca, and P. One sample was excluded because it contained approximately 10-times the amount of Ca (5.22% vs a mean of 0.57%) as other samples. The results of chemical analysis of the 38 samples were used to determine maximum, minimum, and mean values on a DM basis. Estimated DE values were calculated according to an equation described by Noblet and Perez (1993). Regression equations among the nutrients also were established. A high correlation was observed between CF and CP, with the CF predicting 94.7% of the variation in CP content ($Y = -1.160x + 55.49$; $R^2 = 0.95$). Crude fiber also was highly correlated to ADF ($Y = 1.256x + 0.612$; $R^2 = 0.96$); NDF ($Y = 1.657x + 2.234$; $R^2 = 0.97$); and estimated DE ($Y = -90.86x + 4819$; $R^2 = 0.94$). A high correlation also was observed between CP and estimated DE ($Y = 74.79x + 521.9$; $R^2 = 0.90$). Lower correlations were observed between ash concentration and Ca and P. Also, lower correlations were observed between GE and all the other nutrients. In

summary, the chemical composition of soybean hulls can be highly variable; however, CF content can help explain much of the variation in CP, ADF, NDF, and estimated DE.

Table 1. Nutritional values of soybean hulls on a DM basis

Nutrient	Minimum	Mean	Maximum	SD
Moisture, %	3.39	8.18	9.51	1.16
CP, %	9.90	13.40	29.40	3.99
GE, kcal/kg	4036	4375	4825	177
Est. DE, kcal/kg	1166	1553	2654	365
CF, %	23.90	36.30	39.90	3.35
ADF, %	30.20	46.20	50.50	4.30
NDF, %	41.50	62.40	68.00	5.36
Fat, %	0.70	1.70	4.50	0.90
NFE, %	39.50	42.70	44.90	1.40
Ash, %	4.50	5.30	6.70	0.50
Ca, %	0.46	0.57	0.76	0.06
P, %	0.11	0.16	0.35	0.05

Key Words: Nutritive Value, Soybean Hulls

698 Influence of soybean hulls on active nutrient transport in the gastrointestinal tract of nursery pigs. D. M. Sholly*¹, B. E. Aldridge¹, J. G. Stevens¹, L. L. Snyder¹, J. S. Radcliffe¹, K. E. Bach Knudsen², A. L. Sutton¹, and B. T. Richert¹, ¹Purdue University, West Lafayette, IN, ²University of Aarhus, Tjele, Denmark.

Twenty four barrows and 24 gilts (initial BW=5.65 kg) were used to determine the influence of adding soybean hulls (SH) to nursery pig diets on active nutrient absorption. Pigs were weaned at 17 d of age, blocked by BW, sex and ancestry, and housed in individual pens (0.41×0.86 m). All pigs were provided ad libitum access to a common, pelleted phase 1 diet (d 0-5) followed by a phase 2 diet (d 6-10) in meal form. Pigs were then fed experimental diets for an additional 15-18 d: 1) Control, C; 2) C + 3% SH; 3) C + 6% SH; and 4) C + 12% SH. Diet C (20.5% CP, 1.1% Lys) was corn-SBM based with 10.75% starch, 5 % lactose, 4% fish meal, and 1.25% soy concentrate. Soy hulls were added to experimental diets in place of starch and soy concentrate. Experimental diets were fed at 9% metabolic BW and intake was adjusted every 4 d. After 15, 16, or 18 d of feeding the experimental diets, pigs were euthanized. Jejunal tissue was removed, mounted in modified Ussing chambers, and active nutrient absorption was estimated based on changes in transepithelial short circuit current (Isc) following mucosal challenges with 10 mM glucose (Glc), phosphorus (P), and glutamine (Gln). Osmotic balance was maintained by adding mannitol to the serosal chamber. Overall ADG (0.36 kg/d), ADFI (0.53 kg/d), G:F (0.68) and active transport of P and Gln were not affected by diet or sex ($P > 0.10$). Active Glc transport tended ($P < 0.10$) to be increased in pigs fed diets containing 6% SH (59.3 $\mu\text{A}/\text{cm}^2$) compared to diets with 0 or 3% SH (36.1 $\mu\text{A}/\text{cm}^2$; 34.2 $\mu\text{A}/\text{cm}^2$, respectively), with pigs fed diets containing 12% SH (53.8 $\mu\text{A}/\text{cm}^2$) being intermediate. In summary, enhanced Glc transport observed with the addition of 6% SH could be due to changes in gastrointestinal morphology or an increased abundance of membrane bound SGLT1 resulting from decreased Glc concentrations in the 6% SH diets.

Key Words: Soybean Hulls, Active Nutrient Transport, Pigs

699 Carbohydrate X gut environment modifier interaction in weaned pigs. B. V. Lawrence*, R. J. Harrell, R. A. Anderson, and F. Navarro, *NOVUS International Inc, St. Louis, MO.*

A 21-d nursery trial was conducted to evaluate the interaction of carbohydrate source and ACIDOMATRIX™ LowLac (LowLac), a blend of organic acids, MOS, esters of butyrate, and ethoxyquin, in medicated (Carbadox) weaned pig diets. Pigs (6.16±0.98 kg) were blocked by weight and sex to pen (23 pigs/pen). Pens were assigned to one of 5 treatments (6 reps/trt) fed from day 0-21 postweaning in 2 diet phases. Treatments were 1) Ctrl (20/10% lactose) 2) Neg1 (5/2.5% lactose) 3) LowLac (10/2.5% lactose+0.69% Low-Lac), 4) Alt1 (10/2.5% lactose+0.69% Low-Lac+10/7.5% alternate CHO), and 5) Alt2 (5/2.5% lactose+0.69% Low-Lac+15/7.5% alternate CHO). The alternate CHO was a hydrolyzed sugar, predominantly dextrose. Lactose replaced was from whey permeate. Day 0-7 gain was greater ($P<0.01$) for Ctrl (175 g/d) than for Neg1 (115 g/d), Low-Lac (131 g/d) or Alt2 (136 g/d) pigs. Alt1 pigs (167 g/d) gained faster ($P<0.05$) than either Neg1 or Low-Lac pigs. Gain/feed was lower ($P<0.05$) for Neg1 (0.67) and Low-Lac pigs (0.72) than for Ctrl (0.85) and Alt1 (0.82) pigs. Day 7-21 gain and intake were similar ($P>0.10$) among treatments. Gain/feed day 7-21 was lower ($P<0.01$) for Ctrl pigs compared with other treatments. Day 0-21 gain and intake were not different ($P>0.10$) among treatments. Low-Lac pigs had a higher ($P<0.05$) day 0-21 gain/feed (0.79) than Ctrl (0.75) pigs. Alt2 pigs had a higher ($P<0.05$) gain/feed (0.80) than either Ctrl or Neg1 (0.77) pigs. Day 0-7 feed cost/kg (FCKG) gain was not different ($P>0.10$) among treatments averaging \$0.986±0.14. Ctrl pigs had the highest day 7-21 FCKG (\$0.681), which was higher ($P<0.05$) than for Alt1 (\$0.638) and Alt2 (\$0.639) pigs which were in turn greater ($P<0.05$) than for Neg1 (\$0.564) and Low-Lac (\$0.586) pigs. For the 21-d period, Ctrl pigs had a higher ($P<0.05$) FCKG (\$0.737) than Alt2 (\$0.695), Low-Lac (\$0.662) and Neg1 (\$0.633) pigs. Alt1 pigs had a similar FCKG (\$0.707) compared to Ctrl and Alt2, but higher ($P<0.05$) FCKG than Neg1 and Low-Lac pigs. These results demonstrate importance of CHO source day 0-7 postweaning and suggest use of ACIDOMATRIX Low-Lac with low lactose diets may be economically advantageous.

Key Words: Lactose, Pigs, ACIDOMATRIX

700 Dietary fatty acids can alter markers of inflammation in cartilage and synovial fluid from multiparous sows. C. I. O'Connor-Robison*¹, J. M. Mapes¹, J. D. Spencer², and M. W. Orth¹, ¹Michigan State University, East Lansing, ²JBS United, Sheridan, IN.

Dietary long chain polyunsaturated fatty acids (LCPUFA) including arachidonic acid, eicosapentaenoic acid, and docosahexaenoic acid can alter the production of inflammation mediators. The objective of this study was to characterize the effects of dietary LCPUFA supplementation on indices of cartilage degradation and inflammation in porcine IL-1 beta (pIL-1) stimulated porcine articular cartilage explants. Sows (7 sows/trt) were fed either control corn/soybean meal based diets or the control diet supplemented with 0.75% protected LCPUFA (Gromega 365™; JBS United, Sheridan, IN) during gestation and 1.0% protected LCPUFA throughout lactation for a minimum of 4 parities prior to tissue collection. The cartilage explants (6 mm diameter) were biopsied from the right and left humeral-ulnar joints of fourteen sows within 36 h of slaughter. Synovial fluid was collected from the right carpal joint of

each sow post-mortem. Cartilage explants were allocated to 24-well culture plates with 2 discs per well, 12 wells/sow and cultured over 72 h. Serum free medium (1 mL/well) consisted of Gibco D-MEM:F-12, amino acids, ascorbic acid, and antibiotics. Explants were incubated at 37°C. Six wells per sow were treated with 10 ng/mL of pIL-1. At 24, 48 and 72 h of culture, media were removed from each well and reserved for analysis. Media were analyzed for proteoglycans (PG), nitric oxide (NO), interleukin-6 (IL-6), and prostaglandin E2 (PGE₂) concentrations. The addition of LCPUFA to the diet tended to decrease PG release compared to control (340 vs. 460 ± 45 µg PG/well) when explants were stimulated with pIL-1 (trt x diet effect; $P=0.075$), suggesting a reduction in cartilage degradation. However, LCPUFA, did not alter NO or IL-6 release. Overall, cartilage enriched with LCPUFA tended to have increased PGE₂ release when stimulated with pIL-1 (430 ± 100 pg/mL) compared to control (180 ± 100 pg/mL; $P=0.09$). There was a trend for the LCPUFA fed sows to have elevated levels of PGE₂ in their synovial fluid (270 vs. 1060 ± 300 pg/mL; $P=0.10$). Thus, dietary LCPUFA supplementation can have an effect on the synthesis of at least some inflammatory mediators in both porcine cartilage and synovial fluid.

Key Words: Swine, Cartilage, Inflammation

701 Effect of pelleting and fat content on energy value of corn for pigs. J. Noblet* and Y. Jaguelin, *INRA, Saint Gilles, France.*

The energy value of ingredients for swine depends on their chemical composition, the technological treatment and the BW of animals. The objective of two trials was to measure the DE content and nutrients digestibility of 5 corn samples either as mash or after pelleting (55-65°C); corns differed mainly for their fat (EE) content. Corn was either fed alone with a minerals and vitamins complement (trial 1, 3 corns; 3 diets) or included at 35% in a basal corn and soybean meal diet (2 corns; 3 diets); in this latter case, the energy value of the basal diet was also measured and the energy value of corn was obtained according to the difference method. Diets (n=6) were fed for 3 wk to pigs weighing 55 kg at the start of the trials (5/treatment) as mash feed or as pellets. Excreta were collected for the last 10 d. Average (min-max) chemical composition of corns (% of DM) was: 1.5 (1.4-1.8) % ash, 9.3 (7.8-11.7) % CP, 6.1 (3.5-10.8) % EE and 68.9 (60.4-73.4) % starch; the GE content was 19.19 (18.42-20.29) MJ/kg DM. Pelleting improved fecal digestibility of nutrients and energy of diets ($P<0.01$); this improvement depended on diet characteristics ($P<0.01$). The average fecal digestibility coefficients (%) of organic matter, energy, crude protein and EE of corns were 89.9 and 91.4, 86.9 and 90.0, 81.0 and 84.0 and 57.0 and 78.1 for mash and pelleted forms, respectively. The corresponding DE contents were 16.66 and 17.26 MJ/kg of DM. The difference in DE value between both presentations depended on corn EE content. The DE value of corn (MJ per kg of DM) can then be predicted as 16.44 + 0.038 EE and 16.44 + 0.133 EE for mash and pellet presentations, respectively (EE as % of DM); the corresponding equation for GE was: 17.72 + 0.241 x EE. Data on nutrients digestibility indicate that the improvement in energy digestibility and energy value of corn due to pelleting is exclusively related to a higher EE digestibility. In conclusion, the DE content of corn depends linearly and positively on its EE content and the relationship is dependent on the form of presentation.

Key Words: Pig, Energy Value, Corn

702 Interaction of dietary protein and energy on growth performance in finishing barrows. P. M. Cline*, C. R. Dove, and M. J. Azain, *University of Georgia, Athens.*

The objective of this study was to determine the performance response to changes in dietary fat and protein content in finishing barrows. Previous work has shown that increases in dietary energy density result in decreased feed intake. The experiment was conducted in 3 trials of 18 pens each (4 pigs/pen, total n=216). Within each trial, barrows (PIC C42 × 280, initial wt. = 84 kg) were blocked by weight and assigned to one of 9 experimental diets in a 3 × 3 factorial arrangement, with main effects of crude protein (12, 16, 20%, lysine: 0.60, 0.80, 1.00%) and added Fat (1, 6, 11%). The lowest protein diet with 1% added fat, met the NRC recommendations for pigs in this weight range. Body weight, intake and efficiency were determined initially and on d 14 and 28. There were no significant interactions of dietary protein and fat. There was a main effect of dietary protein on gain ($P < 0.02$). Average daily gain increased as dietary protein increased from 12 (1.04 kg/d) to 16% CP (1.12 kg/d), but no further increase was observed at 20% CP (1.12 kg/d). There were no effects of protein level on feed or caloric intake or on gain:feed ratio ($P > 0.10$). There were main effects of dietary fat on gain ($P < 0.05$), caloric intake ($P < 0.01$) and efficiency ($P < 0.01$). Gain was not different in pigs fed 1 (1.06 kg/d) or 6% added fat (1.07 kg/d), but was increased in pigs fed 11% fat (1.15 kg/d). Daily caloric intake was increased as dietary fat level increased from 1 to 11% (10.5, 10.8 and 11.8 Mcal/d). Gain:feed ratio improved linearly with fat addition (0.33, 0.35 and 0.37). Serum urea, determined at the end of the feeding period, increased as dietary protein increased ($P < 0.01$), but was not affected by dietary fat. These results contradict earlier research that demonstrated decreased feed intake with increasing dietary fat level.

Key Words: Energy Intake, Pigs

703 Effect of crude protein concentration and sugar beet pulp on nutrient digestibility, nitrogen excretion, intestinal fermentation and manure ammonia and odour emissions from finisher pigs. M. B. Lynch*, C. J. O'Shea, T. Sweeney, J. J. Callan, and J. V. O'Doherty, *University College Dublin, Newcastle, Co. Dublin, Ireland.*

A 2x2 factorial experiment was used to investigate dietary crude protein (CP) (200 vs 150 g/kg) and sugar beet pulp (SBP) (200 vs 0 g/kg) on nutrient digestibility, nitrogen (N) excretion, intestinal fermentation and manure ammonia and odour emissions from 24 boars. Pigs offered SBP-containing diets had a reduced digestibility of N (0.822 vs 0.868; $P < 0.05$) and gross energy (0.851 vs 0.872; $P < 0.05$) and an increased digestibility of neutral detergent fibre (0.706 vs 0.558; $P < 0.001$) compared with pigs offered diets containing no SBP. There was an interaction between CP and SBP on the urine: faeces N ratio. Pigs offered the 200 g/kg CP SBP-based diet reduced the urine: faeces N ratio ($P < 0.05$) compared with those offered the 200 g/kg CP diet without SBP. However there was no effect of SBP in pigs offered 150 g/kg CP diets. Manure ammonia emissions were reduced (71.26 vs 107.23 gNH₃/gN intake; $P < 0.01$), however odour emissions were increased (3544.7 vs 2084.1 OuEm-3; $P < 0.05$)

when pigs were offered SBP diets. Decreasing dietary CP to 150 g/kg reduced total N excretion (19.96 vs 34.65 g/day; $P < 0.001$) and ammonia emissions (76.98 vs 101.51 gNH₃/g N intake; $P < 0.05$). There was an interaction between dietary CP and SBP on isovaleric acid ($P < 0.01$) and branch chain fatty acids ($P < 0.001$) in caecal digesta. Pigs offered the 200 g/kg CP SBP-containing diet reduced isovaleric acid and branch chain fatty acids in the caecum compared with pigs offered the 200 g/kg CP diet containing no SBP. However there was no effect of SBP in the 150 g/kg CP diet. In conclusion, pigs offered SBP-containing diets had a reduced manure ammonia emissions and increased odour emissions compared with diets containing no SBP. Pigs offered the 200 g/kg CP SBP-containing diet had a reduced urine: faeces N ratio compared with those offered the 200 g/kg CP diet containing no SBP.

Key Words: Sugar Beet Pulp, Ammonia, Odour

704 Effect of insoluble and soluble dietary fiber on the standardized ileal digestibility of protein and selected amino acids in growing pigs. V. Halas*¹, G. Végvári², and L. Babinszky¹, ¹*Kaposvár University, Kaposvár, Hungary,* ²*Corvinus University of Budapest, Budapest, Hungary.*

Dietary fiber is a diverse fraction of feed, its mode of action in the digestive process depends on its solubility. Our trial was aimed at studying the effect of insoluble and soluble fiber on the standardized ileal digestibility (SID) of protein (CP) and selected amino acids (AAs).

A total of 24 simple T-cannulated barrows (45 kg LW) were used in 2 replicates. Dietary treatments consisted of supplementing the basal corn-soybean diet with 0, 100, 200, 300 g/kg wheat bran (WB) or sugar beet pulp (SBP) as sources of insoluble and soluble fiber, resp. All diets were formulated according to the NRC (1998) recommendations with 5 g/kg Cr₂O₃. Insoluble and soluble non-cellulosic polysaccharide (I, S) content of the diets was between 61-116 g/kg and 19-127 g/kg, resp. The trial consisted of a 14-day adaptation and a 3x12-hour collection period. The SID of CP and AAs were calculated as AID+EndogenousAA [g/DMI kg]/FeedAA [g/DM kg], where AID is the apparent ileal digestibility of CP or AA. Endogenous CP and AA losses were determined in a separate study. The fiber source and dose effects were analyzed by ANOVA, the effect of dietary S and I content on SID values were computed by linear regression (SAS, 2004).

Inclusion of SBP reduced the SID of CP, Lys, Thr and Trp from .84, .85, .73 and .96 to .76, .78, .58 and .88, resp. Increasing the level of SBP did not change the SID of CP and AAs. Inclusion of WB did not reduce the SID values significantly. Increasing WB from 0 to 300 g/kg reduced the SID of Lys from .85 to .74 ($P \leq 0.05$). The regression model showed that SID of CP was affected by I and S, SID of Cys by I and SID of Thr and Trp by S ($P \leq 0.05$).

In conclusion, SBP but not WB reduces the SID of CP and some AAs, however, no dose response was observed. The effect of soluble and insoluble fiber has to be quantified and considered in diet formulation when fiber rich feedstuffs are used.

Key Words: Dietary Fiber, Pig, Digestibility

Nonruminant Nutrition: Feed Additives II

705 Effects of dietary supplementation of benzoic, formic, and lactic acids on nitrogen balance of pigs. B. J. Min^{*1}, D. A. Monson², J. O. Vaughn³, and S. W. Kim¹, ¹North Carolina State University, Raleigh, ²Texas Tech University, Lubbock, ³Emerald Performance Materials, Kalama, WA.

A total of 384 pigs was used to evaluate the effects of benzoic acid supplementation on nitrogen balance of pigs compared to antibiotics and organic acids. Pigs were weaned at 21 d of age and fed 7 diets for 5 wk based on 3 phase feeding program following nutrient requirements from NRC. There were 8 replicates per treatment and 8 pigs per pen. Treatments were **NC**: negative control without any supplements; **PC**: positive control with Aureomycin during phase 1, 2, and 3 and Tylan during phase 4, 5, and 6; **BA**, and **BB**: benzoic acid supplementation groups with 0.5 and 1.0% benzoic acid (KalamaTM BA Feed, Emerald Performance Materials, Kalama, OR), respectively; and **OA** and **OB**: organic acid supplementation groups with 0.5 and 1.0% organic acids at 1:1 ratio of formic acid and lactic acid. At the end of 5 wk feeding, each pig representing the average body weight of each pen was selected and housed individually in metabolism crates for 4 d adjustment period followed by 5 d collection periods of fecal and urine samples to measure nitrogen balance (n=8). Fecal samples were weighed, freeze dried, ground, and analyzed for nitrogen content. Urine samples were analyzed for nitrogen content. Nitrogen digestibility of PC (83.3%), BA (84.3%), BB (85.1%) was greater (P<0.05) than NC (79.3%). Nitrogen digestibility of OA (82.3%) and OB (82.5%) did not differ to other treatment groups. Nitrogen digestibility of PC, BA, and BB did not differ among each other. The percentages of nitrogen retained in the body were 52.4, 54.6, 61.1, 68.6, 66.8, and 55.7% for NC, PC, BA, BB, OA, and OB, respectively and did not differ among treatment groups. This study shows that dietary benzoic acid supplementation improves the digestion of proteins by pigs.

Key Words: Benzoic Acid, Organic Acid, Pigs

706 Dietary energy density affects response to a dry organic acid blend in late nursery pigs. R. J. Harrell^{*}, B. V. Lawrence, R. Anderson, F. Navarro, and C. D. Knight, *Novus International Inc., St. Charles, MO.*

Meeting dietary energy requirements has become more difficult for swine producers due to ingredient availability and increased cereal grain costs. Organic acids have successfully improved performance of early nursery pigs, especially in non-medicated diets. Previously, we reported improvements in gain by increased feed intake in grow-finish pigs fed a dry organic acid blend (DOAB, ACTIVATE[®]DA). The present trial evaluated the interaction of DOAB and dietary energy density. Forty pens of pigs with an initial weight of 11.5±0.22 kg (21 days post-weaning) were randomly assigned in a 2 x 2 factorial (n = 10 pens/treatment) to energy density (3460 vs. 3280 kcal ME/kg) and DOAB (0 vs. 0.3%) for a period of 21 days. Diets medicated with Carbadox 25 g/ton were formulated to provide a similar level of nutrients other than energy. High energy diets were a corn-SBM diet with 4% choice white grease. Low energy diets contained 10% wheat midds and 1% choice white grease. Ending bodyweights (24.21 vs. 24.12±0.51 kg; P> 0.90), ADG (602 vs. 597±9 g/d; P> 0.69), or ADFI (922 vs. 929±16 g/d; P> 0.74) were not different for high vs. low energy, respectively. High energy diets had

1.5% greater GF than low energy diets (0.653 vs. 0.643±0.003; P<0.01). The DOAB did not affect final bodyweights (24.18 vs. 24.15±0.51 kg; P> 0.95), ADG (601 vs. 598±9 g/d; P> 0.84), or ADFI (935 vs. 917±15 g/d; P> 0.41), but increased GF by 1.6% (0.643 vs. 0.653±0.003; P< 0.01), for 0 vs. 0.3% DOAB, respectively. The DOAB tended to interact with dietary energy density in GF (P = 0.11) with a greater improvement in GF in low (2.5%), but not in high energy diets (0.5%). These results indicate that DOAB improves GF and can mitigate the loss of performance associated with feeding lower energy dense diets.

Key Words: Energy, Organic Acids, Swine

707 Effect of phytobiotics and acidifiers on the performance of post-weaning piglets. Y. Acosta Aragón^{*1}, T. Steiner¹, R. Castillo², and M. Lopez³, ¹Biomim GmbH, Herzogenburg, Lower Austria, Austria, ²Universidad Zamorano, Tegucigalpa, Honduras, ³Biomim America Inc, Guatemala City, Guatemala.

The aim of this study was to investigate the effects of an acidifier (blend of propionic and formic acid) and phytogenics (blend of essential oils) as well as their combination on feed intake (FI), average daily weight gain (ADWG), feed conversion ratio (FCR) and incidence of diarrhea. 262 piglets (Duroc x Landrace x Yorkshire), weaned at 21 days of age, were distributed to 5 treatments: I- negative control (without additive), II- positive control (combination of tiamulin + chlortetracycline, 2 kg/t), III- acidifier (3 kg/t), IV- phytogenic (1 kg/t), and V- acidifier and phytogenic (3 and 1 kg/t, respectively). Feed was offered ad libitum. A completely randomized design was used with 5 replicates per treatment. The study was divided in two phases: Phase I (28th to 42nd day), phase 2 (43rd to 70th day).

In phase 1, significant (p<0.05) differences were obtained in overall weight gain. The best treatments were I, III and V (3.1, 2.1 and 2.6 kg). Also, ADWG in phase 1 differed significantly (p<0.05) between treatments, with 216 and 176 g/day for the treatments I and V. Overall weight gain was numerically higher in the treatments III, IV and V (16.3, 16.0 and 16.4 kg) compared to treatments I and II (15.3 and 15.4 kg); as well as in the final BW (22.9, 23.2 and 23.6 vs. 22.6 and 22.1 kg, respectively). Overall FI was 713, 684, 731, 651 and 744 g/d (p>0.05) in treatments I through V, respectively, and overall FCR was 2.0, 1.9, 1.9, 1.7, and 1.9 (p>0.05), respectively.

In conclusion, the use of adequately designed phytogenics and acidifiers represents an alternative to the use of antibiotic growth promoters.

Key Words: Piglets, Phytobiotic, Acidifier

708 Gut environment modifier x lactose interaction in weaned pigs. J. Lampe¹, B. V. Lawrence^{*2}, R. J. Harrell², G. Gourley¹, R. A. Anderson², and F. Navarro², ¹Swine Graphics Enterprises, Webster City, IA, ²NOVUS International Inc, St. Louis, MO.

ACIDOMATRIXTM LowLac (LowLac), a blend of gut environment modifiers including organic acids, MOS, esters of butyrate, and ethoxyquin, was evaluated in low lactose nursery diets fed for 14-d. Pigs (350) were blocked by weight (5.47±0.24 kg) and sex to pen (11 pigs/pen). Pens were assigned to one of 4 treatments (8 reps/trt) fed

from day 0-14 postweaning in two budget phases (1.36 kg/pig Phase 1 (7-d); 2.27 kg/pig Phase 2 (7-d)). Treatments were 1) Ctrl (19.2/12.2% lactose) 2) Neg1 (5 and 2.5% lactose) 3) LowLac (10/2.5% lactose + 0.69% Low-Lac, 4) Neg2 (10/2.5% lactose). Lactose replaced was from whey permeate. Diets contained 100 g/ton CTC. Zn from ZnO was supplemented at 3,240 ppm Phase 1 and 2,160 ppm Phase 2. CuSO₄ was added at 0.05% Phase 1 and 0.075% Phase 2. LowLac gain (178 g/d) day 0-7 postweaning tended ($P < 0.10$) to be greater than both Neg1 (147 g/d) and Neg2 (161 g/d) gains and was similar to Ctrl (163 g/d). Day 0-7 intake was not different ($P > 0.10$) among treatments. LowLac gain/feed day 0-7 (0.97) tended ($P < 0.10$) to be greater than Neg1 (0.84), Ctrl (0.89) and Neg2 (0.89) gain/feed. Ctrl gain (339 g/d) day 7-14 was greater ($P < 0.001$) than LowLac (291 g/d) which was greater ($P < 0.01$) than Neg1 (251 g/d). Neg2 gain (269 g/d) was intermediate to LowLac and Neg1. Day 7-14 gain/feed was poorer ($P < 0.05$) for Neg1 (0.78) and Neg2 (0.79) than for Ctrl (0.91). LowLac gain/feed was intermediate (0.84). Intake day 7-14 followed a similar pattern to gain. Over the 14-d feeding period, Neg1 and Neg2 gains were similar (199 and 215 g/d) and were lower ($P < 0.01$) than LowLac gains (236 g/d) which were lower ($P < 0.01$) than Ctrl gains (258 g/d). Neg1 and Neg2 pigs day 0-14 gain/feed (0.81 and 0.83 respectively) was lower ($P < 0.05$) than gain/feed for LowLac (0.88) and Ctrl (0.90) pigs. Day 0-7 feed cost/kg gain (FCKG) was \$0.15 - \$0.17/kg higher ($P < 0.01$) for Ctrl vs. other treatments. Day 7-14, FCKG for Ctrl (\$0.55/kg) was higher ($P < 0.05$) than for Neg2 (\$0.50/kg) with Neg1 (\$0.54) and LowLac (\$0.51/kg) being intermediate. These results demonstrate that low lactose diets may be economically fed when accompanied by ACIDOMATRIX LowLac.

Key Words: Lactose, Pigs, Organic Acids

709 Effect of antimicrobial growth-promoters in diets of nursery pigs on growth performance and the development of antibiotic resistant bacteria. J. P. Holt*, E. van Heugten, A. K. Graves, M. T. See, and W. E. M. Morrow, *North Carolina State University, Raleigh.*

A study was conducted with 40 weaned pigs (BW = 5.0 ± 0.8 kg), from a herd kept antibiotic-free for 33 years, to determine the effect of growth-promoting antimicrobials on performance and antibiotic resistance. Pigs were assigned by weight to one of four diets (10 pigs per diet) consisting of a control (CON), or diets containing high levels of zinc (ZN) from ZnO (3000 ppm for 2 wk, 1500 ppm for 3 wk), 240 ppm copper (CU) from CuSO₄, or 110 mg/kg (AB) each of tylosin (TYL) and sulfamethazine (SUL). Feces was collected from 16 pigs (4 per diet) from d 0 to d 7, and on d 14, 24, 31 and 38 for isolation of *E. coli* and *Enterococcus* (ENT). Resistance to TYL, SUL, erythromycin (ERY) and neomycin (NEO) was tested. Performance was unaffected by diet ($P > 0.05$). On d 7, ENT resistant to TYL was greater for AB (23%) than CON (5.8%), CU (0%), or ZN (3.7%; $P < 0.05$). On d 14, ENT resistance to TYL and ERY, respectively, was greater for AB (39, 37%), CU (50, 50%), and ZN (41, 40%) than CON (4.7, 6.6%; $P < 0.05$). On d 14, NEO resistance in ENT was greater for CU (50%) and ZN (45%) than CON (5.3%) and AB (0.9%; $P < 0.05$). On d 38, ENT resistance to TYL and SUL, respectively, was greater for AB (73, 76%) than CON (6.3, 52%) and CU (9.3, 50%; $P < 0.05$). On d 38, ENT resistance to ERY was greater for AB (69%) than CON (9.4%) and CU (12%; $P < 0.05$). *E. coli* resistance to TYL was greater for AB (55%) than CON (26%), CU (20%), or ZN (8.5%) at d 4 ($P < 0.05$), but on d 38, resistance was greater for CU (60%) than CON (34%), AB (28%), or ZN (28%; $P < 0.05$). *E. coli* resistance to SUL was greater for AB (33%) than CON (12%) at d 1 ($P < 0.05$) but on d 7, resistance was lower for AB

(5.5%) than CON (32%). NEO-resistant *E. coli* were isolated only from pigs fed AB (6.3%). Development of antibiotic resistant bacteria can be increased by feeding antimicrobial growth-promoters, but resistant bacteria are present regardless of their use.

Key Words: Antibiotic Resistance, *Enterococcus*, *E. coli*

710 Kinetics of glucose absorption is affected by dietary oat β -glucans in portal-vein catheterized grower pigs. S. Hooda*¹, J. J. Matte², T. Vasanthan¹, and R. T. Zijlstra¹, ¹University of Alberta, Edmonton, AB, Canada, ²Agriculture and Agri-Food Canada, Lennoxville, QC, Canada.

Kinetics of nutrient digestion and absorption may impact intestine health and metabolic status and has, unlike nutrient digestibility, not been studied thoroughly in swine. A catheterized grower pig model was used to study effects of dietary β -glucans on net glucose absorption, which excludes glucose utilization by the gut. Three 35-kg pigs were surgically modified with catheters in the hepatic portal vein and carotid artery and an ultrasonic blood flow probe around the portal vein. Catheters were flushed daily with heparinized saline (200 IU/L). After 10 d, pigs were fed 3 wheat and soybean-based diets containing 0 (control), 3, and 6% concentrated oat β -glucans for 6 consecutive 7-d periods in a double Latin square design. Feed was offered twice daily at 12 h-intervals. On d 7 of each period, serial blood samples were taken for 12 h postprandially: every 15 min from -15 to 60 min, then every 30 min to 240 min, 60 min to 480 min, and at 600 and 720 min; blood flow was measured simultaneously. Plasma was analyzed for glucose. Glucose absorption rate was calculated from blood (via plasma and hematocrit) portal-arterial differences x blood flow. Carotid artery glucose and portal blood flow were not affected by diet, but changed with time ($P < 0.001$). Preprandial portal glucose was 8 mmol/L and increased postprandially to 16 mmol/L, with highest peak for the control diet ($P < 0.05$). Diet influenced ($P < 0.05$) glucose absorption rate at 15, 30, and 60 min postprandial, and was highest for the control diet. Net glucose absorption during first h after feeding was reduced ($P < 0.05$) by β -glucans; 3 and 6% β -glucans did not differ. Diet did not affect daily net glucose absorption (3464, control; 3216, 3% β -glucans; and 3357 mmol/d 6% β -glucans). The impact of reduced elevations of portal blood glucose on systemic utilization of nutrients requires further study; however, oat β -glucans clearly affect the kinetics of glucose absorption, but not daily net glucose absorption.

Key Words: β -Glucans, Glucose Absorption, Pig

711 Evaluation of ractopamine dose and feeding duration on growth performance and carcass characteristics of late finishing market pigs. R. B. Hinson*¹, G. L. Allee¹, M. J. Ritter², C. W. Parks², and S. N. Carr², ¹University of Missouri, Columbia, ²Elanco Animal Health, Greenfield, IN.

The study objective was to compare various doses and durations of ractopamine hydrochloride (RAC; Paylean®, ELANCO Animal Health, Greenfield, IN) on growth performance and carcass characteristics. Late finishing pigs with an average starting weight of 93 kg were allotted to 12 treatments. Treatments consisted of two control diets: negative control (NEG; 13.13 % CP, 0.64 TID Lys), positive control (POS; 17.77

% CP, 0.94 TID Lys); two RAC diets 5 ppm or 7.4 ppm with pigs receiving RAC for 7, 14, 21, 28, or 35 d prior to market. Durations intended for RAC were fed the NEG diet until initiation of RAC when CP was increased to POS in order to comply with label requirements. All diets met or exceeded NRC nutrient recommendations. Pen weights and feed disappearance were recorded weekly. This study was conducted during June and July. At d 35, pigs were marketed by intact pen to a commercial slaughter facility. No differences ($P > 0.05$) were observed between the two RAC doses, therefore only the main effects of RAC and duration will be discussed. The feeding of RAC increased ($P < 0.001$) final BW (119.1 vs. 116.2 kg), overall ADG (0.76 vs. 0.68 kg), and improved F:G (2.99 vs. 3.39) when compared to the NEG with no difference ($P > 0.05$) in ADFI. Average daily gain (7.4 ppm RAC) was linearly increased ($P < 0.007$) and F:G (5 and 7.4 ppm RAC) was linearly improved ($P < 0.001$) with increased feeding duration of RAC. Feeding RAC increased ($P < 0.05$) carcass weight (89.7 vs. 87.3 kg), loin depth (7.01 vs. 6.77 cm), and % lean (55.6 vs. 54.98%) while reducing ($P < 0.05$) BF depth (1.74 vs. 1.85 cm) compared to the NEG diet. Carcass weight (7.4 ppm RAC) and loin depth and % lean (5 ppm RAC) linearly increased ($P < 0.05$) with increased duration and BF depth (5 ppm RAC) was linearly reduced with increased duration. From this data, the feeding of RAC and the increased feeding duration resulted in improved growth performance and carcass characteristics compared to the NEG.

Key Words: Ractopamine, Pigs, Duration

712 Effects of EcoCare® feed on growth performance and nutrient excretion of finishing pigs. T. Walraven*¹, S. Carter¹, M. Lachmann¹, J. Bundy¹, J. Jarrett¹, and B. De Rodas², ¹Oklahoma State University, Stillwater, ²Land O'Lakes Purina Feed, Gray Summit, MO.

Eighty crossbred (D x LY) pigs (30.2 kg BW) were used to determine the effects of EcoCare® Feed (Land O'Lakes Purina Feed) on growth

performance, pit characteristics, and DM, N, and P excretion during a 122-d finishing period. Pigs were blocked by BW and sex, and allotted randomly to 2 dietary treatments. Pigs were housed in an environmentally-controlled building divided into 4 identical rooms (20 pigs/room; 2 rooms/trt) with each having a shallow pit, pull-plug system. A fortified corn-soybean meal-based diet served as the control (20.1, 19.3, 17.9, 16.5, 15.1, and 13.7% CP; 0.37, 0.34, 0.31, 0.29, 0.27 and 0.25% available P for Phases 1 - 6, respectively). The experimental diet (EcoCare, EC) was similar to the control diet with the exceptions that CP was reduced by 2.6% units, available P by 0.11% units, with additions of Lys, Thr, Met, EC Pak (containing phytase) and EC premix. Both diets were formulated on true dig. Lys (1.02, 0.92, 0.83, 0.74, 0.65, and 0.56% for Phases 1 to 6), and Thr and Met were added to EC on an ideal basis. Pigs and feeders were weighed at each phase change, and pit volume and pH were measured. Feed and pit samples were collected for DM, N, and P analysis. Dietary treatment did not affect ($P > 0.10$) ADG (875 g), ADFI (2,370 g), G:F (0.37), or final weight (130 kg). Water disappearance (L/d) and pit volume decreased ($P < 0.05$) for pigs fed EC. Pit pH tended to decrease ($P < 0.06$) with EC. The avg concentration of DM in the pit was similar ($P > 0.10$), but N and P were reduced ($P < 0.01$) for pigs fed EC. Daily DM intake was similar for both diets, but N and P intakes were reduced ($P < 0.05$) for pigs fed EC. Daily DM excreted was similar ($P > 0.10$) between diets. However, daily N and P excretion for pigs fed EC was decreased ($P < 0.05$). Cumulative N and P excreted for the entire 122-d period was reduced ($P < 0.05$) for pigs fed EC. Based on these results, the EC diet did not affect pig growth performance, but reduced daily and total N and P excreted during a 122-d finishing period.

Key Words: Pigs, Diet, Nutrient Excretion

Physiology and Endocrinology: Synchronization of Estrus in Cattle

713 ASAS Centennial Presentation: Development of cattle estrus and breeding management. J. W. Lauderdale*, *Lauderdale Enterprises, Inc, Augusta, MI.*

McKenzie's laboratory (U. MO; 1930s) described the estrous cycle of domestic animals. Brownell (Cornell; 1936) reported AI and bull bred pregnancy rates were similar. Between 1938 (first, EJ Perry, NJ) and 1940, 54 AI organizations in 21 states were formed. Ulberg, Christian and Casida (1951) controlled time of ovulation in cows with progesterone (P) injected daily. Trimberger and Hansel (1955) controlled time of ovulation in cows with P injected daily but conception rate was reduced. Zimbelman (1963) reported the dose-response for MAP in cattle, leading to the first orally active progestogen to synchronize estrus in cattle. Participants at the Brook Lodge Ovarian Regulatory Mechanisms Conference (1965) reviewed P for cattle estrus synchronization; discussions launched discovery and development of prostaglandins (PGF₂alpha) for regressing corpora lutea (CL) in cattle. Laboratories led by Thorburn, Niswender, Scaramuzzi, Henricks and Hansel (1969-1972) reported profiles of reproductive hormones, data crucial to development of successful breeding management programs. Rowson et al., Lauderdale, and Liehr et al. (each 1972) reported PGF₂alpha to be luteolytic in cattle. Lauderdale (1974) reported PGF₂alpha estrus synchronization programs and AI, including AI at a specifically designated day and time (TAI). Hansel and Fortune (1978) reported use of GnRH plus PGF₂alpha enhanced estrus synchronization and pregnancy rate over PGF₂alpha alone in cattle. The Ginther laboratory pioneered and developed transrectal ultrasonography (1982-1998), leading to characterization of follicular waves in cattle (Fortune et al. and Ginther et al., each 1988). Harms, Wiltbank and Randel (1984) reported pulsatile release of LH in cattle, leading to management of follicular waves with GnRH. Knowledge of the estrous cycle of cattle, including follicular waves, and commercially available progestogen, PGF₂alpha and GnRH products led to development of multiple cattle breeding management programs by numerous ASAS members. TAI pregnancy rates of 60%-70% are achieved routinely under commercial cattle breeding management programs using PGF₂alpha, GnRH and progestogen products.

Key Words: Cattle, Breeding Management, History

714 Identification of differential gene expression during transition of bovine corpus luteum from early to mid-phase and their potential role in acquisition of luteolytic sensitivity to prostaglandin F₂ alpha. M. P. Gorvanahally*, M. Salem, J. Yao, K. Inskeep, and J. A. Flores, *West Virginia University, Morgantown.*

Prostaglandin F₂ alpha (PGF₂α) brings about regression of the bovine corpus luteum (CL). This luteolytic property of PGF₂α is used in the beef and dairy cattle to synchronize estrus. A limitation of this protocol is an insensitivity of the early CL to luteolytic actions of PGF₂α. The mechanisms underlying luteal sensitivity (LS) are poorly understood. The early CL has maximum number of PGF₂α receptors; therefore differences in signaling events might be responsible for LS. Hence differential gene expression at two developmental stages, days 4 (D-4) and 10 (D-10) post estrus, might account for differences in signal transduction pathways associated with LS. This possibility was examined in these studies. Microarray analysis (n=3 per stage) identified 180 genes that were differentially expressed (P<0.05). These were categorized

into genes involved in cell signaling (13%), metabolism (10%), protein degradation (5%), RNA processing and transcription regulation (15%), protein biosynthesis and modification (19%), extracellular matrix and cytoskeletal proteins (6%), DNA replication and modulation (2%), antioxidant property (3%), miscellaneous (17%), and unknown functions (10%). Real-time PCR confirmed the differential expression of 9 randomly selected genes, including protein kinase C inhibitor protein-1 (KCIP-1) and regulator of G-protein signaling 2 (RGS2), observed in microarray. Further, the in vivo effect of exogenous PGF₂α (n=3 per stage) on selected genes that were found differentially expressed during this developmental transition was examined. PGF₂α increased the expression of a guanine nucleotide binding protein beta polypeptide 1 (GNB1) in D-4 CL and Ca²⁺/calmodulin dependent kinase kinase 2 beta (Camkk2) in D-10 CL. Therefore, GNB1, Camkk2, KCIP-1, and RGS2 are candidate genes that might play significant role in acquisition of luteal sensitivity to PGF₂α.

Key Words: Corpus Luteum, PGF₂α, Corpus Luteum Insensitivity

715 Synchronizing new follicular wave emergence in *Bos indicus*-influenced heifers with estradiol benzoate: Role of the magnitude of the acute increase in progesterone. J. D. Pack*^{1,2}, I. C. Velez^{1,2}, M. Amstalden^{1,2}, and G. L. Williams^{1,2}, ¹Texas AgriLife Research, Beeville, TX, ²Texas A&M University, College Station.

The hypothesis was that incremental changes in circulating progesterone (P₄) are an important factor in the ability of estradiol benzoate (EB) to successfully synchronize new follicular wave emergence (NFW) and ovulation. Eight pubertal Braford (F-1) heifers were used in a twice replicated Latin square design with four treatments designed to provide differing maximum concentrations of plasma P₄: 1) EB; 2.5 mg EB i.m. only; 2) EB + CIDR; EB and new CIDR; 3) EB + AC-CIDR; EB and new autoclaved CIDR; 4) EB + AC-CIDR + P₄; EB, new autoclaved CIDR and 500 mg P₄ i.m. at CIDR insertion. Heifers received treatments in random order between d 3 and 6 after ovulation (d 0), with a 2 to 3-wk washout period between each experimental period. On d 7, CIDR inserts were removed and all cows were treated with 25 mg prostaglandin F₂-alpha. Transrectal ultrasonography was used to monitor ovarian structures throughout. Jugular blood samples were collected at 0, 30, 60, 120, 240, and 360 min, and at 6-h intervals through 60 h for hormone assays. Treatments 2 through 4 increased (P < 0.01) circulating P₄ concentrations compared to treatment 1 (EB only); however, treatment 4 (EB + AC-CIDR + P₄) created the greatest increase (2-h peak = 42.5 ng/mL) of longest duration (at least 60 h). Groups 2 and 3 (EB + CIDR and EB + AC-CIDR) were intermediate (4-h peaks = 10.7 ng/mL) and did not differ. Plasma progesterone in group 1 (EB only) remained < 5 ng/mL. Suppression of plasma FSH was greatest (P < 0.001) in group 4 (EB + AC-CIDR + P₄), with mean 60-h concentrations (1.5 ± 0.4 ng/mL) less than in all other groups (1.8 ± 0.4 ng/mL). Mean concentrations of LH (0.4 ± 0.1 ng/mL), frequencies of occurrence of NFW (87.5 ± 7.2 %) and ovulation (84.4 ± 6 %), and intervals to NFW (5.0 ± 0.3 d) did not differ among treatments. Elevating circulating P₄ above that created by a corpus luteum or corpus luteum + CIDR, delayed FSH resurgence but failed to alter timing or occurrence of ovarian events.

Key Words: Synchronization, *Bos indicus*, Progesterone

716 Effect of PRID[®] administered 5 to 11 days post-insemination on serum progesterone concentrations in lactating dairy cows. S. J. Scott*, R. B. Walsh, S. J. LeBlanc, J. Woodward, J. S. Walton, and K. E. Leslie, *University of Guelph, Guelph, ON, Canada.*

A high rate of hepatic metabolism could decrease progesterone concentrations important for the maintenance of the developing conceptus, leading to early embryonic loss. The effects of a Progesterone-Releasing Intravaginal Device (PRID[®]) administered at d 5–11 post-insemination, on circulating serum progesterone concentrations was studied in 222 lactating dairy cattle on 4 farms. Cows were randomly assigned to receive PRID or PID (Placebo Intravaginal Device). Blood was collected at both insertion and removal of the device. Serum progesterone concentrations were determined by ELISA analysis (Immulite). At the time of insertion, circulating progesterone levels were not significantly different between cows administered PRID, versus control (2.0 ± 1.42 ng/mL). There tended to be a treatment by time interaction such that the differences in progesterone concentrations between PRID and control cows was significant only for cows that received the device 9–11 d post-insemination ($P < 0.08$) (Table 1). At d 12–18 post-insemination the serum progesterone concentration in cows that became pregnant on the previous service was 4.0 ng/mL and 3.1 ng/mL, in cows that were and were not diagnosed pregnant, respectively. For cows that were diagnosed pregnant the change in progesterone from d 5–11 to d 12–18 was 1.8 ± 1.6 ng/mL, versus 1.1 ± 1.9 ng/mL in cows that were not diagnosed pregnant ($P < 0.005$). These results indicate that the administration of PRID approximately 1 wk post-insemination will increase progesterone levels, potentially affecting reproductive success.

Table 1: Circulating progesterone concentrations at insertion and removal of device.

Days post-AI	n	Mean P ₄ at insertion (ng/mL)	SD	Mean P ₄ at removal (ng/mL)	SD
5–8 PID	58	1.6	1.1	3.7	1.9
5–8 PRID	75	1.7	1.3	3.5	1.9
9–11 PID	48	2.5	1.6	3.1	2.2
9–11 PRID	41	2.5	1.5	3.7	2.0

Key Words: PRID, Progesterone, Post-Insemination

717 Comparison of long-term CIDR-based protocols to synchronize estrus in beef heifers. N. R. Leitman*, D. C. Busch, D. A. Mallory, D. J. Wilson, M. R. Ellersieck, M. F. Smith, and D. J. Patterson, *University of Missouri, Columbia.*

Two experiments evaluated modifications to a long-term CIDR-based protocol to synchronize estrus and compared differences among protocols on the basis of their potential to facilitate fixed-time AI in beef heifers. In Exp. 1 estrous cycling beef heifers ($n = 85$) were assigned to 1 of 2 treatments by age and BW. Heifers in T1 received a CIDR from d 0 to 14, GnRH on d 23, and PG on d 30. Heifers in T2 received a CIDR from d 2 to 16, GnRH on d 23, and PG on d 30. Ovaries were scanned by ultrasonography on d 23 to characterize follicular dynamics and d 25 to determine response to GnRH. In Exp. 2 beef heifers ($n = 353$) were assigned within reproductive tract scores (2 or 3 = prepubertal; 4 or 5 = estrous cycling) by age and BW to 1 of 4 treatments. Heifers in

T1 and T2 received the same treatments described in Exp. 1. Heifers in T3 and T4 received the same treatments as T1 and T2, respectively, minus the addition of GnRH. All heifers were fitted with HeatWatch transmitters for estrus detection and AI was performed 12 h after estrus onset. In Exp. 1 heifers assigned to T1 had larger dominant follicles at GnRH compared to T2 ($P < 0.01$; 10.9 vs. 9.5 mm, respectively) but response to GnRH, estrous response after PG, mean interval to estrus and variance for interval to estrus after PG did not differ ($P > 0.05$). AI conception and final pregnancy rate were similar ($P > 0.05$). In Exp. 2 estrous response after PG did not differ ($P > 0.10$). Differences in mean interval to estrus and variance for interval to estrus ($P < 0.05$) differed based on the 3-way interaction of treatment length, GnRH, and estrous cyclicity status. AI conception and final pregnancy rates were similar ($P > 0.05$). In summary, the 2 d schedule modification failed to improve synchrony of estrus. In Exp. 1 no differences in estrous response or synchrony of estrus were detected between T1 and T2. In Exp. 2 the 3-way interaction suggests that further evaluation of long-term CIDR-based protocols is required with and without the addition of GnRH to determine the efficacy of these protocols for use in facilitating fixed-time AI. This research was supported by USDA-NRI grant 2005-55203-15750.

Key Words: Beef Heifer, Estrus Synchronization, Progesterin

718 Timing of artificial insemination in beef cows following the CO-Synch + CIDR protocol. D. C. Busch*¹, D. J. Schafer², D. J. Wilson¹, D. A. Mallory¹, N. R. Leitman¹, J. K. Haden², M. R. Ellersieck¹, M. F. Smith¹, and D. J. Patterson¹, ¹*University of Missouri, Columbia,* ²*MFA Inc., Columbia, MO.*

The experiment was designed to compare pregnancy rates in postpartum beef cows resulting from fixed-time AI (FTAI) after administration of the CO-Synch + CIDR protocol. Cows ($n = 851$) at two locations over two years (yr 1; $n = 218, 206$; yr 2; $n = 199, 228$) were stratified by age, BCS and days postpartum (DPP) to 1 of 2 FTAI intervals. Cows were administered GnRH (100 µg, i.m.) and equipped with a controlled internal drug release (CIDR) insert (1.38 g progesterone, d 0). CIDR inserts were removed 7 d later at the time PG (25 mg, i.m.) was administered (d 7). Continuous estrus detection was performed at Location 2 using HeatWatch. Transmitters were fitted at the time of PG and removed at the time of AI. Artificial insemination was performed at predetermined fixed-times [54 h (FTAI 54; $n = 424$) or 66 h (FTAI 66; $n = 427$) after PG] and all cows were administered GnRH (100 µg, i.m.) at AI. Two blood samples were collected between 8 to 10 d and immediately prior to treatment initiation to determine pre-treatment estrous cyclicity status of cows [progesterone ≥ 0.5 ng/mL; (FTAI 54, 288/424, 68%; FTAI 66, 312/427, 73%); $P = 0.07$]. At Location 2, more cows exhibited estrus prior to FTAI 66 than FTAI 54 ($P < 0.01$; 107/216, 50% and 57/218, 26%, respectively). Pregnancy rates were higher ($P < 0.01$) among cows that exhibited estrus than those that did not (123/163, 76% and 150/270, 56%, respectively). There were no treatment by location interactions within year ($P > 0.10$) for age, DPP, or BCS; thus the results were pooled for the respective treatments. Fixed-time AI pregnancy rates were higher for FTAI 66 than FTAI 54 ($P = 0.05$; 286/426, 67% and 257/424, 61 %, respectively). Pregnancy rates resulting from FTAI did not differ between year ($P = 0.09$), farm ($P = 0.80$), AI sires ($P = 0.11$) or technicians ($P = 0.64$). There was no difference between FTAI pregnancy rates based on pre-treatment estrous cyclicity status ($P = 0.30$), and no difference between treatments in final pregnancy rates

($P = 0.77$). In summary, fixed-time AI following CO-Synch + CIDR at 66 h resulted in significantly greater FTAI pregnancy rates compared to FTAI at 54 h.

Key Words: Artificial Insemination, Estrus Synchronization

719 Substitution of estradiol benzoate for GnRH in the Select Synch + CIDR protocol with or without temporary calf removal in *Bos indicus*-influenced cattle. J. D. Pack^{*1,2}, I. C. Velez^{1,2}, M. Amstalden^{1,2}, and G. L. Williams^{1,2}, ¹Texas AgriLife Research, Beeville, TX, ²Texas A&M University, College Station.

The hypothesis was that estradiol benzoate (EB) would be more effective than GnRH in synchronizing new follicular wave emergence (NFWE) and subsequent ovulation in Brahman-influenced cows subjected to a controlled intravaginal drug release insert (CIDR)-based treatment protocol. Sixty-four postpartum (PP) Braford (F-1) cows (79 % cyclic) in 2 replicates (32 cows/replicate) were stratified by parity, d PP and body condition score (BCS), and assigned randomly to a 2 x 2 factorial arrangement of groups that contrasted hormone treatments (GnRH vs EB) at time 0 and post-CIDR suckling status (weaned vs suckled). Treatments were: 1) Select-Synch + CIDR; n=16; 2) Select-Synch + CIDR with 48h calf removal; n=16; 3) E-Synch + CIDR; n=16; or 4) E-Synch + CIDR with 48h calf removal; n=16. All females were a minimum of 50 d PP and had a BCS of at least 5 (1 to 9 scale) at treatment onset. On d 0, cows in all groups received a CIDR, with those in groups 1 and 2 receiving a single injection of 100 µg GnRH i.m., and those in groups 3 and 4 receiving a single injection of 2 mg EB i.m. CIDR inserts were removed on d 7 and all cows received a single injection of prostaglandin F2-alpha (25 mg i.m.), with 48-h calf removal in groups 2 and 4. Transrectal ultrasonography was performed daily for a maximum of 144 h after CIDR removal. Proportions of GnRH- and EB-treated cows exhibiting (75 vs 68.9%) and intervals (4.1 ± 0.3 vs 3.8 ± 0.3 d) to NFWE did not differ. Proportions of GnRH- and EB-treated cows ovulating (68.8% vs 78.1%) and their respective intervals to ovulation (88.6 ± 6.3 vs 94 ± 6 h) after CIDR removal did not differ, nor did post-CIDR suckling status affect ovulation frequency (77.4 vs 69.7) or interval to ovulation (87.3 ± 6.5 vs 95 ± 5.8 h). However, ovulation before 72 h was greater ($P < 0.07$) in Select-Synch + CIDR (4/32) compared to E-Synch + CIDR (0/32). Although minor, the latter effect could contribute to a reduction in asynchronous follicle maturity in TAI protocols.

Key Words: Synchronization, Estradiol Benzoate, *Bos indicus*

720 Ovarian and fertility responses of Holstein heifers after GnRH, progesterone, and PGF_{2α} at five stages of the estrous cycle. J. S. Stevenson*, Kansas State University, Manhattan.

Estrus and ovulation were manipulated in 283 heifers by administering GnRH, progesterone (P4), and PGF at 5 stages of the estrous cycle. Estrus was presynchronized with a P4 insert (CIDR) for 7 d before PGF was administered 24 h before insert removal. Successive groups of 10 heifers were assigned to treatments (2 heifers/treatment) beginning on d 2 of the cycle; then groups of treatments on d 5, 10, 15, and 18. Treatments were a CIDR insert placed intravaginally (d 0) for 7 d plus: 1) 25 mg of PGF on d 7 at insert removal (PGF); 2) 100 µg of GnRH on d 0

+ PGF on d 7; 3) PGF 24 h before insert removal (early PGF); and 4) 100 µg of GnRH + early PGF. Controls received no insert (GnRH on d 0 and PGF on d 7). Ovaries were scanned ultrasonically on d 0, 2, 7, 9, and 11 to assess follicular diameters and ovulation. Blood was collected on d 0, 2, 6, 7, 8, and 9 to quantify serum concentrations (ng/mL) of P4. Insemination occurred after detected estrus or by timed AI (TAI) at 64 h after insert removal. Only 15.6% of 141 GnRH-treated heifers ovulated by 48 h after GnRH, with twice as many ovulating when treatment was initiated on d 5 (26%) compared with other cycle days (12.4%). Stage of cycle at treatment influenced serum P4; it was greater in all CIDR-treated heifers on d 2 and 6 of treatment. Progesterone tended ($P = 0.08$) to be greater in GnRH-treated heifers on d 6. Treatment effects on P4 on d 7 and 9 occurred because of the early decrease in P4 in response to PGF 24 h before insert removal. Follicle diameters at 48 h after insert removal (d 9) were unaffected by treatment, but were less ($P < 0.05$) in heifers when treatment was initiated on d 5 (12.0 ± 0.4 mm) compared with other stages of the cycle (13.9 ± 0.3 mm). Pregnancies per AI (P/AI) were unaffected by stage, but tended ($P = 0.10$) to be less after TAI (43.5%) than after detected estrus (56.1%) and in control compared with CIDR treatment. Treatments initiated on d 10 of the cycle produced the greatest P/AI (65.4%) compared with other stages (d 2 = 38.9%; d 5 = 37.7%; d 15 = 47.4%; or d 18 = 41.5%). Compared with control, more P4-treated heifers ovulated by d 11.

Table 1.

Trait	Treatment				Control	Trt	$P <$	
	PGF	GnRH	Early PGF	GnRH + early PGF			Stage	T × S
Heifers (n)	47	48	47	45	48			
Ov. by d 2, %	0.0	18.8	0.0	28.9	29.2	0.001	0.06	0.52
P4, d 2	6.1	6.4	6.5	6.4	3.7	0.001	0.001	0.71
P4, d 6	5.2	5.4	4.8	5.6	4.3	0.04	0.001	0.67
P4, d 7	5.1	5.0	2.4	2.3	4.2	0.001	0.001	0.001
P4, d 8	0.9	0.8	0.7	0.7	0.9	0.24	0.001	0.44
P4, d 9	0.6	0.5	0.4	0.5	0.9	0.001	0.01	0.99
Follicle diam. (d 9), mm	13.3	13.3	13.3	14.1	13.6	0.001	0.01	0.33
Ov. by d 11, %	89.4	89.6	91.5	88.9	68.8	0.001	0.01	0.33
P/AI, % (n)	52.7 (55)	52.5 (59)	43.6 (55)	44.6 (56)	36.4 (55)	0.35	0.31	0.74

Key Words: Progesterone, GnRH, Heifers

721 Relationship between uterine pH at fixed-time AI and pregnancy success in beef cattle. S. F. Lares*, S. D. Fields, B. L. Perry, D. G. Chen, and G. A. Perry, South Dakota State University, Brookings.

Research has shown that cows in estrus within 24 h of fixed-time AI had greater pregnancy rates compared to cows not in estrus. Furthermore, uterine pH decreased at the initiation of estrus and pH has been reported to influence sperm motility and longevity. Our objective was to determine the relationship between uterine pH at fixed-time AI and pregnancy success. Lactating beef cows in two herds were synchronized with the CO-Synch protocol [100 µg GnRH on d -9; 25 mg PG on d -2; and 100 µg GnRH plus timed AI on d 0 (48 h after PG)]; n = 126] or the CO-Synch+CIDR protocol [100 µg GnRH and CIDR insertion on d -10; 25 mg PG and removal of CIDR on d -3; 100 µg GnRH with timed AI on d 0 (60 h after PG)]; n = 97]. Uterine pH was determined

at fixed-time AI (n = 80 and 63 for herd 1 and 2, respectively). Cows were determined to be in standing estrus by activation of an EstroTect estrus detection aid, determined at timed AI and approximately 18 h later. Pregnancy was determined 60 to 70 d after AI. At time of AI, cows that had initiated estrus had decreased ($P = 0.01$) uterine pH compared to cows not in estrus (6.78 ± 0.03 and 6.89 ± 0.03 , respectively). In addition, cows that had initiated estrus by 18 h after AI had decreased ($P < 0.01$) uterine pH at time of AI compared to cows that did not initiate estrus (6.78 ± 0.02 and 6.96 ± 0.04 , respectively). Cows that initiated estrus prior to AI had increased ($P = 0.05$) pregnancy success (52% vs. 38%) compared to cows that had not initiated estrus by AI. Cows that initiated estrus by 18 h after AI tended to have increased ($P = 0.078$) pregnancy success (43% vs. 32%) compared to cows that did not initiate estrus. Furthermore, uterine pH at AI had an approximately linear effect on pregnancy success within the observed pH range. As uterine pH increased pregnancy success decreased ($P = 0.076$, logistics regression). In summary, uterine pH at time of AI was decreased in cows that exhibited estrus and uterine pH tended to have a linear effect on pregnancy success.

Key Words: Uterine pH, Pregnancy Rate, Fixed-Time AI

722 Comparison of pregnancy rates in beef cattle after fixed-time AI using semen processed with two different extenders. D. C. Busch^{*1}, N. R. Leitman¹, D. A. Mallory¹, D. J. Wilson¹, J. F. Bader², J. L. Martin³, M. F. Smith¹, and D. J. Patterson¹, ¹University of Missouri, Columbia, ²Meril Limited, Fulton, MO, ³Accelerated Genetics, Baraboo, WI.

This experiment was designed to compare pregnancy rates in beef heifers and postpartum beef cows after fixed-time AI (FTAI) with semen processed with two different extenders. A single ejaculate of semen was collected from each of 4 bulls. Semen was processed using either a control (C) or Affirm™ (A) semen extenders. The semen was frozen and stored in liquid nitrogen. Heifers (n = 53) at one location were stratified by age and BCS and cows (n = 968) at 7 locations were stratified by age, BCS, and days postpartum (DPP) to 1 of 2 treatments involving the two semen extenders (C or A). Heifers were synchronized using the CIDR Select protocol and cows were synchronized using the CO-Synch + CIDR protocol. Fixed-time AI was performed at 72 and 66 h, respectively, after treatment administration for the two age groups of females. There were no interactions involving semen extender X location ($P > 0.10$) for age, DPP, or BCS; thus the results were pooled for the respective treatments. There was no difference in the resulting FTAI pregnancy rates between heifers and cows inseminated with C (58%) or

A (54%, $P = 0.20$) and there was no difference between sires ($P = 0.47$); however, there was an interaction involving semen extender X sire ($P = 0.02$). One sire exhibited a reduction (-18%, $P < 0.01$) in FTAI pregnancy rates while another exhibited an improvement (+19%, $P = 0.10$) in FTAI pregnancy rates with A versus C. The other two sires exhibited no differences ($P > 0.70$) between C and A. Furthermore, there was an effect ($P < 0.05$) of AI technician, age, BCS, and DPP on FTAI pregnancy rates. Cows ≥ 7 yr of age had lower pregnancy rates ($P < 0.05$) than cows 3 to 6 yr of age but were similar to 2 yr-old cows. Pregnancy rates were higher ($P < 0.01$) for cows that calved > 50 d before FTAI (59%) than those that calved ≤ 50 d before FTAI (41%). In summary, there was no difference in pregnancy rates resulting from FTAI between the C and A semen extenders; however, there were significant differences involving the interaction of sire X semen extender.

Key Words: Artificial Insemination, Estrus Synchronization, Semen

723 The effect of an opioid antagonist on dairy cattle fertility after insemination. V. Fuentes-Hernandez*, A. Bernal-Canseco, P. I. Fuentes-Castro, and R. Orozco-Hernandez, *Universidad de Guadaluajara, Mexico.*

With the objective of studying the effect of naloxone administered im at the onset on estrus in dairy cattle, and to observe the effect of this opioid antagonist on conception rate after insemination, a small cattle holding with 120 cows was selected. There was no discrimination regarding to age and number of parturitions. A double blind experiment was designed to avoid bias in the results. The veterinarian was instructed to inject the drug using multiple dose flasks with no label. When a cow showed the first signs of estrus, im injections of 5 mL containing either saline or 10 mg naloxone were administered at 12 hr intervals and continued for 24 hr after insemination. Note was taken of conception at first insemination after treatment, and the number of inseminations required for positive pregnancy in cows repeating estrus. The experiment was carried out from January 2007 to January 2008. An accumulated total of 43 cows were treated during this period. It was observed that cows treated with naloxone (n = 21) required 1.25 ± 0.25 inseminations and insemination rate in saline treated was 2.5 ± 0.5 . After an ANOVA it was observed that conception rate in naloxone-treated cows was higher ($P < 0.01$) compared with controls. It was concluded that naloxone treatment during the estrous period in dairy cattle reduced insemination rate and gives further support to endogenous opioids as important modulators of reproduction in cows.

Key Words: Opioids, Cow, Fertility

Ruminant Nutrition: Protein and Amino Acids - Beef

724 Heat production and efficiency of energy utilization in finishing steers fed diets containing wet distillers grains with solubles (WDGS). M. J. Spieth*, C. L. Ferrell, J. A. Nienaber, T. M. Brown-Brandl, and S. D. Shackelford, *ARS-USDA, US Meat Animal Research Center, Clay Center, NE.*

This study was conducted to evaluate heat production (HP) and efficiency of energy utilization in feedlot cattle fed diets containing WDGS. Steers ($n=24$, $BW = 452.5 \pm 36.8$ kg) were assigned in a randomized complete block design to diets containing 0, 20, 40, or 60% WDGS on a DM basis providing calculated ME concentrations of 3.11, 3.06, 3.05, and 3.02 Mcal ME per kg and 0.70, 5.89, 7.63, and 9.36% fat, respectively. The trial consisted of three 96 h periods of total urine and feces collection followed by 6 h of indirect calorimetry with 8 steers per period (2/trt). Data were analyzed as a randomized complete block design. Regression analysis was conducted to determine linear and quadratic effects. There was a linear decrease in DMI ($P < 0.01$; $R^2 = 0.29$) with increasing level of WDGS in the diet. As a result, ME intake decreased as levels of WDGS increased in the diet. Heat production was similar for cattle fed all four diets but retained energy (RE) decreased linearly ($P < 0.01$, $R^2 = 0.40$) with increasing inclusion of WDGS in the diet. Due to the high fat content in WDGS, RQ decreased as WDGS increased in the diet. Based on this data, HP for cattle fed diets containing WDGS can be estimated using the following equation: $HP = 174.9 + 16.4 \cdot DMI + 11.5 \cdot \text{proportion of WDGS in diet}$. This study indicates that finishing cattle fed increasing levels of WDGS in the diet have decreased efficiency of energy utilization which could lead to decreased performance in the feedlot, primarily due to lower DMI.

Table 1.

Item	0% WDGS	20% WDGS	40% WDGS	60% WDGS	SEM	<i>P</i> Value
DMI, g/ ($BW^{0.75,d}$)	84.3 ^a	71.7 ^{a,b}	68.3 ^{a,b}	64.0 ^b	2.04	0.013
ME intake, kcal/ ($BW^{0.75,d}$)	262.2 ^a	219.3 ^{a,b}	208.2 ^b	193.3 ^b	6.27	0.001
HP, kcal/ ($BW^{0.75,d}$)	178.4	171.0	177.4	168.6	2.74	0.526
RE, kcal/ ($BW^{0.75,d}$)	83.8 ^a	48.3 ^{a,b}	30.8 ^b	24.7 ^b	5.31	0.004
CH ₄ , L/ ($BW^{0.75,d}$)	1.20 ^a	1.08 ^{a,b}	0.85 ^{a,b}	0.95 ^b	0.04	0.096
RQ	1.00 ^a	0.99 ^{a,b}	0.95 ^{b,c}	0.93 ^c	0.01	0.001

Within a row means without a common superscript letter differ ($P < 0.05$).

Key Words: Distillers Grains, Energy, Finishing Cattle

725 Effects of distillers grains on feedlot performance of crossbred steers. C. Ferrell*, S. Shackelford, and V. Varel, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

Objectives were to determine effects of wet distillers grains with solubles (WDGS) on growth rate, feed intake and feed efficiency of finishing steers when fed at 0, 20, 40, or 60% of diet DM. Crossbred, fall-born steers (304) were weaned, moved to the feedlot, and fed a corn silage

based diet. Steers were implanted with Synovex-S (April) and with Revalor-S at study initiation (July). Steers were moved to individual feeding facilities, and trained over 4 wk to headgates (Calan-Broadbent®) in pens of 4 or 10 steers. Steers were blocked by sire breed, dam breed, and pretrial BW and assigned to diets. Alfalfa was included in all diets at 10.6% of DM. Control diet contained 82.7% rolled corn, 5.7% soybean meal, and 1.1% supplement. The 20, 40, and 60 WDGS diets contained 68.2, 48.2, and 28.2% corn and 20, 40, and 60% WDGS on DM basis. The WDGS diets contained 1.2% of a second supplement. Monensin (480 mg•hd•d) and thiamin (200 mg•hd•d) were fed in all diets. The CP, P, S, and fat % increased with increased WDGS inclusion in diets. Initial BW (IBW; 402 kg), 28 d, 56 d, 84 d, and final BW (FBW) were recorded. Feed was recorded daily, and orts weekly. Linear and quadratic effects of proportion WDGS were evaluated. The IBW was included as a covariate. Means were compared by *t* test if $P \leq 0.05$ for *F* test. Linear and quadratic effects of diet influenced ($P < 0.001$) DMI, ADG, and FBW, and linear ($P < 0.001$) effects influenced gain/dmi (G/F). Steer performance traits were improved or unaffected by inclusion of WDGS at 20 or 40% of diet DM. WDGS at 60% decreased DMI, ADG, and FBW, but did not depress G/F. Although inclusion of 60% WDGS significantly decreased ADG, feeding levels of WDGS as high as 60% may be the most profitable choice, depending on the relative costs of feed ingredients and yardage costs.

Table 1.

WDGS	CP, %	P, %	S, %	DMI, kg/d	ADG, kg/d	FBW, kg	G/F
0%	13.44	0.35	0.16	9.48 ^b	1.73 ^b	584 ^b	0.184 ^b
20%	15.50	0.45	0.28	9.84 ^a	1.82 ^a	594 ^a	0.187 ^b
40%	21.06	0.57	0.42	9.16 ^c	1.82 ^a	594 ^a	0.200 ^a
60%	25.63	0.66	0.54	7.39 ^d	1.43 ^c	552 ^c	0.195 ^a
SEM				0.09	0.03	3	0.003

Key Words: Efficiency, Environment, WDGS

726 Effects of increasing level of corn dried distiller's grains with solubles on intake, digestion, and ruminal fermentation in steers fed backgrounding diets. J. L. Leupp*, G. P. Lardy, and J. S. Caton, *North Dakota State University, Fargo.*

Five ruminally and duodenally cannulated steers (500 ± 5 kg of initial BW) were used in a 5×5 Latin square to evaluate effects of increasing level of corn dried distiller's grains with solubles (DDGS) in backgrounding diets (60% concentrate) on OM intake, site of digestion, ruminal fermentation, and microbial efficiency. Diets consisted of 30% grass hay, 6% concentrated separator byproduct, 4% supplement, and 60% dry-rolled corn, sunflower meal, and/or DDGS (DM basis). Treatments consisted of increasing DDGS at 0, 15, 30, 45, or 60% of diet DM replacing a combination of dry-rolled corn and sunflower meal. Diets were balanced for growing steers gaining 1.22 kg/d and included 0.25% (DM basis) chromic oxide as a digesta flow marker. Steers were offered diets ad libitum (10% above previous day's intake) and adapted to diets for 14 d followed by a 7-d collection period. Intake of OM responded quadratically ($P = 0.004$) with greatest intakes at 15% DDGS and lowest at 60% DDGS. No differences ($P > 0.13$) were observed in CP intake or duodenal flow of OM, CP, and NDF. Apparent and true ruminal OM

digestibilities decreased (linear; $P \leq 0.009$) with increasing DDGS inclusion. Total tract CP digestibility increased (linear; $P < 0.001$) with increasing DDGS, however, total tract OM digestibility was not different ($P = 0.74$). Microbial efficiency, expressed as g of microbial N/kg of OM truly fermented, was not affected ($P = 0.22$) by treatment. As dietary DDGS increased, ruminal pH increased (linearly; $P = 0.004$) while ammonia concentration remained unchanged ($P = 0.42$). Acetate proportions decreased ($P < 0.001$) with increasing DDGS while propionate and butyrate were similar ($P \geq 0.19$). A cubic ($P = 0.02$) effect was observed for total ruminal fill (as is basis) with the greatest fill at 30% DDGS and the least fill at 45% inclusion. Replacing dry-rolled corn with moderate to high levels of DDGS in backgrounding diets resulted in no adverse effects on digestion or ruminal fermentation although OM intake was reduced at 60% DDGS inclusion.

Key Words: Backgrounding Diets, Corn Dried Distiller's Grains with Solubles, Steers

727 Effect of feeding distillers grains on performance and marbling deposition in steers fed high-concentrate or high-forage diets. J. P. Schoonmaker*, A. H. Trenkle, and D. C. Beitz, *Iowa State University, Ames.*

One hundred thirty-seven Angus cross yearling steers (init. BW 390 ± 0.5 kg), were allotted by BW to a 3×2 factorial arrangement of 6 treatments (4 pens per treatment) to determine the effect of wet distillers grains concentration (0, 20, 40 % diet DM) in high concentrate (12 % hay) and high forage (50 % hay) diets on growth performance and marbling content. Steers were implanted on d 0 with Component TE-S® and were slaughtered in 3 groups when final BW was estimated to be 579 kg. Final BW was similar among treatments and averaged 578 kg. Concentrate-fed steers gained faster ($P < 0.01$) than did forage-fed steers; amount of distillers grain fed did not affect ($P > 0.25$) daily gain. Hot carcass weight and dressing percentage was greater ($P < 0.01$) for concentrate-fed than for forage-fed steers. Dressing percentage tended ($P < 0.08$) to increase as distillers grain concentration increased. Longissimus dorsi area tended to be greater ($P < 0.08$) and yield grade was greater ($P < 0.01$) for concentrate compared with forage-fed cattle. Longissimus dorsi area and yield grade increased ($P < 0.03$) as distillers grain concentration increased. In concentrate-fed steers, marbling score decreased as distillers grain concentration increased (325, 306, 265), but, in forage-fed steers, marbling score increased from the 0 to 20% inclusion rate, and then decreased from the 20 to 40% inclusion rate (249, 282, 262; diet x distillers grain interaction; $P < 0.01$). Similarly, in concentrate-fed steers, fat thickness tended to decrease as distillers grain concentration increased, but, in forage-fed steers, fat thickness tended to increase from the 0 to 20% inclusion rate, and then tended to decrease from the 20 to 40% inclusion rate (diet x distillers grain interaction; $P < 0.08$). In conclusion, when fed to a common live-weight end-point, starch concentration of distillers grain diets alters lean and adipose tissue deposition. (Supported in part by the Iowa Beef Industry Council and the Iowa Beef Center).

Key Words: Beef, Marbling, Distillers Grains

728 Effect of wheat-, corn-, and triticale-based distillers grains with solubles on performance and carcass characteristics of growing lambs. L. E. McKeown*^{1,2}, A. V. Chaves², M. Oba¹, E. Okine¹,

T. A. McAllister², and D. Gibb², ¹University of Alberta, Edmonton, AB, Canada, ²Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.

The objective of this study was to determine the effect of wheat-, corn- and triticale-based dry distillers grains with solubles (DDGS) on dry matter intake, average daily gain, feed efficiency (FE; g gain / g DM ingested) and carcass traits in lambs. Sixty ram lambs were blocked by live weight (LW; 22.6 ± 3.0 kg) and randomly assigned to one of four experimental diets. Either wheat-, corn- or triticale-based DDGS was included at 20% of dietary DM, replacing 10% canola meal and 10% barley grain in the control diet. The control diet contained 54% barley grain, 16% sunflower hulls, 11.5% beet pulp, 10% canola meal and an 8.5% mixture of oil, molasses, vitamins and minerals. All experimental diets were formulated to contain approximately 17% CP and 23% NDF. The lambs were individually housed, weighed weekly, and slaughtered between 45-50 Kg LW. Saleable meat yield (SMY) was determined from proximal cuts such as short cut leg, sirloin, chine off rack, loin short cut, square shoulder and front shank. Data were analyzed using the MIXED procedure of SAS. Dry matter intake was similar among treatments (1.40 ± 0.05 kg/d; $p=0.32$). Average daily gain was 15% higher ($p=0.05$) for lambs fed the corn-based DDGS (377 ± 14.0 g/d) than for lambs fed the wheat- or triticale-based DDGS (329 and 328 ± 14.0 g/d respectively) although no treatment differed from the control (338 ± 14.0 g/d). There was a treatment by week interaction for FE ($p=0.03$). In week 1, FE was higher ($p < 0.05$) for lambs fed corn-based DDGS (0.49 ± 0.03) compared to lambs fed control, triticale- or wheat-based DDGS (0.35, 0.31 and 0.33 ± 0.03 respectively). Overall, final LW (48.2 ± 1.1 kg), cold carcass weight (21.9 ± 0.07 kg), and SMY (14.5 ± 0.4 kg) were not affected by dietary treatment ($p > 0.05$). This study indicates that the sources of DDGS tested can replace a mixture of barley grain and canola meal at 20% of the dietary DM without adverse effects on intake, growth performance or carcass traits of lambs.

Key Words: Dried Distillers Grains with Solubles, Feed Efficiency, Growing Lamb

729 Feeding dry-rolled or steam-flaked corn with increasing levels of wet distillers grains to finishing steers. C. M. Godsey*, M. K. Luebbe, G. E. Erickson, and T. J. Klopfenstein, *University of Nebraska, Lincoln.*

The objective of this study was to determine the effect of corn processing method, either dry-rolled (DRC) or steam-flaked (SFC) corn, on cattle performance and carcass characteristics in diets containing 0, 20, or 40% wet distillers grains (WDG). The WDG used in this trial did not contain solubles and was 33.6% CP and 10% fat. One hundred twenty individually fed steers (BW = 355 ± 55 kg) were weighed on three consecutive d and assigned randomly to 1 of 8 treatments (15 head/treatment). Diets contained 0, 20 or 40% WDG and 82.5, 67.5 or 47.5% corn respectively, as either DRC or SFC. Two additional diets containing 40% WDG and 11.25 or 15.0% alfalfa were fed with SFC to determine if added roughage improves performance in diets containing WDG and SFC. No significant interaction between corn processing method (DRC or SFC) and WDG (0, 20, or 40) level was observed for DMI ($P=0.27$) or G:F ($P=0.17$). However, a significant interaction was observed for ADG ($P=0.09$), therefore only the simple effects of processing method and WDG level are reported. A quadratic response was observed for ADG in DRC-based diets ($P=0.02$), with 1.38, 1.67, 1.58 kg/d for 0, 20, and 40, respectively. No response was observed for ADG in diets containing

SFC ($P=0.20$). Quadratic G:F responses in DRC-based diets ($P=0.03$) were observed, however no response was observed in SFC-based diets. Feed efficiency was 0.140, 0.164, 0.163 for 0, 20, 40 DRC-based diets and 0.158, 0.169, and 0.165 for 0, 20, 40 SFC-based diets, respectively. For steers fed SFC, increasing roughage level tended to increase DMI ($P=0.07$) and decrease G:F linearly (0.165, 0.153, 0.155 for 7.5, 11.25, and 15.0% roughage; $P=0.09$). In this study, G:F was similar as WDG inclusion increased from 20 to 40% in the diet. However, in corn control diets (0% WDG), steers fed SFC had 12.9% greater G:F than steers fed DRC. Additionally, increasing roughage levels in SFC-based diets containing WDG did not improve feed efficiency.

Key Words: Corn Processing, Feedlot, Wet Distillers Grains

730 Effects of distiller's grain and probiotic on growth and carcass characteristics of finishing beef steers. F. F. Korthaus^{*1}, E. S Vanzant¹, G. Rentfrow¹, K. K. Kreikemeier^{1,2}, D. L. Harmon¹, and K. R. McLeod¹, ¹University of Kentucky, Lexington, ²Vit-E-Men, NE.

To evaluate the effects of modified corn distiller's grain (MDG) and a direct fed microbial (DFM; Vit-E-Men probiotic 10G), 192 crossbred steers (initial BW 394 ± 1.2 kg) were used in a 112 day finishing study. Steers were assigned, within weight blocks, to 6 treatments in a 3x2 factorial arrangement and fed in pens of 4 (8 pens/treatment). Treatments included 0, 20 or 40% (DM basis) of MDG with or without DFM provided at $10 \text{ g} \cdot \text{hd}^{-1} \cdot \text{d}^{-1}$. The diet DM was comprised of 5% corn silage, 5% alfalfa haylage, 10% supplement and 80% concentrate, comprised of varying quantities of MDG, cracked corn, and high moisture corn. The 0 and 20% MDG diets contained 14.2% CP and the 40% MDG diet, 18.6% CP. Body weight measurements were taken on d 0, 1, 28, 56, 84, 111 and 112. Steers were harvested on d 113 and carcass data was collected. There were no interactions between the level of MDG and DFM ($P > .14$). Across the entire feeding period, steers fed 20% MDG consumed more DM (quadratic, $P = .01$; 11.1 kg) and gained more (quadratic, $P = .09$; 2.03 kg/d) compared with the 0% (10.59 kg and 1.91 kg/d) and 40% (10.76 kg and 1.96 kg/d) treatments, such that gain:feed was unaffected ($P \geq .63$) by MDG. Steers fed DFM had greater ADG ($P = .04$; 1.91 vs 2.02 kg/d), HCW ($P = .02$; 369 vs 378 kg), ribeye area ($P = .08$; 83.7 vs 85.6cm) and were more efficient ($P = .07$; gain:feed .186 vs .179). Including MDG at 20% of a finishing diet increased DMI and ADG by 4% and 6%, whereas at 40% MDG, these responses diminished to control levels. Administration of DFM resulted in a 4% increase in growth efficiency concomitant with a 6% increase in ADG which were both consistent across levels of MDG. These data demonstrate the efficacy of DFM and suggest that steer growth can be compromised by MDG inclusion above 20%.

Key Words: Distiller's Grain, Direct Fed Microbial, Carcass Traits

731 Effect of varying ruminally degradable to undergradable protein ratio on feed intake, nutrient digestion and N balance of buffalo calves. J. I. Sultan^{*1}, A. Javed¹, M. Yaqoob², and P. Akhtar², ¹Institute of Animal Nutrition and Feed Technology, University of Agriculture, Faisalabad, Pakistan, Faisalabad, Punjab, Pakistan, ²University of Agriculture, Faisalabad, Pakistan.

A 4 X 4 Latin Square design buffalo calves metabolism trial was conducted with buffalo calves to explore the effects of varying ruminally degradable protein (RDP) to ruminally undegradable protein (RUP) ratio on dry matter intake (DMI), nutrient digestion and N balance. Four Nili Ravi buffalo calves (avg wt, 100kg) were fed diets viz A, B, C and d, having RDP to RUP ratio of 70:30, 65:35, 60:40 and 55:45, respectively. All experimental diets were isonitrogenous (CP 16%) and isocaloric (ME, 2.74 Mcal/kg). Dry matter intake in calves fed diet C was higher ($P<0.05$) than those fed diet D and lower ($P<0.05$) than calves fed diet A, however, it was similar to those fed diet B. Total tract dry matter digestibility (DMD) was higher ($P<0.01$) in calves fed diet A and B than those fed diet C and D. There was a linear decrease in DMI and DMD with decreasing the RDP and RUP ratio. The N retention (g/d) was similar among the calves fed diet B, C and D; however, it was higher ($P<0.05$) than those fed diet A. Decreasing the RDP to RUP ratio resulted in linear increase ($P<0.01$) in N retention. N retention, as percent of N intake was significantly ($P<0.05$) different across all treatments. Decreasing RDP to RUP ratio resulted in linear increase ($P<0.01$) in N retention, as percent of N digestion. Decreasing dietary RDP to RUP ratio resulted in a linear decrease ($P<0.05$) in blood urea nitrogen concentration. A linear increase in weight gain was observed with decreasing RDP to RUP ratio. The diet containing RDP to RUP ratio 55:45 resulted in more weight gain compared to other diets.

Key Words: RDP, Digestibility, RUP

732 Effects of 20% corn wet distillers grain's plus solubles in steam-flaked and dry-rolled corn-based finishing diets. J. C. MacDonald^{1,2}, K. H. Jenkins^{*1}, F. T. McCollum III³, and N. A. Cole⁴, ¹Texas AgriLife Research, Amarillo, TX, ²West Texas A&M University, Canyon, ³Texas AgriLife Extension, Amarillo, TX, ⁴USDA- Agricultural Research Service, Bushland, TX.

Two hundred sixty four crossbred yearling heifers (354 ± 1 kg) were blocked by weight and used in a 2X2 factorial arrangement of treatments to determine effects of wet distiller's grains plus solubles (WDGS) derived from corn on animal performance, carcass characteristics, and the amount of manure harvested in steam-flaked corn (SFC) and dry-rolled corn (DRC) based finishing diets. Heifers were fed DRC or SFC based finishing diets with or without 20% WDGS (DM basis). Control diets with no WDGS were formulated to contain 13.5% CP. The WDGS replaced 15.2 percentage units of corn and 4.8 percentage units of cottonseed meal. All diets contained 10% alfalfa hay, 2% supplemental yellow grease, 4% glycerin, 1.2% urea, and 0.70% Ca. There were 24 pens ($n=6$ per treatment) that housed 8, 10, or 18 heifers with pen size serving as a blocking factor. Heifers were implanted once with Revalor-H[®] approximately 120 days before slaughter and were on feed for an average of 154 d. No corn processing method by WDGS inclusion interactions were found for any response variable ($P > 0.39$). Heifers consuming SFC-based diets had lower DMI ($P < 0.01$), similar ADG ($P = 0.71$), and greater feed efficiency ($P < 0.05$) than heifers consuming DRC-based diets. Corn processing method had no effect on any carcass characteristic ($P > 0.58$). There was a slight tendency for heifers consuming WDGS to have greater final BW ($P = 0.15$), ADG ($P = 0.18$), and hot carcass weight ($P = 0.16$). Inclusion of WDGS did not impact any other animal performance or carcass characteristic ($P > 0.22$). Feeding DRC resulted in increased manure OM harvested •heifer¹•d¹ ($P < 0.01$) compared to SFC and feeding WDGS resulted in a slight tendency

to increase manure OM harvested•heifer¹•d⁻¹ ($P = 0.16$). These data indicate that corn processing method has a greater impact on animal performance and amount of manure harvested than does the inclusion of WDGS when WDGS is included at 20% of diet DM.

Key Words: Corn Processing, Wet Distiller's Grains, Feedlot

733 Effect of supplementation frequency of soyhulls and corn gluten feed based mix on digestion and nitrogen balance of beef steers. M. E. Drewnoski* and M. H. Poore, *North Carolina State University, Raleigh.*

For small producers the labor cost of feeding is often very high. Feeding a supplement less frequently would reduce labor and could therefore have the potential to increase profit. Six ruminally cannulated beef steers were used in a replicated 3 × 3 Latin square design to determine the effect of supplement frequency (daily or alternate days) on digestion and ruminal parameters when feeding hay and supplementing with a mixture of soyhulls and corn gluten feed. Dietary treatments consisted of ad-libitum fescue hay (8.8% CP and 35.8% ADF) that was supplemented at 1% BW daily (SD), supplemented 2% BW on alternate days (SA) or

not supplemented (H). The supplement contained 47% soyhull pellets, 47% corn gluten feed pellets, 2% feed grade limestone and 4% liquid yeast and was 14.6% CP and 29.8% ADF. Each period consisted of a 14 d adaptation phase followed by 6 days of total fecal, urine and ort collection. All supplement offered was consumed within 2 h. Ruminal fluid was collected every 4 h over two days; therefore samples were taken on a day that both SD and SA were supplemented and on a day when only SD was supplemented. Hay intake was reduced by daily supplementation and further reduced ($P < 0.01$) by less frequent supplementation. Hay intake was 1.54, 1.19 and 1.02% BW (SE ± 0.036) for H, DS and SA, respectively. There was a significant ($P < 0.01$) a trt by day interaction for mean ruminal pH. Ruminal pH for SA (6.13), on the day of supplementation was lower ($P < 0.01$) than both SD (6.29) and H (6.52). However, on the day SA did not receive supplement ruminal pH of SA (6.53) did not differ ($P = 0.87$) from H and was higher ($P < 0.01$) than SD. Ruminal pH was lower ($P < 0.01$) for SD than for H on both days. Diet DM digestibility was increased ($P < 0.01$) by supplementation but did not differ ($P = 0.94$) due to frequency. DM digestibility was 57.93, 64.37, 64.42% (SE ± 0.71) for H, SD and SA, respectively. The amount of N retained was higher ($P < 0.01$; SE ± 4.81) for both supplemented trt (23.7 and 19.8 g for SD and SA, respectively) than H (4.22 g) but did not differ ($P = 0.35$) due to frequency.

Key Words: Supplementation Frequency, Cattle, Digestibility

Ruminant Nutrition: Rumen Fermentation Modifiers

734 Effect of Rumensin® and Tylan® in feedlot diets containing wet distillers grains plus solubles fed to beef steers. N. F. Meyer*¹, G. E. Erickson¹, T. K. Klopfenstein¹, J. R. Benton¹, M. K. Luebber¹, and S. B. Laudert¹, ¹University of Nebraska, Lincoln, ²Elanco Animal Health, Greenfield, IN.

The objective of this study was to evaluate the effects of Rumensin and Tylan in feedlot diets containing wet distillers grains plus solubles. Eight hundred beef steers (329 ± 25 kg) were blocked by initial BW and randomly assigned to one of five treatments (20 steers per pen, 8 pens per treatment). Treatments consisted of a corn-based diet with Rumensin and Tylan (CORN+RT) and four treatments with 25% wet distillers grains plus solubles (DG) and either 36.7 mg/kg (R) or 49.0 mg/kg (HIR) of Rumensin and Tylan (T) at 90 mg•hd⁻¹•d⁻¹. Compared to CORN+RT, steers fed DG+RT gained more, were more efficient ($P < 0.05$), and had similar DMI (10.7 vs. 10.6 kg). Feeding Rumensin increased G:F by 3.1% and Rumensin plus Tylan increased G:F by 4.9% when compared to DG alone ($P < 0.05$). With the exception of dressing percentage, there were no differences in performance or carcass characteristics when Rumensin was fed at 36.7 compared to 49.0 mg/kg. Total liver abscesses were significantly greater for DG (42.4%) and DG+R (40.8%), compared to treatments containing Tylan, CORN+RT (17.0%), DG+RT (8.3%), and DG+HIRT (8.9%). Severe liver abscesses were also less for diets containing Tylan ($P < 0.05$). This study indicates that steers fed Rumensin and Tylan in diets containing wet distillers grains plus solubles results in improved feed efficiency and decreased liver abscesses compared to similar diets without these feed additives.

Table 1.

	CORN +RT	DG	DG +R	DG +RT	DG +HIRT	SEM	P- value
Final BW, kg ¹	587 ^a	597 ^b	601 ^b	605 ^b	597 ^b	3	<0.01
DMI, kg	10.7 ^{abc}	10.8 ^a	10.7 ^{ac}	10.6 ^{bc}	10.4 ^b	0.1	0.02
ADG, kg ¹	1.69 ^a	1.76 ^b	1.78 ^b	1.80 ^b	1.76 ^b	0.02	<0.01
G:F	0.159 ^a	0.162 ^a	0.167 ^b	0.170 ^b	0.168 ^b	0.001	<0.01
Liver Abscesses							
Total, %	17.0 ^a	42.4 ^b	40.8 ^b	8.3 ^a	8.9 ^a	3.0	<0.01
A+, %	4.4 ^a	16.5 ^b	19.1 ^b	3.8 ^a	7.0 ^a	2.2	<0.01

^{abc}Within a row means without a common superscript letter differ ($P < 0.05$). ¹Calculated from carcass weight, adjusted to a common 63% dress.

Key Words: Cattle, Feed Additives, Wet Distillers Grains Plus Solubles

735 Effect of Rumensin® and Tylan® fed separately on in combination on feedlot performance and carcass characteristics of feedlot cattle. G. J. Vogel*¹, S. B. Laudert¹, and R. S. Swingle², ¹Elanco Animal Health, Greenfield, IN, ²Cactus Feeders, Amarillo, TX.

One-thousand six hundred eleven crossbred steers (345 kg) were randomly allotted to 16 pens in a 2 × 2 factorial with 4 replications. Experimental treatments included a non-medicated control (C), Rumensin only (RO), Tylan only (TO) and Rumensin plus Tylan (R+T). Formulated Rumensin (R) and Tylan (T) levels were 36.5 and 10.0 mg/kg (DM basis), respectively. A two ration step-up program was used

to adapt steers to final diets with cattle reaching the final diet by d 20. Steers were fed three times daily during the ration transition phase and twice daily once acclimated to the final diet. The study averaged 142 d (range 139 to 144 d). The final ration was formulated to contain 1.52 Mcal NEg/kg, 13.5% CP, 15.1% NDF, 7.0% EE, 0.56% Ca and 0.32% P. Performance parameters were analyzed using PROC MIXED with treatment as fixed effects and block as random effects. Orthogonal contrasts were used to evaluate main effects of R, T and R*T. Significant R*T interactions were observed for DM Intake and feed to gain. With both variables the magnitude of the effect was greater for steers fed R+T. R decreased ($P < 0.001$) daily feed intake by 4.0% (9.98 vs. 9.55 kg) while feed to gain was improved ($P < 0.001$) by 4.3% (5.52 vs. 5.30). Cattle fed T experienced a 72.4% decrease ($P < 0.0001$) in liver abscess prevalence (26.8 vs. 7.4%) which resulted in a 2.3% increase ($P = 0.06$) in daily gain (1.79 vs. 1.83 kg/d) and a 4.0 kg increase ($P = 0.03$) in carcass gain. Compared to C, steers fed R+T consumed 4.4% less ($P < 0.05$) feed and converted 6.4% more ($P < 0.05$) efficiently. Quality and yield grade were not affected by treatment. These data indicate Rumensin and Tylan improved feed efficiency and decreased liver abscess incidence in steers fed to harvest on a conventional diet.

Table 1.

	Treatment				Main R	Effect T	P- Values R*T
	C	RO	TO	R+T			
DM intake, kg	9.89 ^{ab}	9.66 ^{bc}	10.08 ^a	9.45 ^c	<0.001	NS ^d	0.03
Daily Gain, kg/d	1.80	1.78	1.82	1.84	NS	0.06	NS
Feed to Gain	5.51 ^a	5.44 ^a	5.54 ^a	5.16 ^b	<0.001	0.01	<0.01
Liver Abscess, %	29.3 ^a	24.2 ^a	6.6 ^b	8.2 ^b	NS	<0.0001	NS
Carcass Gain, kg	185.4 ^{ab}	182.2 ^a	189.3 ^b	186.2 ^{ab}	0.08	0.03	NS

^{abc}Means with different superscripts differ ($P < 0.05$), ^dNS=($P > 0.10$)

Key Words: Cattle, Feed Additives, Liver Abscess

736 Interactions of monensin with dietary fat and carbohydrate components on ruminal fermentation and production responses by dairy cows. B. Mathew*, E. R. Oelker, M. L. Eastridge, and J. L. Firkins, *The Ohio State University, Columbus.*

Variation in milk fat percentage due to monensin supplementation to lactating dairy cows could be due to altered ruminal fermentation with interactions of monensin with ruminal biohydrogenation of fat and ruminal carbohydrate availability. The objective of the study was to determine the effects of feeding monensin in diets differing in starch availability, effective fiber, and fat. Six ruminally cannulated lactating Holstein cows were used in a balanced 6 × 6 Latin square design with 21 day periods. The cows were fed six diets: 1) C = control diet with ground corn (GC) and long particle size for alfalfa hay (LAH), 2) CR = C plus 12 g/ton DM of monensin (R), 3) CRFL = CR plus 4% added fat (F), 4) CRFS = 4% F, R, GC, and short particle size of alfalfa hay (SAH), 5) SRFL = 4% F, R, steam-flaked corn (SFC), and LAH, and 6) SRFS = 4% F, R, SFC, and SAH. All diets were formulated to have 18% CP, 21% forage NDF, and 40% NFC. Monensin decreased DMI

($P < 0.10$). There was no effect of treatment ($P > 0.12$) on milk yield. Addition of monensin decreased ($P < 0.05$) milk fat yield and tended to decrease milk fat percentage (3.41 vs 2.98%; $P = 0.11$). Interactions between corn processing and hay particle size occurred for milk fat percentage ($P < 0.10$) and feed efficiency (FCM/DMI; $P < 0.05$). With feeding diets containing R: 1) SAH tended to increase milk fat percentage for the ground corn diet while it tended to decrease milk fat percentage with SFC (CRFL + SRFS vs. CRFS + SRFL), and 2) feed efficiency was not affected by particle size of hay with ground corn but was increased for SAH fed with SFC. The SFC increased ($P < 0.10$) NDF digestibility (CRFL + CRFS vs. SRFL + SRFS; 51.1 vs 56%). Addition of fat with monensin decreased ($P < 0.001$) total VFA but increased rumen pH ($P < 0.05$). Fat addition with monensin decreased rumen $\text{NH}_3\text{-N}$ ($P < 0.05$) and MUN (12.8 vs 13.9 mg/dl; $P < 0.01$), and SFC decreased $\text{NH}_3\text{-N}$ ($P < 0.10$). Fat, effective fiber, and ruminal starch availability may explain some responses of feeding monensin on ruminal fermentation and animal production.

Key Words: Monensin, Forage Particle Size, Starch Availability

737 Effects of Optaflexx™ on ruminal ammonia and amino acid concentrations in cattle fed dry-rolled or steam-flaked corn finishing diets with or without dried distiller's grains. C. E. Walker* and J. S. Drouillard, *Kansas State University, Manhattan.*

The effects of ractopamine (Optaflexx™, Elanco Animal Health) supplementation on ruminal concentrations of ammonia and free amino acids were evaluated in a randomized complete block experiment utilizing a $2 \times 2 \times 2$ factorial arrangement of treatments. Factors consisted of grain processing method (steam-flaked or dry-rolled corn; SFC or DRC); level of dried distiller's grain with solubles (0% DG or 25% DG, dry basis); and level of Optaflexx (0 or 200 mg/d). Sixteen ruminally fistulated Holstein steers were randomly assigned to the 8 treatment combinations and adapted to their respective diets for 21 d prior to sampling ruminal fluid. Ruminal fluid was collected during a 3-d sampling period; d 1 at 0, 6, 12, 18 h; d 2 at 2, 8, 14, 20 h; d 3 at 4, 10, 16, 22 h. Ruminal fluid was strained through 4 layers of cheesecloth, mixed in a 4:1 ratio with 25% metaphosphoric acid solution, and frozen. Prior to analysis, samples were thawed, thoroughly homogenized, and then centrifuged at 21,000 x g to remove particulate matter. Concentrations of ammonia and amino acids in the supernatant were measured colorimetrically using an autoanalyzer (Technicon III Auto Analyzer). Ruminal NH_3 concentrations were lower when Optaflexx was fed in combination with DRC, but not when fed in conjunction with SFC (grain processing x Optaflexx, $P < 0.01$). Addition of Optaflexx, SFC, and DG all resulted in lower ruminal ammonia concentrations (main effects, $P < 0.01$). Amino acid concentrations were decreased when Optaflexx was added to diets without DG, but were unchanged in diets with DG added (interaction, $P < 0.05$). Changes in ruminal NH_3 and amino acid concentration with Optaflexx supplementation are dependent on processing method of the grain and the addition of distiller's grains to finishing diets. The results of this experiment suggest that Optaflexx may influence ruminal degradation of dietary protein, which could have important implications for diet formulation.

Key Words: Cattle, Optaflexx, Rumen Fermentation

738 Effects of cinnamaldehyde-eugenol and capsicum on rumen fermentation and feeding behavior in beef heifers fed a high-concentrate diet. M. Rodriguez-Prado¹, S. Calsamiglia¹, A. Ferret¹, J. Zwieten¹, L. Gonzalez¹, and D. Bravo*², ¹*Universitat Autònoma de Barcelona, Spain*, ²*Pancosma, Switzerland.*

Four beef Holstein heifers (BW = 436 ± 17 kg) fitted with a 1-cm i.d. plastic ruminal trocars were used in a 4×4 Latin square design to evaluate the effect of feeding combinations of essential oils on feeding behavior and ruminal fermentation in heifers fed a high-concentrate diet. Animals were fed (DM basis) 10% barley straw and 90% concentrate (32.2% barley grain, 27.9% ground corn, 7.5% wheat bran, 10.7% soybean meal, 10.7% soybean hulls, 7.2% corn gluten feed, 3.1% mineal-vitamin mix; 16.6% CP, 18.3% NDF). Treatments were arranged in a factorial design with cinnamaldehyde and eugenol (CINE, 167 and 334 mg /animal/d, respectively) with or without capsicum (CAP, 500 mg/animal/d). Each experimental period consisted of 25 d (15 d for adaptation, 5 d DM intake continuous measurements and 3 for rumen sample collection). Animals had ad libitum access to water and feed offered once daily at 0800. Data was analysed using PROC MIXED for repeated measures (SAS), and differences were declared at $P < 0.05$. Consumption of water was higher in CAP compared with CTR (33.7 vs. 37.8 L/d). Although there were no differences in total (9.3 kg/d) and concentrate DM (8.6 kg/d) intake, animals fed CAP spent more time eating (11.3 vs 8.0% of the time of the day) and the pattern of intake was more stable during the day compared with CTR. As a result, the pH fell to its lowest level 6 h after feeding but was lower in CTR compared with CAP, suggesting that the modification of the pattern of intake induced by CAP was responsible for controlling the sharp drop of pH after feeding. Total volatile fatty acids tended ($P < 0.07$) to be higher in CAP compared with CTR (162.4 vs. 133.6 mM), but the proportion (mol/100mol) of acetate (59.2), propionate (25.2), butyrate (13.4) and lactate (0.31) was not affected by treatments. Feeding CAP may modify the pattern of intake and help to control the drop of pH after feeding high concentrate diets.

Key Words: Intake Pattern, Essential Oils, Fermentation

739 Meta-analysis on the effect of a cinnamaldehyde and eugenol mixture on the performance of lactating dairy cows. D. Bravo*¹ and P. Doane², ¹*Pancosma Research, Geneva, Switzerland*, ²*ADM Research, Decatur, IL.*

This abstract presents a meta-analysis of lactating dairy cow studies involving a botanical composition comprised of eugenol and cinnamaldehyde (XT). Data from 16 studies with side by side comparisons of XT to a control diet provided 33 treatment groups which were pooled for evaluation. The model used was a mixed model with a fixed effect (effect of XT: present vs. absent) and a random effect (ie. the trial effect). For each measure of performance, mean value of XT or control, the number of groups involved, partial R^2 , and P value were determined. Addition of XT increased dry matter intake (22.1 vs. 20.6 kg/d; $N=16$, $P < 0.001$, $R^2=0.96$), and milk yield (34.2 vs. 33.1 kg/d; $N=36$, $P < 0.001$, $R^2=0.45$). Feed efficiency (kg of milk/kg of DMI) was equivalent for XT and control, (1.44 vs. 1.46; $N=16$, $P=0.441$, $R^2=0.10$). When XT was present, milk protein content decreased, and milk fat content was

unchanged. However, protein and fat yields were increased because of improved milk yield.

Between trials, correlation between diet composition and XT response were explored to determine the interaction of XT and dietary nutrient profile. For each trial, the efficacy of XT was represented as the ratio of the mean for XT to the mean of the control and assessed with linear correlation and regression procedures. Results suggest an interaction of diet nutrient composition and product efficacy. For example, XT was more efficacious for improving milk yield when diets contained greater amounts of NEL, NFC or digestible fiber.

Meta analysis using a data set consisting of a diverse population of trials avoided emphasis of a particular trial while illustrating the robust nature of XT. Meta analysis is useful for developing a statistically valid framework for additive use in diets of varying composition. The results of meta-analysis demonstrate benefits for using XT to increase DMI and milk yield by lactating dairy cows.

Key Words: Meta Analysis, Plant Extracts, Dairy Cows

740 Effects of yeast culture on rumen microbial fermentation of heifers challenged with high-concentrate feeding. D. Moya*¹, S. Calsamiglia¹, A. Ferret¹, J. I. Fandiño¹, and L. Castillejos², ¹Universitat Autònoma de Barcelona, Bellaterra, Spain, ²Diamond V Europe, Marum, the Netherlands.

Twelve Holstein heifers (277 ± 28 kg BW) fitted with ruminal trocars were used in a crossover design study to determine the effects of yeast culture on ruminal microbial fermentation during a feed challenge. The challenge consisted of a 3-week adaptation period (100% forage diet) followed by a 2-week transition period when heifers were gradually switched to a 10:90 forage to concentrate diet to cause digestive upset (visual observation of bloat or reduction in feed intake by 50% from the previous day). Treatments consisted of a control diet without (CT) or with yeast culture supplementation at 14 g/hd/d (YC, Diamond V XPC_{LS}TM Yeast Culture, Diamond V Mills, Cedar Rapids, IA, USA). Ruminal fluid samples were collected at 0 and 6 h post-feeding on the first and last day of the adaptation period and daily during the transition into the high concentrate diet. Foam height and strength were determined on the day when a digestive upset was detected as a measure of potential foam production and bloat appearance. The addition of YC had no effect on ruminal fermentation during the 100% forage diet period except for an increase ($P < 0.01$) in ammonia N concentration. Yeast culture did not affect the incidence (83.3%) or the time (7.00 ± 0.62 d) to cause digestive upset. However, YC increased ($P < 0.05$) ruminal pH and branched chain VFA, and decreased ($P < 0.05$) lactate concentration on the day after digestive upset. Yeast culture reduced ($P < 0.05$) ruminal fluid viscosity 3 days prior and 2 days after digestive upset, and foam strength on the day digestive upset occurred. Ruminal population of *S. bovis* or *M. elsdenii* was not affected by treatment. Results indicated that YC had no effect on development of digestive upset during the feed challenge, but contributed to a faster recovery by increasing ruminal pH and reducing lactate production. In addition, YC reduced foam strength which could reduce the risk of developing bloat.

Key Words: Yeast Culture, Microbial Fermentation, Fed Challenge

741 Influence of body condition at calving and feed supplementation with yeast culture on feed intake, peripheral blood metabolites and blood mineral concentrations in early lactating dairy cows. R. Allbrahim*, M. Doherty, L. O'Grady, V. Gath, P. Duffy, and F. Mulligan, University College, Dublin, Ireland.

The influence of body condition score (BCS) at calving and feed supplementation with *Saccharomyces Cerevisiae* live yeast culture (Yea-Sacc1026) on feed intake, blood metabolites and major blood minerals, were determined by randomly allocating thin (mean BCS= 3.25 ± 0.5) or moderate condition (mean BCS=4.00 ± 0.25) forty Holstein/Friesian cows of mixed parity to receive one of two nutritional treatments (yeast supplemented and control diets) from day 14 pre-calving till day 70 post-calving. Daily feed intake was monitored individually. Blood samples were taken via jugular venipuncture on the day of calving and on days 5, 25 and 35 post-calving and analysed for glucose (GLS) non-esterified fatty acids (NEFA), beta-hydroxybutyrate (BHB), calcium (Ca), magnesium (Mg) and phosphorus (P). In weeks 1 and 2 of lactation, cows in moderate condition had a lower ($P < 0.06$) feed intake than thin cows. Moderate condition cows tended to have higher NEFA ($P = 0.08$) on the day of calving, and higher BHB concentrations ($P = 0.09$) on day 5 post-calving, when compared with thin cows. Moderate condition cows also had higher BHB concentrations at days 25 ($P = 0.07$) and 35 ($P < 0.01$) and had higher NEFA concentrations at day 25 ($P < 0.01$) post-calving when compared with thin cows. Thin cows had higher GLS concentrations at days 25 ($P < 0.01$) and 35 ($P = 0.06$) post-calving when compared with the moderate condition group. Cows supplemented with yeast tended to have lower NEFA concentrations at day 25 post-calving ($P < 0.10$) than control cows. On the day of calving, moderate condition cows had a higher ($P < 0.05$) Mg, lower ($P = 0.06$) Ca and tended to have a lower ($P < 0.10$) P than thin cows. Yeast supplementation had no effect ($P > 0.05$) on Ca, Mg or P status on the day of calving. These data clearly indicate that appropriate body condition score at calving and offering yeast supplements, significantly altered feed intake, indices of energy balance and major mineral concentrations in the peripheral blood of early lactating dairy cows.

Key Words: Body Condition Score, Blood Metabolites, Yeast Culture

742 Effect of feeding Diamond V Yeast CultureTM on milk production and dry matter intake in lactating dairy cows: A meta-analysis. A. R. Rabiee¹, I. J. Lean*¹, K. L. Dorton², M. E. Engstrom², and W. K. Sanchez², ¹Bovine Research Australasia, Camden, NSW, Australia, ²Diamond V Mills, Cedar Rapids, IA.

A meta-analytic approach was used to evaluate the effectiveness of supplementation with Diamond V YCTM, XPTM, and XPCTM Yeast Culture (fermented *Saccharomyces cerevisiae*) on milk production and dry matter intake (DMI) in lactating dairy cows. The presence and sources of heterogeneity in responses were also investigated. Published research papers and other reports (n = 60) were considered for meta-analysis. Trials were included if these provided: information on the form and dose of Diamond V Yeast Culture, adequate description of randomization, data on milk production or DMI, a measure of variance (SE or SD), and/or P-value. Switch back trials were not included. A total of 32 studies (milk production trials = 49; DMI trials = 28) met the selection

criteria. Treatment significantly increased milk production by 0.93 kg/day/cow (weighted mean difference = 95% confidence interval (CI) = 0.70 to 1.15, $P < 0.0001$). There was no evidence of heterogeneity in milk production responses ($P = 0.347$). Meta-regression showed that the effect of treatment was not influenced by stage of lactation, type and dose of yeast culture, duration of supplementation before and after calving, type of diet and parity. However, meta-analysis on subgroups (early-mid vs. late lactation trials) showed that the response to Diamond V Yeast Culture was slightly greater in late lactation. The effect of Diamond V Yeast Culture on DMI was not significant (effect size (ES) = 0.084; 95% CI = -0.025 to 0.19), and there was no evidence of heterogeneity ($P = 0.628$). Meta-regression analysis showed that this response was influenced by the delivery method (mixed vs. topdressed) as DMI was significantly greater when the treatment was top dressed (ES = 0.44; 95% CI = 0.18 to 0.70; $P = 0.001$). Dry matter intake was significantly greater during the early stage of lactation (ES = 0.31; 95% CI = 0.084 to 0.53; $P = 0.049$) studies compared to later studies.

Key Words: Diamond V Yeast Culture, Meta-Analysis, Dairy Cows

743 Dose-response effects of Rumensin® supplementation on kinetics of biohydrogenation of fatty acids in the rumen. M. S. Allen* and Y. Ying, *Michigan State University, East Lansing.*

Eight ruminally and duodenally cannulated multiparous Holstein cows were assigned randomly to replicated 4 × 4 Latin squares in a dose-response arrangement of treatments. Treatments were Rumensin® supplementation at 0, 8, 16, and 24 ppm DM. Diets consisted of corn silage and alfalfa silage (2:1 ratio, DM basis), high moisture corn, distiller's grains (6.9% of diet DM), protein supplement, minerals and vitamins. Diets were intended to promote milk fat depression and contained 25% NDF, 18.5% forage NDF, 28.6% starch, and 3.5% total fatty acids (FA). Treatment periods were 28 d with the final 11 d used for sample and data collection. Treatment did not affect concentration or molar percentage of acetate or propionate in ruminal fluid, or ratio of acetate to propionate. Rumensin® tended to decrease rate of biohydrogenation of 18:1 trans FA linearly from 38.9 to 32.6 %/h ($P = 0.09$). This resulted in a quadratic increase in the ruminal pool of 18:1 trans FA ($P = 0.04$) and numerically greater flow of 18:1 trans FA at the duodenum from 61.0 to 80.6 g/d ($P = 0.13$). Linear increases in concentrations of 18:1 t10 and t10, c12 CLA were detected in the milk ($> 2.2X$, $P < 0.05$). Mean daily ruminal pH tended ($P = 0.09$) to decrease from 6.26 to 6.14 with increasing Rumensin® concentration. Rumensin® decreased milk fat concentration from 3.23% for 0 ppm to 2.85% for 24 ppm ($P = 0.03$) but did not affect yield of milk fat ($P = 0.28$). Lack of effect of treatment on milk fat yield is consistent with effects on de novo FA synthesis; total FA < C16 as a % of total FA in the milk was not affected by treatment ($P = 0.75$). Although milk fat yield was not affected by treatment in this experiment, a reduction in rate of biohydrogenation resulting in increased flow of trans 18:1 FA from the rumen may contribute to the development of milk fat depression when supplementing Rumensin® in highly fermentable diets.

Key Words: Milk Fat Depression, Kinetics, CLA

744 Exogenous glucosamine administration alters glucose and insulin homeostasis in sheep. M. W. Robertson*, F. R. Dunshea, and B. J. Leury, *The University of Melbourne, Parkville, Victoria, Australia.*

The objective of this study was to determine whether exogenous glucosamine alters glucose, insulin and NEFA metabolism in sheep by increasing flux through the hexosamine biosynthetic pathway, a purported nutrient sensing pathway. Six cross bred ewes (34.9 kg ± 3.8) were used. Each ewe underwent a saline (C), and a 2.5 (LG) and 5 (HG) mg/kg/min glucosamine infusion for 6h. Blood samples were taken during a 1.5 h baseline period, at 1h intervals throughout the infusion and during a 6h recovery period. There was a significant time × treatment interaction ($P < 0.001$) throughout the sampling period for glucose, insulin and NEFA plasma concentrations. Mean baseline concentrations were not significantly different for glucose (C, 2.61; LG, 2.90; HG, 2.99 mmol/L), insulin (C, 5.66; LG, 6.39; HG, 4.88 mU/ml) or NEFA (C, 724; LG, 576; HG, 589 μmol/ml). Significant differences in plasma concentration of glucose were first observed at 2h (C, 2.34; LG, 3.54; HG, 3.88 mmol/L; $P < 0.002$) and for insulin at 4h (C, 5.66; LG, 6.39; HG, 4.88 mU/ml; $P < 0.003$) from start of infusion. Glucose and insulin concentrations continued to increase in both LG and HG treatments throughout the remaining infusion period. At the end of the 6h infusion there were significant differences ($P < 0.001$) between all 3 treatments (glucose: C, 2.40; LG, 4.28; HG, 5.44 mmol/L and insulin: C, 1.67; LG, 5.98; HG, 17.37 mU/ml). Post infusion, concentrations of glucose and insulin remained higher than C treatment and did not approach C values until around 4h and 6h, respectively. Changes in NEFA concentration were variable throughout the infusion period. At 2h post infusion NEFA concentration in LG and HG treatments fell significantly ($P < 0.003$) below the C treatment (C, 831, LG, 481; HG, 415 μmol/ml), but there were no significant differences in plasma NEFA concentration at 6h post infusion (C, 922, LG, 914; HG, 670 μmol/ml). These data indicate that glucosamine affects glucose and insulin homeostasis in a manner that is indicative of an insulin resistant state and this effect is dose dependant.

Key Words: Glucosamine, Insulin, Sheep

745 Effect of ZADO®, as enzymes from anaerobic bacterium, on extent of ruminal fermentation kinetics, microbial protein synthesis and milk production in dairy cows. H. M. Gado*¹, M. Hassan², and A.-F. Z. M. Salem³, ¹Ain Shams University, Cairo, Egypt, ²Cairo University, Cairo, Egypt, ³Alexandria University, Alexandria, Egypt.

A 2 × 2 factorial experiment was conducted to evaluate the effect of ZADO®, as enzymes preparation containing cellulases, xylanases, α-amylase and proteases from an anaerobic bacterium, on milk production and composition, ruminal fermentation activities and nutrients digestibility in dairy cows. Twenty multiparous lactating Brown Swiss cows (550 kg BW) were randomly assigned in two groups of 10 animals fed a mixed ration (CP 15%, TDN 74%) with or without addition of 40 g/head/d ZADO®. Milk production was recorded daily during 12 weeks of the experiment. Total and individual VFA (acetate, propionate, and butyrate), NH₃-N concentrations, and microbial protein synthesis were significantly ($P < 0.05$) increased for cows fed ZADO® diet. Digestibility coefficients of DM, OM, NDF and ADF were significantly ($P < 0.05$)

improved by addition ZADO® in cow diet. Consequently, total milk yield, 3.5 and 4% fat corrected milk and energy corrected milk improved ($P<0.05$) by 12, 21, 14, and 20% respectively, and there was no affect on milk composition. In conclusion, supplementing dairy cow diets with ZADO® has the potential to enhance milk yield as consequence

for improving the nutrients digestibility, ruminal fermentation activities and microbial protein synthesis. ZADO® confirm its roles in improving the fiber digestibility and suggested positive effects on ruminal fibrolytic microorganisms and increased milk production in dairy cows

Key Words: ZADO®, Microbial Protein Synthesis, Milk Yield

Friday, July 11, 2008

SYMPOSIA AND ORAL SESSIONS

Animal Behavior and Well-Being: Beef and Dairy Cattle

746 Effect of receiving weight on predicted days to onset of respiratory disease in feedlot steers. C. M. McAllister*¹, B. W. Brigham¹, R. M. Enns¹, R. L. Weaber², H. Van Campen³, G. H. Loneran⁴, J. L. Salak-Johnson⁵, C. C. L. Chase⁶, J. J. Wagner¹, and E. J. Pollak⁷, ¹Colorado State University, Fort Collins, ²University of Missouri, Columbia, ³Colorado State University, Fort Collins, ⁴West Texas A&M, Canyon, ⁵University of Illinois, Urbana, ⁶South Dakota State University, Brookings, ⁷Cornell University, Ithaca, NY.

Data were collected to determine the relationship between receiving weight and predicted days until the onset of respiratory disease (PDTs). Crossbred steers (n=1,551) from a single source were shipped from western Nebraska to southeast Colorado. Cattle from 3 ranch units were received in shipments occurring over 3 separate days. Steers were housed overnight in feedlot receiving pens before being processed and allocated to their pens. In some cases, initial processing did not occur until the second day after arrival due to time limitations. Steers were weighed during initial processing and housed in pens until identified as sick by feedlot personnel. Sick animals were treated according to approved protocols and assigned to sick pens until time of recovery. Only animals identified as afflicted with bovine respiratory disease (n=675) were included; (\bar{x} =16.52, σ =9.94). Animals not identified as sick (n=879) were given a constant variable (250 d) as their PDTs representing the predicted days in the feedlot. Alternatively, only observations on sick animals could have been included. Therefore the total data set (n=1,551) had an average PDTs (\bar{x} =148.49) and a standard deviation (s=115.98). Animals identified as sick for other reasons were not included. A mixed effects model was used to analyze the data with SAS PROC MIXED. Ranch unit (n=3)-processing day combinations (n=5), and pen (n=6) were included as fixed class variables. Random effects were animal within ranch unit-feedlot pen. Receiving weight was included in the model as a covariate. Receiving weight and ranch-lot classes had significant effects on PDTs (P<0.001 and P<0.05 respectively). Therefore as receiving weight increased 0.33 ± 0.142 kg the PDTs was expected to increase by one day. These results indicate that heavier cattle are less susceptible to bovine respiratory disease due to processing stress than calves that enter feedlots at lighter weights.

Key Words: Beef Cattle, Bovine Respiratory Disease, Receiving Weight

747 Correlations among measures of temperament, weight and gain of steers at placement and reimplant in a commercial feed yard. R. L. Weaber*¹, R. M. Enns², H. Van Campen², G. H. Loneragan³, J. L. Salak-Johnson⁴, C. Chase⁵, J. J. Wagner², and E. J. Pollak⁶, ¹University of Missouri, Columbia, ²Colorado State University, Fort Collins, ³West Texas A&M University, Canyon, ⁴University of Illinois, Urbana, ⁵South Dakota State University, Brookings, ⁶Cornell University, Ithaca, NY.

Single source, crossbred steers (n=1,551) were shipped from western Nebraska to southeast Colorado. Cattle from 3 ranch units were received over 3 separate days. Steers were housed overnight in receiving pens before processing and allocation to feedlot pens. In some cases, initial processing did not occur until the second day after arrival due to time limitations. Two data sets were collected to determine the relationship between measures of temperament and weight traits of steers at 1) placement into a commercial feedlot and 2) at reimplant approximately 75 d later. All body weight (BW) and temperament measures were recorded in a single processing facility at initial processing and at reimplant (RI). Beef Improvement Federation Chute Scores (CS; 1=gentle, 6=aggressive), collected by 4 independent trained observers (2 at each processing), and exit velocity (EV; m/sec) were used to measure temperament during both processing events. Processing time (PT) and EV were measured using an infrared triggered electronic time recording device as a steer entered the squeeze chute then traveled a fixed distance upon exit. Two CS collected for each animal within each processing were averaged (AVGCS and AVGCS_RI). Partial correlation coefficients were computed using the MANOVA features of SAS PROC GLM. Day of initial processing (n=5) and reimplant processing (n=4) were included as class variables. EV had correlations with EV_RI, AVGCS, AVGCS_RI, BW_RI, and PT of: 0.44, 0.12, 0.15, -0.06, and -0.07, respectively (all P<0.04). EV_RI had correlations with AVGCS, AVGCS_RI, BW_RI, gain, and average daily gain of: 0.15, 0.25, -0.08, -0.06 and -0.06, respectively (all P<0.03). AVGCS was correlated with AVGCS_RI (r=0.24, P<0.01) and PT (r=0.13, P<0.01). AVGCS_RI was correlated with PT_RI (r=0.09, P<0.01). Correlation between CS collected by observers 1 and 2 was 0.73 (P<0.01). The correlation between CS_RI collected by observers 3 and 4 was 0.85 (P<0.01). Increases in EV and EV_RI were associated with increases in AVGCS and AVGCS_RI. Trained observers assigned similar CS within a processing event. EV at reimplant was inversely associated with average daily gain.

Key Words: Temperament, Exit Velocity, Beef Cattle

748 The effect of exit velocity at receiving and re-implant on average daily gain and weight at re-implant. A. R. Pepper^{*1}, R. M. Enns¹, R. L. Weaber³, H. Van Campen², G. H. Loneragan⁴, J. L. Salak-Johnson⁵, C. C. L. Chase⁶, J. J. Wagner¹, and E. J. Pollak⁷, ¹Colorado State University, Fort Collins, ²Colorado State University, Fort Collins, ³University of Missouri, Columbia, ⁴West Texas A&M University, Canyon, ⁵University of Illinois, Urbna, ⁶South Dakota State University, Brookings, ⁷Cornell University, Ithaca, NY.

The objective of this study was to explore the relationship between temperament, as measured by exit velocity at receiving and re-implant, and weight (**IW**) and average daily gain (**ADG**) after 75 d in the feedlot. Crossbred steers (n=1,551) from a single source were shipped from western Nebraska to southeast Colorado. Cattle from 3 ranch units within that source were received in shipments occurring over 3 separate days. Steers were housed overnight in feedlot receiving pens before being processed and allocated to their lots (n=6). Exit velocity was measured at receiving (**EV**; m/s) and approximately 75 d later at re-implant (**EV_RI**; m/s) using 2 infrared electronic triggers to start and stop an electronic time recording device, the first as the steer left the chute and a second 2 m away from the first to finalize the exit velocity. Analyses were conducted using the MIXED procedure of SAS. In the first 2, EV_RI was evaluated as to its influence on IW and ADG (calculated as IW minus receiving weight divided by the number of days on feed). A third analysis evaluated the effect of EV on IW. All 3 models included the fixed effect of ranch-lot class, along with a random animal effect. An increase of 1 m/s in EV_RI resulted in a decrease in IW and ADG of 2.68 kg (P<0.001) and 0.03 kg (P<0.01), respectively. Similarly a 1 m/s increase in EV decreased IW by 2.89 kg (P<0.01). The ranch-lot class effect was significant in all 3 models (P<0.05). These results suggest that cattle with calmer temperaments gain better in the first 75 d of feeding.

Key Words: Average Daily Gain, Beef Cattle, Exit Velocity

749 Effect of processing stress on feedlot cattle sickness. B. W. Bringham^{*1}, R. M. Enns¹, R. L. Weaber², H. VanCampen¹, G. H. Loneragan³, J. L. Salak-Johnson⁴, C. C. L. Chase⁵, J. J. Wagner¹, C. M. McAllister¹, and E. J. Pollak⁶, ¹Colorado State University, Fort Collins, ²University of Missouri, Columbia, ³West Texas A&M University, Canyon, ⁴University of Illinois, Urbana, ⁵South Dakota State University, Brookings, ⁶Cornell University, Ithaca, NY.

Processing time and order were measured to determine their effect on sickness rate in feedlot cattle. Crossbred steers (n=1,551) from a single source were shipped from western Nebraska to southeast Colorado. Cattle from 3 ranch units were received in shipments occurring over 3 d. Steers were housed overnight in feedlot receiving pens before being processed and allocated to their feedlot pens. In some cases, initial processing did not occur until the second day after arrival due to time limitations. All animals to be processed in a single day were removed from the receiving pen and held in alleys until processing was completed. Processing included radio frequency identification tag, visual tags, oral wormer, injectable wormer, growth promotant, 30 ml of blood collected and carcass ultrasound measurements of loin eye muscle area, backfat and percent intramuscular fat. Processing time ranged from 50 to 577 s with an average time of 112 s. An average of 320 animals were processed

daily. Post processing, calves were placed in feedlot pens where they remained unless identified as sick. Individual animals were considered sick if they exhibited clinical signs typical of bovine respiratory disease such as lethargy, depression, coughing, and nasal discharge, as determined by feedlot personnel. Sick animals were treated according to defined protocols and housed separately with other sick animals until recovered. The outcome, sick versus not sick, was analyzed with the GENMOD procedure of SAS on the binomial scale (yes/no). The model included the fixed effects of feedlot pen-unit class, time in the processing chute, and processing order. Fixed effects that influenced outcome included feedlot pen by unit-class (P<0.05), processing time in seconds (P=0.06) and processing order within day (P=0.06). As the processing order each day or processing time increased the probability of becoming sick increased by 0.15 ±0.3 and 0.24 ±0.13 percent, respectively. These results indicate animals that spent more time awaiting processing or being processed had a higher likelihood of becoming sick.

Key Words: Beef Cattle, Processing Stress, Feedlot

750 Effect of daily ambient temperature and wind speed on sickness of feedlot cattle. S. E. Speidel^{*1}, R. M. Enns¹, G. H. Loneragan², R. L. Weaber³, H. Van Campen¹, J. L. Salak-Johnson⁴, C. C. L. Chase⁵, J. J. Wagner¹, and E. J. Pollak⁶, ¹Colorado State University, Fort Collins, ²West Texas A&M University, Canyon, ³University of Missouri, Columbia, ⁴University of Illinois, Urbana, ⁵South Dakota State University, Brookings, ⁶Cornell University, Ithaca, NY.

The objective of this study was to determine the magnitude of the effect of daily temperature range and mean wind speed on the probability an individual animal would be identified as sick. Crossbred steers (n=1,551) from a single source were shipped from western Nebraska to southeast Colorado. Cattle from 3 ranch units were received in shipments occurring over 3 separate days. Steers were housed overnight in feedlot receiving pens before being processed and allocated to their feedlot pens. In some cases, initial processing did not occur until the second day after arrival due to time limitations. Individual animals were considered sick if they exhibited clinical signs typical of bovine respiratory disease such as lethargy, depression, coughing, and nasal discharge; as determined by feedlot personnel. The effects of weather (difference between daily maximum and minimum temperature, TDIFF, and mean wind speed, MWS) from 7 d prior to sickness identification through d 0, the day the animal was observed sick, were evaluated as to their influence on sick observations using binary logistic regression and the GENMOD procedure of SAS; where an animal was coded "1" if diagnosed sick on a particular day or "0" if healthy. The model resulted in a significant pen by ranch interaction (P<0.005) and significant effects of TDIFF and MWS on sickness diagnosis. On d 0, unit increases in both TDIFF (1 ° C) and MWS (1 m/s) increased the probability of an animal being pulled by 5.9 ± 0.02% (P<0.001) and 10.1 ± 0.04% (P<0.03), respectively. At d -2 and earlier, MWS did not have a significant effect on the probability of an animal being pulled (all P>0.23). Likewise, TDIFF had no significant effect on the probability of an animal being pulled prior to d -3 (all P>0.13). These results indicate that TDIFF and MWS can influence whether or not an animal becomes sick in the feedlot up to 3 d prior to the onset of disease.

Key Words: Beef Cattle, Feedlot Sickness, Weather

751 Effect of rubber flooring on cow locomotion and gene expression. K. O'Driscoll^{1,2}, M. M. Schutz³, and S. D. Eicher^{*4}, ¹*Teagasc, Fermoy, Ireland*, ²*NUI Dublin, Dublin, Ireland*, ³*Purdue University, West Lafayette, IN*, ⁴*USDA-ARS, West Lafayette, IN*.

The aim of this study was to evaluate the effect of 2 free stall flooring systems on cow locomotion (including speed) and expression of genes associated with lameness, during the dry and peri-parturient period. Cows were assigned to free-stall housing with either rubber (RUB; n=13) or concrete (CON; n=14) at the feed alley immediately after their first calving, and managed on this system during all subsequent lactations. Between lactations cows remained in a straw bedded-pack dry-cow pen. Cows entered the experiment at the end of either their 1st (n=16) or 2nd (n=11) lactations. Locomotion scores (5 point system each for foot rotation, tracking, back arch, and head carriage, and speed) and blood samples were obtained at approximately -60, -30, 0, +7 and +14 days relative to calving. Expression of genes in blood leukocytes which may be related to pain or lameness; substance-P receptor (TAC1), histamine receptor (HRH1), and metalloproteinase-13 (MMP13) was estimated using qRT-PCR. Treatment effects on locomotion scores, cow speed, and gene expression were analyzed using repeated measures ANOVA. Contrary to expectation, rubber flooring did not improve dairy cow locomotion (1.7 vs 1.8 ± 0.85). However it had an effect on locomotion score (1.7, 1.6, 1.9, 1.9, 1.8 ± 0.8 for d -60, -30, 0, 7, and 14) and speed (6.2, 6.2, 8.4, 7.6, and 7.1 ± 0.48 for d -60, -30, 0, 7, and 14), both peaking on day 0. Post calving, cows on CON were slower than RUB, relative to pre calving (P=0.01). Cows at the end of the 2nd lactation were slower than cows at the end of the 1st (6.0 vs 8.2 ± 0.42), particularly RUB cows (CON = 6.6 and 7.7 ± 0.56 and RUB = 5.4 and 8.8 ± 0.60 for 1st and 2nd lactations). RUB cows had higher expression of MMP13 than CON (0.24 vs 0.19 ± 0.04), which was more highly expressed in lame than in sound cows in previous work by others. Cows in RUB also tended to have higher expression levels of TAC1 (0.47 vs 0.32 ± 0.07). In summary, bedded-pack surfaces during the dry period may have resulted in more pain for cows coming from rubber flooring than from concrete flooring and MMP13 is up-regulated in clinically lame cows and thus this gene holds promise as an objective indicator of lameness.

Key Words: Lameness, Locomotion, PCR

752 Effect of feed bunk sprinklers on attendance at un-shaded feed bunks in dry-lot dairies. B. H. Carter^{*}, T. H. Friend, J. E. Sawyer, and M. A. Tomazewski, *Texas A&M University, College Station*.

Feed bunk sprinklers combined with fans effectively increase feed bunk attendance when bunks are shaded. This summer study characterized feed bunk attendance at a Texas Panhandle dairy where sprinklers were installed above un-shaded feed bunks. Holstein-Friesian cows were housed in pens with shade structures 45 m from and parallel to feed bunks. Three pens were equipped with sprinklers above the feed bunk that sprayed the backs of cows in 1.5 min on, 10 min off cycles when temperature was above 22.2°C. Two pens without sprinklers served as controls. Cow numbers and pen density were similar among treatments. Each pen held 135 to 390 cows. Bunk attendance (proportion of cows within 2 m of the feed bunk) was recorded for each pen at 2-h intervals over a 48-h period. Data were analyzed as repeated measures with sprinkler treatment, time, and their interaction as effects in a mixed model with pen (treatment) as the subject. Means associated with

time-treatment interactions were separated using t-tests. Relationships between bunk attendance, thermal heat index (THI) and wind speed within treatment were evaluated using linear regression. Sprinkler effect on bunk attendance was dependant on time of day (P < 0.01). Bunk attendance was greater in pens with sprinklers than pens without at 1700 h for both 24-h periods (P < 0.02), corresponding to peak daily THI. Bunk attendance was greater for pens without sprinklers at 0900 h of the first 24-h period and 2100, 0300 and 1100 h of the second 24-h period (P < 0.01), all of which occurred at lower THI. Bunk attendance was similar between treatments at all other times (P > 0.09). Bunk attendance decreased with increasing THI in pens without sprinklers (P = 0.02), but was not influenced by THI for pens with sprinklers (P = 0.54). Wind speed did not affect bunk attendance for either treatment (P > 0.10). Sprinklers altered the timing of bunk attendance but did not alter overall mean bunk attendance (P = 0.91). Further research is needed to determine if altered feeding pattern influences feeding duration, intake and milk yield.

Key Words: Sprinkler, Dairy, Feedbunk

753 Effect of shade on panting score of feedlot cattle exposed to heat stress. J. B. Gaughan^{*1}, M. L. Sullivan¹, J. Cawdell-Smith¹, and T. L. Mader², ¹*The University of Queensland, Gatton, Qld, Australia*, ²*University of Nebraska, Concord*.

A 120-d finisher feedlot study using 126 Angus heifers (BW = 350 ± 45 kg) was undertaken to determine the optimal shade area to alleviate heat stress. Four shade treatments (70% solar block) were used: no shade, 2.0, 3.3 and 4.7 m²/animal. The shade was 4 m high with a north-south orientation. Cattle were randomly allocated to pen (9/pen; 19.2 m²/animal). Climatic conditions (ambient temperature, relative humidity (RH), black globe temperature (BG), wind speed (WS)) were recorded every 10 min. From these data the heat load index {HLI; HLI_{BG>25} = 8.62 + (0.38 × RH) + (1.55 × BG) - (0.5 - WS) + [e^{2.4 - WS}], and HLI_{BG<25} = 10.66 + (0.28 × RH) + (1.3 × BG) - WS, (approximate value of e = 2.71828)} and accumulated heat load units (AHLU; based on the time cattle are exposed to HLI > 86) were determined. The HLI and the AHLU were combined to determine climatic stress: low stress: HLI < 70; AHLU < 1, moderate stress: HLI 70.1-77; AHLU 1-10, high stress: HLI 77.1-86; AHLU 20-50, and extreme stress: HLI > 86; AHLU > 50. Individual panting scores were obtained every 2 h from 0600 to 1800. Treatment mean panting scores (MPS) were then determined. A MPS of 0 to 0.4 indicates no stress; 0.4 to 0.8 low stress; 0.8 to 1.2 high stress, and >1.2 extreme stress. Treatment differences were examined using repeated measures analysis. Within treatment, MPS increased (P < 0.01) when climatic stress shifted from low to moderate. There were no between treatment differences. There were small changes in MPS between moderate and high climatic stress, and larger increases (P < 0.01) between high and extreme. The MPS was greatest (MPS = 1.72; P < 0.001) in the unshaded cattle under extreme conditions. There were no differences (P > 0.05) between the shaded treatments (MPS = 1.03) when climatic stress was extreme. The provision of shade reduced the effects of extreme climatic stress conditions. There does not appear to be an advantage of increasing the area of shade above 2.0 m². This project was funded by Meat Livestock Australia P/L.

Key Words: Heat Stress, Welfare, Beef Cattle

754 A comparison of behavior of steers raised in hoop buildings or feedlots. R. Baker*, A. Johnson, S. Lonergan, M. Honeyman, K. Stalder, L. Sadler, and P. Lammers, *Iowa State University, Ames.*

The objective of this study was to compare steer behavior between 2 treatments; hoop building (HP n=3; 4.65m² / steer), which is a semi-cylindrical structure, vs. feedlot (FD n=3; 14.7m² / steer) dirt pad with concrete strip for the feed bunks. A total of 240 crossbred *Bos taurus* steers was used. Steers were ear tagged, implanted, and weighed (445 ± 31.7 kg) upon arrival and sorted by weight and breed. All steers were fed a completely balanced diet and offered water ad libitum from 1 drinker/pen. Corn stalks were provided to HP steers for bedding. Behavioral data were collected using a 10 min scan sampling technique using live observation by 2 experienced observers from 0700h to 1600h on d 34, 56, and 91 of the trial. Two behaviors (head in bunk and drinking) and 3 postures (lying, walking, and standing) were recorded. The day after behavior collection, steers were moved through a squeeze chute for subjective temperament scoring. Scores ranged from 1 (calm) to 5 (wild). Behavioral data was transformed using the arcsine of the measure to normalize the distribution and subsequently analyzed using ANOVA (PROC MIXED, SAS). Temperament scores were analyzed using non-parametric methods (PROC GLIMMIX, SAS). There were no (P>0.05) differences for head in bunk behavior between treatments. However there was a difference (P=0.02) for drinking, with HP steers spending more time at the drinker than FD. Lying was greater (P<0.004) for HP vs. FD steers. Fewer (P<0.05) steers exhibited walking or standing behavior in the HP compared to their FD counterparts. Temperament scores were not different between treatments (P=0.13) but day and day*treatment (P<0.001) were significant sources of variation for temperament measures. In conclusion, overall time budget differences were observed with HP steers being less active yet with more time spent engaged in drinking related behaviors, and steer temperament at exit increased over the trial. Therefore, housing steers in a hoop does not result in detrimental behavior or temperament alterations.

Key Words: Behavior, Hoops, Steers

755 Effects of soil surface temperature on daily water intake in feedlot steers. R. A. Arias*¹ and T. L. Mader², ¹*Universidad Católica de Temuco, Temuco, Chile,* ²*University of Nebraska, Lincoln.*

Ambient temperature (AT) has been used as indicator of cattle comfort and productivity. This study explores the relationship between soil surface temperature (SST), 10.2 cm depth soil temperature (ST), and daily water intake (DWI). Equations to predict DWI from SST (99 d) and ST (186 d) were developed with data collected from 2004 to 2006. Data from an experiment conducted during summer of 2007 (60 d) were used to validate these equations. Environmental variables were collected from a weather station located in the feedlot. The DWI was obtained by dividing the amount of water consumed per day in 2 adjacent pens by the number of animals present. Animals (n=116) were crossbred Angus cattle on finishing diets. The procedures included simple and polynomial linear regression. A repeated measures analysis was conducted to compare differences among ST, SST, and AT using SAS software. During July and August the mean of SST and ST were similar and higher than mean

AT being 26.7±.2, 26.5±.07, and 23.5±.12, °C respectively (P<0.001). However, ST was higher than AT between 8 p.m. and 10 a.m. The SST was higher than AT between 7 a.m. and 8 p.m. On the other hand, ST and AT were similar between 9 am and 3 p.m., whereas SST and AT were similar between 9 p.m. and 6 a.m. The data set was analyzed in 2 ways: the overall model representing the period May to October and the summer model representing the period June to August. In the overall model, SST was a better predictor of DWI than ST (r²=0.82 vs. 0.65, P<0.001). The greatest r²=0.86 (P<0.001) was reached with SST in a quadratic model. A similar response was observed in the summer model (SST, r²=0.70, P<0.001). In the validation process, the summer and overall model tended to over predict slightly DWI for the period July to August (13.5% and 12.5%, respectively). In conclusion, ST has a significant effect on DWI, whereas SST appears as the best predictor for DWI compared with other weather variables such as AT. Further studies of variables affecting DWI are required.

Key Words: Soil Temperature, Daily Water Intake, Modeling

756 Effect on performance and animal welfare of an all-concentrate diet fed to heifers. G. Faleiro, L. A. González, A. Ferret*, X. Manteca, J. L. Ruiz de la Torre, and S. Calsamiglia, *Nutrition, Management and Animal Welfare Research Group, Universitat Autònoma Barcelona, Bellaterra, Barcelona, Spain.*

Forty-eight Friesian female calves (Initial BW = 84.5 kg) were assigned to a factorial arrangement of treatments in a randomized complete block design with 2 treatments and 4 BW blocks, to study the effects of an all-concentrate diet on performance and animal welfare. Treatments consisted of concentrate with barley straw (C) and the same concentrate without straw (BP). Ingredients of the concentrate (DM basis) were 31.3, 32.2, 16.0, 8.0, 9.0, 1.1, 1.0 and 1.0% of barley, corn, beet pulp, soybean meal, corn gluten feed, calcium carbonate, sodium bicarbonate and salt, respectively, with the remainder being minerals and vitamins. Feeding management allowed ad libitum consumption of diets, which were fed daily at 0830. During 9 periods of 28 d each, DMI and ADG were measured, and blood samples were taken for haptoglobin determination as a welfare indicator. Animals were slaughtered at 350 kg BW, in a commercial abattoir where hot carcass weight was registered and dressing percentage calculated. A logarithmic transformation was applied to blood haptoglobin concentrations. Variables normally distributed were analyzed using the PROC MIXED of SAS. Concentrate intake was similar in both treatments (6.7 and 6.5 kg ± 0.28 for C and BP, respectively), but there were differences in total feed intake (7.3 and 6.5 kg ± 0.31 for C and BP, respectively; P = 0.045). Because there were no differences in ADG between treatments (1.12 and 1.11 kg/d ± 0.058 for C and BP, respectively), feed efficiency was lower in C (0.151 kg BW/kg DMI) than in BP (0.168 kg BW/kg DMI; SEM = 0.0046; P = 0.019). There were no differences between treatments in dressing percentage and hot carcass weight. Blood concentrations of haptoglobin were not different between treatments (0.233 and 0.221 mg/mL ± 0.027 in C and BP, respectively). In conclusion, performance was not different and well-being as reflected by haptoglobin levels was not affected by treatments.

Key Words: Beef Cattle, Performance, Welfare

Breeding and Genetics: Dairy, Sheep & Goat - Crossbreeding, Inbreeding and Breed Conservation

757 Genetic variation in the threshold of sensitivity to heat stress in Holsteins. J. P. Sánchez^{*1}, R. Rekaya², I. Aguilar², and I. Misztal^{2,3}, ¹Universidad de León, Campus de Vegazana, León, Spain, ²University of Georgia, Athens, ³Instituto Nacional de Investigación Agropecuaria, Estación Las Brujas, Canelones, Uruguay.

Past studies in genetics of heat tolerance assumed a fixed threshold in sensitivity to heat stress. The objective of this study was to assess genetic variation in individual variability to that threshold. Data included 379,833 first-parity test day records on 40,986 Holsteins heifers in US, sired by 327 bulls. Inferences were obtained by a Bayesian non-linear hierarchical sire model. Effects in the model included DIM x milking frequency, HYS of the milking day, and two sire effects: the intercept (I_S) and the regression (S_S) on the Temperature-humidity index (THI) above a sire specific threshold (T_S). In the second hierarchical stage the means and (co)variances of I_S , S_S and T_S were estimated using a linear model. The estimated average of the threshold across sires was 22.7(0.20) THI C°, and its variance 4.0(0.74). The marginal posterior mean for the heritability (marginal posterior standard deviation) in the absence of heat stress was 0.083(0.006), and it increased to 0.46(0.047) at 30 THI C°. The DIC indicated a superiority of this model compared to a model where the threshold was fixed for all sires. Genetic variability exists for the threshold of heat stress; however, the threshold can only be well estimated for popular sires. Very fast rise in heritability with increasing THI may be an artifact of a sire model. It would be useful to extend the current methodology to animal models, however, after preliminary analyses, the computing time would be high and convergence could be hard to obtain.

Key Words: Heat Tolerance, Hierarchical Model, Non-Linear Reaction Norm

758 *In situ* goat conservation population and selection for parasite resistance. J. M. Dzakuma^{*1}, B. M. Johnson¹, N. C. Beckford¹, L. C. Nuti¹, and T. M. Craig², ¹Prairie View A&M University, Prairie View, TX, ²Texas A&M University, College Station.

In 2002 the International Goat Research Center at Prairie View A&M University obtained animals from 3 goat breeds - the Tennessee Stiff-legged (TS) or Myotonic, the Spanish (SP) and the Boer (BR) - and established them in live populations (*in situ*) for use in a conservation program. Genetic materials are collected and preserved on this population. Simultaneously, we also collect, and preserve germplasm (*ex situ* conservation) from available breeds and strains of goats.

Kids produced from this population are challenged, orally each year, with one large dose of 5000 infective *Haemonchus contortus* larvae per animal to evaluate the impact of management treatments on growth weight (WT), fecal egg count (FEC), blood packed cell volume (PCV) and serum protein levels (SPL). The objective was to compare resistance or tolerance to parasites. The initial experimental design in 2004 included: (1) 32 kids were maintained on pasture as the control; (2) 74 kids challenged and maintained on concrete floors; (3) 74 kids maintained on concrete floors without challenge; and (4) 72 kids were challenged and maintained on pasture. Body weights, fecal and blood samples were collected on day zero to establish initial baseline samples

before kids were challenged. Weights and samples were taken weekly for 8 weeks. Statistical analyses were performed using SAS Proc Mixed. Variables were: WT, FEC, PCV and SPL. Sources of variation were: breed, sex, treatment, kid ID, time and all interactions.

Results from the 2004 initial trial indicated that progress could be made by selecting goats, for both high and low tolerance to *Haemonchus*, by selecting from those that are artificially challenged and maintained on pasture. From the 3 breeds used in the initial study, and for FEC (egg/gm) and PCV (%), respectively: BR (485.2±61.6; 25.6±0.4), SP (308.2±53.8; 30.5±0.3) and TS (301.9±40.6; 29.4±0.3). The BR breed appears to be significantly less resistant ($P<.02$) to the parasite load than the SP and TS that were similar ($P>.05$). Statistically significant differences were observed for WT and SPL. Results from 2005-2007 (challenged and pastured) followed a similar pattern. Individuals within breed analyses will be presented.

Key Words: Goats Spanish Boer, Tennessee Stiff-Legged, *Haemonchus Contortus*

759 Genetic diversity of US sheep breeds. H. Blackburn^{*1}, M. Brown², S. Wildeus³, R. Stobart⁴, D. Bixby⁵, J. Dzakuma⁶, S. Ericsson⁷, W. Getz⁸, N. Cockett⁹, D. Matsas¹⁰, C. Welsh¹, S. Spiller¹, and D. Waldron¹¹, ¹ARS National Animal Germplasm Program, Ft. Collins, CO, ²ARS Grazing Lands Research, El Reno, OK, ³Virginia State University, Petersburg, ⁴University of Wyoming, Laramie, ⁵American Livestock Breeds Conservancy, Pittsboro, NC, ⁶Prairie View A&M University, Prairie View, TX, ⁷Sul Ross University, Alpine, TX, ⁸Fort Valley State University, Fort Valley, GA, ⁹Utah State University, Logan, ¹⁰Tufts University, North Grafton, MA, ¹¹Texas A&M University, San Angelo.

Understanding the genetic relationships between US sheep breeds is useful in developing conservation strategies and actions. A broad sampling of individual sheep from 28 breeds was performed. Breed types included: fine wool, meat types, long wool, hair, prolific, and fat tailed. Blood and semen samples (n=660) were derived from 222 breeders in 38 states. DNA was extracted from the samples and genotyped using the FAO/ISAG panel of 31 microsatellites, however, based on amplification success only 28 markers were used in the analysis. Genotyping data were analyzed using GENALEX, PHYLIP and STRUCTURE. The following breeds were found to have relatively high inbreeding values: Columbia (0.60), Gulf Coast Native (0.54), Jacob (0.52), and Targhee (0.62) suggesting genetic diversity is an issue for rare breeds and some commercially popular breeds. The average number of alleles per breed ranged from 3.67 (Black Welsh Mountain) to 7.89 (Rambouillet). Private alleles ranged from one to five and were found in 22 breeds. There were six breeds with no private alleles. Of interest were the high frequencies of three private alleles in the Tunis (0.62 and 0.15) and Warhill (0.30) breeds. Nei's genetic distances were computed and ranged from 0.08 for Hampshire:Suffolk to 0.80 for the combinations of Blackbelly Barbados:Black Welsh Mountain, and Hog Island:Tunis. Data were clustered using STRUCTURE assuming 28, 20, 19, and 15 clusters; the assignments from these runs suggest the number of clusters for this dataset is 19. Breeds showing a constant grouping with one another included: Rambouillet:Warhill, Hampshire:Suffolk, Barbados Blackbelly:St Croix, Cotswold:Lincoln, and Columbia:Targhee:Dorset:Polypay. These data provide a baseline for determining the degree of

genetic similarity/dissimilarity between many US sheep breeds. With this information germplasm collection activities can be refined, thereby ensuring that germplasm collections capture the genetic diversity needed to safely conserve sheep populations.

Key Words: Genetic Diversity, Sheep, Conservation

760 Heterogeneity of founder-specific inbreeding depression on birth BW of Ripollesa lambs. J. Casellas*¹, J. Piedrafit², G. Caja², and L. Varona^{1,3}, ¹*Genètica i Millora Animal, IRTA-Lleida, Lleida, Spain*, ²*Departament de Ciència Animal i dels Aliments, Universitat Autònoma de Barcelona, Bellaterra, Spain*, ³*Departamento de Anatomía, Embriología y Genética Animal, Universidad de Zaragoza, Zaragoza, Spain*.

Estimates of inbreeding depression are usually obtained by modeling the overall inbreeding coefficient of each individual, without considering that heterogeneity between founders could be anticipated. Inbreeding has special relevance in local and endangered sheep breeds, whose flocks are characterized by small size, limited genetic connectedness and small number of rams per generation. The objective of this research was to examine heterogeneity in founder-specific inbreeding depression (FSID) effects on lamb birth BW. Data were recorded in the Ripollesa experimental flock of the Universitat Autònoma of Barcelona (Spain), between 1986 and 2007, and included 2,459 birth BW records (3.29 ± 0.02 kg) from 1,634 parturitions and 384 ewes. The operational model accounted for birth type, sex, year of birth, environmental dam effect and infinitesimal genetic effect, as well as FSID effects from 9 founders contributing with more than 50 inbred lambs with phenotypic data. Birth BW was analyzed under a linear animal model solved through Bayesian inference, and each FSID effect was appropriately tested by an empirical Bayes factor (BF; model including the FSID effect against model excluding the FSID effect). Four founders showed null FSID effects with BF ranged between 0.05 and 0.42. The remaining 5 founders showed relevant FSID effects, birth BW being reduced between -8 g (BF = 1.42) and -96 g (BF = 8.80×10^{19}) for each 1% increase in inbreeding. Note that those estimates were obtained from a small range of partial inbreeding coefficients (0% to 10%), and they must be seen with caution outside that range of values. These results revealed a substantial degree of between-founders heterogeneity of FSID effects, where null and negative effects were reported on birth BW of Ripollesa lambs.

Key Words: Birth Weight, Inbreeding Depression, Ripollesa Breed

761 Type appraisal of Holsteins, Jerseys, and reciprocal crosses under two classification systems. B. G. Cassell*¹, K. M. Olson¹, and A. J. McAllister², ¹*Virginia Polytechnic Institute and State University, Blacksburg*, ²*University of Kentucky, Lexington*.

Holstein appraisers scored Holsteins (HH) and two reciprocal crosses, (HJ and JH with breed of sire first) while Jersey (JJ) appraisers scored JJ, HJ, and JH crosses in the Virginia Tech and Kentucky university dairy herds. Holstein appraisers visited each herd twice scoring 115 HH, HJ, and JH cows. Jersey appraisers visited Virginia Tech twice and Kentucky once scoring 86 JJ, HJ, and JH cows. Fifty four HJ and JH cows were scored on both systems. Only first available appraisals, whether in first or second lactation, were used. Purebreds were compared to crossbreds

within the Holstein or Jersey appraisal system using a single score per cow and a fixed model including lactation, age fresh within lactation, station, appraiser within station, days in milk when scored, and breed. Interest was in breed differences. Crossbred cows scored on both systems were analyzed using two scores per cow in a mixed model including random cow within breed, the effects in the previous fixed model, plus appraisal system, station by system, and appraiser nested within station and system. Interest was in system differences. From the fixed analysis, HJ and JH scored significantly lower than HH for final classification (70 and 71 points versus 79), were significantly shorter than HH, with less strength and deeper udders. Front teat placement favored HJ and JH over HH. In the Jersey system, final score was not different for HJ, JH, and JJ breed groups, while crosses were taller than JJ with wider rear udders. Crosses and purebreds were not significantly different in either system for almost all other traits. In the mixed model comparing Holstein and Jersey systems, we observed system differences in final score, dairy form, stature, strength, foot angle, udder depth, and front teat placement. Breed systems assigned similar scores for rump angle, rear udder height and width, udder cleft, and teat length. In general, crossbred conformation was more acceptable to Jersey than to Holstein type standards.

Key Words: Crossbreeding, Dairy, Type Appraisal

762 Montbeliarde-sired crossbred cows compared to pure Holstein cows for production, SCS, days open, and body condition score during their first two lactations. A. R. Hazel*, B. J. Heins, L. B. Hansen, A. J. Seykora, D. G. Johnson, J. G. Linn, and J. E. Romano, *University of Minnesota, Saint Paul*.

Montbeliarde-sired crossbred (MX) cows ($n = 83$) were compared to pure Holstein cows ($n = 61$) for 305-d milk, fat, and protein production; SCS; days open (DO); and BCS during their first two lactations. Cows were in two research herds of the University of Minnesota and calved from October 2005 to December 2007. Best Prediction was used to determine actual production for 305-d lactations with adjustment for age at calving, and records less than 305 d were projected to 305 d. For DO, cows were required to be at least 250 d in milk and those with greater than 250 d for DO were truncated to 250 d. First and second lactations of cows were analyzed separately. Independent variables for statistical analysis were the fixed effects of herd, season (fall or spring) nested within herd, breed group, and two-breed (Montbeliarde \times Holstein) vs. three-breed (Montbeliarde \times Jersey/Holstein) crossbred nested within breed group. Age in months at calving and days in milk were also covariates for BCS. The MX and pure Holstein cows were not significantly different for fat plus protein production during first lactation (493 kg vs. 502 kg, respectively) and second lactation (617 kg vs. 618 kg, respectively). Also, MX cows (2.74) were not significantly different from pure Holstein cows (2.66) for SCS during first lactation; however, MX cows (1.53) had significantly ($P < 0.01$) lower SCS than Holstein cows (2.51) during second lactation. During first lactation, MX cows (121 d) had significantly ($P < 0.01$) fewer days open (40 d) than pure Holstein cows (161 d). The MX cows carried significantly ($P < 0.01$) more body condition than pure Holstein cows during both first lactation (3.22 vs. 2.77, respectively) and second lactation (3.27 vs. 2.65, respectively).

Key Words: Crossbreeding, Heterosis, Montbeliarde

763 Jersey × Holstein crossbred cows compared to pure Holstein cows for production, SCS, days open, body condition score, and udder measurements during the first three lactations. B. J. Heins*, A. R. Hazel, L. B. Hansen, A. J. Seykora, D. G. Johnson, J. G. Linn, and J. E. Romano, *University of Minnesota, Saint Paul.*

Jersey × Holstein crossbred (J×H, n = 76) cows were compared to pure Holstein (n = 73) cows for 305-d milk, fat, and protein production; SCS; days open (DO); BCS; and udder measurements during the first three lactations. Cows were in two research herds of the University of Minnesota and calved from September 2003 to June 2007. Best Prediction was used to determine actual production for 305-d lactations with adjustment for age at calving, and records less than 305 d were projected to 305 d. For DO, cows were required to be at least 250 d in milk and those with greater than 250 d for DO were truncated to 250 d. Independent variables for statistical analysis were the fixed effects of herd, season (fall or spring) nested within herd, and breed group. During first lactation, J×H (497 kg) and pure Holstein (515 kg) cows were not significantly different for fat plus protein production. However, during second (577 kg vs. 608 kg) and third (598 kg vs. 641 kg) lactations, J×H cows were significantly ($P < 0.01$) lower for fat plus protein production than pure Holstein cows. The J×H cows were not significantly different from pure Holstein cows for SCS during first and second lactations; however, J×H cows (4.00) had significantly ($P < 0.05$) higher SCS than pure Holstein cows (3.20) during third lactation. The J×H cows tended ($P < 0.10$) to have fewer days open than pure Holstein cows (127 d vs. 150 d) in first lactation and had significantly ($P < 0.01$) fewer days open than pure Holstein cows (130 d vs. 162 d) in second lactation. For BCS, J×H cows had significantly ($P < 0.05$) greater body condition (2.80 vs. 2.71 and 2.96 vs. 2.85) than pure Holstein cows in first and second lactations, respectively. For udder measurements, J×H cows had significantly ($P < 0.01$) less udder clearance than pure Holstein cows in first (47.7 cm vs. 54.6 cm) and second (41.7 cm vs. 50.2 cm) lactations. Furthermore, J×H cows had significantly ($P < 0.01$) greater distance between front teats in first (15.8 cm vs. 14.0 cm) and second (17.0 cm vs. 14.7 cm) lactation than pure Holstein cows.

Key Words: Crossbreeding, Heterosis, Jersey

764 Number of services per conception, estimated calving interval and lactation length in New Zealand and Mexican Holstein cows in Torreon, Coahuila, Mexico, Case study. T. B. Garcia-Peniche*¹ and A. Aranda-Munguia², ¹*Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias, Paso del Toro, Veracruz, Mexico,* ²*Establo La Montaña, Torreon, Coahuila, Mexico.*

This work compares calving interval (CI), empty time (Emp), number of services per conception (NuIns), and lactation length (TotDIM) in Holstein cows from 3 origins (breedtyp): imported as pregnant heifers from New Zealand (NZ), born in Mexico, from New Zealand dams (d_NZ) or from American parentage (d_EUA). All the cows were in the same herd in an intensively managed, confined dairy in Torreon, Coahuila, Mexico. Data were obtained from 15 test days from March 2007 to January 2008. Records from 1657 dry cows (73% NZ, 20.6% d_EUA and 6.4% d_NZ) provided information about totDIM, as well as days pregnant (days_preg) and days dry (dd). Assuming a pregnancy length of 283 d, the time that the cows are expected to remain dry can be calculated from 283 d minus the reported days_preg. Thus, CI was estimated as: { [(283-days_preg) + dd] + TotDIM }, and EMP = CI-283. The NuIns were directly obtained from the records of 2006 pregnant

cows in production (68% NZ, 8.4% d_NZ, and 20.6% d_EUA). No interaction was found between breedtyp with either lactation number (1 to 3) or season of conception, yet the models were adjusted for those effects. The data were analyzed using SAS[®] 9.1. Calving interval, EMP and totDIM were analyzed with the MIXED procedure, while NuIns was assumed to follow a poisson distribution and analyzed with the GENMOD procedure. Total time that the cows remained dry was also analyzed, but no differences for breedtyp were found. There were no significant differences between d_EUA and d_NZ for CI, TotDIM and EMP, as the Table shows. The expected NuIns values have the Wald 95% confidence lower and upper limits between parentheses, and the letters a and b show that no significant Chi-square difference was found between NZ and d_EUA. The total time that the cow remains dry is a trait derived from management and showed no breedtyp difference, however, results show that the longer CI in NZ comes both from longer lactations (totDIM) and more difficulties in achieving pregnancies (larger EMP and NuIns) in this study.

Table 1. Calving interval (CI), empty time (EMP), lactation length (totDIM), and number of services per conception (NuIns) in New Zealand (NZ) and Mexican (d_NZ and d_EUA) Holstein cows

Origin	CI (d)	EMP (d)	totDIM (d)	NuIns
NZ	418.3 ± 4.7 a	135.3 ± 4.7 a	332.5 ± 4.3 a	3 (2.67 - 3.36) a
d_NZ	383.2 ± 10.1 b	100.2 ± 10.0 b	297.2 ± 9.2 b	2.5 (2.16-2.99) b
d_EUA	382.0 ± 7.2 b	99.0 ± 7.2 b	297.8 ± 6.6 b	2.9 (2.73–3.03) a

d_NZ are daughters of New Zealand dams, d_EUA are cows with American parentage

Key Words: Fertility, Lactation Length, Mexican Dairies

765 Puberty and conception in Holsteins, Jerseys and reciprocal crossbred heifers. W. J. Silvia*¹, K. G. Hall², C. M. Williams³, A. J. McAllister¹, B. G. Cassell², and S. P. Washburn³, ¹*University of Kentucky, Lexington,* ²*Virginia Polytechnic Institute and State University, Blacksburg,* ³*North Carolina State University, Raleigh.*

Reproductive performance was compared in purebred Holstein (HH, n=54), Jersey (JJ, n=35) and reciprocal crossbred heifers (HJ, n=45 and JH, n=37; sire breed first) from 3 research herds. Blood samples were collected at weekly intervals beginning at approximately 8 mo of age for quantification of progesterone. Age at puberty was defined as difference in days between birth and the first date on which a significant increase in progesterone was observed. Heifers were bred by artificial insemination following visual detection of estrus beginning at 15 mo of age. The number of services required for each heifer to become pregnant was recorded. Age at first service and age at conception were also determined. Genetic group comparisons for quantitative variables were made using a fixed model with additive, maternal, and heterotic genetic effects partitioned. Effects of herd, season of birth (win:Jan-Mar, spr:Apr-Jun, sum:Jul-Sept, fall:Oct-Dec) and year of birth (2003-2006) were also included in the model. Percentages of heifers requiring 2 or fewer services to conceive were compared among breed groups by logistic regression with additive, maternal, and heterotic effects partitioned. Age at puberty differed across breed groups with significant additive and heterosis effects: LSMEANS: HH = 349 ± 11.2 d; HJ = 315 ± 11.0

d; JH = 304 ± 11.7 d; and JJ = 300 ± 10.8 d. Also, proportions of heifers pregnant after 2 services differed by breed group with significant heterosis: HH = 83.6%; HJ = 91.7%; JH = 91.1%; JJ = 66.7%. Trends for heterosis were observed for number of services ($P = 0.10$) and for age at conception ($P = 0.07$). There were no effects of genetic group on age at first service, service interval, or total breeding period. In conclusion, beneficial heterotic effects were observed on age at puberty and percentage of heifers conceiving to 1 or 2 services.

Key Words: Puberty, Conception, Crossbred

766 Production, conformation, health, and fertility of backcross Holstein × Jersey cattle and their Holstein contemporaries. K. A. Weigel*, P. C. Hoffman, C. Maltecca, and T. J. Halbach, *University of Wisconsin, Madison*.

Since 2003, lactating Holstein cows in the University of Wisconsin herd have been randomly mated to Holstein young sires or F1 Jersey × Holstein young sires, resulting in an experimental population of 75% Holstein × 25% Jersey females and a control population of pure Holstein

females. Age at first calving tended to be lower in crossbred cows ($N = 64$) than in Holstein cows ($N = 98$) (721 d vs. 731 d; $P < 0.10$), and crossbred cows weighed less at first calving (562 kg vs. 601 kg; $P < 0.01$). Crossbred cows had higher dystocia scores at first calving than Holsteins (2.27 vs. 1.73; $P < 0.01$), despite the fact that their calves were lighter (37.6 kg vs. 40.5 kg; $P < 0.01$). In first lactation, average daily milk yield of crossbreds was lower than that of Holsteins (26.3 kg vs. 29.4 kg; $P < 0.01$), as was peak daily milk yield (31.0 kg vs. 35.1 kg; $P < 0.01$) and total 305-d milk yield (7647 kg vs. 8737 kg; $P < 0.01$), but protein percentage of crossbreds was higher (3.12 vs. 3.00; $P < 0.05$). On a 50-point scale, crossbred cows had shorter stature (21.2 vs. 35.2; $P < 0.01$), more sloped rumps (32.3 vs. 28.0; $P < 0.05$), narrower rumps (24.0 vs. 30.2; $P < 0.01$), and longer teats (22.1 vs. 17.7; $P < 0.01$) and tended to have deeper udders (21.9 vs. 24.5; $P < 0.10$) than Holsteins. Milking duration tended to be longer in crossbreds than in Holsteins (5.2 min vs. 4.9 min; $P < 0.10$). Differences between breeds in fat percentage, somatic cell score, body condition score, and other linear type traits were not statistically significant ($P < 0.10$), nor were differences in days open, services per conception, or the incidence of mastitis, lameness, retained placenta, ketosis, or respiratory disease.

Key Words: Crossbreeding, Production, Conformation

Symposium: Growth and Development: The Molecular Basis for Feed Efficiency

767 Mitochondrial efficiency in lines of mice divergently selected for heat loss. J. M. McDonald* and M. K. Nielsen, *University of Nebraska, Lincoln.*

Divergent selection (high=MH, low=ML, and control=MC) for heat loss was applied in mice in three replicates. After 16 generations (G) of selection, no selection was practiced for 26 generations; another 9 generations of selection ensued; then selection was relaxed again. A total of 25 generations occurred, and at G51, differences of 55% in heat loss 34% in feed intake:BW^{0.75} in mature males existed between MH and ML mice. Rates of mitochondrial respiration states, degree of coupling and mitochondrial efficiency were measured in liver tissue of G58 mature males using a Clark-type oxygen electrode in an attempt to explain part of the line differences in feed intake. Body weight, body composition, feed intake and liver weight were also measured. Data from 69 mice (total for MH, ML and MC) in Replicate 1 and 67 in Replicate 2 were analyzed with contrasts used to test selection response (MH – ML) and asymmetry of response ($[(MH+ML)/2 - MC]$). There were no significant differences in body weight or percents lean and fat between MH and ML mice ($P>0.15$). However, liver:BW of MH mice was approximately 5.6% larger than in ML mice ($P<0.06$). Selection response ($P<0.01$) in feed intake:BW was similar to that observed at G51 with MH mice consuming 31.7% more than ML mice. States 2 and 4 respiration rates approached significance ($P=0.09$ and $P=0.12$, respectively) with rates for MH mice greater than for ML mice. Differences in State 3 respiration failed to show significance. No differences existed in the degree of coupling, expressed as respiratory control ratio. ADP:O ratio in ML mice averaged 27.2% greater than in MH mice ($P=0.03$), indicating greater mitochondrial efficiency in the liver for ML mice. Asymmetry of response was not observed for any of the characteristics ($P>0.10$). Across all lines, a correlation of -0.32 was observed between feed intake:BW and ADP:O, however within lines this correlation failed to exist. These data indicate that efficiency of mitochondrial respiration explains a portion of the difference in feed intake between mice of the MH and ML lines.

Key Words: Mice, Heat Loss, Mitochondrial Efficiency

768 The molecular basis for feed efficiency in beef cattle. S. S. Moore*¹, E. L. Sherman¹, J. D. Nkrumah², F. D. Mujabi¹, Z. Wang¹, and P. Stothard¹, ¹*University of Alberta, Edmonton, AB, Canada*, ²*Merial Limited, Duluth, GA.*

Feed intake and feed efficiency are economically important traits in beef cattle as feed is the highest variable cost in production. Feed efficiency can be measured as feed conversion ratio (FCR, intake per unit gain) or residual feed intake (RFI, measured as DMI corrected for BW and growth rate, and sometimes a measure of body composition, usually carcass fatness, RFIbf). In an effort to fine map the genes underlying feed intake and feed efficiency we have used an increasing density of genetic markers to identify quantitative trait loci (QTL). QTL discovery was carried out as a whole genome scan on 400 to 500 steers, depending on analysis, that comprised 20 half sib families. The number of genome wide markers used for the scans increased from an initial 450, to 3,000 and eventually 51,000 SNP. Various statistical approaches were used for analysis and these included single and multiple marker regressions to estimate SNP effects as well as linear mixed models for QTL mapping.

To date we have identified 48 putative SNP markers for residual feed intake. Validation of these markers is ongoing in independent populations of animals with available individual animal intake records. The identification of narrow QTL regions will aid greatly in the identification and testing of positional candidate genes underlying traits associated with feed intake and efficiency in cattle.

Key Words: Residual Feed Intake, Feed Efficiency, Beef Cattle

769 Associations between mitochondrial function and feed efficiency in poultry and livestock species. W. G. Bottje*¹ and G. E. Carstens², ¹*University of Arkansas, Fayetteville*, ²*Texas A&M University, College Station.*

Meeting future global demands for animal protein in the face of rising feed costs, emerging bioenergy policies and environmental concerns will require substantive improvements in feed efficiency to maintain viable meat production systems in the U.S. In livestock and poultry, genetic variation exists in feed consumed above and below predicted requirements for production and maintenance, which can be quantified as the difference between actual and expected feed intake based on size and weight gain (residual feed intake; RFI). While research has established that inter-animal variation in RFI is favorably linked with variation in total energy expenditure, our understanding of the cellular and biochemical mechanisms responsible for bioenergetic processes associated with feed efficiency is incomplete. There is evidence that mitochondrial function, respiration, and/or biochemistry are linked to the phenotypic expression of feed efficiency (FE; g gain to g feed) and RFI in livestock and poultry. This paper will provide a short overview of biochemical mechanisms controlling mitochondrial energy metabolism and function, and will review the literature that examines the role that these important mitochondrial-linked biological processes could play in accounting for genetic and phenotypic variation in feed efficiency. Enhanced understanding of the mechanisms controlling mitochondrial function will provide useful insight into development of physiological biomarkers and genetic markers that are predictive for RFI or FE in livestock and poultry. Development of new selection tools will enhance the accuracy of identifying livestock and poultry with superior genetic merit for RFI, thereby improving the economic and environmental sustainability of U.S. meat-production systems.

Key Words: Mitochondria, Residual Feed Intake, Feed Efficiency

770 Physiological basis for residual feed intake. R. M. Herd*¹ and P. F. Arthur², ¹*NSW Department of Primary Industries, Armidale, Australia*, ²*NSW Department of Primary Industries, Camden, Australia.*

Residual feed intake (RFI) is a measure of feed efficiency that is independent of level of production and hence a useful new trait for studying the physiological mechanisms underlying variation in feed efficiency. Five major physiological processes are likely to contribute to variation in RFI; being processes associated with intake of feed, digestion of feed, metabolism (anabolism and catabolism associated with and including variation in body composition), activity, and thermoregulation. Studies on Angus steers following divergent selection for RFI estimated that heat

production from metabolic processes, body composition and activity explained 73% of the variation in RFI. The proportion of variation in RFI that these processes explain are: protein turnover, tissue metabolism and stress (37%), digestibility (10%), heat increment and fermentation (9%), physical activity (9%), body composition (5%) and feeding patterns (2%). Other studies in cattle and studies in poultry similarly found these processes to be important in explaining RFI. The physiological mechanisms identified so far are based on very few studies, some of which have small sample sizes. The genomic basis to variation in these physiological processes remains to be determined. Early studies have shown many hundred genes to be associated with differences in RFI, perhaps in hindsight not surprising given the diversity of physiological processes involved. Further research is required to better understand the mechanisms responsible for the variation in RFI in target populations and to marry the physiological information with molecular genetics information which will become the basis for commercial tests for genetically-superior animals.

Key Words: Feed Efficiency, Body Composition, Genomics

771 Physiological basis for residual feed intake in pigs. C. de Lange* and G. vanderVoort, *University of Guelph, Guelph, ON, Canada.*

Selection for residual feed intake in growing pigs is an important means to improve pork production efficiencies. Differences in pork production

efficiencies between pigs can be attributed largely to between-animal variation in the composition of growth (fat tissue vs lean tissue vs visceral organs), energy and nutrient requirements for body protein deposition, and basal energy expenditure. Visceral organ mass, an important predictor of whole body energy expenditure in growing pigs, is influenced by factors associated with feed (feed intake level and diet composition), environment (i.e. disease) and pig genotype. In isotope tracer studies it has been shown that variation in the ratio between whole body protein synthesis, an important contributor to whole body energy expenditure, and body protein deposition varies between extreme pig genotypes. Between-animal variation in this ratio should be explored further within lines of pigs. Basal energy expenditure can be defined as the available energy requirements at the tissue level to support body functions that are not related to growth and feed intake. Basal energy expenditure, in contrast to maintenance energy requirements, is largely independent of feeding level, diet composition, composition and rate of growth and can thus be related more easily to animal characteristics. The contribution of animal activity to between-animal variability in basal energy expenditure appears quite substantial and deserves further exploring. Key aspects of animal activity in ad libitum fed pigs are time spend standing, feeding frequency and eating rate. At the cellular level, special consideration should be give to the efficiency of oxidative phosphorylation which is influenced by uncoupling proteins, and maintenance of ion gradients across membranes. A better understanding of the biology of energy and nutrient utilization may lead to means to improve the efficiencies of pork production, including the identification of genetic markers that may be used in pig breeding strategies.

Key Words: Residual Feed Intake, Energetic Efficiency, Growing Pigs

Nonruminant Nutrition: Protein and Feed Additives

772 Bacteria composition, richness and diversity differ in colon digesta of piglets fed diets with different levels of protein and challenged with *Escherichia coli* K88. F. O. Opapeju*¹, R. L. Payne², D. O. Krause¹, and C. M. Nyachoti¹, ¹University of Manitoba, Winnipeg, MB, Canada, ²Evonik-Degussa Corporation, Kennesaw, GA.

Feeding excessive amount of protein to weaned pigs will increase the amount of undigested protein reaching the hindgut and may alter the types and the number of bacteria in the hind gut. Forty piglets (average BW = 5.32 ± 0.24 kg) were used to investigate the effect of dietary CP level on microbial composition, richness and diversity in piglets challenged with enterotoxigenic *Escherichia coli* K88 in a 14-d study. Pigs were housed in groups of 4 pigs per pen and were randomly allotted to 2 diets (5 pens/diet) immediately after weaning. Diet 1 contained 22.5% CP and diet 2 contained 17.6% CP supplemented with amino acids. The diets contained the same amount of ME and standardized ileal digestible Lys, Met + Cys, Thr, Trp, Ile and Val based on the ideal protein ratio. Pigs had unlimited access to feed and water throughout the experimental period. On d 8 after weaning, pigs received 6 mL of *E. coli* K88 suspension (10¹⁰ cfu/mL) by gavage. Thirty pigs were serially slaughtered on -1, 3 and 7 d post-challenge (5 pigs/diet/day of slaughter). Colon contents were analyzed for microbial profile and diversity indices using terminal restriction fragment length polymorphism. Pigs fed the 17.6% CP diet had a higher ($P < 0.05$) proportion of order Clostridiales (73 vs. 50%), family Lachnospiraceae (43 vs. 18%), and genus Roseburia (13 vs. 3%) 7 d after challenge compared with those fed the 22.5% CP diet. Pigs fed the 17.6% CP diet had lower ($P < 0.05$) richness and diversity compared with those fed the 22.5% CP diet at -1, 3 and 7 d post-challenge. The results show that a reduction in dietary CP level from 22.5 to 17.6% with amino acid supplementation altered the hind gut microbial profile 7 d post-challenge and reduced the microbial richness and diversity before and after challenge.

Key Words: Microbial Profile, Protein, Weaned Pigs

773 Value of spray-dried egg in pig nursery diets. M. Song*¹, B. G. Harmon², M. T. Che¹, M. U. Steidinger³, and J. E. Pettigrew¹, ¹University of Illinois, Urbana, ²Railsplitter Feed Technology, Wildwood, MO, ³Swine Nutrition Services, Inc., Forrest, IL.

A study was conducted to verify the nutrient contributions of a spray-dried egg (SDE) product containing only unfertilized eggs and to assess potential physiological benefits. Weaned pigs (n=1007, 6 kg, 20 d of age) were used in a randomized complete block design with pen as the experimental unit. There were 4 rooms with 12 pens/room and 21 pigs/pen. There were 3 weight blocks within each room and each weight block had 4 pens with the same number of barrows and gilts. The treatments were formulated to the same ME and standard ileal digestible (SID) AA levels and were: 1a) 6% spray-dried animal plasma (SDAP) (CON A), 1b) CON A + 6% SDE (SDE A), 2a) 3% SDAP (CON B), and 2b) CON B + 6% SDE (SDE B). There was a 4-stage feeding program with declining diet complexity and with phases of 1, 1, 2, and 2 wk, respectively. ADFI, ADG, G:F, removal rate (REM), and frequency of medical treatments per pen and day (MED) were measured. During phase 1 only, pigs fed A treatments or SDE treatments had higher ($P < 0.01$) ADFI and lower ($P < 0.05$) MED than pigs fed B treatments or CON treatments. Pigs fed B treatments had higher ($P < 0.05$; phase 3) ADFI and ADG and lower ($P < 0.05$; phase 3 and overall) MED than pigs fed A treatments. During

the overall experiment, there was a tendency ($P = 0.06$) for a reduction in MED with SDE. In conclusion, SDE provides bioavailable nutrients to nursery pig performance and may provide physiological benefits to the health of nursery pigs.

Table 1. Growth performance and health

Period	Treat	Pigs	ADFI,g	ADG,g	G:F	REM,%	MED,%
Phase 1	CON A	251	170	117	0.684	0.39	1.02
	SDE A	252	185	124	0.672	0	0.56
	CON B	252	157	110	0.696	0	1.64
	SDE B	251	174	114	0.658	0	0.90
SE		14		21		0.08	0.68
A vs. B							
& CON		<i>P</i>	<0.01	NS	NS	NS	<0.05
vs. SDE							
Overall	CON A	237	540	337	0.625	5.95	1.05
	SDE A	236	548	342	0.624	6.34	0.98
	CON B	241	541	338	0.626	4.36	0.95
	SDE B	246	557	344	0.618	2.00	0.68
SE		34		22		0.01	4.43
CON							
vs. SDE		<i>P</i>	NS	NS	NS	NS	0.06

NS: No significant difference; 12 pens/treatment

Key Words: Spray-Dried Egg, Nursery Pigs, Performance

774 The use of dried bacterial cells in nursery pig diets. R. B. Hinson*¹, J. L. Usry², A. M. Gaines³, and G. L. Allee¹, ¹University of Missouri, Columbia, ²Ajinomoto Heartland LLC, Chicago, IL, ³The Maschhoffs Inc., Carlyle, IL.

Two studies were conducted to evaluate the use of dried bacterial cells (DBC) in nursery pig diets. Dried bacterial cells are yeast cell bodies that remain after the production of synthetic amino acids. In Exp. 1, 528 newly weaned pigs (TR-4 × C22; Initial BW = 5.5 kg) were randomly allotted to treatments consisting of 0, 1, 2, or 3% DBC with 22 pigs/pen. In the diets containing DBC, blood cells and poultry by-product meal were replaced by DBC. Growth performance was evaluated during three dietary phases: Ph. 1 (d 0-7), Ph. 2 (d 7-14), and Ph. 3 (d 14-24). Diets were formulated to contain 1.60, 1.50, and 1.55% total lysine in ph. 1-3, respectively. In Exp. 2, 560 newly weaned pigs (TR-4 × C22; Initial BW = 5.3 kg) were randomly allotted to treatments consisting of 0, 1, 2, or 3% DBC with 22 pigs/pen. In the diets containing DBC, fishmeal was partially replaced by DBC. Growth performance was evaluated during four dietary phases: Ph. 1 (d 0-7), Ph. 2 (d 7-14), Ph. 3 (d 14-21), and Ph. 4 (d 21-42). Diets were formulated to contain 1.43, 1.43, 1.42%, and 1.31% TID lysine in ph. 1-4, respectively. During ph. 4, all treatments received a common diet. In Exp. 1, overall ADG (295, 308, 313, and 299 g/d) and F:G (1.30, 1.28, 1.32, and 1.36) were not affected ($P > 0.05$) by the use of DBC. Overall, a linear increase ($P < 0.03$) in ADFI and a linear improvement ($P < 0.02$) in F:G were observed with increasing DBC inclusion. In Exp. 2, d 0-21 ADG (272, 272, 272, and 259 g/d) and F:G (1.32, 1.34, 1.33, and 1.34) were unaffected ($P > 0.05$) by the inclusion of DBC. Additionally, overall d 0-42 ADG (435, 440, 435, and 435 g/d) and F:G (1.41, 1.41, 1.43, and 1.42) were unaffected by the inclusion of DBC. These data would suggest that at least 3% inclusion of dried bacterial cells can be used in nursery pig

diets replacing other high quality protein ingredients without affecting growth performance..

Key Words: Dried Bacterial Cells, Nursery Pigs

775 Effects of increasing true ileal digestible lysine/metabolizable energy ratios on gilts grown in a commercial finishing environment.

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Two four-week experiments were conducted to determine the effects of increasing true ileal digestible (TID) Lys:ME ratio on performance of growing and finishing gilts. All diets were corn-soybean meal based and contained 0.15% L-Lysine HCl and 3% added fat. Desired Lys levels were achieved by altering the corn and soybean meal level in the diet. Each experiment consisted of six treatments with seven replications per treatment and approximately 27 pigs per pen. In Exp. 1, 1,085 gilts (PIC, initially 38.2 kg) were fed TID Lys:ME ratios of 2.01, 2.30, 2.58, 2.87, 3.16, or 3.45 g/Mcal. Both ADG (0.82, 0.87, 0.93, 0.95, 0.97, and 0.97 kg/d) and G:F (0.42, 0.45, 0.48, 0.49, 0.51, and 0.51) improved (quadratic, $P < 0.003$) with increasing the TID Lys:ME ratio and optimal performance was reached at the TID Lys:ME ratio of 3.16 g/Mcal. Increasing the TID Lys:ME ratio resulted in increased daily TID Lys intake (linear, $P < 0.001$) and TID Lys intake per kg of gain (16.8, 18.0, 18.9, 20.3, 21.8, and 23.5 g, quadratic, $P < 0.001$). In Exp. 2, 1,080 gilts (PIC, initially 84.1 kg) were fed TID Lys:ME ratios of 1.55, 1.75, 1.95, 2.05, 2.35, or 2.55 g/Mcal. As TID Lys:ME ratio increased, ADG (0.83, 0.87, 0.87, 0.93, 0.95, and 0.98 kg/d) and G:F (0.33, 0.34, 0.35, 0.37, 0.37, and 0.39) improved (linear, $P < 0.001$) through the highest lysine/ME level of 2.55 g/Mcal. Increasing TID Lys:ME ratio also increased (linear, $P < 0.001$) daily TID Lys intake and TID Lys intake per kg of gain (16.58, 18.08, 19.65, 20.44, 22.05, and 22.98 g). It appears that the optimal Lys level to meet the biological needs of the pig may have increased compared to previous research conducted in the same facility (Main et al., 2002).

Key Words: Lysine, Finishing Pigs, Growth

776 Effects of feeding excess crude protein on growth perfor- mance and carcass traits in finishing pigs.

S. M. Williams*, J. D. Hancock, C. Feoli, S. Issa, and T. L. Gugle, *Kansas State University, Manhattan.*

A total of 176 pigs (88 barrows and 88 gilts with an average initial BW of 95 kg) were used in a 33-d experiment to determine the effects of excess dietary CP on growth performance and carcass measurements in finishing pigs. The pigs were sorted by ancestry and blocked by BW with 11 pigs/pen and four pens/treatment. Treatments were corn-soybean meal-based and formulated to 12, 14, 16, and 18% CP. Feed and water were consumed on an ad libitum basis until the pigs were slaughtered (average final BW of 125 kg) at a commercial abattoir. Increasing CP concentration in the diet had no effect on ADG ($P > 0.41$), ADFI ($P > 0.20$), G:F ($P > 0.24$), and hot carcass weight ($P > 0.20$). With hot carcass weight used as a covariate, there were linear decreases in dress- ing percentage ($P < 0.02$) and loin depth at the last rib ($P < 0.05$) as crude protein concentration in the diet was increased from 12 to 18%. However, fat thickness at the last rib and percentage carcass lean were not affected ($P > 0.34$) as crude protein concentration in the diet was increased. For diets with 12, 14, 16, and 18% CP, ADG was 944, 927,

921, and 936 g/d, ADFI was 2.86, 2.85, 2.83 and 2.79 kg/d, G:F was 330, 325, 325, and 336 g/kg, hot carcass weight was 92.6, 91.6, 91.0, and 91.7 kg, dressing percentage was 73.6, 73.3, 73.1, and 73.2%, loin depth was 6.4, 6.2, 6.2, and 6.1 cm, last rib backfat thickness was 19, 19, 19, and 19 mm, and percentage carcass lean was 55.0, 54.5, 54.5, and 54.4, respectively. Our results indicate that increasing CP in diets for pigs during late finishing from 12 to 18% does not affect growth performance or carcass leanness with only a small negative effect on dressing percentage.

Key Words: Pig, Protein, Growth

777 Effects of organoleptic properties of the feed and diet complexity on nursery pig performance.

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A total of 480 weaning pigs (6.6 kg and 20 ± 2 d, PIC) were allotted to one of eight treatments using a randomized complete block design with exposure to the flavor in the creep feed (no vs. yes), diet complexity (complex vs. simple), and flavor in the nursery diets (no vs. yes) as treat- ment factors. Each treatment had six pigs per pen and ten replications. Experimental diets were the combinations of complex or simple diets with or without the flavor for Phase 1 (d 0 to 10) and 2 (d 10 to 28). Diets with the flavor were supplemented with Luctarom[®] at 1500 and 1000 ppm in Phase 1 and 2 diets, respectively. A tendency for a three-way interaction for ADG from d 5 to 10 ($P < 0.11$), d 10 to 28 ($P < 0.09$), and d 0 to 28 ($P < 0.06$) were observed. Post-weaning ADG of pigs exposed to the flavor in creep feed and fed flavored-complex diets were greater than any other treatment combination. Increasing diet complexity increased ($P < 0.01$) ADG, ADFI, and G:F during both phases. Adding flavor in the creep feed had no effect on G:F ($P > 0.34$) and pig BW ($P > 0.45$) in both periods post-weaning. Adding Luctarom to starter diets tended to improve ADFI ($P < 0.06$; 163 vs. 154 g) during d 0 to 5. In conclusion, pre-weaning exposure to Luctarom[®] improved post-weaning daily gain of pigs fed complex diets supplemented with the same flavor, but did not influence performance of pigs fed simple diets.

Table 1. Interactive effects of flavors and diet complexity on nursery performance.

Flavor in Creep:	No				Yes				SED
	Simple		Complex		Simple		Complex		
Diet Complexity:	No	Yes	No	Yes	No	Yes	No	Yes	SED
Flavor in Nursery:									
D 0 to 10									
ADG, kg	0.18	0.19	0.24	0.24	0.17	0.17	0.24	0.27	0.01
ADFI, kg	0.20	0.20	0.25	0.25	0.18	0.18	0.24	0.26	0.01
G:F	0.95	0.96	0.99	0.99	0.95	0.94	0.98	1.04	0.03
D 0 to 28									
ADG, kg	0.37	0.38	0.43	0.42	0.38	0.37	0.42	0.44	0.01
ADFI, kg	0.48	0.49	0.57	0.56	0.48	0.47	0.55	0.57	0.02
G:F	0.77	0.79	0.76	0.76	0.79	0.78	0.77	0.77	0.01

Key Words: Flavor, Nursery, Diet Complexity

778 Effects of adding an enhanced flavor to the creep feed on the proportion of piglets consuming creep feed and pre-weaning performance. R. C. Sulabo*¹, J. M. DeRouchey¹, M. D. Tokach¹, C. D. Riskey², R. D. Goodband¹, S. S. Dritz¹, and J. L. Nelssen¹, ¹Kansas State University, Manhattan, ²Lucta USA Inc., Northbrook, IL.

A total of 50 sows (PIC Line 1050) were used in the study to determine the effects of adding an enhanced flavor to the diet on the proportion of piglets consuming creep feed within litters and pre-weaning performance. Sows were blocked according to parity and date of farrowing and were allotted to two experimental treatments using a randomized complete block design. Treatment 1 was a creep diet with no flavor (Control) and Treatment 2 was the Control diet with the enhanced flavor (Luctarom®) included at 1500 ppm. Both creep diets contained 1.0% chromic oxide and were offered *ad libitum* from d 18 until weaning (d 21) using a rotary creep feeder with hopper. A single lactation diet (3,503 kcal ME/kg, 0.97% TID Lys) was used, and sows were allowed free access to feed throughout lactation. Fecal samples from all piglets were taken twice using sterile swabs between 3 and 12 h before weaning. Piglets were categorized as 'eaters' when the fecal sample was colored green at least once on any of the two samplings. Litter weaning weights (66.7 vs. 66.5 kg; $P>0.94$), total gain (8.9 vs. 8.8 kg; $P>0.77$), and daily gain (3.0 vs. 2.9 kg; $P>0.77$) were not different between litters fed creep with and without the enhanced flavor. For individual pigs, weaning weight (6.5 vs. 6.6 kg; $P>0.53$), total gain (0.87 vs. 0.88 kg; $P>0.89$), and average daily gain (0.29 vs. 0.29 kg; $P>0.89$) between the two treatments also were not different. Flavor added to the creep feed did not influence both total (0.60 vs. 0.63 kg; $P>0.66$) and daily (202 vs. 211 g; $P>0.66$) creep feed intake of litters and the proportion of creep feed eaters (73 vs. 69%; $P>0.41$) in whole litters. When creep was provided for 3 d before weaning, adding the enhanced flavor to the creep feed did not affect litter creep feed intake, the proportion of piglets consuming creep feed, and pre-weaning performance.

Key Words: Flavor, Creep Feed, Piglet

779 Diet preference and growth performance in weanling pigs fed diets with *Morinda citrifolia* (noni). C. Feoli*¹, J. D. Hancock¹, K. C. Behnke¹, and R. G. Godbee², ¹Kansas State University, Manhattan, ²Morinda Agricultural Products, Orem, UT.

Two experiments were conducted to determine the effects of adding 5% *Morinda citrifolia* (Tahitian Noni International, Orem, UT) to diets for weanling pigs. In the first experiment, 48 pigs (average initial BW of 4.2 kg) were used in a 29-d preference study. There were six pigs/pen and eight pens total. The pens were equipped with two identical feeders (for diets without and with noni puree) and each afternoon position of the feeders was switched to prevent feeder location from affecting diet consumption. The diets were corn-soy-based, pelleted, and had 1.8% Lys for d 0 to 5, 1.6% Lys for d 5 to 15, and 1.4% Lys for d 15 to 29. Feed and water were consumed on an *ad libitum* basis. No differences were noted among diets without and with noni for pelleting ease and/or pellet durability index. Feed intake was increased for d 0 to 5 (50 vs 102 g/d, $P<0.05$) and d 0 to 15 (66 vs 167 g/d, $P<0.006$) when noni was added to the diets. However, this effect disappeared for d 15 to 29 so that overall feed intake was not different (183 vs 227 g/d, $P>0.39$) for d 0 to 29. In a second experiment, 96 pigs (average initial BW of 6.7 kg) were used in a 29-d growth assay. There were six pigs/pen and eight pens/treatment. The diets were the same as those used in the first experiment. Results indicated no differences ($P>0.16$) in ADG, ADFI, and G:F for d 0 to 5

and 0 to 15 among pigs fed diets without and with noni. However, for d 15 to 29 and overall (d 0 to 29) ADG and ADFI were decreased ($P<0.04$) for pigs fed diets with noni compared to the control. In conclusion, there was a preference for diets with noni for the first 15 d of the preference study. In the growth assay, prolonged feeding of diets with noni resulted in reduced feed intake and, ultimately, decreased rate of gain. Thus, it seems likely that any advantages to inclusion of noni will be in the early portions of the nursery phase.

Key Words: Pig, *Morinda citrifolia*, Noni

780 Effects of *Morinda citrifolia* (noni) and diet complexity on growth performance in weanling pigs. C. Feoli*¹, J. D. Hancock¹, K. C. Behnke¹, and R. G. Godbee², ¹Kansas State University, Manhattan, ²Morinda Agricultural Products, Orem, UT.

Two experiments were conducted to determine the effects of concentration (none, 0.75, 1.5, 3.0, and 6.0%) of *Morinda citrifolia* (Tahitian Noni International, Orem, UT) and diet complexity in weanling pigs. In Exp. 1, 210 pigs (average initial BW of 6.1 kg) were used. There were seven pigs/pen and six pens/treatment during the 35-d growth assay. Diets were corn-soy-based and had 20% whey, 10% lactose, and 5% plasma protein for d 0 to 7 and 15% whey and 2.5% plasma protein for d 7 to 21. Lysine concentrations were 1.8% for d 0 to 7, 1.6% for d 7 to 21, and 1.4% for d 21 to 35 with feed and water consumed on an *ad libitum* basis. Average daily gain (quadratic effect, $P<0.03$) and G:F (quadratic effect, $P<0.08$) for d 0 to 7 and G:F for d 0 to 21 (quartic effect, $P<0.03$) increased as noni concentration in the diet was increased from none to 0.75%. However, no treatment effects were observed overall (d 0 to 35). For Exp. 2, 168 pigs (average initial BW of 6.3 kg) were used. There were six pigs/pen and seven pens/treatment in the 35-d growth assay. Treatments were arranged as a 2 x 2 factorial with main effects of diet formulation (simple vs complex) and noni addition (none vs 3%). Complex diets were those used in Exp. 1. Simple diets had the same minimum nutrient specifications as complex diets but had no added lactose or plasma protein for d 0 to 7 and only 10% added whey for d 7 to 21. Pigs fed simple diets had lower ADG and G:F ($P<0.07$) for d 0 to 7 and lower ADG and ADFI ($P<0.06$) for d 0 to 21 than pigs fed complex diets. During d 0 to 35 for ADG and d 0 to 21 for G:F, addition of noni to the simple diets had negative effects and addition of noni to the complex diets had positive effects (diet complexity x noni interaction, $P<0.02$). In conclusion of the two experiments, noni tended to improve growth performance early in the nursery phase but those positive responses were observed only with complex diet formulations.

Key Words: Pig, *Morinda citrifolia*, Noni

781 Cloning of Ningxiang porcine growth hormone gene and its construction respectively of prokaryotic and eukaryotic expression vector. W. C. Wang¹, W. Y. Chu¹, W. T. Gu¹, M. M. Geng¹, T. J. Li¹, Y. L. Yin*¹, and G. Y. Wu^{1,2}, ¹The Chinese Academy of Sciences, Changsha, Hunan, P. R. China, ²Texas A&M University, College Station.

The Ningxiang pig (a Chinese swine breed) has a relatively small body size but its meat has a special flavor of economic importance. To elucidate the mechanisms responsible for the slow rate of growth in this swine breed, we decided to clone the Ningxiang porcine growth hormone

(nxGH) gene and obtain its prokaryotic and eukaryotic expression vectors for future studies. The nxGH gene was cloned from the porcine pituitary gland. Its entire open reading frame (ORF) was 651 bp and encoded 216 amino acid residues. The identity of nucleotide sequences between the nxGH and the reported porcine GH genes was 99.85 %. Subsequently, the nxGH gene was inserted into a prokaryotic expression vector (pET-32) to generate a recombinant vector pET-GH. In addition, we constructed a eukaryotic expression vector for the nxGH gene. The gene encoding an enhanced green-fluorescence protein (EGFP) and the nxGH cDNA (amplified by RT-PCR using RNA from the Ningxiang pig pituitary gland as the template) were cloned, respectively, into an

eukaryotic expression pCI vector, resulting in the construction of pCI-GH-EGFP that encoded a fusion protein (GH-EGFP). Vero cells were transfected with pCI-GH-EGFP and Lipofectaine 2000 to express the GH-EGFP protein, which was observed under a fluorescent microscope. The fluorescence of the protein remained for 48 h after cell fusion. Collectively, these results indicate that the nxGH gene can be expressed in vero cells and provide a foundation for further studies of growth physiology in Ningxiang pigs

Key Words: Ningxiang Pig, Eukaryotic Expression, Growth Hormone Gene-Prokaryotic Expression

Symposium: Nonruminant Nutrition: Energy Systems and Alternative Energy Ingredients for Swine

782 Recent developments in net energy research for pigs. Jean Noblet*, *INRA, Saint Gilles, France.*

Feed represents the most important cost in pig production and energy represents the greatest proportion of this cost. It is then important to express the feed energy value on an appropriate basis and both energy supply (a diet characteristic) and energy requirement (an animal characteristic) should be expressed using the same system. Feeds can be attributed energy values according to DE, ME or NE bases. Reference methods for evaluating DE or ME contents are based on in vivo digestibility measurements while NE values originate from prediction equations established from energy balance studies. Literature results indicate that energy digestibility of feeds is negatively affected by dietary fiber content but the negative effect is attenuated with body weight increase. This suggests that feeds should be attributed DE values according to pig BW; in practice, two different DE values, one for growing-finishing pigs and one for reproductive sows, are recommended. The energy digestibility of pig feeds can also be affected by feed processing (pelleting, extrusion, etc.); this effect is the most important for some fat rich ingredients (corn, rapeseed, linseed). Metabolic utilization of ME averages 75% but it is dependent on diet chemical composition with efficiencies higher for energy from fat (90%) or starch (82%) than from protein or dietary fiber (60%). The hierarchy between feeds is then dependent on the energy system with overestimation of protein rich feeds and underestimation of starch and/or fat rich feeds in the DE or ME systems. For example, in the system proposed by INRA, the energy values (% of a conventional diet) of corn, soybean meal and animal fat are 100, 104 and 235 on a DE basis, 102, 99 and 244 on a ME basis, and 107, 79 and 289 on a NE basis. The NE system provides an energy value which is the closest estimate of the "true" energy value of a feed and it predicts accurately the performance of the pigs independently of diet characteristics. Furthermore, it allows implementing new feeding strategies such as the use of low protein and/or high fat and/or high fiber diets.

Key Words: Feed, Pig, Net Energy

783 Practical application of the net energy system in swine nutrition. R.T. Zijlstra*¹ and R.L. Payne², ¹*University of Alberta, Edmonton, AB, Canada,* ²*Evonik-Degussa Corporation, Kennesaw, GA, USA.*

Energy is the greatest cost-pressure in swine feed; thus, an accurate system to evaluate energy quality is critical managing feed costs. The NE system has been used for decades in swine feed formulation in Europe, and interest in this system has recently increased in North America due to an apparent competitive disadvantage of the DE and ME systems. Advantages of the NE versus the DE or ME systems are: 1) ensuring consistent growth performance and carcass quality while altering the macro-nutrient composition and thus NE content of feeds; 2) managing the risk of including alternative feedstuffs into swine diets, and 3) reductions in feed costs per kg of feed or lean gain. Other advantages such as higher growth or feed efficiency have been overstated, resulting in reluctance by nutritionists to implement the NE system following lack of positive experimental results. Following a decision to apply the NE system, an implementation plan focused on feedstuff composition and formulated diet NE content is required. For feedstuffs, the focus

is to develop or update a feedstuff data base including macronutrient composition. Used NE systems are solidly based on macronutrient composition of feedstuffs indicating that laboratory analyses and variation in composition should be part of the evaluation. For diets, these can be reformulated or directly recalculated to a NE content. The NE system might be implemented without an evaluation of feedstuff data base; however, ingredients vary regionally in macronutrient profile and thus NE content. Thus, feedstuff evaluation is recommended for risk management. Following the switch to the NE system, feed costs, growth performance, and carcass characteristics should be monitored to ensure that the switch was implemented successfully, and diet DE or ME content can be monitored initially for comfort. Application of the NE system combined with standardized ileal digestible AA and ideal AA profile will allow practical feed formulation providing the pig with the energy and AA required for efficient and predictable growth performance and carcass quality.

Key Words: Feed Formulation, Net Energy, Pig

784 Impact of the biofuels industry on alternative ingredients available to swine. B.J. Kerr* and T.E. Weber, *USDA-ARS-NSTL, Ames, IA, USA.*

The biofuels industry has exhibited astonishing production advances in the past decade, and in its wake, has led to a wide diversity of co-products available to the livestock industry. During times of historically high prices for grains, proteins, minerals, and fats, this has led to a rapid increase in research activities evaluating the nutritional potential of these products. For example, from the biodiesel industry, research has recently been conducted on the availability of energy from crude glycerin for swine and poultry of various ages, and on the variability of energy from crude glycerin produced from biodiesel plants utilizing different initial feedstock. Likewise, from both the wet and dry corn milling industry there are numerous products produced that vary in CP, AA, P, S, GE, and 'fiber' concentration. Data will be presented showing variations in the nutrient profiles of these co-products, how they might fit into feed formulations, limitations or concerns with product use, and variability of co-product quality.

Key Words: Biofuels Co-Products, Crude Glycerin, Dried Distillers Grains

785 Effects of feeding increasing levels of glycerol with or without distillers dried grains with solubles in the diet on grow-finish pig growth performance and carcass quality. J. Stevens*, A. Schinckel, M. Latour, D. Kelly, D. Sholly, B. Legan, and B. Richert, *Purdue University, West Lafayette, IN.*

Crossbred pigs (N=150; initial BW = 28.2 kg) were assigned to one of 6 dietary treatments to assess the impact of increasing levels of glycerol in grow-finish pig diets on growth and carcass traits. The 6 dietary treatments were: 1) Control, 0% Glycerol (Gly); 2) 5% Gly; 3) 10% Gly; 4) 15% Gly; 5) 20% dried distillers grains w/ solubles (DDGS); and 6)

20% DDGS +10% Gly. Diets were formulated to be equal in ME and dig. Lys. Growth performance was evaluated on a four phase feeding program. Pigs were fed two grower diets (G1 d0-d28; G2 d28-d56) and two finisher diets (F1 d56-d84; F2 d84-d105). A crude glycerol (84% Gly, <100 ppm methanol) was fed for Phases G1-F1 and a food grade glycerol (99.7% Gly) was fed during F2. As glycerol increased in the diet from 0 to 15%, overall ADG (851, 876, 880, 851 g/d, respectively; $P < 0.05$) responded quadratically while linearly increasing ADFI (2.47, 2.54, 2.57, 2.67 kg/d, respectively; $P < .01$) and linearly decreasing G:F ($P < 0.001$). Adding DDGS (0 or 10% Gly) decreased ADG (836 and 831g/d, respectively; $P < 0.02$) and G:F ($P < 0.04$). Increasing Gly to 10% increased final BW 3.0 kg ($P < 0.07$) while DDGS decreased final BW 1.9 kg ($P < 0.03$). Increasing Gly linearly increased tenth rib backfat (21.9, 23.5, 26.8, 25.3 mm, respectively, $P < 0.02$) and linearly decreased percent fat free lean (FFL) (52.1, 51.8, 49.8, 50.4%, respectively, $P < 0.02$). Feeding 20% DDGS increased FFL (53.1%) while feeding DDGS+10% Gly decreased FFL (50.8%; $P < 0.05$). Adding Gly to diets tended to linearly increase liver weights ($P < 0.06$). Adding DDGS tended to increase kidney weights ($P < 0.10$). Visual loin marbling decreased linearly with increasing Gly ($P < 0.01$). Loin Minolta color L* linearly increased with increasing Gly ($P < 0.09$). Feeding Gly up to 10% of grow finish diets can improve ADG and ADFI; however, carcass quality may be impacted by increasing backfat and reducing percent FFL and loin quality characteristics.

Key Words: Swine, Glycerol, Pork Quality

786 Effects of increasing dietary glycerol and dried distillers grains with solubles on growth performance of finishing pigs. A. W. Duttlinger^{*1}, M. D. Tokach¹, S. S. Dritz¹, J. M. DeRouchey¹, J. L. Nelssen¹, R. D. Goodband¹, and K. J. Prusa², ¹Kansas State University, Manhattan, ²Iowa State University, Ames.

A study was conducted to determine the effects of dietary glycerol and dried distillers grains with solubles (DDGS) on grow-finish pig performance and carcass characteristics. The experiment was conducted at a commercial swine research facility in southwest Minnesota. A total of 1,160 barrows (initially 31.0 kg, PIC) were used in a 97-d study. Pigs were blocked by initial weight and randomly allotted to one of six dietary treatments with seven replications per treatment. Pigs were fed corn-soybean meal-based diets with 3% added fat arranged in a 2 × 3 factorial with main effects of glycerol (0, 2.5, or 5%) and DDGS (0 or 20%). There were no glycerol × DDGS interactions ($P > 0.13$). Increasing glycerol did not affect ($P > 0.33$) ADG or G:F. Adding 20% DDGS to the diet did not affect ADG. Pigs fed diets with added DDGS had greater ($P < 0.02$) ADFI than pigs fed diets with no DDGS (2.47 vs. 2.41 kg/d) resulting in decreased ($P < 0.01$) G:F (0.40 vs. 0.39) for pigs fed DDGS. Increasing glycerol tended to increase (linear, $P < 0.11$) yield (74.8, 75.7, and 75.7%). In conclusion, adding up to 5% glycerol to finishing diets did not affect growth performance, but tended to improve carcass yield. Adding 20% DDGS decreased G:F, but did not influence growth rate. Funded by National Pork Board in cooperation with the Minnesota Pork Board.

Item	DDGS, %							SE
	0	0	0	20	20	20		
	Glycerol, %							
	0	2.5	5	0	2.5	5		
ADG, kg	0.97	0.96	0.96	0.97	0.96	0.96	0.01	
ADFI, kg	2.43	2.39	2.40	2.45	2.46	2.51	0.03	
G:F	0.40	0.40	0.40	0.40	0.39	0.38	0.01	
Carcass wt, kg	93.1	92.9	92.1	91.4	91.9	92.7	1.08	
Carcass wt CV, %	9.0	9.4	9.2	8.8	8.1	8.9	0.67	
Yield, %	75.1	75.5	75.7	74.5	75.9	75.7	0.47	
Backfat, mm	19.9	19.7	19.8	19.3	19.0	19.6	0.48	
Loin depth, mm	62.9	62.8	60.7	60.9	61.2	62.0	0.79	
FFLI, %	49.2	49.1	49.1	49.3	49.4	49.3	0.24	
Lean, %	54.3	54.3	54.2	54.4	54.6	54.4	0.33	

Key Words: Dried Distiller Grains with Solubles, Glycerol, Finishing Pig

787 Effect of feeding an alternative carbohydrate source on nursery pig growth performance. B. E. Bass^{*}, C. L. Bradley, C. V. Maxwell, Z. B. Johnson, and J. W. Frank, *University of Arkansas, Fayetteville.*

Lactose is a key ingredient in nursery pig diets due to its digestibility and improvement on performance. The purpose of this study was to examine the impact of replacing whey permeate (WP; 80% lactose) with a carbohydrate blend (CB; 40% lactose, 30% sucrose, 10% dextrose) on growth performance of nursery pigs. In the study, 240 pigs were weaned at 21.1±0.1 d of age (BW = 7.36±0.1 kg) and penned in groups of 6-7 pigs/pen in an offsite nursery facility. Pigs were randomly assigned to one of five experimental diets during phase 1 (10 d) and phase 2 (10 d). The phase 1 and 2 diets were corn-soy based and contained spray-dried plasma, fish meal, and soy protein concentrate. Phase 1 and 2 treatments were: control (CON, 0 and 0%), Low WP (7.5 and 5% WP), High WP (15 and 10% WP), Low CB (7.5 and 5% CB), and High CB (15 and 10% CB), respectively. All pigs were fed a common corn-soy phase 3 (14 d) diet. During phase 1, ADG (110^b, 133^{ab}, 178^a, 153^{ab}, 178^a g/d; $P = 0.06$) and ADFI (232^b, 238^b, 318^a, 254^b, 303^a g/d; $P < 0.01$) were different in CON, Low WP, High WP, Low CB, and High CB fed pigs, respectively. Phase 2 G/F for CON, Low WP, High WP, Low CB, and High CB were different (0.770^{ab}, 0.802^a, 0.797^a, 0.819^a, 0.717^b, respectively; $P < 0.01$). For phase 1 and 2 combined, ADG (323, 347, 385, 378, 355 g/d; $P = 0.12$) and ADFI (466, 470, 531, 495, 526 g/d; $P = 0.07$) were not different for CON, Low WP, High WP, Low CB, and High CP, respectively. Overall (phase 1 through 3), there was no effect of dietary treatment on growth performance. Final BW for CON, Low WP, High WP, Low CB, and High CB (23.90, 23.67, 24.87, 24.28, and 24.66 kg, respectively) were not different ($P = 0.48$). This experiment demonstrates that incorporating lactose into nursery diets improves growth performance. In addition, lactose can be at least partially replaced with simple sugars such as sucrose and dextrose without reducing growth performance.

Key Words: Pigs, Lactose, Sucrose

Ruminant Nutrition: Acidosis, DCAD and Acid-Base Metabolism

788 The relationship between the severity of ruminal acidosis and the expression of genes associated with the absorption and metabolism of volatile fatty acids and glucose in ruminal tissue. G. B. Penner^{*1}, M. Taniguchi¹, L. L. Guan¹, K. A. Beauchemin², and M. Oba¹, ¹University of Alberta, Edmonton, AB, Canada, ²Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.

The objective of this study was to determine the relationship between the severity of ruminal acidosis and the expression of genes related to the absorption and metabolism of volatile fatty acids (VFA) and glucose in ruminal tissue. We hypothesized that cows with lower expression for genes related to the absorption and metabolism of VFA and glucose in ruminal tissue would have more severe ruminal acidosis. Six ruminally cannulated dry Holstein cull cows were fed a diet containing 60.9% barley grain, 30.2% barley silage, 5.7% grass/alfalfa hay, 1.8% mineral, 1.4% canola meal, and 0.1% canola oil (DM basis) to predispose them to ruminal acidosis. After a 28-d diet adaptation period, ruminal pH (4320 data points/72 h/cow), ruminal VFA concentrations, ruminal content volume, and in vivo VFA clearance rates were measured. An acidosis index was calculated by dividing the area below pH 5.8 by dry matter intake (pH × min/kg) in order to describe the severity of ruminal acidosis for each cow. Cows were euthanized and ruminal tissue was harvested (ventral sac) for gene expression analysis using quantitative real-time PCR. The fold change (FC) in gene expression relative to the cow with the lowest acidosis score was determined for each gene. Mean ruminal pH, the area below pH 5.8, and the acidosis index varied from 5.88 to 6.19, 895 to 9250 pH × sec/d, and 84.7 to 459.0, respectively. The acidosis index was not correlated to the fractional rate of VFA absorption or clearance, but was negatively correlated to the FC for butyryl CoA synthetase ($r = -0.919$; $P < 0.001$) and pyruvate carboxylase ($r = -0.884$; $P = 0.02$). Further, the acidosis index tended to be negatively related to the FC for β -hydroxybutyrate dehydrogenase ($r = -0.753$; $P = 0.08$). These data indicate that cows with higher gene expression levels for enzymes involved in butyrate or glucose metabolism in rumen tissue might be more tolerant to ruminal acidosis.

Key Words: Ruminal Acidosis, Gene Expression, VFA Metabolism

789 Effects of bulk density of steam-flaked corn and dietary roughage concentration on performance, rate of intake, and acid-base balance of Holstein steers. K. E. Hales^{*}, K. R. Wilson, J. T. Vasconcelos, J. C. Declerck, M. L. May, M. J. Quinn, and M. L. Galyean, Texas Tech University, Lubbock.

Effects of bulk density of steam-flaked corn and roughage concentration on performance, rate of intake, and acid-base balance were evaluated in 24 Holstein steers (initial BW = 507 kg) in a completely random design. Each steer was housed in a partially slotted-floor pen (12 steers/treatment). The 2 treatments consisted of either: (1) 334.7 g/L steam-flaked corn with 6% (DM basis) coarsely ground alfalfa hay (**LOWBD**); or (2) 387.0 g/L steam-flaked corn with 10% (DM basis) alfalfa (**HIGHBD**). Cattle were fed an 85% concentrate diet, and baseline measurements were collected before they were switched to treatment diets for an experimental period of 29 d. Feed intake was measured at 0.5, 1.0, 1.5, 2.0, 3.0, 4.0, 6.0, and 8.0 h after feeding on d 7, 14, 21, and 28. On d 8, 15, 22, and 29, urine pH was measured, and arterial blood samples were taken for measurement of pH, partial pressures of CO₂ and O₂, hematocrit,

and concentrations of Na⁺, K⁺, and ionized Ca⁺. No differences ($P > 0.10$) between treatments were noted for blood gases and electrolytes or urine pH; however, day effects ($P < 0.02$) were detected for blood pH, partial pressure of CO₂, Na⁺, K⁺, ionized Ca⁺, and urine pH. Rate of intake data were fit to a quadratic model and solved for time required to consume 25, 50, 75, and 100% of the daily intake. A treatment × day interaction was detected ($P < 0.03$) for time to consume 25, 50, and 75% of the daily intake. No differences were noted on d 7, 21, and 28, but on d 14 steers fed the HIGHBD diet consumed 25, 50, and 75% ($P = 0.06$, 0.05, and 0.08, respectively) of their daily intake in less time than those fed the LOWBD diet, with no difference in time to consume 100% of daily intake. Results suggest that bulk density of steam-flaked corn and dietary roughage concentration within the ranges fed in this study have little effect on blood acid base balance; however, the combination of greater bulk density and greater roughage concentration increased rate of feed consumption on d 14 of the experimental period.

Key Words: Acid-Base Balance, Beef Cattle, Bulk Density

790 Effect of dietary cation-anion difference on feedlot performance, N mass balance, and manure pH in open feedlot pens. M. K. Luebbe^{*}, G. E. Erickson, T. J. Klopfenstein, and J. R. Benton, University of Nebraska, Lincoln.

A summer feedlot trial was conducted to evaluate the impact of dietary cation-anion difference on performance and N mass balance. Ninety-six steers (260±56 kg) were stratified by BW and assigned randomly to 12 pens (6 pens/treatment). Steers were fed for 145 d from June to October. Basal diets consisted of high-moisture and dry-rolled corn, fed at a constant 1:1 ratio (DM basis), 20% modified wet distillers grains, 7.5% alfalfa, and 5% supplement. Calcium chloride and sodium bicarbonate were used in the supplement to adjust dietary cation-anion difference (DCAD) to 20 mEq for the positive (POS) diet and -16 mEq for the negative (NEG) diet. Nitrogen excretion was determined by the difference between N intake and individual steer N retention. Total N lost was calculated by subtracting manure and runoff N from excreted N. Dry matter intake was not different ($P=0.17$) among treatments and was 11.1 and 11.4 kg for NEG and POS, respectively. Average daily gain was not different ($P=0.82$) among treatments and was 1.84 and 1.83 kg for NEG and POS, respectively. Gain efficiency was not different ($P=0.11$) among treatments and was 0.166 and 0.160 for NEG and POS, respectively. Carcass characteristics were not different ($P>0.20$) among treatments except for marbling score. Marbling score was greater ($P=0.04$) for POS than NEG (543 and 523, respectively). Intake, retention, and excretion of N were not different ($P>0.10$) among treatments. Manure N was not different ($P=0.67$) among treatments (11.1 and 11.7 kg for POS and NEG, respectively). Percent N lost was not different among treatments (64.6 and 61.3% for POS and NEG respectively). Manure pH was greater ($P<0.01$) for POS than NEG (8.12 and 7.70, respectively). Pen surface soil core pH was not different ($P=0.29$) among treatments (8.01 and 8.07 for POS and NEG, respectively). Amount of DM and OM removed from pens was similar ($P>0.50$) among treatments. Lowering DCAD in diets with wet distillers grains decreases manure pH but not soil core pH. The decrease in manure pH is likely not enough to decrease N losses in open feedlot pens.

Key Words: Acid Base Equilibrium, Cattle, Nitrogen

791 Grain species and cultivars and ruminal acidosis. I. Determination of challenge level. I. J. Lean*¹, A. R. Rabiee¹, J. L. Black², and R. H. King³, ¹*Bovine Research Australasia, Camden, NSW, Australia*, ²*John L. Black Consulting, Warrimoo, NSW, Australia*, ³*RHK Consulting, Essendon, Victoria, Australia*.

Two grain challenge diets containing (Triticale cv Jackie; and a mix of 20 grains (Wheat (n = 6), Barley (n = 4), Triticale (n = 4), Sorghum (n = 3), Oats (n = 3)) were used to determine the amount required to produce a moderate acidotic change in rumen function following ingestion. Holstein-Friesian heifers, <18 months of age (n = 8), Holstein-Friesian dairy cows (n = 8) were stratified on parity and randomly allocated to the 2 challenge diets, fed at four different levels. There was a pre-adaptation period of 7 days - 1 kg of mixed grain and *ad libitum* grass silage, an adaptation period of 5 days- 1 kg of the test grains and *ad libitum* grass silage. In the challenge period; cattle were withheld from all feed for 14h and fed the challenge diets. The 4 different levels of intake were 0, 0.4, 0.8 and 1.2% of body weight (BW). The trial was a single treatment, repeated measures study conducted with four levels of intake. There was a significant reduction in rumen pH (P = 0.01) of cattle fed at 1.2% BW. Concentrations of VFAs were higher in cattle fed at 0.8% and 1.2% BW than the control (0.0%). Concentrations of valerate (P < 0.001) and ammonia (P = 0.04) were significantly greater in cattle fed 1.2% BW. Rumen concentrations of valerate were significantly (P = 0.05) higher in cattle fed with Triticale than mixed grain. Rumen pH, volatile fatty acids (VFA), lactate and ammonia data were used in a discriminant analysis algorithm derived from earlier field studies to provide an acidosis index. Cattle fed at 1.2% BW had a higher acidosis index compared with cattle fed grain at 0%, 0.4% and 0.8% BW. The acidosis index of Triticale Jackie grain was also greater than the mixed grain.

Key Words: Acidosis, Dairy Cows, Grain

792 Grain species and cultivars and ruminal acidosis. II. Comparisons and validation of a near infra-red reflectance assay. I. J. Lean*¹, A. R. Rabiee¹, J. L. Black², S. Nielsen³, and R. H. King⁴, ¹*Bovine Research Australasia, Camden, NSW, Australia*, ²*John L Black Consulting, Warimoo, NSW, Australia*, ³*NSW Department of Primary Industries, Orange, NSW, Australia*, ⁴*RHK Consulting, Essendon, Victoria, Australia*.

We compared effects of twenty different grains (Wheat (n=6), Barley (n=4), Triticale (n=4), Sorghum (n=3), Oats (n=3)) and a mixed grain control fed to cattle on ruminal pH and ruminal volatile fatty acids (VFAs), lactate (D-and L-) and ammonia. We determined correlations between near infra-red reflectance (NIR) derived *in vitro* estimates of acidotic risk of grains and *in vivo* effects of the same grains. The study comprised 40 rows (heifers) and column (run) with cattle in four groups of 10. Feeding was divided into a pre-trial (mixed silage and 1kg mixed grain), adaptation (1kg of test grain with mixed silage for four days), withholding period (feed withheld for 14 hours), and then were fed test grains at 1.2% body weight. Ruminal samples were collected by stomach tube immediately after the challenge over the next 5h. A 9-day wash out period was used between study phases. Rumen pH significantly changed throughout sampling (P<0.01). Rumen pH 4h after challenge was lower in cattle fed barley, triticale and wheat, than oats or sorghum. Rumen concentrations of propionate, butyrate, isobutyrate, valerate, isovalerate and D-Lactate changed significantly during sampling (P<0.05). Concentrations of propionate, isovalerate, valerate and ammonia were significantly different among grains (P<0.05). The acidosis index based

on discriminant analysis showed that triticale and wheats had the highest acidosis index. The *in vivo* discriminant scores were significantly correlated with rankings of rumen valerate concentrations derived from a mixed effect model (P<0.0001). The coefficients of discriminant scores (P=0.0003) or rumen valerate (P=0.017) were correlated with the NIR results derived from the tests ranking. Only the discriminant scores are related to biological measures of acidosis.

Key Words: Acidosis, Dairy Cows, Grain

793 Influence of electrolyzed alkaline water on milk production in dairy cows. J. D. Ferguson*, D. Remsberg, and Z. Wu, *University of Pennsylvania, Kennett Square*.

Electrolyzed alkaline water (EAU Technologies) may have some anti-oxidation and rumen stabilization properties. This pilot study examined the influence of electrolyzed water (EAU) on milk production, water intake, and blood physiology over a 12 wk period in 62 lactating Holstein cows (81 ± 56 DIM). Cows were blocked on parity, milk production and DIM and randomly assigned to EAU water or untreated well water (CON) following a 2-wk covariate period. Overall covariate adjusted milk yield was not different between the groups, but a significant interaction between water source and initial DIM (P<0.03) was apparent. Cows <60 DIM consuming EAU produced 2.1 kg/d more milk over the course of the study than the CON cows. Cows >60 DIM at the beginning of the study consuming the EAU water produced less milk than cows consuming CON water (-0.8 kg/d). It appeared that cows required a 4-6 wk period to adapt to the alkaline water. Water coliform counts were consistently lower from EAU waterers. Consuming EAU water may enhance production in early lactation and increase milk fat content.

Table 1. Influence of electrolyzed water on water, blood chemistry, and production

Item	EAU	SEM	CON	SEM	P<	
Water	pH	9.4	0.1	6.1	0.1	0.01
	Alkalinity, mg/L	154.4	7.3	52.1	7.3	0.01
	Na, mg/L	137.8	21.8	22.2	21.8	0.01
	Cl, mg/L	86.6	11.8	107.5	37.2	0.15
	Mg, mg/L	1.5	0.9	23.2	0.9	0.01
Blood	Inatke, L/d	228.5	35.8	174.4	30.3	0.05
	Base excess, mmol/L	4.0	0.2	5.5	0.3	0.05
	Bicarbonate, mmol/L	26.9	0.3	28.6	0.2	0.05
Milk	Total CO ₂ , mmol/L	28.0	0.3	29.7	0.2	0.05
	Yield, kg/d	33.5	0.3	33.8	0.3	0.44
	Fat,%	4.02	0.04	3.68	0.04	0.01
	Protein,%	3.03	0.01	3.00	0.01	0.02
MUN, mg/dl	11.5	0.1	12.6	0.1	0.01	

Key Words: Water, Dairy Cattle, Production

794 Timothy hays differing in dietary cation-anion difference affect the capability to maintain calcium homeostasis in dairy cows. V. S. Heron*¹, G. F. Tremblay², and M. Oba¹, ¹*University of Alberta, Edmonton, AB, Canada*, ²*Agriculture and Agri-Food Canada, Quebec, QC, Canada*.

The objective of this study was to evaluate the effectiveness of timothy hays differing in dietary cation-anion difference (DCAD) at maintaining calcium homeostasis. Six non-lactating, non-pregnant multiparous cows were fed diets containing timothy (*Phleum pratense L.*) hay with DCAD values of 4.1 ± 3.6 (LOW), 14.1 ± 3.0 (MED), or 25.1 ± 2.5 (HIGH) mEq/100 g DM in a duplicated 3×3 Latin square design with 14-d periods. The LOW and MED hays were produced by fertilizing established timothy fields at a rate of 224 kg CaCl₂/ha, and HIGH hay was obtained from the same field that LOW hay was produced, but from a section not fertilized with CaCl₂. Experimental diets, containing LOW, MED or HIGH timothy hay at 70% of dietary DM, had DCAD values of 0.72, 7.26, and 14.4 mEq/100 g DM, respectively. Animals were limit-fed at 108% of their energy requirement. For each period, after a 12-d diet adaptation, cows were subject to an EDTA challenge (3 cows each on d 13 and 14); infusion of EDTA solution into the jugular vein decreases the availability of blood ionized calcium. The EDTA challenge protocol determined the resistance time and recovery time: the

time required to reduce blood calcium concentration to 60%, and time required for recovery from 60 to 90% respective to the pre-challenge value, respectively. Urine pH was reduced for cows fed LOW compared to HIGH diet (6.88 vs. 7.83; $P = 0.04$), but both of them did not differ from that for cows fed MED diet (7.15). However, immediately prior to the EDTA challenge, blood pH were lower ($P = 0.01$) for cows fed LOW or MED compared to HIGH diet (7.44 and 7.44 vs. 7.47, respectively). Although the resistance time was not affected by treatment, averaging 155 min, the recovery time was shorter ($P = 0.01$) for cows fed LOW compared to MED or HIGH diet (185 vs. 248 and 263 min, respectively). Cows fed LOW or MED diet decreased the extent of metabolic alkalosis, but the capability to maintain calcium homeostasis was enhanced only for cows fed LOW diet, in which the DCAD value was lowered to below 1 mEq/100 g DM.

Key Words: EDTA Challenge, Low DCAD Timothy Hay, Hypocalcemia

Ruminant Nutrition: Energy and Carbohydrate Byproducts - Beef

795 ASAS Centennial Presentation: Discovery and application of energetic principles to feeding systems for beef cattle. C. Ferrell*¹ and J. Oltjen², ¹USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE, ²University of California, Davis.

Development of nutritional energetics can be traced to the eras of Leonardo da Vinci (1452-1519) and Lavoisier (1743-1794), who discovered the basic concepts. Lavoisier established relationships among O₂ use, CO₂ production and heat production (HP). The laws of thermodynamics were discovered in the 1840's. They state that 1) energy can be neither created nor destroyed, but can be transformed from one form to another, 2) all forms of energy can be quantitatively converted to heat, and 3) heat loss in a chemical reaction is independent of path. These laws enabled the fundamental entity ME = RE + HP to be established. Objectives became 1) establish relationships between gas exchange and HP, 2) devise basis for evaluation of foods that could be related to energy expenditures, and 3) establish causes of energy expenditures. The bomb calorimeter was invented, allowing determination of the energy contents of organic compounds. Concepts and equipment for animal calorimetry were developed. Early systems for evaluation of foods for their value in supplying animal energy needs were based in measurements of ME and HP determined from calorimetry. Work in these areas arguably culminated in 1965 with the Brouwer equation for calculation of HP from O₂ use and CO₂, CH₄, and N excretion. For many years, primary efforts were devoted to measurement of ME and HP, with RE a secondary consideration. The California Net Energy System, developed for finishing beef cattle, was the first net energy system based on RE as determined by comparative slaughter and was the first to use two net energy values (NE_m and NE_g) to describe feed and animal requirements. This system has been broadened conceptually to encompass energy requirements during the life cycle of beef cattle. This system remains useful, but has limited capacity, due to its empirical and static nature, to capture the dynamics of energy utilization by diverse animals as they respond to changing environmental conditions.

Key Words: Calorimetry, Comparative Slaughter, Net Energy

796 ASAS Centennial Presentation: Discovery and application of energetic principles to feeding systems for beef cattle: Use of dynamic models. J. W. Oltjen*¹ and C. L. Ferrell², ¹University of California, Davis, ²USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.

Static feeding systems are being replaced by dynamic simulation models that attempt to capture the underlying biology which is sensitive to a wide range of genetic and environmental conditions. In 1986, the Davis Growth Model used cell number and size mechanisms of growth to predict growth and body composition as affected by frame size, implant status, and energy intake. Fat gain was underpredicted for high energy diets, because fat gain was computed after subtracting energy for maintenance and protein gain. France proposed an integrated model of growth, carbon and nitrogen metabolism. Synthesis and degradation were represented for each body pool based on animal factors and absorbed nutrient levels. Di Marco extended the Davis Growth Model to two pools of protein and included a digestion and metabolism element. Separation of the protein pools accounted for variable maintenance wherein a relatively smaller viscera was associated with

decreased fasting heat production. The metabolism submodel corrected errors in prediction of fat gain since efficiency of each nutrient's use was explicitly represented. Input complexity precludes general use of these larger models. A dynamic sheep model of the visceral and muscle protein and fat pools was developed, with an upper bound for muscle and viscera. Heat production for maintenance depends on viscera size, hence nutritional history. New additions refine predictions at levels of energy intake at, or below maintenance. The model provides the structure for predicting composition of growing cattle, but has yet to be completely parameterized and tested. Generally, with each new system, advances in prediction accuracy came about by adding new terms to conceptually validated models.

Key Words: Modeling, Body Composition, Growth

797 ASAS Early Career Achievement Award Presentation: Advances in modeling ruminant nutrient utilization. E. Kebreab*¹, J. Dijkstra², A. Bannink³, and J. France⁴, ¹University of Manitoba, Winnipeg, MB, Canada, ²Wageningen University, Wageningen, the Netherlands, ³Wageningen University and Research Centre, Wageningen, the Netherlands, ⁴University of Guelph, Guelph, ON, Canada.

Nutrition modeling has been applied to study various aspects of the ruminant such as rumen function, post-absorptive metabolism and product composition. However, the objective of this study will be limited to advances in modeling rumen function with respect to environmental issues and animal health, particularly, rumen disorders. Interest in environmental issues comes from the potential to manipulate rumen functions to reduce energy losses as methane and utilization of nitrogen (N) by rumen microorganisms. Enteric methane production arises principally from microbial fermentation of hydrolysed dietary carbohydrates. A widely used empirical model estimates that 5.5% to 7.5% of gross energy (GE) intake is lost as methane. However, mechanistic models of rumen function are based on the laws of mass and energy conservation and take into account the rumen economy of primary substrates for ruminal methanogenesis (hydrogen and carbon dioxide). Mechanistic models have suggested that 3.8 to 7.4% of GE is lost as methane depending on the diet. They help understand the system under study and therefore provide more insight on how dietary manipulation reduces methane loss than empirical models. One such mitigating option is the use of starch, which, if used excessively, can lead to health problems such as sub-acute rumen acidosis (SARA) due to rumen pH depression. Mathematical models have been developed to describe changes in rumen pH and rumen fermentation. The models were used to determine the maximum amount of nonfiber carbohydrate to be included in the diet above which SARA would likely occur. Models that relate rumen temperature to rumen pH have also been developed and have the potential to aid in the diagnosis of SARA. Several empirical and mechanistic models have been constructed to predict N utilization in the rumen and the form in which N is excreted from the animal. These models show that the magnitude of feces to urine N ratio has implications on ammonia volatilization, nitrate leaching and contribution to greenhouse gas emission as nitrous oxide. A rumen model that integrates nutrient utilization and health has great potential benefit for ruminant nutrition research.

Key Words: Modeling, Ruminant, Nutrient Utilization

798 Effects of feeding high levels of byproducts in different combinations to finishing cattle. M. F. Wilken*, M. K. Luebke, J. R. Benton, G. E. Erickson, and T. J. Klopfenstein, *University of Nebraska, Lincoln*.

Crossbred steers (n=288; BW=373 kg) were used to evaluate feedlot performance from feeding diets with no grain and different inclusions of wet distillers grains plus solubles (WDGS) and wet corn gluten feed (WCGF). A RCBD was utilized with steers being assigned randomly to 36 pens with 8 steers/pen and 3 weight blocks. Six treatments were tested (6 pens/treatment): 1) control (CON) of 82.5% dry rolled corn (DRC) and 5.0% molasses, 2) 43.8% WDGS and 43.8% DRC (WDGS), 3) low blend (CORN) with 32.8% WDGS, 32.8% WCGF, and 21.9% DRC, 4) soyhulls blend (HULLS) with 32.8% WDGS, 32.8% WCGF, and 21.9% soyhulls, 5) high blend (BYPROD) with 43.8% WDGS and 43.8% WCGF, and 6) WDGS and grass hay (HAY) with 65.6% WDGS and 21.9% grass hay (DM basis). All diets contained 5.0% supplement and 7.5% alfalfa hay. Data were analyzed using mixed procedures of SAS, with weight block fixed, and using a protected F-test. Steers fed HAY had greater DMI ($P < 0.05$) than those fed WDGS and BYPROD. Intake for BYPROD was lowest ($P < 0.05$). Comparing all diets, ADG was greatest for WDGS ($P < 0.05$) and least for HULLS ($P < 0.05$). Steers fed WDGS had greater G:F ($P < 0.05$) compared to all other diets. Steers fed HULLS had numerically lower G:F ($P = 0.06$) compared to HAY and was lowest in relationship to all diets. Interestingly, steers fed HAY and BYPROD were similar ($P > 0.05$) to CON when comparing ADG and G:F, allowing us to conclude it is possible to feed byproduct diets with no corn and not sacrifice feedlot performance.

Table 1. Yearling steer finishing feedlot performance

Item	CON	WDGS	CORN	HULLS	BYPROD	HAY	SEM
DMI, kg/d	11.8 ^{ab}	11.4 ^{bc}	11.8 ^{ab}	11.7 ^{abc}	11.3 ^c	12.1 ^a	0.4
ADG, kg/d	1.83 ^x	2.03 ^w	1.89 ^x	1.69 ^y	1.80 ^x	1.83 ^x	0.09
G:F	0.155 ^{xy}	0.177 ^w	0.160 ^x	0.145 ^z	0.160 ^x	0.151 ^{yz}	0.003

^{a,b,c}Within a row, means without common superscript differ ($P = 0.06$).

^{w,x,y,z}Within a row means without common superscript differ ($P < 0.01$).

Key Words: Byproducts, Corn, Distillers Grains

799 Nutrient digestibility and utilization by cattle consuming cotton gin mote as a replacement for forage. C. M. Welch* and B. J. Rude, *Mississippi State University, Mississippi State*.

Cotton production provides a variety of by-products that can be utilized by beef cattle as an alternative roughage source which can reduce cost of production. The objectives of this study were to evaluate cotton gin mote as a forage replacement when fed to cattle by determining nutrient digestibility and nitrogen and energy retention. A seven day metabolism trial was conducted using twelve steers (249 ± 18.0 kg BW) allotted to one of three treatments: 0% mote (100% hay); 50% mote + 50% hay; and 100% mote. Steers consuming 0% mote consumed less ($P = 0.0029$) DM (1.45% BW/d) compared to those consuming 50% and 100% mote (1.93 and 2.29% BW/d, respectively). Digestibility of DM, OM, CP, and energy was least ($P < 0.0005$) by steers consuming 50% mote (56.3, 58.0, 35.9, 55.8%, respectively) with steers consuming

100% mote digesting more (59.4, 60.5, 42.1, 58.1%, respectively) and steers consuming 0% mote digesting the most (61.5, 63.8, 53.3, 62.4%, respectively). Digestibility of NDF and ADF was greater ($P = 0.0032$) for steers consuming 0% mote (62.1 and 61.3%, respectively) compared to steers consuming 50% mote (58.3 and 57.1%, respectively) and 100% mote (57.2 and 54.8%, respectively). Hemicellulose digestibility was greatest ($P = 0.001$) for steers consuming 100% mote (64.8%) and least for steers consuming 50% mote (60.9%) with 0% mote (63.2%) being in between. Fat digestibility tended to be greatest ($P = 0.0699$) by steers consuming 0% mote (79.7%) and least by steers consuming 100% mote (74.3%) with 50% being intermediate (55.8%). Steers consuming 0 and 50% mote retained less ($P = 0.0065$) protein (17.8 and 13.4 g/d, respectively) than those consuming 100% mote (24.5 g/d). Likewise, steers consuming 0 and 50% mote retained less ($P = 0.0100$) energy (100.1 and 115.3 kcal/d, respectively; no gaseous losses accounted for) than those consuming 100% mote (145.0 kcal/d). It appears that cotton gin mote can be used to replace up to 100% hay. However, additional protein and energy may need to be supplemented as their digestibility may be decreased by animals consuming cotton gin mote.

Key Words: Cotton Mote, Roughage, Digestibility

800 Beef steer intake and performance when fed whole cottonseed free-choice with hay. G. M. Hill*¹, M. H. Poore², D. J. Renney¹, and A. J. Nichols¹, ¹University of Georgia, Tifton, ²North Carolina State University, Raleigh.

Steers were fed whole cottonseed (WCS) free-choice (FC) with hay. Supplement treatments (TRT) were fed for 42 d in a feedlot (Phase 1) to allow adjustment to high WCS intake on the FC diet, and then individually-fed the diets for 17-d (Phase 2). In Phase 1, steers (n=32; 452.9 ± 55.2 kg initial BW; Brahman derivative breeding) were ranked by BW, randomly assigned to four TRT (4 steers/pen; 2 pens/TRT). Steers were fed round bale bermudagrass hay (93.0% DM, 13.4% CP, 78.8% NDF, 52% TDN) FC using hay rings in a feedlot with FC minerals. Supplement TRT included hay without WCS (H); or with WCS (DM basis: 25.4% CP, 45.6% ADF, 59.0% NDF, 15.6% crude fat) fed at three levels (LCS = WCS at 0.25% initial BW; MCS = WCS at 0.5% initial BW; and FCS = WCS fed FC). During Phase 1, DMI and ADG (kg) least squares means with initial BW as a covariable, for H, LCS, MCS, and FCS with SE, were: Hay DMI, 11.13, 8.51, 5.83, 5.21, 1.23, ($P < 0.12$); WCS DMI, 0.0, 1.06, 1.84, 2.99, 0.17, ($P < 0.01$); Total DMI, 10.93, 9.53, 7.70, 8.24, 1.25, ($P < 0.44$); ADG, 0.54, 0.46, 0.85, 0.88, 0.11, ($P < 0.02$). In Phase 2, steers (n=28; 494.2 ± 51.3 kg initial BW) were individually-fed the four TRT for 17 d. Hay (Tifton 85; 92.6% DM, 16.8% CP, 38.9% ADF, 75.2% NDF, 53% TDN) was coarsely ground (5 to 7 cm, length of cut), and WCS (DM basis: 25.5% CP, 45.6% ADF, 61.7% NDF, 15.3% crude fat) was fed as in Phase 1. The DMI (kg) least squares means with initial BW as a covariable, for H, LCS, MCS, and FCS with SE, respectively, were: Hay DMI, 7.43a, 6.75ab, 6.33b, 5.65c, 0.24; WCS DMI, 0.0d, 1.04c, 2.18 b, 3.55a, 0.03, and Total DMI, 7.56a, 7.93ab, 8.64b, 9.34c, 0.24; means followed by uncommon letters differ ($P < 0.01$). Dietary digestibility and blood components are being analyzed. In Phase 1 and Phase 2, steers fed FCS had reduced hay DMI, but higher Total DMI. Feeding FCS increased DMI of WCS above recommendations, which was not cost effective, it increased gossypol toxicity risk, and it has reduced dietary fiber digestibility.

Key Words: Cottonseed, Steer, Hay

802 Influence of roughage source and level in feedlot diets containing wet distillers grains on ruminal metabolism and nutrient digestibility in steers. J. R. Benton*, G. E. Erickson, T. J. Klopfenstein, N. F. Meyer, and C. D. Buckner, *University of Nebraska, Lincoln*.

Six ruminally fistulated steers (347 ± 25 kg) were used in a 6x6 Latin square to determine effects of roughage source and level in feedlot diets containing wet distillers grains plus solubles (WDGS) on ruminal metabolism and nutrient digestibility. Treatments were arranged as a 2x3 factorial with alfalfa hay or corn stalks included at a normal, low, or zero roughage (zero) level consisting of: 1) 8% alfalfa (8ALF); 2) 4% alfalfa (4ALF); 3) 0% alfalfa (0ALF); 4) 6% corn stalks (6STK); 5) 3% corn stalks (3STK); 6) 0% corn stalks (0STK). Diets were balanced to provide equal percentages of NDF from roughage at each level and contained 30% WDGS (DM basis). Periods included a 9-d adaptation and 5-d collection. Steers were fed once daily at 0730 h, and ruminal pH and DMI were continuously monitored during collection. There was not a source x level interaction for digestibility or rumen pH. There were no differences ($P > 0.05$) in DMI (9.4 kg/d) or CP digestibility (77.6%) across diets. No differences ($P > 0.16$) in DM and OM digestibility (DMD, OMD) were observed between cattle fed alfalfa or corn stalks. A linear increase ($P < 0.01$) was observed in DMD and OMD as roughage decreased with 81.7, 82.5, and 86.4% DMD for normal, low, or zero roughage levels, respectively. Cattle fed alfalfa had greater ($P < 0.05$) NDF digestibility (NDFd) compared to corn stalks (75.8 and 72.2%, respectively). A linear increase ($P = 0.02$) in NDFd was observed as roughage level decreased with 72.1, 72.9, and 76.9% NDFd for normal, low, or zero roughage levels, respectively. Average daily ruminal pH decreased linearly ($P < 0.05$) as roughage decreased and measured 5.70, 5.49, and 5.31 for normal, low, or zero roughage levels, respectively. Roughage source did not affect ($P > 0.50$) ruminal pH. Acetate:propionate ratio was lowest for cattle fed 6STK and highest for cattle fed 0ALF, 0STK, and 3STK (source x level interaction; $P < 0.01$). In summary, these data indicate roughages can be exchanged on an equal NDF basis and that roughage levels can be decreased but not removed in feedlot diets containing 30% WDGS.

Key Words: Cattle, Distillers Grains, Roughage

803 Feedlot performance of Holstein steers fed treated-wheat straw-distillers grains diets as a corn replacement pellet. J. R. Sewell¹, L. L. Berger*¹, M. J. Cecava², N. A. Pyatt², and P. H. Doane², ¹*University of Illinois, Urbana*, ²*ADM Animal Nutrition Research, Decatur, IN*.

Thirty-two Holstein steers (BW 185.2 ± 0.9 kg) were utilized in a 120-d study to evaluate growth performance when fed wheat straw (WS) or a corn fiber-wheat chaff (CFWC) corn replacement pellet (CRP) compared with a corn-based diet or native (NAT) WS. Crop residues were processed with 5% calcium oxide (DM basis) and 35% water in a double-shaft enclosed mixer (Readco Kurimoto Continuous Processor) and subsequently pelleted with distillers grain plus solubles (DDGS) to form a CRP. Individual feed intakes were monitored using the GrowSafe® feeding system (GrowSafe Systems, Ltd, Airdrie, AB). Steers were fed a common diet for 14 d prior to allotment and for 7 days before termination of trial. Upon initiation and termination of the trial, the average of two consecutive-day weights served as starting and J. Anim. Sci. Vol. 86, E-Suppl. 2/J. Dairy Sci. Vol. 91, E-Suppl. 1

final weights. All dietary treatments contained 25% DDGS, 15% corn silage, and 10% supplement. The remaining portion of the four dietary treatments were: 1) 50% cracked corn, 2) 50% CFWC CRP (containing 56.25% CF, 18.75% WC and 25% DDGS), 3) 50% WS CRP (containing 75% WS and 25% DDGS), and 4) 50% NAT wheat straw. Digestibilities were estimated using acid insoluble ash by collecting fecal grab samples from individual animals at 7 d after initiation, midterm, and prior to the end of the trial.

Table 1. Performance and DM digestibility of Holstein steers fed corn replacement pellets

Item	Control	Treatment			SEM
		CFWC CRP	WS CRP	Nat WS	
Initial wt., kg	195.2	193.1	194.8	193.1	
Final wt., kg	362.6 ^a	360.4 ^a	349.4 ^a	290.6 ^b	18.7
Gain, kg/d	1.35 ^a	1.44 ^a	1.38 ^a	0.92 ^c	0.13
Intake kg DM/d	7.07 ^a	7.86 ^{a,b}	8.65 ^b	8.24 ^b	0.35
Gain:feed, g/kg	201 ^a	177 ^c	149 ^b	101 ^d	10
DM digestibility, %	65.9 ^a	62.0 ^a	60.0 ^a	42.1 ^b	4.2

^{a,b,c,d}Different superscripts within row differ $P < 0.05$

Key Words: Treated Wheat Straw, Distillers Grains, Corn Replacement

804 Characterizing quality and composition of beef from cattle fed combinations of steam-flaked corn, dry-rolled corn, and dried corn distiller's grains with solubles. P. L. Black*¹, G. L. Parsons¹, M. K. Shelor¹, M. E. Dikeman¹, K. K. Karges², M. L. Gibson², and J. S. Drouillard¹, ¹*Kansas State University, Manhattan*, ²*Dakota Gold Research Association, Sioux Falls, SD*.

Color shelf life, lipid oxidation, and sensory attributes were evaluated for longissimus steaks from crossbred heifers ($n=689$, 302 ± 65 kg initial BW) fed finishing diets consisting of combinations of steam-flaked corn (SFC), dry-rolled corn (DRC), and dried corn distiller's grains with solubles (DDG). The study was a randomized complete block design with a 2×2 factorial arrangement of treatments. All diets contained SFC, and factors consisted of levels of DDG (0 or 25%) and DRC (0 or 25%). Heifers were individually weighed and blocked into heavy and light groups. Within block, heifers were assigned randomly to pens containing 25 animals each, with 6 pens per treatment. Heifers were fed once daily *ad libitum*, and the heavy and light weight blocks were harvested after 137 and 157 d, respectively. Four heifers were randomly selected from each of 24 pens (3 pens per treatment at each harvest point), and the wholesale rib sections were removed from one side of each carcass following a 24-h chill. Steaks (2.54-cm thick) were evaluated for color shelf life during a 7-day retail display period, as well as for purge loss during a 21-day aging period, weight loss during cooking, and lipid oxidation (TBARS). Sensory traits of initial tenderness, juiciness, chewiness, beef flavor, residual connective tissue, mealy texture, fiber awareness, bloody/serummy flavors, metallic flavors, and rancidity were evaluated by a 5-member professional profile panel using a 12-point scale. Steaks from cattle fed the different diets did not differ in color display attributes or TBARS values ($P > 0.20$). Weight loss during cooking was greater for steaks from heifers fed DRC diets compared with counterparts without DRC ($P < 0.05$). Replacing portions of SFC with DRC or DDG had no effect ($P > 0.10$) on sensory traits, lipid oxidation, or retail color display attributes.

Key Words: Sensory Attributes, Beef, Distiller's Grains

Symposium: Triennial Lactation Symposium joint with Lactation Biology: 9th ASAS-EAAP International Workshop on the Biology of Lactation in Farm Animals

805 Immune components of colostrum and milk. K. Stelwagen*, T. T. Wheeler, and E. A. Carpenter, *AgResearch, Ruakura Research Centre, Hamilton, New Zealand.*

Colostrum and milk provide for a complete diet for the neonate. In ruminants it is also the sole source of initial immunity for the offspring. However, milk also plays an important role in host defence. The level of immunoglobulins is particularly high in colostrum, with IgG being the predominant immunoglobulin class in ruminant milk, compared to IgA in human milk. Immunoglobulin transport into milk is only partially understood. In addition to immunoglobulins, both colostrum and milk contain viable cells, including neutrophils and macrophages, which secrete a range of immune-related molecules into milk. These include cytokines and some antimicrobial proteins and peptides such as lactoferrin, defensins and cathelicidins. Mammary epithelial cells themselves also contribute to host defence through secretion of a range of innate immune effector molecules, such as lactoferrin, RNAses, lysozyme, cathelicidins and defensins. A detailed understanding of these proteins and peptides offers great potential to 'add value' to milk. This is demonstrated by the wide ranging commercial applications of milk-derived lactoferrin (e.g. as an ingredient in food, toothpaste, cosmetics and fish food). Knowledge of the immune function of milk, in particular how the gland responds to pathogens, can also be used to boost the levels of immune factors in milk through farm management practices and vaccination protocols. The latter approach is currently being used to maximise yields of bovine milk-derived IgA directed at specific antigens for therapeutic and prophylactic use. Increasingly sophisticated proteomics technologies are being applied to identify and characterise the function of the minor components of milk. An overview of immune factors in colostrum and milk as well as the results of research aimed at realising this untapped value in milk will be presented.

Key Words: Milk, Innate Immunity, Mammary Gland

806 Mammary immunology and protection of the neonate. H. Salmon*, *IASP, Lymphocyte et Immunité des Muqueuses, Nouzilly, France.*

Colostrum and milk, secretions of mammary gland (MG) are the two components of the post-natal delivery of maternal immunity to the neonate. In monogastrics, sIgA is the predominant colostrum or milk Ig depending upon to the degree of prenatal Ig transfer, whereas in ruminants IgG1 predominate. In ungulate such as swine and ruminant absence of prenatal Ig transfer is compensated for by IgG enriched colostrum. These immunoglobulins enter neonate circulation and provide the newborn with the maternal serum antibodies that arose from antigenic stimulation of the mother's systemic immune system and sustain the systemic protection of the neonate against invasive pathogens. In contrast, the passive mucosal protection of neonatal mammals is dependent on the continuous supply until weaning of maternally dimeric IgA (Monogastric) and IgG1 (Ruminants), the so-called lactogenic immunity. Based on multistep model of lymphocyte migration between compartments we analyzed the spatio-temporal relationships between adhesion

molecules and chemokines in the gut and/or nasal mucosa and MG. In sows and mice, localization of $\alpha 4\beta 7$ T-cells follows MadCAM-1 development on capillaries. In contrast, $\beta 7/c$ -IgA B plasmablasts increased in mid- and late lactation when MadCAM-1 density declined; this result implicates additional factors; one of these has been identified as chemokine CCL28 (MEC) interacting with CCR10 receptor onto sIgA B cells. As the same pattern of adhesion molecules and chemokines was observed in small gut and nasal mucosa, that indicates the existence of a cellular link between the upper respiratory tract and MG in addition to the entero-mammary link. By comparison, absence of MadCAM-1 in ruminant MG is in agreement with the absence of a link with the intestinal immune system and explains the low levels of IgA in bovine mammary secretions. Further, in ruminants and in mice VCAM-1 is not present on capillaries in lactation but only on larger blood vessels. In conclusion, knowledge of these humoral and cellular factors of mucosa-mammary links may pave the way of optimal route of vaccination to protect the mammary gland itself and to protect the neonate via its secretion.

807 Characterisation of the bovine RNase gene family: Evidence for rapid evolution and acquisition of an innate immune function in the mammary gland. T. T. Wheeler*¹, N. Maqbool², A. Molenaar¹, P. Harris¹, and M. Callaghan¹, ¹*AgResearch, Hamilton, Waikato, New Zealand,* ²*AgResearch, Mosgiel, New Zealand.*

The mammalian RNase A family of genes comprises a cluster of 13 genes on human chromosome 14 that share significant similarity with RNase A (RNase1). Several members of the family are secreted from circulating immune cells and some mucosal epithelia. RNase5, which is secreted by intestinal cells, has been reported to have bactericidal activity. RNase5 is also secreted from mammary epithelial cells and is present in milk. The aim of this study was to address the hypothesis that members of the RNase family have undergone rapid evolution (typical for many innate immune effector proteins) and play a role in the host defence function of bovine milk.

Analysis of the assembled bovine genomic sequence revealed significant expansion of the RNase locus in cattle, with 22 orthologous or paralogous RNase genes being identified within the cluster. As with the human RNases, the protein coding regions of the bovine RNase genes were contained within a single exon. Orthologues for 12 of the 13 human RNase genes were found, the exception being RNase3. An additional 10 genes appeared to be found only in cattle. Two of these encode a significantly shortened protein, and thus appear to be pseudogenes. Phylogenetic and substitution analyses suggest that the bovine RNase locus is under evolutionary pressure, consistent with rapid evolution.

Northern, quantitative PCR, in-situ hybridisation and western analyses of RNase4 and RNase5 revealed these genes are expressed most abundantly in the mammary gland, liver and small intestine. RNase5 was purified from milk and tested for antimicrobial activity. Microbicidal activity was obtained against *Candida albicans*, with a 50% kill rate being obtained at a concentration of 31 μ g/ml. This level of activity was typical among four independent purifications). However, no growth

suppression activity was observed in RPMI medium. The results are consistent with the idea that some members of the RNase family have a role in host defence against pathogens in the mammary gland and/or digestive tract.

Key Words: Lactation, Mammary, RNase

808 Neonatal protection by an innate immune system of human milk consisting of oligosaccharides and glycans. D. S. Newburg*, *Massachusetts General Hospital and Harvard Medical School, Boston, MA.*

Infants not breastfed have a higher incidence of severe diarrhea and respiratory diseases than those breastfed. In the past, this had been attributed primarily to human milk secretory antibodies. However, the oligosaccharides are major components of human milk, and milk is also rich in other glycans, including glycoproteins, mucins, glycosaminoglycans and glycolipids. These milk glycans, especially the oligosaccharides, are comprised of thousands of components. The milk factor that promotes gut colonization by *Bifidobacterium bifidum* was found to be a glycan, and such prebiotic characteristics may contribute to protection against infectious agents. However, the ability of human milk glycans to protect the neonate seems primarily to be due to their inhibition of pathogen binding to their host cell target ligands. Many such examples include specific fucosylated oligosaccharides and glycans that inhibit specific pathogens. Most human milk oligosaccharides are fucosylated, and their production depends on fucosyltransferase enzymes; mutations in these fucosyltransferase genes are common, and underlie the various Lewis blood types in humans. Variable expression of specific fucosylated oligosaccharides in milk, also a function of these genes (and maternal Lewis blood type), is significantly associated with the risk of infectious disease in breastfed infants. Human milk also contains major quantities and large numbers of sialylated oligosaccharides, many of which are also present in bovine colostrum. These could similarly inhibit several common viral pathogens. Moreover, human milk oligosaccharides strongly attenuate inflammatory processes in the intestinal mucosa. These data support the hypothesis that oligosaccharides and other glycans are the major constituents of an innate immune system of human milk whereby the mother protects her infant from enteric and other pathogens through breastfeeding. These protective glycans may prove useful as a basis for the development of novel prophylactic and therapeutic agents that inhibit disease by mucosal pathogens in many species.

809 Immune signaling during mammary development and involution. C. J. Watson*, *University of Cambridge, Cambridge, UK.*

Dramatic changes in cell composition and function occur in the mammary gland during a pregnancy/ lactation/involution cycle. We have investigated the transcriptional changes associated with these biological events using microarray analysis and identified the critical genes involved using genetically modified mice. Two surprising findings arose from these studies. Firstly, our microarray data showed that post-lactational regression was associated with an acute phase/inflammatory response in addition to cell death. Conditional deletion of Stat3, or the NF- κ B regulatory kinase IKK β , resulted in a failure to induce cell

death indicating that these signaling pathways are essential mediators of the involution process. Both Stat3 and NF- κ B have been shown to regulate acute phase gene expression in addition to apoptosis regulators. Four distinct transcriptional profiles are present in the first 4 days of involution while there are three in lactation. At the peak of lactation (day 10 in mouse) over 400 genes reach their maximum expression level before declining dramatically in the first 12 hours of involution. A reciprocal pattern was observed for over 500 genes that were specifically upregulated within the first 12 hours of forced involution. We are now investigating the role of a subset of these genes in involution. We also uncovered a role for genes normally associated with immune cell signaling in differentiation of luminal mammary epithelial cells during pregnancy. Genetic deletion of the transcription factor Stat6 resulted in delayed development during pregnancy and this phenotype was recapitulated in mammary tissue from IL-4/IL-13 doubly deficient mice. Furthermore, we showed that mammary epithelial cells secrete T cell regulatory cytokines. T helper (T_H) type 1 cytokines such as IFN γ and IL12a are secreted by undifferentiated mammary epithelial cells while T_H type 2 cytokines including IL-4 and IL-13 are secreted by differentiated cells. This unexpected finding demonstrates a role for immune cell signaling in mammary epithelial cell fate and function. Support by BBSRC and AICR is acknowledged.

810 Effect of lipopolysaccharides on plasminogen activator activity and lactoferrin mRNA expression in a bovine mammary epithelial cell line. C. Pecorini, R. Rebutti, E. Fusi, F. Galante, L. Rossi, F. Cheli, and A. Baldi*, *University of Milan, Milan, Italy.*

The aim of this work was to examine the urokinase-plasminogen activator (uPA) activity and the mRNA expression of bovine lactoferrin (bLf) after LPS treatment using BME-UV1 (Bovine Mammary Epithelia – University of Vermont 1) cell line as an in vitro model of bovine mammary epithelium. In a preliminary experiment, the effect of LPS on cell growth was examined. Cells were incubated with medium containing 0, 1, 10 or 20 μ g/ml of LPS from *Escherichia coli* O111:B4 for 24 h. The effect of LPS on cell growth was evaluated by MTT test. In order to evaluate the effect of LPS exposure on uPA activity and mRNA bLf expression, cells were treated with 0, 1, 10 or 20 μ g/ml of LPS from *E. coli* O111:B4 for 3, 6, 12 or 24 h. Media were stored at -80°C for the determination of uPA activity using a colorimetric assay and for the quantification of bLf using an ELISA kit. Cells were recovered and total RNA was extracted. The bLf mRNA expression was evaluated by RT-PCR. The experimental design included at least three replicates per treatment and all treatments were repeated twice. Results were evaluated using the GLM procedure of SAS. MTT test provided evidence that LPS treatment did not have any effect on cellular proliferation of BME-UV1 cell line. uPA activity was not affected by LPS treatments at 3 and 6 h, whereas 1 and 10 μ g/ml of LPS significantly stimulated ($P < 0.05$) uPA activity at 12 and 24 h. After 24 h of LPS exposure (1 and 10 μ g/ml) bLf secretion was stimulated compared to the control ($P < 0.05$). RT-PCR analysis confirmed that bLf is constitutively expressed by BME-UV1 cells and LPS treatments slightly modified bLf mRNA expression depending on time and concentrations. Under our experimental conditions, BME-UV1 represented a useful in vitro model to study the inflammatory response in mammary epithelial cells.

Key Words: Lipopolysaccharides, uPA, Lactoferrin

811 Pathogen-dependent variations in the innate immune response to intramammary infection. D. D. Bannerman*, *USDA-ARS, Beltsville Agricultural Research Center, Beltsville, MD.*

Mastitis remains one of the most prevalent diseases among dairy cows and one of the most economically costly diseases to the dairy industry. The majority of cases of mastitis result from intramammary bacterial infection, and numerous genera of bacteria are capable of inducing mastitis. Following penetration of the physical barriers of the teat canal, the innate immune system encompasses the initial and primary mechanism by which the cow defends itself against invading bacterial pathogens. It has been well-described that some pathogens are readily eliminated from the mammary gland, and the accompanying mastitis quickly resolved.

In other cases, bacterial pathogens can persist in the gland resulting in chronic mastitis that may endure throughout the lifespan of the cow. During the past few years, there have been rapid gains in the knowledge surrounding the innate immune responses that are evoked in response to intramammary infection. A major finding from this area of research is that despite the highly conserved nature of the elements involved in host innate immunity, marked variation in innate immune responses to different bacterial pathogens can occur. This review summarizes evidence that the nature of the innate immune response, as well as the rapidity in which it is evoked, influences the outcome of intramammary infection. Furthermore, the utility that immune response modifiers may have in preventing and/or treating mastitis will be considered.

Key Words: Immunity, Infection, Mastitis

Ruminant Nutrition: Feeding Behavior, Chewing and Digestibility

812 Meta analysis of responses of goats to chewing index. D. Sauvant*^{1,2} and S. Giger-Reverdin², ¹Agroparistech, Paris, France, ²INRA - UMR PNA, Paris, France.

The objective was to assess the interest of using a chewing index as predictor of dry matter intake (DMI), milk yield (RMY) and composition in dairy goats by using a meta-analysis. A data base was constructed from 13 (nexp) experiments including 49 (n) treatment groups. The experimental factors were concentrate level (%CO = 27.6 ± SE 30.6 % DM; n = 49), dietary NDF %DM (NDF = 56.3 ± 14.5; n = 41). The following parameters were collected: DM intake % of live weight (DMI = 3.10 ± 1.00 % LW; n = 49), time spent eating (ET = 4.90 ± 1.74 h/d; n = 27), ruminating (RT = 6.77 ± 1.68 h/d; n = 47) or chewing (CT = 11.51 ± 2.79 h/d, n = 29) and the chewing index (CI = 7.89 ± 7.72 hCT/kg DMI, n = 29). When simultaneously measured, CT and RT were closely related (CT = 2.12 + 1.47 RT; n = 27, nexp = 10, R₂ = 0.98, rmse = 0.55). Therefore, 20 values for CI were estimated from RT ones (CI = 11.29 ± 7.57 h/kg DMI, n = 47). The other items were RMY (2.72 ± 1.33 kg/d; n = 25), milk fat (MFC = 3.85 ± 1.07 %; n = 25) and milk protein contents (MPC = 3.20 ± 0.29 %; n = 25). The statistical methods used were either the global regression or the GLM procedure in order to check inter and intra experiment variations.

DMI was negatively correlated with CI, the global relationship being quadratic (DMI = 4.99 - 0.24 CI + 0.004 CI², n = 49, R₂ = 0.80, rmse = 0.30). Also, there was a global negative relationship between RMY and CI (RMY = 5.21 × 0.48 CI, n = 25, R₂ = 0.50, rmse = 0.96). For these two cases, CI estimations did not alter the regression. Due to variations across experiments, there was no global relationship between MFC and CI. In contrast, the within experiment relationship was significant and fairly accurate (MFC = 2.79 + 0.19 CI, n = 25, nexp = 10, R₂ = 0.98, rmse = 0.19). For MPC, there was no global or intra relationship with CI. MFC becomes lower than MPC when CI became lower than 1.8 h/kg DMI.

In conclusion, CI can be valuable to globally explain DMI (fill effect) and RMY variations in goats and to predict MFC in given conditions.

Key Words: Dairy Goat, Chewing Index, Milk Fat Content

813 Is chewing efficiency of dairy cows effected by physiological stage? I. Schadt*¹, J. D. Ferguson², G. Azzaro¹, R. Petriglieri¹, C. Guardiano¹, and G. Licitra^{1,3}, ¹CoRFiLaC Regione Siciliana, Ragusa, Italy, ²University of Pennsylvania, Kennett Square, ³D.A.C.P.A. Catania University, Catania, Italy.

Feed particle size and breakdown have been related to intake, milk production, passage and metabolic disorders. In the present study the particle distribution of swallowed boli during initial feed ingestion from forages fed at various lengths and TMR were measured in both dry and lactating cows. Six ruminally fistulated animals were examined. The study was conducted at two periods. In each period, two dry animals were compared to two animals at >200 DIM. Cows were held off feed for 12 hours, rumens evacuated, and offered 0.25 kg of forage or TMR. Rumen digesta and fecal samples were collected. Swallowed boli were manually retrieved from the reticulo-rumen at the esophageal orifice. Treatments in period 1 were ryegrass hay at various chop lengths: (1) long hay; (2) hay cut to 5 cm lengths; (3) chopped hay retained on a

1.91 cm screen; (4) chopped hay passing a 1.91 cm screen but retained on a 0.787 cm screen, and (5) chopped hay passing a 0.787 cm screen but retained on a 0.127 cm screen. In period 2, in addition to treatments 1-5, vetch hay (6), corn silage (7), grass silage (8) and TMR (9) were examined. Particles were analyzed by sieving with image analysis. Mean particle sizes (mm) for treatments were as follows (superscripts differ by p<.05): (1) long hay, not determined; (2) 43.4^a; (3) 41.4^a; (4) 24.9^b; (5) 5.2^c; (6) vetch hay, not determined; (7) 3.0^{cd}; (8) 4.6^{cd}; (9) 2.2^{cd}. Mean particle bolus sizes (mm) by treatments were as follows (superscripts differ by p<.05): (1) 3.5^{ab}; (2) 2.7^{bd}; (3) 3.5^{ab}; (4) 4.0^{ac}; (5) 2.3^{de}; (6) 3.6^{ad}; (7) 2.3^{de}; (8) 2.6^{de}; (9) 1.5^e. Feed and bolus mean particle size were not affected by stage of lactation. Mean rumen digesta particle size of dry cows (1.0 mm) was significantly shorter than in lactating cows (1.5 mm), p<.05. Mean fecal particle size (0.8mm) was not affected by stage of lactation.

Key Words: Feed Particles, Bolus Particles, Dairy Cattle

814 Competition at the feeder alters feeding and social behavior of transition dairy cows. K. L. Proudfoot*¹, D. M. Veira², D. M. Weary¹, and M. A. G. von Keyserlingk¹, ¹University of British Columbia, Vancouver, BC, Canada, ²Pacific Agri-Food Research Centre, Agassiz, BC, Canada.

Transition cows require sufficient dry matter intake (DMI) to meet the increasing nutrient demands of lactation. Management strategies that reduce competition can increase feeding activity of mid-lactation cows, but it is unclear if this is true for the transition cow. Moreover, it is often recommended that primiparous cows (PP) be managed differently from multiparous cows (MP), yet little evidence supports this claim. The objectives of this study were to test the effect of an overstocked feeder on transition dairy cow feeding and social behavior, and to identify any differences in the behavior of MP and PP cows. DMI, feeding and social behavior were monitored from 2 wk before to 2 wk after calving for 110 Holstein dairy cows using an electronic feeding system. Cows were assigned to a competitive (C, 2:1 cows:bin) or non-competitive (N, 1:1 cow:bin) treatment. Cows diagnosed with clinical illness were removed from the dataset. Each cow on the N treatment was matched for parity and baseline feeding data with one cow from a pair in the C treatment, resulting in 20 matched pairs (PP=16 and MP=24). Differences in feeding behavior between treatment and parity groups were tested using a mixed model with day as a repeated measure, and a t-test was used to detect differences in social behavior. Although MPC cows visited the feeder more often (34 vs. 28 visits/d, P=0.03), they consumed less feed (14.3 vs. 15.3 kg/d, P=0.01) and ate at a faster rate (123 vs. 106 g/min, P<0.01) than MPN cows. Treatment had no effect on the DMI of PP cows, but PPC tended to eat fewer meals (9 vs. 10 meal/d, P=0.07) and these meals were longer in duration (30.8 vs. 25.4 min/meal, P<0.01) and larger in size (1.6 vs. 1.4 kg/meal, P=0.07) than PPN cows. Regardless of parity, cows on the C treatment encountered more aggressive interactions than cows on the N treatment (24 vs. 8/d, P<0.001). The results of this study indicate that limited access to feeder space can alter feeding behavior and increase aggression in both MP and PP transition cows.

Key Words: Transition, Competition, DMI

815 Animal feed assessment quality by SMartNose®. T. Rapisarda*¹, G. Belvedere¹, F. La Terra¹, A. Cannas², G. Licitra^{3,1}, and S. Carpino¹, ¹CoRFiLaC, Regione Siciliana, Ragusa, Italy, ²University of Sassari, Sassari, Italy, ³University of Catania, Catania, Italy.

Animal feed quality for livestock has an important role in good farm management. In order to have an efficient and effective diet, it is important to have feeds of uniform quality. The objective of this study was to compare animal feed samples, from Sicily and Sardinia, by their content of volatile compounds. Ten feeds from these different Italian regions were analyzed by MS-based Electronic Nose (SMartNose®): Brazilian soybean meal, dehydrated alfalfa, wheat bran, beet pulp, pea seed, tick bean, corn gluten meal, sunflower meal, wheat flour middlings and barley grain. The feeds (three replicates per feed) were analyzed by a MS-based electronic nose (SMartNose®) to detect their organic volatile components in the mass-to-charge (m/z) range of 10 to 160 amu. Results were subjected to a principal components (PCA) analysis. Feed samples showed the best separation with PC1 (50.65%) and PC2 (19.38%). The effect of different volatile compounds was discriminant for five feed samples: Brazilian soybean meal, dehydrated alfalfa, wheat bran, beet pulp, and wheat flour middlings. Electronic Nose technology is simple and fast to use, especially if there are a lot of samples to analyze, and represents a very useful tool for discrimination of different feed qualities. Further studies are needed to create a data base and to study different qualities in animal feeds.

Key Words: Feed, SMartNose®, Volatile Compounds

816 Prediction of in vivo diet digestibility in lactating dairy cows from data based on values obtained using sheep. P. Huhtanen*¹, M. Rinne², and J. Nousiainen³, ¹Cornell University, Ithaca, NY, ²MTT Agrifood Research, Jokioinen, Finland, ³Valio Ltd, Helsinki, Finland.

Traditionally the tabulated feed values are based on the digestibility coefficients measured with sheep fed at maintenance level, and the energy value of the diet is assumed to be the sum of individual components without associative effects between dietary ingredients. These coefficients are applied to cattle fed at higher intakes of diets consisting of several ingredients. The objectives of the present study were (1) to evaluate the combined effects of species (sheep vs. cattle) and feeding level on diet digestibility and (2) to develop equations predicting diet digestibility from sheep data. A meta-analysis of dairy cow data was conducted using 497 diets from 92 studies. Diet digestibility in cows was determined by total fecal collection (n=176) or using acid insoluble ash as an internal digestibility marker (n=321). Diet OM digestibility (OMD) at maintenance level of feeding (OMDm) was estimated using in vivo or in vitro digestibility for forages and tabulated values for concentrate ingredients. A mixed model regression analysis with random study effect was used to analyze the data.

Fecal output of metabolic matter (OM-NDF) averaged 96 (SE 0.7; n=388) g/kg DMI and was not influenced by diet composition or DMI

(P>0.2). Forage OMD was positively associated with OMD of the total diet in cows, but the level of concentrate feeding had no effect on OMD in the cows. Protein supplementation improved quadratically OMD. Increased total DMI (TDMI) depressed OMD by 0.0026 units per kg. The following equation was fitted to estimate OMD in cows: $OMD = 0.252 + 0.702 \times OMDm - 0.0026 \times TDMI + 0.0203 \times CCPI - 0.0144 \times CCPI^2$, where CCPI is concentrate CP intake (kg CP above 170 g/kg DM). Residual error of the model was small (0.0089) indicating that diet digestibility in dairy cows can be estimated accurately and precisely from digestibility coefficients estimated in sheep. The equation takes into account both feeding level effects and associative effects in digestion.

Key Words: Digestibility, Cow vs. Sheep, Feeding Level

817 Depression in nutrient digestibility by lactating dairy cows when dry matter intake is expressed as a multiple of maintenance. D. P. Casper*¹ and D. R. Mertens², ¹Agri-King, Inc., Fulton, IL, ²USDA-ARS Dairy Forage Research Center, Madison, WI.

The latest edition of the National Research Council's (NRC) Nutrient Requirements of Dairy Cattle, 7th Revised Edition in 2001, calculates a reduction in digestibility due to increasing dry matter intake expressed as a multiple of maintenance (MM). Data from nonlactating cows was used to determine the depression in digestibility with increasing MM. Our objective was to evaluate the reduction in nutrient digestibility per MM by lactating dairy cows. The Energy Metabolism Database includes data from all energy and N balance trials that were conducted at the Energy Metabolism Unit of the USDA-ARS (3,018 individual energy and N digestion trials). Only 1,351 of the individual metabolism trials used lactating dairy cows of different breeds and stages of lactation that were fed diets that varied in forage types, grain sources, protein sources, and fat supplements. All data were analyzed using linear regression procedures of SAS. Initial data analysis indicated that ruminal acidosis may have occurred in some balance trials, which could affect the nutrient digestibilities. Thus, metabolism trials of lactating dairy cows having inverted fat and protein ratios (acidosis criteria) were removed, which resulted in 495 observations for evaluating nutrient digestibility related to MM, which ranged from a minimum of 1.36 to a maximum of 4.98. Dry matter digestibility (DMD) was reduced as MM increased ($DMD, \% = 68.7 - 0.54 \times MM$; $R^2 = .012$, $P < .02$), but the relationship was not strong. However, N digestibility (ND) was not affected by MM ($NDP, \% = 63.4 + 0.45 \times MM$; $R^2 = .003$, $P < .18$). While NDF digestibility (NDFD) was increased with increased MM ($NDFD, \% = 37.4 + 2.47 \times MM$; $R^2 = .04$, $P < .01$), but the relationship was weak. It would appear that the reduction in nutrient digestibility per MM by lactating dairy cows across all diets is not as high as the value used by the NRC in calculating the energy values of feeds. Additional analysis is needed to confirm if significant depression in digestibility occurs within diets for MM typical of lactating dairy cows.

Key Words: Digestibility, Intake, Maintenance

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818 Nutritional, hormonal and environmental effects on colostrum in sows. C. Farmer*¹ and H. Quesnel², ¹*Agriculture and Agri-Food Canada, Dairy and Swine R & D Centre, Sherbrooke, QC, Canada*, ²*Institut National de la Recherche Agronomique, UMR SENAH, Saint Gilles, France*.

The essential role of colostrum for growth and survival of neonatal piglets is evident, yet very little is known about the factors that can affect its yield and/or composition. Concentrations of IgG in colostrum vary widely between sows and are influenced by parity, season and genotype. Standard colostrum composition is also altered by genotype suggesting that selection strategies could be used to further improve it. Little is known on the environmental effects on sow colostrum; heat stress was shown to decrease IgG concentrations and alter fatty acid composition of colostrum. Endocrine status undoubtedly affects colostrumogenesis and the induction of farrowings reduces both colostrum yield and fat content of colostrum. On the other hand, providing growth hormone or prolactin in late-gestation increases colostrum fat content. A drastic reduction in feed allowance in late gestation also increases colostrum fat content, yet protein intake per se seems to have no effect on colostrum composition. In fact, it is very difficult to change the amino acid composition of colostrum. Supplementing the diet with fat in late gestation not only increases total lipids in colostrum but the source of fat used alters lipid composition. Indeed, inclusion of fish oil in the gestation diet of sows increases the amount of PUFA in colostrum and, interestingly, dietary conjugated linoleic acid also increases colostrum IgG content. Dietary supplementation with vitamin E, but not C, increases its concentration in colostrum and, even though increases in vitamins A and E in the gestation diet do not alter colostrum concentrations of IgG, they improve the IgG status of piglets via unknown mechanisms. Lastly, mineral intake appears to have no effect on mineral content in colostrum. In conclusion, it is apparent that new management strategies to enhance yield and/or composition of sow colostrum could be developed and further research in that area is definitely warranted.

Key Words: Colostrum, Management, Swine

819 Defining gene networks during involution of the mammary gland in dairy cows. P. Piantoni*, W. L. Hurley, S. L. Rodriguez-Zas, R. E. Everts, H. A. Lewin, and J. J. Loo, *University of Illinois, Urbana*.

Gene expression networks in the mammary gland during involution remain largely unknown. Objectives were to evaluate temporal changes in mammary gene network expression profiles due to cessation of milking at peak lactation. At 42 DIM, Holstein cows underwent a period of 5 d during which they were milked once daily until complete cessation of milking. Percutaneous mammary biopsies (n = 5/time point) were obtained on d 1, 5, 14, and 21 relative to the start of once-a-day milking. A 13,257 bovine oligonucleotide (70-mers) array and qPCR were used for gene expression profiling. Annotation was based on similarity searches using BLASTN against human, mouse and bovine RefSeq, human, mouse, and bovine UniGene, and bovine TIGR. Cy3- and Cy5-labelled cDNA from mammary gland and a reference standard were used for hybridizations (40 arrays). ANOVA (false discovery rate = 0.05) identified 75, 374, and 379 differentially expressed genes (DEG) with expression changes >1.5-fold on d 5, 14 and 21, respectively, relative to

d 1. Among DEG, gene network/pathway analysis identified apoptosis (n = 65), cellular growth and proliferation (n = 73), and immune response (n = 38) as the most significant upregulated molecular and cellular functions on d 21 vs. 1. In contrast, lipid metabolism (n = 17) and cellular development (n = 12) were among the most significantly downregulated functions in the same comparison. Downregulated genes on both d 14 and 21 vs. 1 included TNFA (cytokine activity), CD36 (fatty acid transport), SDHD (TCA-cycle), and SREBF1 (transcription factor); whereas, LTF (peptidase activity), CLU (apoptosis), and SPP1 (cytokine activity) were upregulated. Top upregulated signaling pathways among DEG on d 14 and d 21 vs. 1 included epidermal growth factor signaling and acute phase response signaling. Observed gene network expression patterns during “forced” involution were in large part a reflection of diminished milk synthesis and metabolism as the mammary gland transformed into a non-secretory tissue. Immune response-related genes seem to play a central role during mammary involution.

Key Words: Mammary gland, Involution, Oligonucleotide array

820 Mastitis control on organic and traditional dairies. P. L. Ruegg*, *University of Wisconsin, Madison*.

The U.S.D.A. National Organic Program specifies that organic dairy products may not originate from animals that have received hormones or antibiotics for any reason. As a consequence, organic dairy producers utilize a variety of strategies to manage disease. The purpose of this paper is to review research that describes mastitis control and treatments used on U.S. organic dairy farms. Several studies have indicated that fewer cases of clinical mastitis were reported by ORG farms but there are philosophical differences in the detection of disease and perception of cure and it is possible that more diseases are recorded on CON farms because there are more treatment options. Control of contagious mastitis can be a challenge for ORG farms because use of intramammary antibiotics is prohibited. In a WI study, about half of ORG farms reported administration of a variety of non-antimicrobial products at dry-off. Ultra filtered bovine whey products were most common treatment but other products included vitamin or microbial supplements or vitamin C. Both CON and ORG farmers had similar appraisal of products used at dry off. Organic farmers consistently report that they do not use antimicrobials to treat clinical mastitis. Treatments for clinical mastitis included various intramammary compounds such as isoflupredone, vitamin C, apple cider, aloe vera, and microbial supplements. A bovine whey product was the most common product administered by a parenteral route at both dry off and for treatment of clinical cases. Organic producers also reported the use of garlic tincture administered per os, or in the vulva. While efficacy data for these compounds is not available, the perception of cure after treatment of clinical mastitis was not significantly different between CON and ORG farmers. About half of CON farmers and one third of ORG farmers estimated that less than 50% of the treated cases of mastitis were cured as a result of treatment. Almost 74% of ORG farmers using compounds to treat clinical mastitis were satisfied or very satisfied, while only 40% of CON farmers were satisfied or very satisfied with the products used.

Key Words: Mastitis, Organic, Dairy

821 Association of prion protein genotypes with milk production and milk cheese-making properties in two breeds of dairy ewes. Y. Moussaoui, G. Caja, A. A. K. Salama*, E. Albanell, R. Casals, X. Such, D. P. Jaramillo, and A. J. Trujillo, *Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.*

Scrapie is a widespread transmissible spongiform encephalopathy of sheep, which is under official eradication programs. Infectious protein (prion) is encoded by an autosomal gene (*PRNP*). Degree of resistance to scrapie depends on *PRNP* polymorphisms: VRQ and ARR haplotypes being the most and least susceptible, respectively. Frequency of haplotypes varies between breeds, but is currently being modified by selection programs. Very little information is available on association of *PRNP* genotypes with sheep dairy traits. In order to improve this knowledge, 28 Manchega (ARR/ARQ, n = 9; ARQ/ARQ, n = 19) and 34 Lacaune dairy ewes (ARR/ARQ, n = 14; ARR/ARR, n = 20) were used to evaluate lactational performance and milk cheese-making properties. Management and feeding was similar for all ewes. Milk yield was recorded and milk sampled at wk 9 of lactation for analysis of main milk components, Na, K, fatty acid profile, SCC and cheese-making properties. Statistical model included, for each breed, the covariate of SCC, the fixed effects of genotype and parity, the random effects of animal and residual error. *PRNP* genotype had no effect on milk yield and most milk components. Exceptions were: log SCC, which was greater in ARR/ARR than ARR/ARQ (5.58 vs. 5.09; $P < 0.05$) in Lacaune; milk fat, which tended to be lower in ARQ/ARQ than ARQ/ARR (7.47 vs. 8.03%; $P = 0.064$) in Manchega; and, C17:0, which tended to be lower in ARR/ARR than ARR/ARQ (1.34 vs. 1.50%; $P = 0.065$) in Lacaune. Regarding cheese-making properties, milk coagulation pH was lower (6.59 vs. 6.70; $P < 0.05$) and curd DM tended to be greater (35.7 vs. 34.9%; $P = 0.098$) in ARQ/ARQ than ARR/ARQ in Manchega. On the other hand, rennet clotting time (12.7 vs. 10.9 min) and cheese whey protein (2.10 vs. 1.82%) were greater ($P < 0.05$) in ARR/ARR than ARR/ARQ in Lacaune. These results indicate that increasing the ARR frequency in Manchega and Lacaune dairy ewes does not seem to have negative effects on milk and cheese-making traits. However, selection towards ARR haplotypes in Lacaune ewes could have a negative impact on SCC, rennet clotting time and cheese whey proteins.

Key Words: Scrapie, Milk, Dairy Sheep

822 Management effects on colostrogenesis in small ruminants. N. Castro*¹, J. Capote², R. M. Bruckmaier³, and A. Argüello¹, ¹*Las Palmas de Gran Canaria University, Arucas, Spain,* ²*Canarian Agronomic Science Institute, La Laguna, Tenerife, Spain,* ³*University of Bern, Bern, Switzerland.*

Colostrum feeding in small ruminants is crucial during their first hours after birth because it is the only immunoglobulin (Ig) source during early life, due to the lack of Ig transfer during pregnancy via the placenta. In addition the immune system of the neonate is unable to produce Ig during the first month of life. Colostrogenesis, i.e. parturition transfer of Ig from blood into mammary secretions, starts several weeks prepartum. In goats plasma IgG concentration decreased by around 38% from third month of gestation until parturition, which coincided with the dry period (DP). Thus, the management during dp is crucial for the course of

colostrogenesis. The colostrum synthesis is affected by nutrition during the DP but the transfer of Ig seems to be independent. The administration of conjugated linoleic acid (CLA) during the DP to dairy goats caused a less pronounced decrease of plasma IgG concentration (6%) but it did not change colostrum IgG levels. In cattle IgG1 is transported from blood into colostrum by an IgG1 specific receptor located on the surface of alveolar epithelial cells during colostrogenesis which is most likely similar in small ruminants. Via inactivation of this receptor, the Ig transfer is downregulated by the increase of prolactin (PRL) during the final stage of lactogenesis. It was recently demonstrated in goats treated with PGF2 α in order to induce parturition that lower colostrum IgG concentrations occurred concomitantly with an earlier increase of plasma PRL as compared to untreated animals. Litter size did not affect colostrum IgG concentration in goats and ewes. Contrary to cows, the number of lactations did not affect IgG in colostrum of goats.

Key Words: Colostrum, IgG, Immune System

823 Haptoglobin, cortisol, A/G ratio and IGF-1 in goat kids around weaning. D. Magistrelli*, L. Pinotti, and F. Rosi, *University of Milan, Milan, Italy.*

Weaning is the most stressful event in the life of young ruminants. Since stress can affect endocrine and immune functions, weaning often results in a period of growth stasis and risk of disease. In light of this, the aim of this study was to evaluate the effect of weaning on growth and on some physiological mediators of stress and immune function.

Eleven Saanen goat kids were studied from day 3 to day 50 of age. Kids were randomly divided into two groups: MILK (6 animals) and WMIX (5 animals). All were fed goat milk to age 29 days. After that, MILK kids continued to receive milk, while WMIX group underwent weaning, in which milk was gradually replaced by solid feed. WMIX kids were completely weaned on day 48.

During the experimental period, dry matter intake (DMI) and body weights (BW) were recorded and blood was analyzed for metabolic traits, for indicators of health status (cortisol, haptoglobin and albumin/globulin - A/G ratio) and for IGF-1, which has a crucial role in postnatal development.

Starting from day 37 of age, DMI began to lower in WMIX group. On day 50, glucose, amino acids and urea were significantly lower in WMIX kids. On the same day, plasma IGF-1 was also lower in WMIX kids, as possible consequence of the lower plasma glucose and amino acids. Despite these differences, BW did not differ between groups, throughout the entire period.

Along the experimental period, plasma cortisol was always low in both groups, signaling no stressful condition, even if from day 44 to 50 of age, cortisol level significantly increased in MILK kids. This last result may indicate a function for cortisol as metabolic hormone involved in glucose homeostasis, rather than as telltale sign of poor health. In fact, no difference was observed neither in plasma haptoglobin, nor in A/G ratio, which are useful tools for suggesting when the animal is pathologically or physically challenged.

Results imply that a gradual transition from milk to solid feed does not affect the health status of goat kids, but it can decrease plasma cortisol, as hormone involved in glucose metabolism.

Key Words: Health, Weaning, Goat Kids

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Author Index

Abstract numbers preceded by T are Tuesday posters, numbers preceded by W are Wednesday posters, and numbers preceded by TH are Thursday posters; all other numbers indicate oral abstracts.

- A**
- Aalseth, E., 250
Aaron, D. K., 351, 669
Abaker Bertipaglia, L., TH47
Abaker Bertipaglia, L. M., TH47
Abanikandda, O. T. F., W49, W194
Abd El-Salam, M. H., 25
Abdalla, A. K., 45
Abdel-Azim, G., 11
Abdelhamid, K., W127
Abdeljabbar, K., W127
Abdelqader, M. M., 331
Abe, H., T24
Abedini, A., T13, T14
Abo El-Nor, S., TH216
Abreu, D. C., TH247
Abreu, F. M., W157
AbuGhazaleh, A., W69
AbuGhazaleh, A. A., W131, TH216
Acosta, D. C., W259, TH276
Acosta Aragón, Y., T89, T94, 707
Acuña, O. S., TH147, TH148
Adams, D. R., 219
Adaska, J. M., 482
Addis, M., T254
Adefope, N., T283
Adeola, O., 190, 207
Adeseko, O. T., W49
Adesogan, A. T., T81, W196, 159, 598
Adviento-Borbe, A., TH256
Afanador-Tellez, G., T138
Aferri, G., W256, TH280, TH281
Affentranger, P., 356
Afzalzadeh, A., T192
Agazzi, A., T227
Aghaziaraty, N., T190, W195
Aghini-Lombardi, F., T54
Agle, M., 307, 341
Aguerre, M. J., W184
Aguir, A., 128
Aguir, G. A., W236
Aguilar, I., T26, 620, 757
Aguilera, J. F., T108, W136
Ahedo, J., 602
Ahmadzadeh, A., W163, W192
Ahmed, H. F., T72
Ahn, D., 292
Ahn, J., W72, W73
Ahn, J. H., TH144
Ahn, S. I., W73
Aiken, G. E., TH12, 545
Ait-Saidi, A., 500
Ajala, L. C., 194
Ajmone-Marsan, P., TH114, 683
Ajuwon, K. M., T169
Akay, V., W212
Akers, R. M., TH65, TH68, TH108, 54, 660, 684
Akhtar, P., 98, 731
Akinsola, O., W194
Akoh, C. C., 513
Alava, E., 82
Albanell, E., T212, 498, 821
Albarrán, B., W96
Alberti, K. A., 353
Albertini, T. Z., 215
Albrecht, C., TH105, TH107
Albrecht, K. A., T103
Albuquerque, L. G., W41, W45
Aldrich, J. M., 216, 221
Aldridge, B. E., TH93, 698
Alemu, A. W., W202, 92
Alewynse, M. G., 265
Alex, A., 86
Alexander, M., 514
Al-Hassan, M. J., W191
Albrahim, R., 741
Alikhani, M., 91, 584
Alipanah, M., T14
Allee, G. L., 711, 774
Allen, J. C., T289
Allen, M. S., W216, 580, 743
Allen, R. H., TH235
Alleoni, G. F., TH82
Almeida, O. C., TH288
Alonso, L., W83
Alic, M., T149, T167, W119, W262
Altay, N., W80
Altunbas, K., T179, T180
Alvarado, G., TH101
Aly, S. S., 482
Amadori, M., W8
Aman, I. M., T72
Amanlou, H., T190, T201, W195, TH251
Amaral, R. C., T273, TH288, TH290, TH292
Amaral-Phillips, D. M., 431
Amaya-Llano, S. L., W78, TH25
Ames, M. S., 170
Amir, R., W31
Amodeo, P., T82
Ampuero, S., T105
Amrhein, M., T105
Amstalden, M., T186, 283, 284, 715, 719
Amstalden, M. A., W155
Anand, S. K., 21, 47
Anchamparuthy, V. M., TH178, TH180
Anderson, D. B., 357
Anderson, D. C., 628
Anderson, G., W239
Anderson, J. D., 548
Anderson, L., 432
Anderson, M. J., T126, 293, 689
Anderson, R., 193, 706
Anderson, R. A., 699, 708
Anderson, R. C., T76, T256, W275, 395
Anderson, R. J., 482
Anderson Alexander-Huerta, C., 495
Andrade Reis, R., TH47
Andrae, J., 271, 545, 599, 659
André, G., 591
Andrew, S. M., W199
Andrews, J., 469
Andries, K. M., 346
Ange-van Heugten, K. D., TH136
Anguita, M., T141, W119, TH152
Anil, L., W295, W296, W297
Anil, S. S., W295, W296, W297
Animut, G., T282
Anthony, R., 256
Anthony, R. V., TH80
Antonio, L. E., W240
Aparao, G., W131, TH151
Apparao, M. D., T9, T10, T12
Apple, J. K., T109, T110, T112, T113
Applegate, T. J., 657
Appuhamy, J. A. D. R. N., 60
Aragon, F. L., TH185
Arana, M., 313
Aranda-Munguia, A., 764
Araujo, D. B., 376
Araújo, M. J., T276
Araujo, R. C., TH290
Araújo, R. R., W165
Araujo, R. S., T119
Araujo Neto, F. R., W43
Arav, A., TH179
Archibeque, S. L., W21, W242, 304
Archimède, H., TH215
Arece, J., TH215
Argüello, A., 822
Arias, R. A., 755
Arieli, A., TH179
Ariño, L., T114, 354
Ariza-Nieto, C., T138
Armentano, L. E., T203, 499
Armstrong, D. V., W178
Arnold, M., 140
Arnould, V. M.-R., 613, 614
Arquet, R., TH14
Arrigoni, M. D. B., T122, W53, W249, W250, W265, W272, W273, TH222, TH227
Arriola, K. G., W196, 598
Arshami, J., T181
Arthington, J. D., W154, TH48, TH50, 323, 375, 376, 575
Arthur, P. F., 770
Aryana, K., W81, W84, TH29, TH32
Aryana, K. J., TH27
Arzola-Alvarez, C., W112
Arzola-Alvarez, C. A., W113
Asadi, A., T192
Asghari, M. R., T13
Ashokkumar, M., 646
Askar, A. R., T274
Asmare, A., T274
Aso, H., 610
Aspin, P., 454
Ata, A., T174, W169
Atkins, J. A., W162, W168, W170, 503
Atkinson, R. L., TH151
Atzori, A. S., 229
Augsburger, N., TH150
Augsburger, N. R., 564
Augustin, M. A., 643
Austin, B. R., W154, 375
Avci, G., T179, T180
Avellaneda-Cevallos, J. H., W230, W255
Avendaño, S., 408
Ávila-Rodríguez, E., TH51
Avilés, F., W96, W97
Ax, R. L., W191
Ayala-Martinez, A., T241
Ayangbile, G., 38
Ayers, M. W., W192
Ayles, H., W158, W165
Azain, M. J., T156, W139, 197, 702
Azcarate-Peril, M. A., 427
Azevedo, J. A. G., T250, T251
Aziza, G.-B., W127
Azzaro, G., 187, 326, 813
- B**
- Babinszky, L., W114, W115, W116, 704
Babu, R., TH216
Bacciu, N., 527
Bach, A., W5, W176, TH208, TH213, TH232, 581, 602, 675

Bach Knudsen, K. E., 698
 Bacheller, L. R., T6
 Bachman, K. C., TH116, 456
 Bader, J. F., 652, 722
 Badinga, L., 323, 324, 607
 Bae, C., W174
 Bae, D., TH59
 Bae, D. R., T36
 Bagnell, C. A., TH95
 Bah, B., T272
 Bahrami, H., TH217
 Bahrami-yekdangi, H., W200
 Bailey, C. L., W146, TH165
 Bailey, J. D., 572
 Bailey, R., 241
 Baker, A., T164
 Baker, D. H., TH16, 210
 Baker, K. M., 208
 Baker, M. J., 309, 463
 Baker, R., 322, 754
 Bakhtiarizadeh, M. R., T16
 Bal, M. A., W211, W212
 Baldi, A., TH107, 810
 Baldin, S. R., T122, W108, W109,
 W249, W250, W265, TH222,
 TH227
 Baldwin, VI, R. L., TH252
 Balieiro, J. C. C., TH281
 Ballagh, K. E., 660
 Ballam, J. M., T189
 Ballard, C. S., W205, W207, TH4,
 343
 Ballou, M. A., W221, TH214
 Balsalobre, M. A., W251
 Balsalobre, M. A. A., T118, TH44
 Balsbaugh, R., 294
 Bambou, J. C., TH14
 Bani, P., W228
 Bannantine, J. P., 50
 Bannerman, D. D., 811
 Bannerman, J., TH146
 Bannink, A., TH7, 189, 308, 591,
 797
 Banskalieva, V., T42
 Banta, J. P., TH205, 458
 Bañuelos, H. G., W275
 Banz, W., T169
 Barajas, R., W266, W267
 Barb, C. R., T187
 Barbano, D. M., TH19, TH20, TH24,
 510
 Barbosa, F. F., TH132, 697
 Barbosa-Canovas, G., 647
 Barbosa-Canovas, G. V., 645
 Barducci, R. S., T122, W108, W109,
 W249, W250, W265, TH222,
 TH227,
 Bargo, F., 486
 Barkley, N. M., W143
 Barling, K. S., W27
 Barnes, J., T158
 Barmhill, J., T70
 Barry, K., 175
 Barton, B. A., W219
 Barton, C. L., T173
 Barton, H. M., W299, TH167
 Bas, S., W158
 Bashtani, M., T15, T140
 Basirico, L., TH164
 Bass, B. E., 787
 Bassin, S., W98
 Bastin, C., 612
 Bastos, J. P. S. T., T122, W108,
 W109, W249, W250, W265,
 W272, W273, TH222, TH227
 Bateman, II, H. G., 216, 221
 Bates, G. E., TH40
 Bates, R. O., 413, 531
 Battacone, G., T54, T211, T246,
 T254
 Battaglia, M., TH245
 Bauer, M. L., T228, TH98, 287
 Bauman, D. E., T195, W183, 51,
 640, 680, 682
 Bauman, L. M., TH55
 Baumgard, L., 451
 Baumgard, L. H., TH161, TH163,
 TH206, 86, 88, 373
 Baxa, T. J., 459, 460
 Bayão, G. F. V., T121
 Beagley, J. C., 143
 Beal, W. E., 502, 504
 Bear, D., 436, 437
 Beattie, C. W., 411
 Beauchemin, K. A., T199, W254,
 TH243, 39, 55, 788
 Beck, P., TH38, 95, 96
 Beck, P. A., 391
 Becker, P. M., TH7
 Beckford, N. C., 758
 Beckman, D. W., 629
 Bedford, M. R., TH16
 Bee, G., T105, 296
 Beede, D. K., 327
 Beer mann, D. H., 688
 Beguesse, K., T278
 Behnke, K. C., 779, 780
 Behrends, S. M., 389
 Beier, S. L., W272, W273
 Beitz, D. C., 50, 154, 727
 Beker, A., T274
 Bélanger, G., 185, 186
 Beliciu, C. M., TH24
 Belo, C. J., TH112
 Belvedere, G., 187, 539, 815
 Ben Chedly, H., 452
 Benchaar, C., T208, T209, T210,
 T219, W217, W254, 185, 186
 Bene, S., W32, W36
 Benes, S. E., W185
 Benevenga, N. J., W218
 Benítez, G., TH101
 Bennett, G. J., 249
 Bennett-Wimbush, K., T292
 Benson, M. E., 314
 Benton, J. R., 219, 306, 734, 790,
 798, 802
 Benyshek, L. L., 4
 Benz, J. M., 562
 Benz, S. A., 266
 Bequette, B. J., W138
 Berardinelli, J. G., 479, 480, 572
 Berchielli, T. T., T118, T191, T243,
 T281, W251, TH44, TH47,
 TH224, TH231
 Bercovitch, F. B., 179
 Beresford, T. P., 644
 Berger, L. J., 132
 Berger, L. L., W20, W237, 211, 278,
 803
 Bergeron, R., 242
 Bergstrom, J. R., T128, TH124, 158
 Bermudez-Aguirre, D., 645, 647
 Bernabucci, U., T4, W8, W228,
 TH164, 246
 Bernal-Barragán, H., W104, W105,
 TH294, 440
 Bernal-Canseco, A., 723
 Bernard, J., 59
 Bernard, J. K., 94
 Bernardi, F., 153
 Berry, D. P., 73
 Berry, E. D., 311
 Berry, T. K., 40
 Berthiaume, R., 185, 186
 Bertin, G., 105
 Bertocchi, L., T4
 Bertoni, G., T223, T224
 Bertram, M. G., T85
 Bertrand, A., 185, 186
 Bertrand, J. K., T37, W46, 171, 525,
 630
 Bessen, R. A., 572
 Betancourt, L., T138
 Beveridge, H. L., TH85
 Bewley, J. M., TH204, 14, 655, 656
 Bey, R., T10
 Bezerra, L. A. F., W45
 Bhatia, E., 41
 Biagi, G., T79, W231
 Bianchett, F. J., TH106
 Bidner, T. D., TH149
 Biehl, M. V., TH278, TH289,
 TH291, TH292, TH293
 Biemann, V., 387
 Biffani, S., 619
 Bigelow, J. P., 372
 Biegerigo, M., 658
 Bilby, T. R., W178, 108
 Bin, S.-Y., TH156
 Bionaz, M., T178, TH103, TH114,
 278, 606, 609, 678, 679, 681, 683
 Biourge, V., 176
 Bird, S. L., W166
 Bischoff, K. M., W4
 Bisinotto, R., W221
 Bissonnette, N., T33
 Bitencourt, L. L., W208, TH262
 Bittante, G., 15, 616
 Bixby, D., 759
 Blache, D., 73
 Black, J. L., 791, 792
 Black, P. L., 214, 804
 Blackburn, H., W50, 570, 759
 Blanch, M., T238, 581
 Blanco, B., T114, 354
 Bland, J. R., 444
 Blanquet-Diot, S., W262
 Blasco, A., W41
 Blezinger, S. B., W18
 Block, E., 106, 329
 Block, J., TH63, TH183
 Block, S., 59
 Block, S. S., T240, TH41
 Bloemhof, S., 355
 Blount, A. R., T81, 598
 Bo, M. J., W125, W140, W287,
 W289
 Boe, F., 384
 Boeck, G., T89, T94
 Boehlje, M. D., 655, 656
 Boeneke, C. A., TH27
 Boesche, K., T27
 Bogden, R., W150
 Boggs, D. L., 147
 Bohaty, R. E., W62
 Bohmanova, J., 9, 12
 Boisclair, Y. R., T183, 455, 680, 682
 Boissonneault, G., T33
 Boland, H. T., TH39, TH203
 Boland, T. M., T247, W206
 Bolden-Tiller, O., T275
 Boler, D. D., 294, 295
 Boling, J. A., TH74, TH75, TH79, 2,
 3, 76, 78, 665, 669
 Bolte, J. W., W270, 392
 Bömcke, E., TH92
 Bond, J. P., 449, 554
 Bondioli, K., 104
 Bonelli, P., T211, 117
 Bonilha, S. F. M., TH82
 Bonilla, L., TH183
 Bonnette, E. D., T294
 Bor, T., TH23
 Borda, T., T63
 Borg, R. C., W245, W246
 Borger, M. L., W159
 Borgjink, S., 203
 Bork, N. R., T228
 Bornt, L. A., T5
 Borquis, R. R. A. B., T25
 Boschini-Figueroa, C., W92
 Bosma, B., 238
 Boss, D. L., 628
 Botermans, J., TH61
 Bottje, W. G., 769
 Bouattour, M. A., T212
 Boucher, S. E., TH268, 588
 Bounhamous, R., 452
 Boutinaud, M., 452, 455
 Bovenhuis, H., 611, 615
 Bowers, S., 317, 573
 Bowers, S. D., TH181
 Bowker, B., T125
 Bowman, G. R., W207, 333
 Boyd, J., 59
 Brabes, K. C. da S., T83, T96
 Brad, A. M., TH162
 Bradford, B. J., W203, 53, 80, 81
 Bradley, C. L., 201, 787
 Brady, H., 506
 Brady, M. B., W179
 Braga Arcuri, P., TH231
 Braga Malheiros, E., TH47
 Brandherm, M., 369
 Brandt, R. C., TH256
 Brandts, L., TH145
 Brannock, S., 247
 Brauch, A., TH225
 Bravo, D., W262, W268, W271,
 738, 739
 Breen, S., 570
 Breen, S. M., 571
 Bregendahl, K., 292
 Brendemuhl, J. H., W102
 Brennan, C. S., 485
 Brennan, K., W261
 Brew, M., 598
 Brewer, M. S., 294
 Briczinski, E. P., 44

- Bridges, A. J., 58
 Bridges, K. M., 131
 Brigham, B. W., 746, 749
 Brighton, C. J., T38
 Brignac, B., TH29
 Brink, Z., TH175
 Brisson, G., W86
 Brito, A. F., 185, 186
 Brito, M., W185
 Broadbent, J., 46
 Broadbent, J. R., T38, 23, 45, 135
 Broaddus, B., T67
 Broderick, G. A., T221, W142,
 W184, W218, TH271
 Brogna, N., T79, W231
 Brooks, M. A., T237, 149
 Brooks, S., 31
 Brooks, V. J., 52, 155
 Broome, A. I., TH131
 Brothersen, C., T58, 49
 Brouk, M. J., 80, 81
 Brown, D., 359
 Brown, E. G., 212
 Brown, J. L., 399
 Brown, K. R., TH74, 2, 3, 78, 669
 Brown, M., 759
 Brown, M. S., 148
 Brown, W., W131
 Brown, W. H., 547
 Brown-Brandl, T. M., 724
 Browne-Silva, J., T252, 336
 Bruckmaier, R., TH107
 Bruckmaier, R. M., T185, TH105,
 TH112, TH113, 75, 455, 822
 Bruns, K. W., 668
 Brusveen, D. J., W172
 Bruwier, D., 614
 Bryer, P. J., TH171, 243, 244
 Bu, D. P., T2, T29, T171, T172,
 T205, T206, T207, T215, T218,
 T230, T231, T232, T255, T279,
 W90, W224, W277, W278,
 W279, W280, TH70, TH206,
 TH219, TH233, TH236
 Buchanan, D. S., 362
 Buchholtz, H. F., TH255
 Buckner, C. D., 802
 Budge, S. M., 24
 Budinich, M., 46
 Bulbul, A., T179, T180
 Bulut, O., T174
 Bundy, J., TH127, 199, 712
 Bungenstab, E. J., TH42, TH45,
 TH198, TH199, TH200, TH201
 Bunter, K., 536
 Buntyn, J. O., 389
 Burciaga-Robles, L. O., W4, 390,
 393
 Burden, B. T., 351
 Burdick, N. C., T173, 374, 577, 578
 Burges, J. C., W268
 Burk, A. O., 446
 Burk, R. F., 467
 Burke, J. M., T271, 494
 Burke, S. L., 178
 Burkey, T. E., T170, 563
 Burns, J., 544
 Burris, W. R., TH74
 Busby, W., 322
 Busch, D. C., 652, 717, 718, 722
 Buschinelli de Goes, R. H. de T.,
 T83, T96, T234
 Bush, L. P., 2, 3
 Busso, F., 486
 Butler, G. M., 671
 Butler, W. R., 77
 Butzler, R. E., TH4
 Buyukunal Bal, E. B., W211
- C**
 Cabral, C., W87
 Cabrera, V. E., 654
 Caccamo, M., T55, 326, 540
 Cáceres, O., TH215
 Cady, R. A., W183
 Cady, R. D., T189
 Cai, H., 23, 46
 Caja, G., T212, 105, 347, 498, 500,
 760, 821
 Caldari-Torres, C., 607
 Calder, A. G., TH250
 Caldwell, J., T80, 597
 Caldwell, L. C., 74, 374, 577, 578
 Callaghan, M., 807
 Callan, J. J., T150, W120, W286,
 703
 Callaway, T. R., T76, T256, 395, 542
 Calsamiglia, S., T238, T239, W215,
 W271, 581, 588, 675, 738, 740,
 756
 Camacho, L. M., W97
 Camou, J. P., 557
 Campagnoli, A., T227, T253
 Campbell, B. T., TH40, TH41
 Campbell, J., TH8
 Campbell, J. M., W1
 Canavesin, F., 617, 619
 Canesin, R. C., T281
 Cangiano, C. A., T213, W197
 Cannas, A., 229, 384, 815
 Cannon, J. B., W253
 Cano, A., W88
 Cantet, R., 626
 Cao, Z., W181
 Capel, M. B., 248
 Capote, J., 822
 Capper, J. L., T195, W183, 51
 Cappio-Borlino, A., 618
 Capsel, R. T., 484
 Capuco, A. V., TH109, 54, 450, 684,
 686
 Caraway, E., 310
 Cardim, S. T., T234
 Cardoso, B. L., W157
 Cardoso, D., W96, W97
 Cardot, J. P., W119
 Cardot, J.-M., T149
 Cardozo, P. W., T239
 Carletti, M., 163
 Carlos-Valdez, L., W4
 Carlson, D. B., TH117
 Carné, S., 347, 498, 500
 Carney, E. E., 563
 Carnier, P., 530
 Caron, N., 263
 Carpenter, B. B., 458
 Carpenter, D. M., W149
 Carpenter, E. A., 805
 Carpino, S., 187, 326, 539, 815
 Carr, D. L., TH258
 Carr, S. N., 295, 711
 Carrillo Canesin, R., TH231
 Carro, M. D., T248, TH212
 Carroll, J. A., W27, TH2, 152, 374,
 575, 577, 578
 Carroll, T., 648
 Carson, M. E., 248
 Carstens, G. E., W24, W275, W276,
 212, 769
 Carter, B. H., 85, 318, 752
 Carter, F., TH230
 Carter, J. N., 598
 Carter, M. P., W205, TH4
 Carter, S., TH127, 199, 469, 712
 Carter, S. D., 693
 Carvalho, L. F. B., 313
 Carvalho, T. S. M., T222
 Casagrande, D. R., TH37, TH44, 438
 Casals, R., T212, 498, 821
 Casarez, E., W174
 Casas, E., W54
 Case, L. P., 414
 Casellas, J., W52, 760
 Casey, D. S., 650
 Casey, T., 687
 Casper, D. P., T98, 38, 657, 817
 Cassandro, M., 15
 Cassandro, Martino, 616
 Cassell, B. G., 127, 761, 765
 Cassill, B. D., TH99
 Castano-Tostado, E., TH25
 Castillejos, L., 740
 Castillo, M., T56
 Castillo, R., 707
 Castillo-Castillo, Y., W112
 Castillo-Gonzalez, H. A., W113
 Castonguay, F. W., TH273
 Castonguay, Y., 185, 186
 Castro, B. I., TH283
 Castro, C. B., TH166
 Castro, J. J., 94
 Castro, N., T185, 822
 Castro del C, N., W58, W59
 Cate, R. E., 445, 549
 Caton, J. S., 726
 Catunda, F., 194
 Cavali, J., T120, W248
 Cavender, K. B., 253
 Cavinder, C. A., TH97, TH98, 286,
 287
 Cawdell-Smith, J., 753
 Cecava, M. J., 803
 Cecchinato, A., 530
 Cedeño, E. M., TH67
 Celik, H. A., T179, T180
 Centeno, C., 206
 Ceron Munoz, M. F., T25
 Cerri, R. L. A., W155, TH184
 Cerrillo-Soto, A., 440
 Cerrillo-Soto, M. A., W104, W105,
 W106, W238, W258, TH51, 495
 Cervantes, B. J., W266, W267
 Cervieri, R. da C., W265, TH222
 Cespedes, F., TH133, TH134
 Cetz-Solis, F., W57
 Chae, B. J., T129, TH153
 Chagas, L., 73
 Chahine, M., T86
 Chalupa, W., TH266
 Champagne, C. P., 425
 Champod, M., W262
 Chandran, S., 138
 Chang, C. S., W122
 Chang, J., W174
 Chang, L., W174
 Chapinal, N., W193
 Chardulo, L. A. L., W53, W265,
 TH222
 Chase, C., 747
 Chase, Jr., C. C., 575
 Chase, C. C. L., 746, 748, 749, 750
 Chase, L. E., T265, W186, 93
 Chauhan, J., 649
 Chaves, A. S., W236
 Chaves, A. V., T208, T209, T210,
 W217, 728
 Chaves, M., T286
 Che, M. T., T163, 368, 773
 Chebel, R. C., W6, W155, W171,
 W188, W189, W191, W192,
 TH184
 Cheli, F., T253, 810
 Chen, C., 696
 Chen, C. C., T131
 Chen, C. H., TH60
 Chen, C. Y., 532, 533, 535
 Chen, D. G., 721
 Chen, P., W24
 Chen, S. S., T272
 Chen, T. C., 179
 Chen, Y. J., T142, T145, T147,
 T151, T152, T153, T154, W137,
 TH122, TH123, TH140, TH143,
 TH144
 Cheng, H. W., 382
 Cheng, J. B., T2, T29, T171, T172,
 W90
 Cherney, D. J. R., W101, 168
 Cherney, J. H., W101
 Cherry, N. M., T295
 Chesnais, J. P., 263
 Chessa, Stefania, 616
 Chester-Jones, H., TH187, TH188,
 TH189, TH190, TH191, TH192,
 TH193, TH194
 Chestnut, A. B., TH258
 Chettri, R. S., W179
 Chi, F., T131
 Chiba, L. I., W179, TH133, TH134
 Childs, S., TH230
 Chilbroste, P., W185
 Chilliard, Y., T202, 328
 Cho, J. H., T142, T144, T145, T147,
 T148, T151, T152, T153, T154,
 W137, TH122, TH123, TH140,
 TH141, TH143, TH144,
 Cho, K. S., TH117
 Cho, S. B., TH135, TH142
 Choat, W. T., 461
 Choi, C. B., 63
 Choi, C. W., TH135, 63
 Choi, I. S., 413
 Choi, J. K., W220
 Choi, J. Y., T129, TH153
 Choudhary, R. K., TH109
 Chouinard, P. Y., T208, T209, T210
 Christenson, L., 163
 Christiansen, D., 475
 Chromiak, A. B., TH207

- Chu, W. Y., TH156, TH157, TH158, TH160, 781
 Chua, W., TH154
 Chung, I. B., TH135, TH144
 Chung, K. Y., TH73, TH76, TH77, TH78
 Chung, R. H., T196
 Chung, W. T., TH135
 Chung, Y.-H., TH254
 Cibils, A. F., W93, W94
 Cintora, M., W294
 Claeys, M. C., 434
 Clapham, W., 464, 465
 Clapham, W. M., TH43
 Clapper, J. A., TH94
 Clare, D. A., 20
 Clark, D., 454
 Clark, D. S., W145
 Clark, L. M., TH266
 Clark, N., 329
 Clark, R. M., W199
 Clark, S., 649
 Clavero, T., W91
 Clay, J. S., T1, T22
 Cleere, J. J., 458
 Cleveland, M. A., 406
 Clevenger, D. D., TH284, TH285
 Cline, M. K., W98
 Cline, P. M., 702
 Cloninger, M. T., TH87
 Close, W., 194
 Coblentz, W., T80
 Coblentz, W. K., T77, TH237, 270
 Coburn, A. D., 11
 Cockett, N., 759
 Coffey, K., T80, 597
 Cohen, N. D., T173
 Cohick, W., 553
 Coker, O. N., W49, W194
 Cole, J. B., T6
 Cole, L. C., TH161
 Cole, N. A., 148, 310, 693, 732
 Colin-Negrete, J., TH294
 Collier, J., 451
 Collier, R., 451
 Collier, R. J., TH111, TH163, 86, 108
 Collins, E. D., 568
 Collins, J. R., TH279
 Colombatto, D., W268
 Colombini, S., T82, W99, TH271
 Columbus, D., 191
 Colvin, C., 288
 Combs, D. K., T103, W95, TH53, TH54, TH55, TH56
 Comin, A., 616
 Confer, A. W., 393
 Conforti, V., W150
 Coniglio, V., T286
 Connor, E. E., W9, 119, 457
 Connor, L., 27
 Contreras, G., W241, TH166, TH283
 Contreras-Govea, F. E., T90
 Cook, D., 369
 Cook, D. R., 192
 Cook, M. E., 596
 Cook, N. B., 83
 Cooke, F. N. T., 471
 Cooke, R. F., T182, W154, 375, 376
 Cooper, J. B., T1, T22
 Cooper, T. A., 245
 Copedge, K., T278
 Corah, L. R., 61, 146
 Corbellini, C., 486
 Corbin, M. J., 218
 Corl, B. A., W55, 110, 664, 677
 Cornick, N. A., 157
 Corona, L., TH210
 Corral-Flores, G., W111
 Correa, J. A., T104, 242
 Corredig, M., W74, 514
 Corrigan, B., T166
 Corriher, V. A., 600
 Corte, R. R. P. S., W256, TH280, TH281
 Côrtes, C., T208, T209, T210, T219, T220
 Cortina, A. R., TH148
 Cortina, R., TH276
 Corum, L., TH172
 Costa, C., W108, W109
 Costa, M., TH31
 Costa, P. B., T121
 Costa, R. G., T276
 Cotanch, K. W., W205, 343, 583
 Couldrey, C., 453
 Coupland, J., W68
 Courtney, C. H., 159
 Couto, V. R. M., T120
 Coverdale, J. A., TH97, TH98, 286, 287
 Cowieson, A., 190
 Cowles, K. E., T97
 Cox, B. G., T66
 Cox, R., W239
 Cox, R. B., TH125
 Craig, T. M., 758
 Crawford, H. M., TH110
 Crenshaw, J., TH8
 Crenshaw, M., 475
 Crenshaw, T. D., 197
 Crestani, M., T227
 Cromwell, G. L., T168, W117, TH16, TH125, 197, 298
 Cropper, S. L., TH22, TH30
 Crovetto, G. M., T82
 Crowe, T., 242
 Cruppe, L. H., W157
 Cruz, G. D., W22, 313
 Cruz-Diaz, S., T59
 Cruz-Guillen, D., W112
 Cruz-Vazquez, C., W57
 Cucki, T. de O., TH222
 Cuesta, P., W83
 Cueva, O., TH32
 Cufre de Lenardón, G., T286
 Cui, W., T279
 Culbertson, M., 532, 535
 Culham, A. B., 314
 Cummins, K. A., W149, TH133, TH134
 Cummins, L. J., 670
 Cunha, A. P., W158, W165
 Curbelo, J., T3, 573
 Curi, R. A., W53
 Curry, E., W302, TH167
 Cuteri, A., T4
 Cutler, E. A., TH114, 683
 Cutler, S. A., 157
 Cyriac, J., TH263, 60
 Czarniecki-Maulden, G., 415
 D
 da Cunha Leme, T. M., W25, W26
 da Gama, M. A. S., TH106
 da Silva, D. C., T219, T220
 da Silva, T. C. B., T122, W108, W109, W249, W250, W265, TH227
 Da Silva-Mariante, A., W57
 Dahl, G. E., TH110, 457
 Dahlen, C. R., W10, W166, W167, W260
 Dahlquist, J. M., 211
 Dai, Q. Z., W123
 Dailey, J. W., TH2, 374, 577, 578
 Dailey, R. A., TH172
 Dákay, I., W17
 Dal Zotto, R., 15, 616
 Dalton, J. C., W192
 D'Ambrosio, F., TH107
 Damodaran, S., 512
 Dana, G. R., TH16
 Danesh Mesgaran, M., T181, T204, T225, T233, T244, T245, W148, W225, W257, TH209, TH211, TH220, TH221, TH248, TH272
 Daniel, J. A., T287, 668
 Daniel, M. J., T124
 Danieli, P. P., W228
 Daniels, K., TH13
 Daniels, K. M., TH68, 54, 684
 Dann, H. M., W205, W207, TH4, 343, 583
 Dardenne, P., 612, 614
 Dare, A. L., W49, W194
 Darien, B. J., 52, 155
 DaSilva, L. O. C., W40
 Datta, J., 162
 Daubert, C. R., 20, 138
 Davidson, S., W222
 Davila El Rassi, G., T42
 Davis, B. L., TH171, 243, 244
 Davis, E., T164
 Davis, K. C., 628
 Davis, M., W101
 Davis, M. P., T177
 Davis, M. S., W246
 Davis, N. E., 100, 218
 Davis, S., 371
 Davis, T. A., 279
 Davis Rincker, L. E., 237
 Dawson, H. D., 696
 Dawson, K. A., TH259, TH260, TH261, TH266, 88
 Dawson, L. J., 345
 Day, M. L., TH278
 Dayton, W. R., TH76, TH77, TH78
 de Abreu, C. O., T83, T96
 de Albuquerque, L. G., T25
 de Almeida, G. D., T234
 de Bastos, J. P. S. T., W26
 De Beni Arrigoni, M., W25, W26
 de Faria, M. H., TH81
 de Godoy, M. R. C., W62, 174, 420
 De Hario, M., T86
 de la Chevrotière, C., TH14
 De La Llata, M., T162
 de Lange, C., 771
 de Lange, C. F. M., W135, 191
 de los Campos, G., 530, 625
 De Marchi, M., 15, 616
 de Mattos, J. F., TH44
 de Medeiros, S. R., TH253, 215
 de Melo, R. C. M., W208
 de Oliveira, B. M. L., W208
 de Oliveira, C. R., W25, W26
 de Oliveira, D. E., TH106, TH253
 de Oliveira, E. R., T83
 de Oliveira, H. N., T122, W41, W43, W53, W249, W250, W265, W272, W273, TH222, TH227
 de Oliveira, I. M., T120
 de Oliveira, L. A., T234
 de Oliveira, M. P., T122, W25
 De Oliveira Juchem, S., T263, W185, TH106
 de Ondarza, M. B., T88
 de Passillé, A. M., W193
 de Queiroz, A. C., T121, TH81
 de Resende, F. D., T121, TH81
 de Rodas, B., 359, 712
 De Roos, A. P. W., 409
 de Silva, T. C. B., TH222
 de Toledo Piza Roth, A. P., TH224
 de Toledo Piza Roth, M., TH224
 de Vega, A., T243
 De Vries, A., W187, W190, 8
 De Vries, L., TH115, 687
 Dean, D. W., 192
 Dean, M. M., 285
 DeAvila, D., W150
 Decandia, M., T246, 384
 Dechow, C. D., TH196, 172
 Declerck, J. C., 789
 DeDecker, A. E., 378
 Deeb, N., 406
 Deen, J., W295, W296, W297
 DeFrain, J. M., 102
 DeFreitas, J. A., W40
 Dehareng, F., 612
 Dehghan-Banadaky, M., T242, W200, TH217
 Deihl, H. A., T284
 Deiuiliis, J. A., TH59
 DeJarnette, J. M., W164, TH173, TH174, TH176, 603
 Dekel, I., TH179
 Dekkers, J. C. M., T35, 407, 521, 527
 DeLaney, D., 212
 deLange, C. F. M., 191
 Delgado, R., TH215
 Dell'Orto, V., T253, TH107, TH108
 Delmonte, P., T102
 Delmore, R. J., 458
 Demers Caron, V., TH273
 Demétrio, D. G. B., W157
 Deng, D., TH154
 Deng, L. F., TH70
 Denis, S., W119
 DePeters, E. J., T263, W173
 Der Bedrosian, M. C., T95, W204
 DeRouchey, J. M., T128, W132, TH124, TH132, TH145, 158, 195, 562, 697, 775, 777, 778, 786
 Desilva, U., W147
 DeSouza, J. C., W40
 Desrochers, A., TH239
 Detmann, E., T120, TH218
 Detweiler, G. D., T274

- Devant, M., TH208, TH213, TH232, 581
 Devillard, E., TH269
 Devillers, N., T104
 deVries, A., T67
 DeVries, T. J., W198, W201
 Dewey, C., 242
 DeWolfe, T., 155
 Dhali, A., TH178
 Dian, P. H. M., T118, T191
 Dias, B., 424
 Dias, Jr., G. S., W208, TH262
 Dias, R. S., T235
 Diaz, D. E., T69, T70
 Diaz, H. L., 334
 Diaz, T., 672
 Diaz-Muniz, I., 46
 Diaz-Solis, H., T84
 Dib, M. G., W43, W53
 DiCostanzo, A., W10, W25, W26, W166, W260, W272, W273
 Dierenfeld, E. S., 634
 Dietz, A., TH151
 Dijkstra, J., 189, 203, 308, 337, 591, 797
 Dikeman, C., 633
 Dikeman, C. L., 178
 Dikeman, M. E., T124, 804
 Dikmen, B. Y., 82
 Dikmen, S., 82, 84
 Dilling, S. C., 550
 Dillwith, J. W., 393
 DiLorenzo, N., W10, W25, W26, W260, W272, W273
 Dimauro, C., 117
 Ding, S. T., TH60
 Dingwell, R., T10
 Dingwell, R. T., 386
 Dinh, S., 89
 Dinsmore, P., 388
 Dirandeh, E., W151, W152
 Dissanayake, M., 511
 Dittmar, III, R. O., TH49, 74
 Divakala, K. C., TH133, TH134
 do Amaral, B. C., 323, 324, 457
 Doane, P., 739
 Doane, P. H., T240, 803
 Doepel, L., W202, 92
 Doherty, M., 741
 Dohme, F., TH242, 188
 Doig, M. J., TH79
 Donaghy, D. J., TH241
 Donaldson, S. C., T100, 653
 Dong, X. L., T2, T29, T171, T172, W90
 Dong, Z. Y., T231
 Donkin, S., TH13
 Donkin, S. S., TH3, TH66, TH67, 492
 Dorantes, E., W96
 Dorshorst, A. E., T85
 Dorton, K. L., 357, 742
 dos Santos, G. T., T220
 dos Santos, J. F., TH262
 Dosti, B., 538
 Doumit, M. E., 413
 Dove, C. R., T156, W139, 197, 702
 Dover, H., TH115, 687
 Dowler, L. E., TH87, TH96
 Doyle, S., 156
 Dozier, III, W., 292
 Drackley, J. K., T8, T178, T198, 609, 667
 Drake, M. A., T38, T41, T43, T46, T53, W71, TH19, TH20, 134
 Drake, S. L., T43
 Dray, S. M., TH207
 Drennan, M. J., W269
 Dreschel, N., TH91
 Drewnoski, M. E., 733
 Dritz, S. S., T128, W132, TH124, TH132, TH145, 158, 195, 562, 697, 775, 777, 778, 786
 Driver, J. D., W37, W38, W39
 Drouillard, J. S., T75, W270, 64, 214, 218, 338, 339, 344, 490, 737, 804
 Du, M., 277, 691
 Duarte Messana, J., TH231
 Dubois, S., T105
 Dubovi, E. J., 483
 Duckett, S., 599
 Duckett, S. K., TH43, TH71, TH72, 464, 465
 Ducrocq, L., TH269
 Duff, G. C., TH161, 373
 Duffield, T. F., 225, 248
 Duffy, P., 741
 Dumon, H., 176
 Dunne, C. P., 647
 Dunnington, E. A., 502, 504
 Dunsford, B., 175
 Dunshea, F. R., 670, 671, 744
 Dupas, M., TH126
 Durand, H., W294
 Durosoy, S., TH126
 Duske, K., T216, T217
 Dutra de Resende, F., TH224
 Duttlinger, A. W., W132, 786
 Dwivedi, C., 41
 Dye, T. K., 589
 Dyer, P., W174
 Dzakuma, J., 759
 Dzakuma, J. M., 758
- E**
- Ealy, A. D., W144, 470, 471
 Earley, B., W269, 156
 Earleywine, T. J., 667
 Easter, R. A., 299
 Eastridge, J., T125
 Eastridge, M. L., 736
 Ebert, R. A., T198
 Eckerle, G. J., TH80
 Eckert, C. E., 547
 Eckert, J. V., W102
 Edrington, T. S., T76, T256, 395
 Edwards, D. B., TH79, 413
 Edwards, J. L., 145
 Edwards, L. N., 357
 Edwards, M. S., 636
 Edwards, T. D., T196
 Eftekhari, M., T115, T116
 Eguchi, T., W205, 583
 Ehrhardt, R. M., T183, T184
 Eicher, S., T73, TH13
 Eicher, S. D., W11, W263, TH3, 655, 656, 751
 Einstein, M., W263
 Einstein, M. E., TH204
 Eisemann, J. H., TH131
 Eitenmiller, R. R., 513
 Eklund, M., 209
 El Faro, L., T25
 Elia, D., W228
 Eliardi, A., T53
 Elias, A. N., T175
 Elias-Iglesias, A., W112
 Elizondo-Salazar, J. A., T100, W1, W2, W3, W92, 118, 653
 El-Kadi, S. W., W253
 Elkins, D., 70
 Eller, W. S., TH86
 Ellersieck, M., T268, TH225
 Ellersieck, M. R., 717, 718
 Ellis, J. L., 308
 Ellis, R. L., W18
 Ellis, S., TH65, 599, 660
 Ellis, S. E., TH108
 Ellis, W. A., 179
 El-Mogazy, M., 26
 Elmore, J. B., T60, T61, W23
 Elmore, M. F., T60, T61, T62
 Elsasser, T. H., W9, 152
 El-Sayed, M., 26
 Ely, D. G., 351, 669
 Ely, L. O., T67, 330
 Elzo, M. A., T23, W34, W35, W37, W38, W39
 Emiola, I. A., T165
 Endres, M. I., W175, W180
 Engelsma, K. A., 355
 Engle, T. E., W21, W242, 100, 101, 213, 357
 Engle, T. L., 321
 English, C., 501
 Engstrom, M. E., 742
 Enns, R. M., 170, 357, 412, 746, 747, 748, 749, 750
 Epifani, G., T246
 Epstein, D. L., 360
 Erdman, R. A., T102, TH103, TH104, TH246, TH267, 119, 555, 678, 681
 Erez, B., T5
 Erickson, G. E., 219, 306, 729, 734, 790, 798, 802
 Ericsson, S., 759
 Ernst, C. W., 413
 Escobar-Ramirez, M. C., W78
 Esquivel-Vera, M., T59
 Esser, N. M., T85, TH237
 Estell, R. E., W93, W94
 Estienne, M. J., TH186, 353
 Estrada, A., W240, TH166
 Estrada S, G., W58, W59
 Estrada-Angulo, A., TH283
 Etherton, T., 274, 398
 Etherton, T. D., T189
 Etienne, M., TH168
 Etter, S., W192
 Euclides, V. P. B., TH46
 Eugène, M., T208, T209, T210
 Evans, A. C. O., W156
 Evans, E., 329
 Evans, H. L., T117, TH228
 Evans, J. P., W71, TH20
 Everard, C. D., T56
 Eversole, D. E., 502, 504
 Everts, R. E., T8, T178, TH104, 681, 683, 819
- F**
- Fachinello, M. R., TH106
 Faciola, A. P., T221
 Fadel, J. G., W173
 Faga, M., 241
 Fagan, C. C., T56
 Fahey, Jr., G., 175
 Fahey, Jr., G. C., W64
 Fajersson, P., TH101
 Faleiro, G., 756
 Fan, B., W300
 Fan, M. Z., W234, 662
 Fan, Y. C., T132
 Fandiño, I., W215
 Fandiño, J. I., 740
 Farhangfar, H., T13, T14, T15, T140, W28, W29, TH5, TH248
 Faria, M. H. de, T121
 Farias, R., TH48, TH50
 Farkye, N. Y., 140
 Farmer, C., TH109, TH168, 818
 Fatehi, F., W200, TH217
 Fathi Nasri, M. H., T13, W28, TH248
 Faucitano, L., T104, 242
 Faulkner, D. B., W20, 211, 278
 Fear, J. M., 82
 Fedkiv, O., TH61, TH62
 Fedler, C., T126
 Fekete, Z., W36
 Feldpausch, J. L., 549
 Felix, J. A., W259
 Fellner, V., W128
 Felton, E. E., TH172
 Felton, E. E. D., TH43
 Feng, J., T188, W141
 Feng, Q., T133
 Fenn, T. R., 547
 Feoli, C., 565, 693, 776, 779, 780
 Ferguson, C. E., TH169
 Ferguson, J., TH195
 Ferguson, J. D., 107, 116, 224, 793, 813
 Ferlay, A., T202, 328
 Fernandes, D., TH106
 Fernandes, H. J., T250, T251, W248
 Fernandez, S., W241
 Fernandez-Figares, I., T108, W136
 Fernando, R., 407
 Fernando, R. L., T35, 6, 521
 Ferrari, A., T224
 Ferraudo, A. S., TH47
 Ferraz Filho, P. B., W40
 Ferreira, A. C. D., T277
 Ferreira, E. M., T273, TH278, TH289, TH290, TH291, TH292
 Ferreira, J. F. S., T270
 Ferreira, R. M., W165, TH240
 Ferreira Marques, A., W150
 Ferreira Ribeiro, A., TH231
 Ferrell, C., 725, 795
 Ferrell, C. L., 311, 624, 724, 796
 Ferrer, A., TH208
 Ferret, A., W215, W271, 675, 738, 740, 756
 Ferroni, M., T227

- Feuerbach, C., 241
 Fiedler, S., 163
 Fields, S. D., 721
 Fievez, V., T238
 Fife, T., T86
 Figueiredo, L. A., TH82
 Fink, E., 351
 Fink, L., T159
 Finocchiaro, R., 619
 Fiorentini, G., T118, T243, W251
 Firkins, J. L., 334, 736
 Fisher, A. E., W18, TH40, TH41
 Fitzgeral, A. C., T189
 Fitzgerald, R., 361
 Fix, J. S., W290, W293, 650
 Fleenor, C. J., 434
 Fleet, J. C., 69
 Floeter, A., W243
 Flores, C., 105
 Flores, J. A., 714
 Flores-Mariñelarena, A., W111, W161
 Flowers, W. L., T290, T291
 Foda, M., 26
 Foegeding, E. A., T41, W68, TH19, TH20, 40, 137
 Fogleman, A. D., T289
 Foisnet, A., TH168
 Fokkink, W. B., 337
 Foley, P. A., W206
 Folger, J. K., W156
 Fonken, B. C. J., 337
 Fonseca, M. A., TH218
 Fontecha, J., W83
 Fontenot, J. P., TH43, 464, 465
 Forbes, T. D. A., W24, 74, 317
 Forbord, M. J., T68
 Ford, J. J., TH170
 Ford, L. A., TH58
 Ford, S. P., 472, 473, 474
 Fördös, A., W33
 Formigoni, A., T79, W210, W231
 Fornazier, R., TH106
 Forni, S., W41, 625
 Foroughi, A., 666
 Forrest, D. W., W24
 Forsberg, N. E., 250
 Forster, R. J., 39
 Fossa, M. V., W25, W26, W249, W250, W272, W273, TH227
 Fossler, C. P., 484
 Foster, J. L., W102, W196, 598
 Fowler, A. W., TH117
 Fox, D. G., 229, 309, 463
 Fox, J. T., T75
 France, J., T235, 308, 797
 Francesconi, A. H. D., T211
 Francis, C., 175
 François, O., T167
 Frank, J. W., T161, T162, 201, 787
 Frantz, N. Z., W62, 421
 Fraser, D., 519, 673
 Fredeen, A. H., 24
 Free, S. V., T60, T61, W23, 623
 Freeman, M., TH241
 Fregonesi, J., 153
 Freitas, J. A., TH247
 Freking, B. A., W150
 Freyer, G., T32
 Fricke, P. M., T228, W142, W191, TH240
- Friend, T. H., 85, 318, 752
 Friesen, K. G., W61, W62, 174
 Frigeri, M., T54
 Froetschel, M. A., 330
 Fucà, N., 540
 Fuentes, M. C., T238, T239
 Fuentes-Castro, P. I., 723
 Fuentes-Hernandez, V., 723
 Fuentetaja, A., T107, W292, 297
 Fuhrer, J., W98
 Fujishima, Y., W19
 Fulford, J. D., W247
 Fusaro, I., T79, W231
 Fusi, E., 810
 Fustini, M., W209, W210
 Fyock, T., T28, 482
- G**
- Gabriel, S. R., 294
 Gadberry, M. S., T64, 391
 Gado, H. M., 745
 Gagliostro, G. A., T202, T213, T214, W197, 328
 Gagnon, N., T219, T220
 Gahan, D. A., T150, W120
 Gaines, A. M., 774
 Galante, F., 810
 Galassi, G., T82
 Galetti, S., TH7
 Gallegos-Acevedo, M. A., W110
 Galligan, D. T., 116
 Gallo, L., 530
 Galmozzi, A., T227
 Galton, D. M., T101
 Galyean, M. L., TH226, 459, 608, 789
 Gamble, B., TH42
 Gandy, D. M., TH169
 Ganjam, V. K., 1
 Ganner, A., T159, 370
 García, A., W96
 García, A. D., 79
 García, F., W119
 García, M. A., 658
 García, M. D., T186, W54
 García, N., W174
 García, R., W191, W235
 García-Flores, E. O., W230, W255
 García-Galindo, H. S., T59
 García-Gonzalez, R., TH266
 García-Peniche, T. B., 764
 Garciaarena, A. D., W268
 Garciaarena, D., T202
 Garciaarena, D. A., T213, T214, W197, 328
 Garci-Nevarez, H., W110
 Gardner, I. A., 482
 Garey, S. M., 85
 Garner, J., 387
 Garner, J. P., 379, 381, 382
 Garrett, J. G., TH270
 Garrick, D., 5
 Garrick, D. J., 629
 Garverick, H. A., W143
 Garvey, J. R., TH2
 Garzella, G., T54
 Gasa, J., T141, W119, W281, W282, TH152, 205, 675
 Gaskin, J. M., 159
- Gaskins, C., T28
 Gaspa, G., 617
 Gastaldello, Jr., A. L., TH288, TH293
 Gath, V., 741
 Gatnau, R., W133
 Gatti, P., T202
 Gaughan, J. B., 753
 Gauthier, H. M., W205
 Gaxiola, C. S. M., W58, W59
 Gaxiola, M. J., W58, W59
 Gaygadzhiev, Z., 514
 Gazzaneo, M. C., 279
 Geary, T. W., W170
 Gehman, A. M., 233, 579, 582, 590
 Gelaye, S., TH277
 Gen, M. M., TH158
 Geng, M. M., TH156, TH157, TH160, 781
 Gengler, N., TH92, 522, 523, 612, 613, 614, 621
 Gentès, M.-C., 516
 Gentil, R. S., T273, TH278, TH288, TH289, TH290, TH291, TH292, TH293
 Geor, R. J., 442
 George, J., TH111
 George, L. A., 473
 Geraci, J. I., W268
 Geraert, P. A., TH269
 Gerard, P. D., T43
 Gerdes, R., W66
 Gerrits, W. J. J., 203, 337
 Getachew, G., W185
 Getz, W., 759
 Getz, W. R., TH277
 Ghilichkhan, M., T190
 Ghorbani, G. R., T201, 91, 584
 Ghoshal, K., 162
 Gianola, D., T35, 408, 530, 625
 Gibb, D., 728
 Gibson, M. L., T266, 214, 233, 582, 804
 Giesy, R., T67
 Gigante, M., TH31
 Giger-Reverdin, S., 812
 Giguère, A., TH119, 200
 Gilani, S., TH109
 Gilaverte, S., TH290
 Gill, B., TH88, TH89, TH90
 Gill, R. J., 458
 Gill, W. W., W18
 Gilliam, J. N., 393
 Gilliland, S. E., W83
 Giordano, J. O., W158
 Giovanetti, V., 384
 Giovanni, G., W174
 Gipson, T. A., T274, T282, 345, 347
 Girard, C. L., TH235, TH239, TH244
 Girardi, M., TH106
 Glaze, B., W163
 Glennon, H. M., T284
 Glimp, H., T63
 Glimp, H. A., 230
 Glover, K., 24
 Goad, C. L., 393
 Godbee, R. G., 52, 155, 779, 780
 Goddard, M., 260
 Goddard, M. E., 409
- Godden, S., T10
 Godden, S. M., 248
 Godfrey, R. W., 320
 Godio, L., T286
 Godsey, C. M., 729
 Goesser, J. P., W95, TH53, TH54, TH55, TH56
 Goetsch, A. L., T269, T274, T282, 345
 Gokavi, S., TH26
 Goksu, S., W212
 Golden, B. L., W89
 Goldhamer, D. J., 122
 Goldhawk, C., W193
 Golding, M., 646
 Goll, D. E., 557
 Golombeski, G., TH188, TH189, TH190, TH191, TH192, TH193, TH194
 Gomes, H. F. B., W15, W16
 Gomes, R. C., T119, TH214
 Gomez, R. A., 461
 Gomez, R. R., W275
 Gómez de Segura, A., W281, W282
 Gomez-Raya, L., T63, 372, 411, 536
 Gondo, A., W40, W46
 Gonyou, H., T104, 242
 Gonzaga Neto, S., T276
 González, F., W96
 González, I. J., TH101
 Gonzalez, L., W271, 738
 González, L. A., 756
 Gonzalez, R. N., 249
 González-Córdova, A. F., W79
 González-García, E., TH14, TH215
 Gonzalez-Muñoz, S. S., T241, W244
 Gonzalez-Valero, L., T108, W136
 Goodband, R. D., T128, W132, TH124, TH132, TH145, 158, 195, 562, 697, 775, 777, 778, 786
 Goodell, G., 604
 Gooden, M. C., T271
 Goodling, R. C., TH196
 Goodman, M. S., T275
 Goodson, J., 657
 Gooraninejad, S., W151
 Gorvanahally, M. P., 714
 Gourley, G., 708
 Govindasamy-Lucey, S., 42, 538
 Gozho, G. N., T200, T226, W100
 Graeff, A., TH88, TH89
 Gragson, D., W87
 Gramm, B. R., T136, T158
 Grant, R. J., W205, TH4, 343, 583
 Grant, W. E., T84
 Grasso, L., T54
 Graugnard, D. E., TH114, 278, 606, 609, 683
 Graves, A. K., 709
 Graves, T. K., 177
 Gray, A. W., 655, 656
 Gray, J. T., 380
 Green, H. B., W223
 Green, R. D., 400, 627
 Green, S., W56
 Greene, E. A., 430
 Greene, W. A., W159
 Greenwood, S., 76
 Gregorini, P., 435
 Gressley, T. F., T7, 160

- Greter, A. M., W201
Griffin, D. B., 458
Griffiths, M. W., 264
Grigera, J., 486
Grigsby, K. N., 53
Grilli, E., T137, T155
Grinstead, G., T166
Griswold, K., TH202, 89
Grossman-Garber, D., 501
Grosz, M. D., 412
Grott, M. W., TH204
Grubb, P. T., 321
Grubbs, J. K., W23, 623
Grummer, R. R., T262, W218, TH234, TH244
Gu, W. T., W140, TH155, TH157, TH158, 781
Guan, L. L., 55, 788
Guardiano, C., 813
Guay, F., TH119
Gubbiotti, A., T223
Gomez, H. R., TH147, TH148
Guenther, J. N., W158
Guerini, M., T4
Guerra-Medina, E. C., W230, W255
Gugle, T. L., 565, 693, 776
Guimaraes, G., TH247
Guinee, T. P., 644
Gül, S., W67
Gulay, M. S., T174, T179, T180, W169, TH116, 456
Guler, Z., W67, 517
Gunn, D., W163
Gunn, P. J., TH282
Gunter, S., TH38, 95, 96
Gunter, S. A., 491
Guo, J., W141, TH153
Guo, M., W70, TH26
Guo, T. J., TH206
Guo, Y. Q., 342
Gurakan, G. C., W80
Gurung, N., T278
Gurung, N. K., T275
Gutierrez, B. T., T293
Gutierrez, K. A., T173
Gutiérrez-Méndez, N., W79
Gutiérrez-Ornelas, E., W104, W105, TH294, 440
Gutiérrez-Piñ, F. J., W110
Gwazdauskas, F. C., T188, TH178, TH180
- H**
- Ha, H. J., TH21
Haan, M., TH35, TH36, 436, 437
Habier, D., 521
Hackbart, K. S., TH240
Hackmann, T., 57
Hada, M., W19
Haddock, K. L., W12
Haden, J. K., 718
Hadlich, J. C., W25, W26
Hadsell, D. L., TH111
Hahn, J. D., TH124
Haines, R. M., 110
Halas, V., 704
Halbach, T. J., 766
Hale, D. S., 458
Hales, K. E., TH226, 789
Hall, K. E., 603
Hall, K. G., 765
Hallada, C. M., T87, T91
Hallford, D. M., T186, W93, W94
Hamernik, D., 432
Hamlin-Andrus, C., 179
Hammer, C. J., TH97, TH98, 286, 287
Hammon, H. M., T216, T217, W243
Han, H., W21, W242
Han, X., W70
Han, Y., 694
Han, Y. K., T152, TH123,
Hancock, J. D., T144, T145, T151, W137, TH122, TH143, 565, 693, 776, 779, 780
Hand, K., 9, 12
Hanigan, M. D., T66, TH68, TH263, 60
Hansen, G. R., W37, W38, W39
Hansen, L. B., 762, 763
Hansen, P. J., TH162, TH177, TH182, TH183, 82, 84, 302
Hansen, S. A., T161, T162
Hansen, S. L., 67, 99
Hardin, L., T80
Harmon, B. G., 773
Harmon, D. L., W61, W62, W253, TH75, TH79, TH266, 174, 420, 665, 730
Harmon, J., 322
Harmon, S. E., TH84
Harner, J. P., 80, 81
Harp, R., T280
Harper, A. F., TH186, 353
Harper, J., 48
Harper, W. J., T53, T57, TH22, TH30
Harrell, R. J., TH131, 193, 469, 699, 706, 708
Harris, P., 807
Harrison, G. A., TH259, TH260, TH261, TH266
Harrison, J., 106
Harrison, V., W82
Hart, K., T194, W227
Hart, S. P., T269, T270, 345
Hartnell, G. F., TH16
Hartzell, J. A., TH254
Harvatine, K. J., 680, 682
Harvey, E. L., TH34
Hassan, A., 26
Hassan, A. N., 21, 41, 47
Hassan, M., 745
Hathaway, M. R., TH76, TH77, TH78
Haung, Y., T143, W137
Hausman, G. J., T187
Hayashi, M., W264
Hayen, J., 457
Hayen, M. J., TH116, 456
Hayes, B., 260
Hayes, B. J., 409
Hayes, S., TH99, TH188, TH189, TH194
Hazel, A. R., 762, 763
He, M., T203
He, M. L., W217, W254
He, Q. H., W288
He, W., T35
He, Y. X., W280
Head, H. H., TH116, 456
Heck, J. M. L., 611, 615
Heguy, J. M., T263
Heidenreich, J. M., 338, 339, 344
Heimbeck, W. H., TH255
Heinrichs, A. J., T100, T236, T264, W1, W2, W3, W209, W210, TH256, 118, 217, 653
Heins, B. J., 762, 763
Helves, E. B., TH69
Henderson, L., W14
Hendricks, K. E. M., TH177
Hengemuehle, S., W177
Heng-Jin, W., 103
Hennessy, A. A., TH230
Henning, P. H., 338, 339
Henning, W. R., 458, 463
Henrique, D. S., TH81
Heravi Moussavi, A., T181, T204, T225, T244, W148, W257, TH211, TH220, TH221, TH272
Herd, R. M., 770
Herfel, T., W130
Herman-Lara, E., T59
Hermes, R. G., W281, W282, TH152, 205
Hermesch, S., 536
Hernandez, C., W247, TH223
Hernández, J., W96
Hernandez, K., W247
Hernandez, L., 451
Hernandez, L. L., 88
Hernandez, M., T138
Hernandez, P., TH276
Hernández-Aguilar, J. A., W104, W105
Hernández-Gómez, C., W111, W113
Hernot, D., 175
Hernot, D. C., W64
Heron, V. S., 794
Herrera, R. S., 440
Herrera-Torres, E., W106, TH51
Herrero, M., 658
Herring, A. D., W27
Herring, W. O., 35, 532, 535
Herringshaw, S., TH28
Herrmann-Hoesing, L. M., 348
Hershey, M. R., W164
Hersom, M., 439
Hess, B. W., 228, 332, 491
Hess, H. D., TH242
Hess, T., 597
Hesselbrock, K., TH150
Heyler, K. S., TH254
Hibbard, G., W61
Hickman, H. J., T289
Hicks, C. L., W76
Hicks, M. S., 487
Hidaka, S., W19
Higginbotham, G. E., W6
Higgins, J. J., T123, T124, W270, 338, 339, 344
Higginson, J., 380
High, J., TH202, 89
Highstreet, A., TH270
Hill, A., W74, 514
Hill, G. M., 66, 195, 314, 508, 545
Hill, G. M., 600, 800
Hill, G. W., 319
Hill, H., 241
Hill, S. R., 684
Hill, T. M., 216, 221
Hill, W. J., W274
Hines, S., T86
Hinson, R. B., 711, 774
Hintz, H., 441
Hippen, A. R., 56, 331, 585
Hittle, M., W23
Hittle, M. S., 623
Ho, C. S., 411
Ho, M. K., W174
Hoagland, T. A., W199
Hobin, M. R., T200
Hodate, K., W264
Hoffman, P., TH197
Hoffman, P. C., T85, TH53, TH54, TH55, TH56, TH237, 601, 766
Hofherr, M. W., T93, T95
Hofstetter, U., W7
Hogberg, M. G., 165
Hoge, M. D., 531
Hogeveen, H., 655, 656
Hohenboken, W., 622
Holcombe, S. J., 288, 289
Holden, L., 315
Holick, M. F., 179
Holl, J. W., W51
Holland, B. P., W4, 390, 393
Holligan, S., W234
Holliman, J. L., TH45
Hollmann, M., 327
Holmer, S. F., 295
Holt, J. P., 709
Holt, M. G., T168
Holt, R., T135
Holt, W., 359
Holtrop, G., TH250
Holub, G. A., W27, 132
Hommel, J. W., W20, 218
Honeyman, M., 292, 322, 754
Hong, E. K., T47
Hong, J. W., T148
Hong, X., 163
Hong, Y. K., T157
Hooda, S., 710
Hopkins, B. A., W222
Horigan, K. C., 685
Horn, G. W., 272
Horn, T. M., T66
Horne, D. S., 515
Horne, W. J., W27
Horseman, N., 451
Horvath, M. B., T252, 336
Hosseini, A., 71
Hosseini, F., T181
Hosseini, M. E., W29
Hou, Y. Q., TH160
House, B., 315
Hovey, R. C., 685
Hoving, E., T28
Hovingh, E., 247
Howard, A. N., 58
Howard, J., 238
Hristov, A. N., T221, 307, 341, 592
Hu, Q., TH130
Hu, W., T92, T93, T95, W204, W226
Hu, Z. Y., T205, T206
Huang, C., 17, 18
Huang, M. C., W301
Huang, R., W123, W124, TH154

- Huang, R. L., W140, W288, TH130, TH155, TH156, TH159, TH160
Huang, T. H., W301
Huang, Y., T144, T145, T146, T151, T152, T153, T154, TH123, TH143
Hubbard, K. J., 233
Hubbard, S. M., T18
Hubbell, III, D., 597
Huber, K., W243
Hudson, B. P., TH108
Hueston, W. D., 268
Huff-Lonergan, E., T126, 290, 293, 558, 689, 690
Huffman, R. D., 692
Hughes, A., 439
Huhtanen, P., T265, 592, 816
Huisden, C. M., 159
Hulbert, L. E., 374, 577
Hulbert, L. H., 578
Hulland, C., T74
Hume, M., T138
Hume, M. E., W247, TH223
Humphreys, A., 694
Hung, I. F., T168
Hunt, A. S., W65
Hunt, M. C., T123, T124
Huo, X. K., TH206
Hurley, W. L., TH114, 683, 819
Husband, T. P., 501
Hussein, H., T78
Huston, C., 389
Hutchens, T., W239
Hutcheson, J. P., 460
Hutchison, C. F., 58
Hutchison, J. L., T17, T20
Hutjens, M., 429
Hviid, M. S., 560
Hwang, I. W., T147
Hwang, O. H., TH135
Hymoeller, L., TH238
Hyun, Y., T146, T147, T151
- I**
Iager, M. E., T5
Ibáñez-Escriche, N., W52
Ibrahim, S., W69
Ibrahim, S. A., W82, TH23
Ilieji, K. E., 657
Impoco, G., T55
Ing, N. H., T173
Ingham, S. C., 45
Inskeep, K., 714
Invernizzi, G., T227
Inyang, U., TH48, TH50
Ipharragerre, I., T134
Ireland, J. J., W156
Irvine, L., TH241
Ishler, V. A., T196, TH254
Israelson, C., T70
Issa, S., 565, 776
Ivan-Dinh, S. K., TH252
Iwaasa, A. D., T208, T209, T210
Iwazaki, M., 205
- J**
Jacela, J. Y., TH145, 158, 562
Jackson, K. A., 236
Jacob, M. E., T75
Jacobi, S., W130
Jaeger, J. R., T123, W44, W270, 392
Jaeggi, J., 538
Jaguelin, Y., 701
Jahani-Azizabadi, H., T233, W225
Jahani-Azizabadi, H. H., TH209
Jahani-Moghadam, M., TH251
Jalukar, S., 371
James, R. E., T66, 54, 684
Jamison, W., 258
Jamrozik, J., 9, 12
Jang, H. D., T144, T147, T148, T152, TH122
Januskiewicz, E. R., TH37, 438
Jaramillo, D. P., 821
Jardina, D. T. G., TH185
Jarrett, J., TH127, 199, 712
Jarto, I., TH33, 512
Jaster, E., 128
Javed, A., 731
Jayarao, B. M., T100, W3, 653
Jedrzejewski, E., TH91
Jenkins, K. H., 732
Jenkins, T., W182
Jenkins, T. C., T249
Jenkins, T. G., 624
Jennings, J., 597
Jennings, J. A., T64
Jennings, J. S., 668
Jensen, S. K., T193, TH238, 109
Jeong, Y. K., T148
Jergenson, C., TH187
Jesse, G. W., 503
Jeved, A., 98
Jeyapalan, A. S., 279
Jezierny, D., 209
Ji, S. Y., TH121
Jia, L., TH233
Jia, X. H., T130, W129, TH120
Jiang, H., T188, 502, 686
Jiang, J., 482
Jiménez-Castro, J., W110
Jiménez-Flores, R., W86, W87, W88, TH31, 238, 641
Jimenez-Krassel, F., W156
Jiménez-Maroto, L. A., T39
Jin, C., TH195
Jin, M., T160
Jin, Z., TH153
Jing, L. Z., T132, T133, W48, W134
Johnson, A., 241, 322, 359, 361, 534, 754
Johnson, A. K., TH2, 240, 379, 381
Johnson, B. J., TH73, TH76, TH77, TH78, 459, 460
Johnson, B. M., 758
Johnson, C. L., W168
Johnson, C. R., W192
Johnson, C. S., 50
Johnson, D. D., W37, W38, W39, 458
Johnson, D. G., T68, W175, W180, TH187, 762, 763
Johnson, H. A., W173
Johnson, K., W261, 341, 520
Johnson, K. A., 304
Johnson, M., 141, 538
Johnson, M. E., 42
Johnson, P. J., 1
Johnson, R., 418
Johnson, R. C., 62
Johnson, R. K., 533
Johnson, R. W., T163, 368
Johnson, S. E., 470
Johnson, T. R., 657
Johnson, Z. B., T161, T162, 201, 787
Johnston, S. L., T162
Jokela, W. E., T77
Jones, B., 675
Jones, C., 391
Jones, D., 38
Jones, L., 226
Jordan, K. M., 497
Jorge, A. M., W15, W16
Jørgensen, L., T155
Ju, W. S., T157, W121, W122
Juarez, M., W83
Juárez-Reyes, A., TH51
Juárez-Reyes, A. S., W104, W105, W106, W238, W258, 440, 495
Julka, A., W286
Jung, H. G., 182
Jung, H. J., TH121, TH142
Jung, S., TH181
Junghans, P., W243, TH249
Justolin, P. L. T., TH185
- K**
Kachman, S. D., 7, 533
Kadegowda, A. K. G., T102, TH103, TH104, 119, 555, 678, 681
Kahl, S., W9
Kai, P., W128
Kailasapathy, K., 426
Kalbe, C., TH63, T176
Kale, M., T174
Kallenbach, R. L., 97
Kalscheur, K. F., 21, 47, 56, 331, 585
Kamalakar, R. B., TH133, TH134
Kamanga-Sollo, E., TH76, TH78
Kandasamy, S., W12
Kang, D.-K., T139
Kang, P., TH130
Kang, T., 159, 598
Kang, T. W., W196
Kannan, G., T285
Karcher, E. L., 50, 154
Karges, K., T266, 233, 582
Karges, K. K., 214, 804
Karimi Torshizi, M. A., T140
Karns, J., T28
Karreman, H., TH202, 89
Karren, B. J., TH97, TH98, 286, 287
Karriker, L., 359, 534
Kaskous, S., TH113
Kattesh, H. G., 245
Kawachi, H., 63
Kawai, Y., 22
Kawashima, C., T185
Kay, J., 73, 454
Kazama, R., T219, T220
Keane, G. P., T247
Kebe, S., T283
Kebreab, E., T235, 304, 308, 797
Keel, T. L., 177
Keeling, L. J., 676
Keeton, J. T., T127
Kegley, E. B., T64, 391
Keisler, D. H., T186, 237, 668
Keli, A., T243
Kelley, K. W., T163, 368
Kelly, A., 643
Kelly, A. L., 644
Kelly, D., 785
Kelly, D. T., 312
Kelly, M. J., 404, 410
Kelly, P. M., 644
Kelton, D., W14, 386
Kelzer, J. M., 582
Kenny, D. A., T247, W206, W269, TH230
Kensinger, R. S., 235, 435, 552
Kentish, S., 646
Kerley, M., TH225
Kerley, M. S., T117, T177, T237, TH228, 97
Kerr, B., 292
Kerr, B. J., TH128, 784
Kerr, D. E., W12, W13
Kerth, C. R., TH42
Kertz, A., 602
Keskin, M., W67
Ketchen, D. J., 463
Ketting, R. C., 320
Ketterings, Q., W101
Khadem, A., T192
Khalilvandi, H., T242, TH286, TH287
Khatib, H., T12, 365
Khazanehei, H. R., T242
Khorvash, M., 91
Kiarie, E., 695
Kido, K., W264
Kiess, A., T73
Killefer, J., 294, 295
Killion, A., T80
Kim, B. G., T136, T168
Kim, B. W., W220, W229, TH153
Kim, D. H., T157
Kim, D. W., TH135
Kim, H. J., T143, T145, T146, T151, T152, T153, T154, W137, TH123
Kim, H. S., T146, T147, T151
Kim, H. Y., W174
Kim, I. C., T143, TH121
Kim, I. H., T142, T143, T144, T145, T146, T147, T148, T151, T152, T153, T154, W137, TH121, TH122, TH123, TH140, TH141, TH142, TH143, TH144
Kim, J. D., T143, T148, TH140, TH141, TH142, TH143
Kim, J. G., W284, W285
Kim, J. P., W283, W284, W285
Kim, K. G., W283
Kim, K. H., W283, W284, W285, TH58
Kim, M. J., T139
Kim, N. S., W42
Kim, S. C., W196, 598
Kim, S.-D., W47
Kim, S. H., T48, W72, W73, W283, W284, W285
Kim, S. W., 196, 197, 202, 369, 705
Kim, S. Y., T47
Kim, W. T., W137
Kim, Y. H., T127, TH121

- Kim, Y. Y., T157, W121, W122
Kincaid, R., W261, 106
Kindstedt, P. S., T51
King, R. H., 791, 792
Kiran, D., T226
Kirchoff, V., 411
Kirkden, R. D., 379
Kirkpatrick, D., 651
Kirovski, D., 60
Kistemaker, G., 16
Kitazawa, H., 22, 610
Kitts, S. E., W253
Kivipelto, J., 447, 448
Klaenhammer, T. R., 427
Klasing, K. C., T135, TH16
Klein, C. M., T249
Kleinschmit, D., 38
Kleinschmit, D. H., T98
Klimitsch, A., T89, T94
Klingerman, C. M., T92, W204
Klopfenstein, T. J., 219, 306, 729, 790, 798, 802
Klopfenstein, T. K., 734
Klotz, J. L., 2, 3
Klusmeyer, T. D., T189
Knapp, J. R., 334
Knight, C. D., 193, 706
Knight, J. W., 497, 567
Knol, E. F., 355, 529
Knott, S. A., 670
Knowlton, K. F., T66, TH263, 234, 684
Knox, R., 570
Knox, R. V., 571
Kocaoglu-Vurma, N., TH28
Kocaoglu-Vurma, N. A., T53, TH22, TH30
Koch, K. B., T228
Koehler, D., T166
Koehler, R., T294
Koenig, K. M., TH243
Koers, W. C., W246
Kohn, K., 696
Kohn, R. A., TH246, TH252
Kohram, H., W151, W152
Kojima, C. J., 245
Koknaroglu, H., TH197
Koks, P. D., 611
Kolbehdari, D., 410
Kolver, E., 454
Komlósi, I., W36
Kong, X. F., W125, W140, W287, W288, W289, TH130, TH155, TH159
Kononoff, P. J., T65, T266, 233, 579, 582, 590
Koohmaraie, M., W54, 311
Koonawootrittriron, S., T23, W34, W35
Koons, A. J., 112
Koontz, A. F., W253
Kopral, C. A., 87, 319, 481, 483
Korn, N., TH65, 660
Korneli, C., 568
Korthaus, F. F., W253, 730
Koser, S. L., TH66, TH67
Kosiorowska, A., T193
Kothari, K., 644
Kouakou, B., T285
Koutsos, E. A., 635
Kovar, J., TH36
Kowsar, R., 91
Krall, J. M., 332
Krause, D. O., 695, 772
Krause, K. M., 478
Krawczel, P. D., W205, TH4, 583
Krebs, N., TH2
Krehbiel, C. R., W4, W147, 390, 393, 489
Kreider, D., 597
Kreikemeier, K. K., 730
Kremer, P. V., 352
Kress, D. D., 628
Kreuzer, M., 188
Kriese-Anderson, L. A., T60, T61, T62, W23, 623
Kris-Etherton, P. M., T189
Kristensen, N. B., T193, T259, T260, T261, TH257
Kristula, M. A., 251
Kroismayr, A., 356
Kron, M. B., 232
Kronberg, S. L., 325
Krueger, N., T76
Krueger, N. A., T256, W275
Krueger, W. K., W275
Kuchida, K., W19
Kuhla, S., W243
Kuhlman, G., 419
Kühn, I., T137, W114, W115
Kuhn, M. T., T18, T20, T21
Kumar, H. A., 541
Kung, Jr., L., T91, T92, T93, T95, W204, W226
Kurtyka, L. K., TH16
Kutay, H., 162
Kutz, R., W213
Kutzler, L. W., 295
Kwak, H. S., T47, T48, W72, W73, TH21
Kwoczak, R., T49
Kwon, I. K., T129
- L**
La O-Leon, O., W112
La Terra, F., 187, 326, 815
La Terra, S., 326, 539, 540
Laansma, D., TH176
Laborde, J. M., 58
Lacasse, P., 452, 455
Lacetera, N., T4, W8, TH164, 246
Lacey, J. L., 213
Lachica, M., T108
Lachmann, M., TH127, 199, 712
Lacy, M. P., 166
Laforest, J.-P., T104
Lago, A., T10
LaGrange, W. S., 19
Laird, S., T3, 573
Lake, S. L., W263, TH282, 434, 491
Lalman, D. L., 589
Lamb, G. C., W166, W167, 376
Lamberson, W. R., W40
Lambert, B. D., T280, T295, W103
Lambert, G. P., 594
Lametsch, R., 290, 560
Lammers, P., 292, 322, 754
Lampe, J., 534, 708
Lamprecht, E. D., TH95, 446
Lana, R. P., TH247
Lancaster, P. A., W24, W276, 212
Landrito, E., T34
Lane, C., 432
Lane, Jr., C. D., W18, TH41,
Langhof, A. K., T216, T217
Langoni, H., T9
Lanka, E., 38
Lanna, D. P. D., W256, TH253, 215
LaNoce, A. J., TH163
Lantinga, E. A., 189
Lapierre, H., T229, TH239, TH249, TH250, 185, 186
Lardy, G., 432
Lardy, G. P., T228, 726
Lares, S. F., 721
Larraín, R. E., 462
Larry, L. K., 239
Larsen, M., T259, T260, TH257
Larson, C. K., 100
Larson, R., TH188, TH189, TH190, TH191, TH192, TH193, TH194
Larson, R. L., 392
Lascano, G. J., T264, TH256
Latorre, M. A., T106, T114, TH138, 354
Latour, M., TH150, 505, 785
Latshaw, J. D., T36, TH59
Latshaw, M., W13
Laubach, M. S., TH117
Laubscher, A., W88
Lauderdale, J. W., 167, 713
Laudert, S. B., 734, 735
Laurenz, J. C., T173, 152
Lauridsen, C., 468
Laven, R., 220, 485
Lawler, R. C., T275
Lawlor, T. J., 17, 18
Lawrence, B. V., 193, 699, 706, 708
Lawrence, J., 151
Lawrence, L. M., TH9, TH11, TH99
Lawrence, T. E., 458
Lay, D., T3
Lay, Jr., D. C., TH1, 381
Layman, L., 359
Lázaro, R., T107, W118, TH138, 206, 297
Lazcano, R., TH210
Lazenby, D., 9
Le Dividich, J., TH168
le Treut, Y., W294
Lean, I. J., 225, 742, 791, 792
Leão, M. I., W235, TH247
LeBlanc, S. J., 248, 386, 716
Ledoux, D., W213
Lee, A. E., W103
Lee, B. S., TH135
Lee, C. Y., T142, T154, W137
Lee, J., T285
Lee, J. H., W121, TH122, TH135, TH140, TH141
Lee, J. J., W42
Lee, K., T36, TH59
Lee, M. S., T112, T113
Lee, S., T48
Lee, S. H., T129
Lee, S. J., TH121
Leeds, T. D., 348, 349, 350
LeFloch, N., 200
Legan, B., 785
Lehrer, H., TH179
Lei, X. G., TH129, 198, 303, 696
Leibetseder, J., 356
Leibovich, J., TH226
Leigh, A. O., W49, W194
Leitman, N. R., 652, 717, 718, 722
Lema, M., T283
Leme, P. R., T119, W256, TH214, TH280, TH281
Lemenager, R., W263
Lemenager, R. P., TH282, 434
LeMieux, F. M., TH169
Lemley, C. O., 478
Lemor, A., 71, 72
Lemus-Flores, C., W57
Lengi, A. J., W55, 664
Lengyel, Z., W36
Lenin, J., W252
Lenz, R. W., TH173
Leon, F., W259
Leonardi, C., 58
Lescun, T. B., TH93
Leslie, K., T10, W14, 387
Leslie, K. E., 248, 386, 716
Lessard, P., 694
Lethbridge, L. A., 485
Leuer, R. F., W1, W2, W3
Leung, M. C. K., W60
Leupp, J. L., 726
Leury, B. J., 670, 671, 744
Levario, M. A., TH275
Lévesque-Sergerie, J.-P., T33
Levine, M. J., TH16
Lewin, H. A., T8, T178, TH104, 528, 681, 819
Lewis, A. J., TH16
Lewis, A. W., 316, 317, 477
Lewis, G. S., 349, 350
Lewis, N., 242
Lewis, R. M., 170
Li, C. Y., 291, 358
Li, D., T205, T206
Li, F. D., TH206
Li, J., W74
Li, J. G., TH129, 198
Li, L., TH263
Li, Q. Z., 276
Li, S., W181
Li, T., W123, W124, TH154
Li, T. J., W140, TH130, TH156, TH157, TH158, TH159, TH160, 781
Li, W. T., 342
Li, Z., 662
Liang, S., T215, T255, W277, W278, W279, TH219
Liao, S. F., TH74, TH75, 76, 665, 669
Licitra, G., T55, 187, 326, 539, 540, 813, 815
Liesegang, A., TH242
Liesman, J., TH115, 288, 289, 687
Liesman, J. S., TH255
Ligon, J., TH263
Lim, S., TH59
Lim, S. J., T139
Lim, S.-Y., 649
Lima, F. S., W219
Lima, G. J. M. M., 194
Lima, J. C. M., T250, T251

- Lima, J. R., W188
Lima, L., W189
Lin, G. Z., W229
Lin, J. C., W98, TH42, TH45
Lin, R. S., W301
Lin, X., W130
Lindemann, M. D., T168, W117, TH125, 197
Linford, R. L., 548
Link, J. E., 66, 508
Linn, J., TH188, TH189, TH190, TH191, TH192, TH194
Linn, J. G., 79, 762, 763
Lippolis, J. D., 605
Little, D. E., TH145, 56, 562
Liu, G. L., T2, T29, T130, T171, T172, W48, W90, W134, TH120
Liu, H. J., W289
Liu, J. X., 291, 335, 342, 358
Liu, K. J., 177, 178
Liu, K. L., T2, T29, T171, T172, T230, T231, T232, T255, W90, W224, W278, W279, W280, TH70, TH219
Liu, L., T215, T232, T255, W224, W277, W278, W279, TH219
Liu, S. J., T207, T215, T232, T255, W224, W278, W279, W280, TH219, TH236
Liu, S. L., W277
Liu, T. L., W140
Liu, W.-S., T34
Liu, X., 649
Liu, Y., TH129, 198
Liu, Y.-L., TH155
Liu, Z., W85, TH130, TH154
Liu, Z. Q., W125, W140, TH155, TH159
Lo, L. L., W301
Lobley, G. E., TH250
Lobo, R. B., W41, W45
Lock, A. L., W207, 640
Lockee, B. B., 170
Lodge-Ivey, S. L., T252, 336
Loera-Corral, O., T241, W244
Loerch, S. C., TH284, TH285
Loesel, D., T176, TH63
Loetz, E., T269
Lohuis, M. M., 173
Lollivier, V., 455
Lombard, J. E., 87, 319, 481, 483, 484
Loneragan, G. H., 747, 748, 749, 750
Loneran, G. H., 746
Lonergan, P., W156, TH230
Lonergan, S., 292, 322, 558, 690, 754
Lonergan, S. M., T126, 157, 290, 293, 689
Long, C. R., 316
Long, F. Y., T133, W129
Long, H. F., W121, W122
Long, M. R., 118
Long, N., 408
Long, N. M., W146, W147
Long, T., 532, 535
Longuski, R. A., 580
Looper, M., 597
Looper, M. L., TH12
Loor, J., T205, T279
Loor, J. J., T8, T102, T178, T218, TH103, TH104, TH114, 278, 553, 555, 606, 609, 678, 679, 681, 683, 819
Lopes, F., W208
Lopes, J. C., T103
Lopes, N. M., TH262
Lopes, W. C., TH247
López, C., T243
López, D., W96, W97
Lopez, E. J., TH283
Lopez, M., 707
López, V. M., W58, W59
López-Hernández, A., T39
Lord, L. E., 120
Lott, W. M., TH178, TH180
Lovett, D. K., W206
Lowe, G. D., TH284, TH285
Loy, D. D., 147
Loyd, A. N., 316, 577
Lu, D. X., T279
Lu, Z., 179
Luan, S. Y., TH70
Lucey, J., 538
Lucey, J. A., TH33, 42, 139, 512, 515
Luck, P. J., TH20
Luckett, A., TH83
Lucy, M. C., T189
Luebbe, M. K., 219, 306, 729, 734, 790, 798
Luense, L., 163
Luginbuhl, J.-M., T284
Lukas, J. L., 93, 450
Lukose, A., 330
Lum, G., 104
Luna-Rodriguez, L., W244
Lund, M. N., 560
Lundy, III, F. P., 657
Lunsford, A. K., 351, 669
Luparia, F., T213, T214, W197, 328
Lupton, C. J., TH274, 493
Luqué, L. D., 507
Lusk, J. L., 259
Lynch, C. O., TH230
Lynch, E. M., 156
Lynch, M. B., T247, W120, 703
Lyons, J. G., T173
Lyons, J. K., TH207
Lyons, M. A., 334
- M**
Ma, M., W181
Ma, Y., 472
Ma, Y. L., W117, TH125
Mabasa, L., TH117
Macchione, M. M., TH18
Macciotta, N. P. P., 117, 617, 618
MacDonald, J. C., 148, 732
Mach, N., TH232
Machacek, K. J., T65
Machado, C. H. C., W46
Machen, R. V., 458
Mackowiak, C., T81
MacLeod, J. N., 30
MacNeil, M. D., 412
Madden, R., 393
Maddock, R. J., 458
Mader, T., TH197
Mader, T. L., 753, 755
Maduko, C. O., 513
Magalhães, M. A., 438
Maggioni, L., T253
Magistrelli, D., 823
Magliaro, A. L., 235
Magnabosco, C. U., W45
Mahan, D. C., 197, 294, 466
Mahjoubi, E., T190, W195
Maianti, M. G., T223
Maijó, M., TH8
Majdeddin, M., W126
Maldonado, F., TH81
Malhado, I. B., TH229
Mallory, D., TH225
Mallory, D. A., 652, 717, 718, 722
Maltecca, C., 766
Mancio, A. B., TH46
Mandell, I. B., TH229
Mandonet, N., TH14
Manenti, M., 326, 540
Mani, O., TH105
Manini, R., T155
Mann, G. E., 476
Manteca, X., 675, 756
Manuel, L., W136
Manzanilla, E., W119
Manzanilla, E. G., T141
Mapes, J. M., 508, 700
Maqbool, N., 807
Marchant-Forde, J. N., 381, 382
Marchello, J. A., 557
Marcondes, M. I., T120, TH218
Margerison, J. K., 220, 485
Mari, L. J., T91
Mariani, T. M., T122, W26, W108, W109, W249, W250, W265, W272, W273, TH222, TH227
Maria-Rosa, M.-L., W127
Maribo, H., T155
Marino, C. T., W272, W273
Marnet, P.-G., 452
Maroney, M. J., W158
Marques, C. A. T., T276
Marques, L. F. A., W43
Márquez, G. C., 412
Marquezini, G., W166
Marr, L. C., TH263
Marshall, C. E., W164, TH173, TH174, TH176, 603
Marshall, R. T., 509
Marston, T., 432
Marston, T. T., T123, T124
Martel, C. A., W191
Marti, S., TH213
Martin, J. L., 722
Martin, L., 176
Martin, L. C., 362, 363
Martin, S. K., 174
Martineau, R., T229
Martinez, A., W107
Martinez, A. C., T83, T96
Martinez, M., T196
Martinez, M. E., T248, TH212
Martinez-Bustos, F., TH25
Martinez-González, J. C., T84
Martinez-Ramirez, H. R., W135
Martinez-Sánchez, C. E., T59
Martini, S., 49
Martin-Orúe, S., T141
Martins, C. L., T122, W25, W26, W249, W250, W265, W272, W273, TH222, TH227
Martin-Tereso, J., W215
Masoero, F., TH245
Mason, G., 12
Masuda, Y., T24
Mateo, M. J., T56
Mateos, G. G., T107, W118, W292, TH138, 206, 297
Matheney, K. J., TH205
Mathew, B., 736
Mathias, A. E., W25, W26
Mathis, C., 432
Matis, J. H., 318
Matsas, D., 759
Matsuhara, S. A., W25, W26, W249, W250, W272, W273, TH227
Matte, J. J., TH239, 200, 710
Matthews, J. C., TH74, TH75, TH79, 2, 3, 76, 78, 665, 669
Matthews, J. O., 62
Matthews, N., 361
Matukumalli, L., W54
Matukumalli, L. K., 524
Maulfair, D. D., W209, W210
Mawson, R., 646
Maxwell, C. V., T109, T110, T161, T162, 201, 787
May, M. L., 789
Mazza, A., T254
McAllister, A. J., 761, 765
McAllister, C. M., 746, 749
McAllister, T. A., T208, T209, T210, W217, 728
McBride, B. W., W234, 76, 78
McCall, C. A., 547
McCarter, M., 104
McCarthy, C. R., W179
McCarthy, F. D., T294
McCaskey, T. A., W179
McCaslin, M., 183, 184
McClanahan, L., 431
McCleary, C. R., TH173
McClements, R., 181
McCollum, T., 432
McCollum, III, F. T., 732
McComb, A., 180
McCraw, R. L., T290, T291
McDaniel, T. G., 161
McDaniel, M. R., 338, 339
McDonald, J. M., 767
McDonald, L. R., W276
McDonell, E. E., T92, W204
McDowell, K. J., TH9
McElhenney, W. H., 444, 547
McElroy, A. P., 502, 504
McFadden, J. W., 677
McFadden, T. B., TH110, 120, 123, 449, 554
McGee, M., W269, 156, 389
McGilliard, M. L., TH180, 54, 684
McGlone, J. J., TH171, 243, 244
McGrath, M. F., T189
McGuire, M. A., T257
McGuirk, S. M., 155
McKee, S. L., W153
McKeith, F. K., 294, 295, 461
McKeown, L. E., 728
McKernan, H., TH88, TH90
McKinnon, I. R., 643

- McLeod, K. R., W61, W62, W253, TH75, TH79, TH266, 174, 665, 730
- McMahan, W. M., 239
- McMahon, D. J., T38, T46, T58, 49, 540
- McMeniman, J. P., TH226
- McMillin, K. W., 227
- McMurphy, C. P., 589
- McNamara, D. L., 503
- McNamara, J., 126, 280, 281, 422
- McNeill, S., 638
- McSweeney, K., TH175
- Means, W. J., 691
- Mechor, G. D., T195
- Medeiros, A. N., T276, T277
- Meers, S. A., W139
- Meisinger, D. J., 433
- Meiszberg, A. M., TH2
- Mejías, R., 440
- Melchior, D., TH152, 200
- Mello, R., T121, TH81
- Melo, G. M. P., T276
- Mench, J. A., 674
- Mendes, C. Q., T273, TH278, TH288, TH289, TH290, TH291, TH292, TH293
- Mendoza, G. D., W97
- Mendoza-Martinez, G., T241, W244
- Meneses-Mayo, M., T241, W244
- Menoyo, D., W118, 297
- Merkel, R. C., 345, 347
- Merks, J. W. M., 355, 529
- Mersmann, H. J., TH60
- Mertens, D. R., 183, 184, 817
- Mertz, K., TH10
- Messer, N. T., 1
- Messina, M. R., T155
- Messina, S. A., W150
- Metges, C. C., T216, T217, W243, TH63, TH249
- Metzger, L. E., T44, T45, T50, T52, 138
- Meunier, J. P., T141, T149, T167, W119, W262
- Meyer, A. M., 97
- Meyer, D., W173
- Meyer, M. D., TH259, TH260, TH261, TH266
- Meyer, N. F., 734, 802
- Michal, J., W261
- Michaud, R., 185, 186
- Michel-Parra, J. G., W298
- Mickelson, J., 29
- Middelbos, I., 175
- Mielenz, M., 71, 72
- Migliazzo, M. F., T189
- Miglior, F., W14, 9, 12, 16, 618
- Mikolayunas, C. M., 499
- Miles, E. D., 78
- Miles, J., 663
- Millen, D. D., T122, W25, W26, W108, W109, W249, W250, W265, W272, W273, TH222, TH227
- Miller, D. D., 696
- Miller, D. J., 568
- Miller, D. N., 311
- Miller, J. E., T271, 494
- Miller, M., 411, 599
- Miller, M. F., 459, 460
- Miller, M. J., W78
- Miller, P. S., 197, 563
- Miller, R. H., T18, T19, T21, 13
- Miller, R. K., 212
- Miller, S. P., 404, 410
- Milliken, R. S., T64
- Millman, S. T., 380, 386
- Millner, A., 268
- Mills, J. A. N., 308
- Min, B. J., 196, 705
- Min, B. R., W174, W247, W275, TH223
- Miracle, R. E., T46, W71
- Miraei Ashtiani, S. R., W30
- Miranda, J., W203
- Mirando, M. A., 275
- Mireles, M., TH294
- Miró, L., TH8
- Mishellany, A., T167
- Mistry, V. V., 43
- Misztal, I., T26, 17, 18, 171, 532, 535, 620, 757
- Mitchell, A. D., TH64
- Mittelman, N. S., 51
- Mix, N., 424
- Miyagi, E. S., T83
- Miyamoto, A., T185
- Mjoun, K., 56
- Moallem, U., TH179
- Mobini, S., TH277
- Moffet, C. A., 349, 350
- Mohamed, D. A., 25
- Mohammadabadi, T., T245
- Mohammadi, G., W151, W152
- Mohammad Nazari, B., T14
- Mohran, M. A., 45
- Mojtahedi, M., TH220, TH221
- Molenaar, A., 807
- Molist, F., W281, W282, 205
- Moll, J., TH112
- Molle, G., 384
- Monson, D. A., 705
- Montalvo, G., 658
- Montalvo-Paquini, C., W244
- Montañez-Valdez, O. D., T84, W230, W255, W298
- Montel, J., 133
- Montelongo, M., 393
- Montero-Lagunes, M., T59
- Monterrosa, V., W267
- Montoya-Escalante, R., 495
- Mook, J. L., TH279
- Moon, H. G., T142, TH121
- Mooney, C. S., W205, TH4, 343, 583
- Moore, D., T3, T285, 573
- Moore, E. S., TH9
- Moore, J. A., T290, T291
- Moore, J. M. B., 360
- Moore, S., 212
- Moore, S. S., 410, 768
- Moorefield, J., W138
- Moradi Shahrababak, M., T16, W30, W31, TH217
- Morais, J. A. S., T243, W251
- Morales, J., W133
- Morales-Treviño, H., TH294, 440
- Morales-Zambrano, I. E., W230
- Moraru, C., TH19
- Moraru, C. I., TH24
- Moravej, H., W126
- Moreira, F., W191
- Moreira, M. Z., W256
- Moreira, P. S. A., W15, W16
- Morel, I., T185, 75
- Morelli, J., 254
- Moreno, J. F., TH173
- Moreno, R., 563
- Moreno-Valdéz, A., T84
- Morera, P., TH164
- Moretó, M., TH8, 595
- Moretti, M. H., TH44
- Morgan, M., 95, 96
- Moriel, P., T182
- Morin, D. E., T8
- Moron-Fuenmayor, O. E., T111
- Morotti, F., T234
- Morriscal, D., TH35, 437
- Morris, A., T11
- Morrow, W. E. M., 709
- Moschini, M., TH245
- Moseley, W. M., W245
- Mosenthin, R., 209
- Moser, D. W., W44, 65
- Moser, R., T164
- Mosley, E. E., T257
- Moss, J. I., TH182
- Motaghedi, A., W151
- Mote, B., W300, 534
- Moue, M., 610
- Moulton, K., T3, 475, 573
- Moura Dian, P., TH231
- Mourão, G. B., TH293
- Mousel, M. R., 348, 350
- Moussaoui, Y., 821
- Moya, D., W215, 740
- Moyes, K. M., T8, 609
- Moynihan, J. M., T68
- Muck, R. E., T90
- Muir, J. P., T280, T295, W103
- Mujabi, F. D., 768
- Mukesh, M., 606, 609
- Mullarky, I. K., TH180, 234, 677
- Mulligan, F., 741
- Mullinix, Jr., B. G., 600
- Mullins, C. R., 53
- Mullis, N. A., 94
- Mulvihill, D. M., 644
- Muntifering, R. B., W98, TH42, TH45
- Murillo-Ortiz, M., W106, W238, TH51, 495
- Murphy, K. D., T249
- Murphy, M. R., T97
- Murray, D. P., 501
- Murrieta, C. M., 332
- Muset, G., T202
- Mussa, P. P., 416
- Musselman, A. F., TH282
- Musselwhite, A. N., 576
- Musser, R. E., T109, T110, T161, T162
- Mutsvangwa, T., T200, T226
- Muumba, J., 86
- Myer, R. O., W37, W38, W39, W102, 598
- Myers, D. M., 313
- Nacer, F., 95, 96
- Nadarajah, K., W98
- Naemempour, H., T13, T14, T15, T140
- Nagaraja, T. G., T75, 344
- Nakahashi, Y., W19
- Nakao, T., W205
- Nall, J., TH58
- Namroud, N. F., 204
- Nap, R. C., 416
- Naranjo, V. D., TH149
- Narciso, C., W96, W171
- Narciso, C. D., W155, W188, W221, TH184
- Nardon, R. F., TH82
- Nardone, A., T4, W8, TH164, 246
- Nascimento, A. B., W158
- Naserian, A., T225
- Nash, T. G., 211
- Nasiri, M., TH211
- Nasiri, M. R., T245
- Nasirimoghadam, H., T233
- Nasri Moghaddam, H., TH272
- Nathanielsz, P. W., 472, 473, 474
- Navarro, F., 193, 699, 706, 708
- Navidzadeh, S. M., W29
- Nayigihugu, V., 332
- Ndegwa, P., 307, 341
- Neary, M. K., TH282
- Nebel, R. L., W164, TH173, TH174, TH176, 33, 603
- Nebzydowski, S. J., 160
- Necaice, K., 475
- Neel, J. P. S., TH43, 464, 465
- Negrão, J. A., TH214
- Neibergs, H., T28
- Neill, S., T123, T124
- Nejati-javaremi, A., T115, T116, W200
- Nelson, T., W87
- Nelssen, J. L., T128, W132, TH124, TH145, 158, 195, 562, 697, 775, 777, 778
- Nelssen, J. L., TH132, 786
- Nemec, L. M., 160
- Nery, J., 176, 416
- Nestor, K. E., 93
- Nestor, Jr., K. E., W117
- Nettleton, D., 527
- Neuendorff, D. A., TH205, 477
- Neuendorff, D. A., 317
- Neufeld, K., 356
- Nevárez-Carrasco, G., W258, TH51, 495
- Neves, C. A., T121
- Newbold, J. R., 337
- Newbold, M., TH24
- Newbold, M. W., TH19, 510
- Newburg, D. S., 808
- Newman, Y. C., T81
- Newton, B., 369
- Nguyen, H. V., 279
- Nguyen, P., 176, 416
- Nichols, A. J., 800
- Nichols, D. A., 507
- Nichols, W. T., 460
- Nicholson, J. D. W., 458
- Nickerson, S. C., 247
- Nicodemus, M., T288, TH83
- Nicolazzi, E., 617

- Nicolazzi, E. L., 619
Nicolussi, P., T211, 117
Nielsen, B. D., 443, 445, 549, 551
Nielsen, M. K., 624, 767
Nielsen, M. O., TH238
Nielsen, S., 792
Nienaber, J. A., 724
Niero, L. F. S., TH227
Nieto, J., TH101
Nieto, M., W292
Nieto, R., T108, W136
Nightingale, C. R., W242
Nikkhah, A., T115, T116, T201,
TH251, 91, 584
Nikkilä, M., W300, 534
Nimmo, R. D., T136, T158
Nisbet, D., T138
Nisbet, D. J., T76, T256, 395
Nitsch, S., 370
Niven, S. J., 191
Nixon, M., 12
Nkrumah, D. J., 403, 404, 405, 768
Noblet, J., 701, 782
Nobre, P. R. C., W46
Nocek, J., 333
Nofrarias, M., 205
Noguera, J. L., W52
Noland, E., W81
Noorbakhsh, R., W148
Norat-Collazo, L. M., 330
Norell, R. J., T86
Norman, H. D., T17, T18, T19, T20,
T21, 10, 13, 14
Norman, R., TH41
Noroozi, M., T201
Northup, B. K., 272
Norwood, F. B., 259
Notter, D. R., 349, 350, 497
Nouira, W., T40
Nousiainen, J., 816
Novak, S. W., 557
Nudda, A., T54, T211, T246, T254
Nuernberg, G., T176, TH63
Null, D. J., T6
Núñez, O. G., TH275
Nussio, L. G., T91, TH291
Nuti, L. C., 758
Nyachoti, C. M., T165, TH137, 190,
695, 772
- O**
Oba, M., T99, T197, 55, 586, 728,
788, 794
Obregon, J. F., W238, W240,
W241, W258, W259, TH147,
TH148, TH276, TH283
O'Brien, M. D., TH161, TH163, 86,
88, 373
O'Callaghan, D. J., T56
O'Connell, J. R., T31
O'Connor-Robison, C. I., 443, 445,
549, 700
Odde, K. G., T228
Oddy, A., 80
Odhiambo, J. F., TH172
Odle, J., W130, TH131
O'Doherty, J. V., T150, W120,
W286, 703
O'Donnell, A. M., 51
O'Donnell, C. P., T56
O'Driscoll, K., W11, 751
Oelker, E. R., 736
Ogawa, E. S., W108, W109
Ogejo, J. A., TH263
Ogg, C., T51
O'Grady, L., 741
Oh, H. K., W121, W122
Oh, S., W85
Oh, S. J., W283, W284, W285
Oh, S.-H., W47
O'Hanlon, P., T247
Ohene-Adjei, S., 39
Ohh, S. J., TH153
Ohmiya, H., T30
Okine, E., 728
Okoya, I. S., W49, W194
Okumura, T., W19
Ola-Gbadamosi, I. O., W49, W194
Olea, W., TH111
Oliveira, A. S., T250, T251
Oliveira, D., T277
Oliveira, L., T9
Oliveira, R. A., W155, W188, W221,
TH184
Oliver, S. P., 542
Oliver, W., 663
Olsen, J. R., 479, 480, 572
Olsen, S. C., 115
Olson, D., W84
Olson, J., W187
Olson, K. C., W44, W270, 273, 392
Olson, K. E., T71, TH15, 142
Olson, K. M., 127, 761
Olson, T. A., 82
Oltjen, J., 795
Oltjen, J. W., W22, 313, 796
Olukosi, O. A., 207
Olynk, N. J., 90
O'Mara, F. P., W206
Omid, A., TH5, TH6
Ominski, K. H., TH52, TH264
Onteru, S., W300
Ontiveros, J. C., TH275
Opapeju, F. O., TH137, 772
Oppy, J., 371
Orellana, D., T69
Orellana, R. A., 279
Orozco, P., TH210
Orozco-Hernandez, R., 723
Ortega, J. A., TH275
Ortega-Gutiérrez, J. A., W111,
W112, W113
Orth, M. W., TH237, 508, 700
Ortigues-Marty, I., T229
Ortiz, J. J., TH276
Orunmuyi, O., W49
O'Shea, C. J., 703
Osorio, J. S., 667
O'Sullivan, J. T., W120
Otlés, Z., TH197
Ott, T. L., W145
Ouellet, D. R., TH249, 185, 186
Overton, M. W., 143, 248
Overton, T. R., T101, T183, T184,
T265, W186, 77, 93, 450
Owen, G. S., TH86
Owens, F. N., TH16
Owens, K. M., TH87
Owens, S. L., W138
Owsley, W. F., T60, T61, 487
Ozimek, L., TH25
- P**
Pacheco, G. R., TH198, TH199,
TH200, TH201
Pachaeco, L. A., W44, W270, 392
Pacheco, R. D. L., T122, W25, W26,
W108, W109, W249, W250,
W265, W272, W273, TH222,
TH227
Pack, J. D., 283, 284, 715, 719
Packer, I. U., TH82
Paddock, Z. D., W276
Padiernos, C., 649
Padilla, A., T138
Paez, A., T111
Pahm, A. A., 210
Paine, L., T68
Paisley, S., 432
Paiva, L. M., W248
Pajor, E. A., 379
Pakdel, A., T16
Palin, M. F., TH109, TH239
Palmonari, A., T79, W231
Paltanin, C., T253
Pampusch, M. S., TH77
Panciroli, A., T137
Pandit, A. J., 21, 47
Pantoja, J., T74
Pape, D., 304
Parada, P., TH101
Paranhos da Costa, M. J. R., TH37
Pardo, R. M. P., T235
Parik, R., W13
Parisi, B., W66
Park, C. S., TH117
Park, J. C., T153, TH121
Park, K. W., TH140, TH141
Park, S. I., T129
Park, S. J., 196
Park, Y. W., T40, W67, 513, 517
Parker, D. B., 310
Parker, K. R., 576
Parkhurst, A., TH13
Parkinson, S. C., T86
Parks, A. G., TH9, TH11
Parks, C. W., 295, 711
Paroczay, E., T125
Parr, E. N., 564
Parrilli, M., W25, W26, W249,
W250, W272, W273, TH227
Parrish, F. C., 556
Parrish, J. J., 364, 366, 569
Parsons, C. M., TH268, 210, 588
Parsons, G. L., 214, 338, 339, 804
Partyka, K., W21
Paschal, J. C., 458
Pascoa, A. G., TH37
Pasteiner, S., T89, T94
Pastorek, A., TH27
Patel, D. A., 542
Patel, O., TH115
Paterson, J., 428, 432
Patra, A. K., T282, TH102
Patskevich, V., TH10
Patterson, D. J., 652, 717, 718, 722
Patterson, J., T73
Patton, R. A., TH255
Paul, M., W75
Paula, R. M., W248
Paulino, M. F., W248
Paulino, P. V. R., T120, TH218
Paulus, T. J., 155
Pauly, C., 296
Pavan, E., TH71, TH72
Payeur, J. B., 484
Payne, F. A., T56
Payne, R. L., TH133, TH134,
TH137, 772, 783
Paz-Gamboia, E., T59
Peacock, M. M., 372
Pearson, R. E., TH178
Pecorini, C., 810
Pedroso, A. F., W196
Peek, S. F., 52, 155
Peel, R. K., TH80
Peeler, I. D., 603
Peixoto, M. G. C. D., TH106
Pellegrini, P., T202, T214
Pellerin, D., TH273
Pelletier-Grenier, M., TH119
Pelzer, D., T71
Pena, G., T69, T70
Peña, J. R., TH275
Penasa, M., 15
Pendergraft, J. S., T293
Peng, J., TH100
Peng, Y., 515
Penner, G. B., T99, T197, 55, 788
Pennington, K. A., W144
Pepper, A. R., 748
Perdok, H. B., 337
Perdomo, M., 607
Pereira, A. C., TH42, TH45, TH198,
TH199, TH200, TH201
Pereira, A. S. C., W256, TH280,
TH281
Pereira, L., W6
Pereira, M. N., W208, TH262
Pereira, O. G., W235, W236
Pereira Filho, J. M., T281
Perez, A. B., TH283
Pérez, G. M., TH275
Pérez, J. F., W119, W281, W282,
TH152, 205
Pérez-Bosque, A., TH8, 595
Perkins, N., 387
Perry, B. L., W160, 721
Perry, G. A., W160, 300, 721
Persia, M. E., W226
Peruca de Melo, G. M., TH47
Pescador, N., W97
Pescara, J. B., TH234
Peters, D., TH145
Peters, D. N., TH139
Peters, R. R., T5
Petersen, G. I., 564
Petersen, J., 336
Peterson, C., 247
Pettersson, K. H., 27, 501
Pettersson-Wolfe, C. S., 27, 234
Petit, H. V., T208, T209, T210, T219,
T220, 185
Petriglieri, R., 813
Pettigrew, J. E., T158, T163, 197,
210, 368, 561, 773
Petzke, T., 687
Peyron, M. A., T167

- Pfeiffer, F. A., TH274
Phadungath, C., T44, T45
Phandanouvong, V., T138
Phatak, S. C., 598
Philipp, A., TH242
Philipp, D., T80, 597
Phillips, A. T., 44
Phillips, R. L., 182
Phillips, W. A., 272
Pholsing, P., W34
Phyn, C., 454
Piantoni, P., 278, 819
Piao, L. G., W121, W122
Piao, X. S., TH153
Piccioli-Cappelli, F., T224
Pichler, E., W7
Piedrafitra, J., 760
Pierce, J., TH146
Pierce, K. M., W286
Pierfax, C., T283
Pierzynowski, S. G., TH61, TH62
Pietrosemoli, S., T111
Pighetti, G. M., W18
Piles, M., W41
Piña, B., TH275
Pina, D. S., T250, T251
Pinchak, W. E., W247, W275, TH223
Pineiro, C., W133, 658
Pinos-Rodriguez, J. M., W255
Pinotti, L., T253, TH107, 823
Pinto-Jacobo, M. A., W298
Piperova, L. S., T102, TH103, TH104, TH246, 119, 555, 678, 681
Pires, A. V., T118, T273, TH278, TH288, TH289, TH290, TH291, TH292, TH293
Pires, J. A., T221
Pires, J. A. A., W218, TH234, TH244
Pirisi, A., T254
Pisel, J., T252
Pitre, A. L., 113
Pittman, M. R., 379
Piva, A., T137, T155
Piva, G., TH245
Pizzamiglio, V., T155
Plain, R. L., 32
Plaizier, J. C., W100, TH264
Platter, W. J., 218, 461
Plaut, K., TH115, 687
Pnitzner, C., 356
Podetti, M., 486
Pohlmeier, W. E., TH17
Pol, M. V., T212
Poletto, R., 382
Polizel Neto, A., W15, W16
Pollak, E. J., 169, 170, 746, 747, 748, 749, 750
Polo, J., TH8
Ponce, E., W252
Pontes, E., 82
Poock, S. E., 652
Poole, M. C., TH169
Poore, M. H., T284, 733, 800
Popp, M., 597
Porres, J. M., 303
Porter, J. H., T117, T177, T237, TH228
Portillo, J. J., W240, W259, TH166, TH276
Posadas, S., T286
Powell, J. G., 391
Powell, R. L., T17
Powell, S., TH149
Powell, T. H., 692
Pozzo, S. S., T7
Prado-Cooper, M. J., W146, W147, TH165
Prados, L. F., T120
Prates e Oliveira, A., TH47
Pratt, S. E., TH85, TH87, TH96
Pratt, S. L., W299, W302, TH71, TH72, TH167
Preseault, C. L., W207
Preston, R. L., 394
Preynat, A., TH239
Price, P. L., W173, 332
Prieto, B., T106
Pringle, T. D., T287, W139, 353, 458
Pritchard, R. H., 147, 668
Prola, L., 416
Proszkowiec-Weglarz, M., W9
Proudfoot, K. L., 814
Provenza, F. D., 383
Prusa, K., T126, 292, 562
Prusa, K. J., 786
Puchala, R., T274, T282, 345
Puffenbarger, S. M., T66
Puggaard, L., T193
Puigvert, X., T134
Pulina, G., T54, T211, T246, T254, 117
Puntteney, S. B., 250
Purdy, P., W50, 570
Purevjav, T., TH197
Purohit, D. H., 41
Putarov, T. C., W108, W109
Pyatt, N., W263
Pyatt, N. A., T240, 803
Pye, G. W., 179
- Q**
Qu, A., 661
Qu, L., 527
Quaas, R. L., 407
Quarles, S., 111
Queiroz, M. A. A., TH288, TH289, TH290, TH292
Queiroz, M. F. S., T191, T243, W251
Queiroz, O. C., W196
Quesnel, H., TH168, 818
Quinn, M. J., 789
Quintero-Martinez, R., W104, W105
- R**
Rabiee, A. R., 225, 742, 791, 792
Radcliffe, J. S., TH93, 68, 312, 698
Raddatz, J. R., T175
Rademacher, M., 209
Radhakrishna, R., TH90
Radunz, A., TH285
Radunz, A. E., 402
Rae, D. O., W37, W38, W39
Raeth-Knight, M., TH188, TH189, TH190, TH191, TH192, TH193, TH194
Raffrenato, E., TH57
Rafiee, H., T192
Ragagnin de Lima, M., W150
Rahimi, A., 666
Rahmatimanesh, A., W225, TH209
Rajbhandari, P., T51
Raji, A. M., 159
Ramirez, N. D., 317
Ramirez-Godínez, J. A., W161
Ramos, S., T248, TH212
Ramsey, S., 138
Ranathunga, S. D., 585
Randel, R. D., W24, TH205, TH207, 74, 152, 316, 317, 374, 477, 576, 577, 578
Raney, N. E., 413
Ranilla, M. J., T248, TH212
Rankin, M. K., T7
Rankin, S. A., T39, TH34, 512
Rao, H. G. R., 541
Rapetti, L., T82, W99
Rapisarda, T., 187, 539, 815
Rasby, R., 432
Rashidi, A., W30
Rashmir, A. M., 548
Rasmussen, S., TH175
Rasmy, N., 26
Rastani, R. R., TH206
Rathmann, R. J., TH226, 459
Raun, B. M. L., T261
Rauw, W., T63
Rauw, W. M., 372, 411, 536
Razook, A. G., TH82
Razz, R., W91
Reagan, J. O., 150
Rebollar, S., W96, W97
Rebucci, R., 810
Recktenwald, E. B., T265
Reddish, J. M., T36
Reddy, G., T278
Reddy, N. R., W66
Redmon, L. A., 545
Reed, J. D., 462
Reed, M., TH263
Reeves, J. J., W150
Reeves, S., W64
Rego, K. A., 27
Rehberger, T., T164
Rehberger, T. G., TH10
Rehfeldt, C., T176, TH63
Reich, L. J., T93, T95
Reijs, J. W., 189
Reilly, P., W286
Reinemann, D., T74
Reinhard, M. S., T280
Reinhardt, C. D., 64
Reinhardt, T. A., 605
Reis, R. A., T118, T243, W251, TH37, TH44, TH224, 438
Reischl, S., W116
Rekaya, R., T37, 262, 525, 630, 757
Remonato, R., TH199, TH200, TH201
Remonato, R. L., TH198
Rempel, L. A., W51
Rensburg, D., 793
Rensburg, D. W., 107, 116, 251
Ren, F. Z., W291
Renaud, A. M., TH34
Renaud, J., TH250
Reneau, J. K., W180
Rengman, S., TH61, TH62
Renney, D. J., 800
Renter, D. G., T75
Rentfrow, G., W239, TH125, 730
Renyé, J. A., W77
Rérat, M., TH242
Resende, K. T., T276, T277, T281
Reuter, R. R., TH226
Revelo, X. S., 120
Reyes-Estrada, O., W106, TH51
Reyna-Islas, R., 336
Reynolds, G. W., 220, 485
Rezaii, F., T244, TH211
Rezamand, P., W199
Rezayazdi, K., T115, T116, T242, W200, TH286, TH287
Reza-Yazdi, K., TH217
Rezende-Paiva, S., W57
Rhoades, M. B., 310
Rhoades, R. D., 149
Rhoads, R. P., TH161, TH163, 86, 88, 373, 661
Rhoderick, M. B., 127
Ribeiro, A. F., T118, T191
Ribeiro, F. R. B., 212
Ribeiro, J., T234
Ribeiro, K. G., W236
Ribeiro, M. F., T273
Richard, C., TH269
Richards, C. J., 589
Richardson, M. J., W263
Richert, B., 785
Richert, B. T., 312, 379, 382, 698
Richeson, J. T., T64, 391
Richter, R., 537
Richter, S., T185, 75
Ridha, B., W127
Riggins, J. C., TH40
Riggs, L., TH65, 660
Rigueira, J. P., W235
Riley, D. G., W37, W38, W39
Rincker, D., 667
Ringler, J. E., TH99
Rink, A., 411
Rinne, M., 592, 816
Riojas, A. V., W103
Rios, D., W87
Rios, F. G., W238, W240, W241, W258, W259, TH147, TH148, TH276
Ripoll, G., T114
Risley, C. D., 777, 778
Risley, M. E., W162
Ritter, M., 241
Ritter, M. J., 295, 711
Rius, A. G., TH68, 60
Rivera, F., W155, W171, W188, TH184
Rizzi, N., T82
Roça, R. D. O., W15, W16, W249
Robbins, K. R., T37, 525
Robblee, M. M., 682
Roberts, K. S., T117, TH228
Roberts, M. P., 245
Roberts, R. F., 44, 118
Robertson, M. W., 671, 744
Robinson, J., W14
Robinson, P. H., W173, W185, TH270
Robinson, V., 469
Robison, J., TH270

- Robison-O'Connor, C. I., 551
 Rocha, A. A., W248
 Rocha-Chavez, G., T84, W230, W298
 Roche, J., 454
 Roche, J. R., TH241, 73
 Roche, T., 572
 Rodenburg, J., 12
 Rodning, S. P., TH133, TH134
 Rodrigues, É., T122
 Rodrigues, G. H., T273, TH278, TH288, TH289, TH291, TH292, TH293
 Rodrigues, J. F. H., W45
 Rodríguez, A., T214
 Rodriguez, F., T138
 Rodríguez, M. A., T202
 Rodriguez, N., 639
 Rodríguez-Almeida, F. A., W161, TH275
 Rodriguez-Alvarado, C., TH294
 Rodriguez-Lopez, J. M., T108, W136
 Rodríguez-Muela, C., W110, W111, W112, W113
 Rodríguez-Prado, M., W271, 738
 Rodríguez-Ramírez, H. E., W110, W111, W113
 Rodriguez-Saona, L., TH28, 48
 Rodriguez-Saona, L. E., T53, TH22
 Rodriguez-Zas, S. L., TH104, 555, 683, 819
 Roelofs-Prins, D., 529
 Rogers, G. W., T1, T22
 Rogers, N. R., T41
 Rohrer, G. A., W51
 Rojas, P. J., W266
 Røjen, B. A., T260
 Rojo, R., W96, W97
 Rolfe, K. M., 624
 Romano, J. E., 762, 763
 Romero-Villalobos, S., W113
 Romnee, J.-M., 614
 Romo, J. A., W266, W267
 Ronchi, B., TH164, 246
 Roneker, K. R., 696
 Roper, S., T278
 Rosa, G. J. M., T262, W45, 408, 526, 625
 Rose, M. C., 24
 Rosen, C. J., W175
 Rosenkrans, Jr., C., 597
 Rosenstein, D. S., 445
 Rosi, F., 823
 Ross, D. A., T265, TH69
 Rossi, G., T79
 Rossi, L., 810
 Rostagno, M., T73
 Rothschild, M., 534
 Rothschild, M. F., W300
 Rouquette, Jr., F. M., TH49, 545
 Roura, E., T134, T135, TH136
 Rovai, M., 347
 Rowntree, J., 104
 Rowson, A., 250
 Rozeboom, D. W., 360
 Rozeboom, K. J., 569
 Rubattu, R., T54
 Rubio Robles, M. C., W58, W59
 Rude, B. J., 799
 Ruegg, P., T9, T74, 257
 Ruegg, P. L., T10, T12, 820
 Ruggieri, A. C., TH37, TH44
 Ruggieri, A. C. R., 438
 Ruiz de la Torre, J. L., 756
 Ruiz-Barrera, O., W110, W112, W113
 Rule, D. C., 332
 Rumph, J. M., 170, 628
 Rungruang, S., W178
 Rupasinghe, H. P. V., 24
 Rushen, J., W193
 Russell, J., TH35, TH36, 436, 437
 Russell, J. B., T90, 397
 Russell, L., TH8
 Rutherford, W. C., T60, T61, W23, 623
 Rutten, M. J. M., 529
 Rutz, F., 194
 Ryan, C. M., T101, W186
 Ryan, P., T3, 389, 475
 Ryan, P. R., 548
 Rychlik, J. L., 395
- S**
- Sa Filho, O. G., T182
 Sabharwal, R., W149
 Sadoris, K. L., 192
 Sadler, L., 241, 754
 Sadler, L. J., TH2
 Saghi, D. A., W28
 Sahl, T., T269, T282, 345
 Sainz, R. D., T119, W22, TH214, TH218, 313
 Saito, T., 22, 610
 Sakugawa, J. K., W21
 Salak-Johnson, J. L., 378, 609, 746, 747, 748, 749, 750
 Salama, A., 105
 Salama, A. A. K., 498, 500, 821
 Salazar, S., W107
 Salem, A.-F. Z. M., 745
 Salem, M., TH162, 714
 Sales, M. F. L., T120
 Salim, E. M., 42
 Salim, H., W234
 Salmon, H., 806
 Salunke, P., T52
 Salvador-Torres, F., W111
 Samford, R. A., 196
 Sampson, J., W213
 Sampugna, J., 119
 Sanches, G. M., T25
 Sánchez, A. I., W58, W59
 Sánchez, J. M. I., W107
 Sánchez, J. P., 757
 Sanchez, U., W252
 Sanchez, W. K., 742
 Sanchez-Dávila, F., TH294
 Sanders, A. H., W190
 Sanders, S. R., TH161, TH163, 373
 Sandrucci, A., W99
 Sangabriel, W., TH101
 Santana, H., TH215
 Santana, M. C. A., T118, TH46
 Santibañez-Escobar, R., W298
 Santos, G. T., T219
 Santos, J., 248
 Santos, J. E., W188, W189, W191
 Santos, J. E. P., T222, T263, W155, W171, W219, W221, TH184
 Santos, M. C., T95
 Santos, R. M., W157
 Santschi, D. E., TH235
 Sapienza, D. A., T87
 Saraiva, T., TH48, TH50
 Saremi, B., 666
 Sargolzaei, M., 410
 Saro, C., T248, TH212
 Sarti, L. M. N., T122, W108, W109, W249, W250, W265, W272, W273, TH222, TH227
 Sartini, J. L., 152
 Sartini, B. L., W56
 Sathonghon, W., W178
 Sato, T., 22
 Sauerwein, H., 71, 72
 Saunders, L. S., T60, T61
 Sauviant, D., 812
 Savell, J. W., T127, 458
 Savin, M., 597
 Savoini, G., T227, T253
 Sawyer, J. E., W27, TH49, 63, 132, 149, 318, 752
 Sawyer, J. T., T109, T110, T112, T113
 Scaglia, G., TH39, TH203
 Scanes, C., 475
 Scarpa, A. B., TH185
 Scatena, T. S., T182
 Schachtschneider, C., 126, 280
 Schadt, I., 187, 539, 813
 Schaefer, D. M., 462
 Schaeffer, L. R., 12, 618
 Schafer, D. J., 718
 Schaffer, E., 247
 Scharenberg, A., 188
 Schatzmayr, G., T89, T94, T159, 370
 Schauff, D., 38
 Schefers, J. M., 83
 Schenck, E. L., 381
 Schenkel, F., 261, 263, 410
 Schenkel, F. S., 524
 Schennink, A., 611, 615
 Scherer, C. S., 210
 Schillo, K. K., 78
 Schinckel, A., TH150, 785
 Schingothoe, D. J., 56, 144, 331, 585
 Schlegel, M. L., 180
 Schlegel, P., TH126
 Schlegel, S., TH112
 Schlessner, J. E., W66
 Schlotterbeck, R. L., 216, 221
 Schmidt, D. A., 179
 Schmidt, J., 599
 Schmidt, R. J., T91, T92, T93
 Schmidt, S. P., TH42, TH198, TH199, TH200, TH201
 Schmidt, T. B., 389, 392
 Schnabel, R. D., 261, 524
 Schneider, C., 307, 341
 Schneider, F., T216, T217
 Schneider, S., 352
 Schnell, S. A., 11
 Schocken-Iturrino, R. P., TH224
 Schoenberg, K. M., T183
 Scholljegerdes, E. J., W274, 325
 Scholz, A. M., 352
 Schönhusen, U., W243, TH249
 Schoonmaker, J. P., 727
 Schopen, G. C. B., 615
 Schott, II, H. C., 549
 Schrick, F. N., TH12, TH40, TH41
 Schroeder, G., W223
 Schroeder, J. W., T228
 Schukken, Y., T28, 481
 Schulte, H. F., 249
 Schultz-Kaster, C., 361
 Schultz Kaster, C. M., 62
 Schutz, J. S., 100
 Schutz, M. M., W11, TH3, TH13, TH204, 14, 232, 655, 656, 751
 Schwab, C. G., TH268, 588, 657
 Scott, M., W64
 Scott, M. C., T66
 Scott, S. J., 716
 Scramlin, S. M., 461
 Scudder, J. M., 121
 Seabolt, B. S., TH136
 Seangjun, A., T23
 Sears, P. M., 249
 Sebek, L. B. J., 591
 See, M. T., W290, W293, 650, 709
 Seeger, T. K., T85
 Sehested, J., T193
 Seidel, G. E., TH175, 566
 Sejrsen, K., TH105
 Selk, G., 432
 Sellahewa, J., 642
 Sellers, R. S., 488
 Sennikov, S. A., 323, 324
 Seo, C. W., W82, TH23
 Seo, M. H., W72
 Seo, S., 528
 Seok, H. B., TH142
 Serenius, T., W300, 534
 Serrano, M. P., T106, T107, W118, W292, TH138, 206, 297
 Sesana, R., T25
 Settles, M., T28
 Sewall, J. R., 803
 Sexton, J., TH225
 Seybold, C., 72
 Seyfert, H. M., T217, 453
 Seykora, A. J., 762, 763
 Schachtschneider, C., 281
 Shackelford, S., 725
 Shackelford, S. D., W54, 311, 724
 Shaeffer, A. D., T284
 Shah, M. A., W223
 Shah, N. P., 423
 Shamsi, K., 647
 Shan, T., W141
 Shan, T. Z., 291
 Shane, E. M., W175, W180
 Shanks, R. D., T27
 Sharma, A., TH114, 683
 Sharman, E. D., 100
 Sharp, D., 282
 Shaver, R. D., W95, W214, TH240
 Sheahan, A. J., 73
 Shelor, M. K., 214, 338, 339, 804
 Shelton, J. L., 443
 Shelton, N. W., 195, 775
 Shenkoru, T., T78
 Shepherd, S. S., T170
 Sherman, E. L., 768
 Sherrow, E., 346

- Shi, C. Y., TH156
Shieh, J. J., T49
Shimazu, T., 610
Shimosato, T., 22
Shin, J., TH59
Shin, J. H., T36
Shin, J. S., W220, W229
Shin, S. O., T143, T146, T152, T153, T154, W137, TH121, TH122, TH140, TH141
Shinde, P. L., T129
Shingfield, K., 341
Shivazad, M., 204
Shockey, D., 95, 96
Shojaeian, K., T14
Sholly, D., 785
Sholly, D. M., 312, 698
Shouse, S., 322
Shreck, A. L., W20
Shwartz, G., 88
Siari, S., W195
Siciliano, P. D., TH96
Siciliano-Jones, J. L., 102
Sides, G. E., W245, W246
Sido, J., 587
Siécola, Jr., S., W208, TH262
Siemens, M., 34
Sierra-Vasquez, A., W57
Siewerdt, F., T5
Signoretti, R. D., T191
Sikand, V., W89
Silk, T., TH26
Silman, A., TH166
Silva, A. G., W248
Silva, H. G., W58, W59
Silva, J. R. M., W208, TH262
Silva, L. O. C., W46
Silva, S. L., T119, TH280
Silva del Rio, N., W142
Silva Filho, J. C., T235
Silveira, A. C., W53, W265, TH222
Silver, G. A., T186
Silvestre, F., 323
Silvestre, F. T., T222
Silvia, W., 237
Silvia, W. J., 765
Simal, N., W292
Simmons, L., 632
Simmons, L. G., 178
Simpson, A., 644
Simpson, M. M., 351, 669
Simpson, S. B., 123
Sims, L. E., T240
Singh, D., TH38
Singh, K., 453
Singh, M., W78
Singh, V., 561
Sipkovsky, S. S., 289
Siqueira, G. R., TH224
Siqueira, R. F., TH214
Skibsted, L. H., 560
Skidmore, A., 388
Skinner, G. E., W66
Skirpstunas, R. T., 253
Skow, L. C., 28
Slayers, A., 396
Sletmoen, J., W100
Slifka, K., 181
Slominski, B. A., T165, 695
Smeianov, V., 46
Smith, A. E., 235
Smith, B. I., 251
Smith, D. M., 411
Smith, E. A., 234
Smith, G. W., W156, W222, TH162
Smith, H., TH225
Smith, J., T28, 244
Smith, J. F., TH171, 80, 81
Smith, K. E., TH33, 512
Smith, K. L., T183, T184, 77
Smith, M. F., W143, W162, W168, W170, 652, 717, 718, 722
Smith, P. G., 330
Smith, R. M., 293, 689
Smith, S. B., TH58, 63, 149
Smith, T. K., W60, 301
Smith, T. P. L., W54
Smith, T. S., 548
Smith, W. A., 237
Smithers, G., 642
Smits, M. C. J., 308, 591
Sniffen, C. J., W231, 329
Snowder, G. D., 385
Snyder, L. L., 698
Soares, J. A., 561
Soares, M. P., TH106
Soares, T., T235
Soberon, F., T101, 450
Sobreira, G. F., TH247
Sobreira, N., TH185
Socha, M. T., TH240, 102
Soder, K. J., 269, 435
Sodré, L. R. A., 313
Sofos, J., 543
Solaiman, S., T278
Solans, A., W176
Soledad, M. C. M., T57
Solis, D., 654
Sollenberger, L. E., TH48, TH50, 545, 598
Solomon, M., T125
Soltani, A., 584
Somkuti, G., W75
Somkuti, G. A., W77
Sommerer, D., T268
Somni, H. S., 43
Song, D., W82, TH23
Song, M., T158, 773
Song, X. Y., W125
Sonnenberg, T. D., TH69
Sonstegard, T. S., 261, 524
Sorensen, M. T., TH105
Soria-Flores, A. I., W237
Soriano, S., W157, TH185
Soster, D., TH106
Soto-Navarro, S., W93, W94
Southern, L., 104
Southern, L. L., TH149
Southwick, L. H., 249
Souza, A. H., W172
Souza, N. K. P., T250, T251, TH218
Souza, S. F., T243, T276, W251
Souza, W. F., W236
Sowerby, M., T67
Soyeurt, H., 612, 613, 614
Spain, J., W213
Spain, J. N., 57
Spangler, D. A., T98
Spangler, M. L., 651
Spanu, G., T246
Spears, J. W., 67, 99
Speidel, S. E., 750
Spelman, R. J., 409
Spence, C., TH128
Spencer, J., TH150
Spencer, J. D., T164, 564, 700
Spencer, K., 570
Spiehs, M. J., 311, 724
Spiller, S., W50, 570, 759
Splan, R. K., 502, 504
Spooner, H. S., 549
Sproul, A., 392
Sproul, N. A., W270
Spurlock, D., 70
Sreenan, J. M., TH230
Stabel, J. R., 50, 154
Stabenow, B., TH63
Stahl, C. H., 121, 157, 661
Stalder, K., 359, 361, 534, 754
Stalder, K. J., W300
Stallings, C. C., T66
Staniar, W. B., 442
Stanko, R. L., 317
Stanton, A., 386
Staples, C. R., T81, T222, W196, 323, 324
Starkey, J. D., 122
Steadham, E., T126
Stebulis, S. E., T262
Steele, J., 46, 136
Steele, J. L., W80, 23, 45
Steibel, J. P., 526
Steidinger, M. U., 773
Stein, H. H., T136, T158, TH139, 208, 210, 561
Steiner, T., 707
Stella, T. R., TH214
Stelwagen, K., 453, 805
Step, D. L., W4, 390, 393
Steri, R., 617
Sterle, J. A., 364
Stern, M. D., 588
Stevens, J., 785
Stevens, J. G., 698
Stevens, S. L., T71
Stevenson, D. M., T262, 340
Stevenson, J. S., W191, 720
Stevenson, M. J., TH255
Stewart, A., T268
Stewart, B., TH38, 95, 96
Stewart, F., W100
Stewart, L. L., T136, T158
Stewart, T., 570
Stewart, Jr., R. L., TH266
St-Gelais, D., 516
Stika, J. F., 401
Stobart, R., 759
Stoffegen, W., 292
Stone, W. C., W186, 93
Stoop, W. M., 611
Stothard, P., 410, 768
St. Pierre, N., 106
St. Pierre, N. R., 223
Strang, B. D., W223
Streeter, M. N., 460
Stricker, C., 6
Strickland, J. R., TH12, 2, 3
Stricklin, W. R., 255, 377
Strohbehn, D., 432
Stuska, S. J., TH85
Suarez, B., 486
Subramanian, A., 48
Such, X., T212, 498, 821
Suchomel, J. M., 378
Sui, Q., 647
Sulabo, R. C., 158, 777, 778
Sullivan, K. E., TH131
Sullivan, M. L., 753
Sultan, J. I., 98, 731
Summer, P., TH265
Summers, C. R., T289
Sumner, J., 280, 281
Sun, P., T132
Sunny, N. E., W138
Suryawan, A., 279
Susin, I., T273, TH278, TH284, TH285, TH288, TH289, TH290, TH291, TH292, TH293
Sutherland, M. A., TH171, 243, 244
Sutton, A. L., 312, 698
Suwanasopee, T., W34, W35
Suzuki, M., T24, T30
Svendsen, J., TH61
Swann, J., TH133, TH134
Swanson, K., 453
Swanson, K. C., W234, TH229
Swanson, K. S., 177, 178
Swartz, H. A., T268
Swecker, Jr., W. S., TH39, TH43, 464, 465
Sweeney, T., W286, 703
Swingle, R. S., W245, 735
Swinker, A., TH88, TH89, TH90, TH91
Swyers, K. L., W242
Syed Reza, M. A., W31
Szabó, F., W17, W32, W33, W36
- ## T
- Tager, L. R., 478
Tahmasbi, I., T15
Tahmasebi, A., TH220, TH221
Taibl, J., 570
Tallon, R., 427
Tamburini, A., W99
Tan, B. E., W125, W287, W288, W289
Tanan, K. G., 221
Tang, W. J., W125, W140, TH155, TH159
Taniguchi, M., 55, 788
Tao, S., 457
Tapia-Gonzalez, J. M., T84, W230
Tashakkori, T., TH272
Tassoul, M. D., W95, W214
Tauc, S. A., 479, 480
Tauzel, J. P., W186
Tavendale, M. H., W63
Taylor, A. R., TH94
Taylor, J. F., 524
Taylor, S. J., T263
Taylor-Edwards, C. C., W253, TH79
Taysom, D., T87
Tedeschi, L. O., T266, TH82, TH106, 212, 229, 309, 463
Tedó, G., T134
Teixeira, I. A. M. A., T276, T277, T281
Tejido, M. L., T248, TH212

- Tekippe, J. A., 129
 Telles, E., T119
 Tempelman, R. J., 7, 222, 526
 ter Wijlen, H., W215
 Terre, M., W5
 Terrill, T., T285
 Terrill, T. H., T40, T271, 494
 Terry, E., W261
 Teter, B. B., 119
 Tetrick, M. A., 419
 Tewolde, A., 672
 Tewolde-Medhin, A., T84
 Thain, D., 411
 Thaler, R. C., TH145, 562
 Thatcher, A., 555
 Thatcher, W. W., T222, W155, W171, 323, 324
 Theil, P. K., T260
 Thering, B., TH103
 Thivierge, C., TH239
 Thomas, D. L., 499
 Thomas, M., TH66
 Thomas, M. D., W270, 392
 Thomas, M. G., T186
 Thompson, V. F., 557
 Thomson, D. U., 392
 Thorn, B., 534
 Thorson, J. F., TH97, TH98, 286, 287
 Throop, C., 387
 Thurgood, J. E., 49
 Tilbrook, A. J., 671
 Timms, L. L., 252, 254, 305
 Tipton, S. G., 548
 Tirabasso, P. A., TH284, TH285
 Titus, J. G., TH110, 123
 Todd, R. W., 310
 Tohno, M., 22, 610
 Tokach, M. D., T128, W132, TH124, TH132, TH145, 158, 195, 562, 697, 775, 777, 778, 786
 Tomasula, P. M., T49
 Tomaszewski, M. A., 318, 752
 Tomlinson, D. J., 102, 667
 Tong, J., 691
 Tong, J. F., 277
 Tong, P., TH31
 Tong, P. S., W89
 Tonhati, H., T25
 Tooker, M. E., 522
 Toosi, A., 407
 Topper, D., TH256
 Topper, P. A., TH256
 Torrence, M. E., 542
 Torrent, T., W176
 Torrentera, N., W252
 Torres, A., 267
 Torres, D., TH111
 Torres N., F. G., W58, W59
 Torres, Jr., R. A. A., W46, 215
 Torrey, S., T104, 242
 Tossenberger, J., W114, W115, W116
 Tournier, C., 176
 Townsend, J., TH13
 Tramontana, S., TH114, 683
 Tramontini, R. de C. M., T83, T234
 Traylor, S. L., 417
 Trejo, C., 389
 Trejo, C. O., W20, 211
 Tremblay, G. F., 185, 186, 794
 Trenkle, A., 668
 Trenkle, A. H., 727
 Treviño-Ramírez, J. E., W104, W105
 Trevisi, E., T223, T224
 Tricarico, J. M., TH266
 Trott, J. F., 685
 Trottier, N. L., 288, 289
 Trujillo, A. J., 821
 Trujillo, J. D., 253
 Tsai, C. C., W301
 Tsai, T. C., T156
 Tseng, Y. C., W76
 Tsuruta, S., T26, W46, 17, 18, 532, 535, 620
 Tucker, C. B., 87
 Tuminello, L., T55, 540
 Tunick, M. H., T49
 Tuñon, G., 486
 Turgeon, O. A., W246
 Turgeon, S. L., 516
 Turiello, P., T286
 Turner, L. G., T289
 Tyler, P. J., W149
- U**
 Udabage, P., 643
 Udabage, S., 646
 Ugarte, C. E., W63
 Ullrey, D. E., 631
 Ulmer, R. R., 268
 Ulrich, B. T., 657
 Umberger, C., TH68
 Underwood, K. R., 277, 691
 Undi, M., W100, TH264, TH52
 Unruh, J. A., T123, T124
 Urano, F. S., T273, TH278, TH289, TH290, TH291, TH293
 Urban, J. F., 696
 Uriarte, J. M., W241, TH147, TH148
 Uruakpa, F. O., W82
 Usry, J. L., 201, 774
 Utsumi, S. A., W93, W94
 Uwituze, S., 344
- V**
 Vaccaro, M., W197
 Vachiéry, N., TH14
 Vaddella, V. K., 307, 341
 Vafa, T., T225
 Vahdani, N., T242, TH286, TH287
 Vakili, A. R., W257
 Valadares Filho, S. C., T120, T250, T251, W235, W236, TH218
 Valdes, E. V., 180
 Valdez, F. R., TH124
 Valencia, D. G., T106, T107, W118, TH138, 206, 297
 Valencia, E., W247
 Valenzuela-Soto, E., W79
 Valizadeh, R., T225, T233, TH248
 Valkeners, D., TH249
 Vallejo-Cordoba, B., W79
 Valls, N., W176
 Van Amburgh, M. E., T195, T265, TH57, TH69, 450
 van Arendonk, J. A. M., 611, 615
 Van Campen, H., 746, 747, 748, 750
 Van den Borne, J. J. G. C., 203
 Van der Meulen, J., TH7
 van der Land, H. A., T185, 75
 van Duinkerken, G., 591
 Van Eenennaam, A. L., TH17
 Van Emon, M. L., TH282
 Van Hekken, D. L., T49
 van Heugten, E., W128, TH136, 197, 709
 van Hooijdonk, A. C. M., 615
 van Kempen, T., W128
 Van Kessel, J., T28
 Van Slyke, T., 481
 Van Soest, P. J., TH57, 187
 Van Tassel, C., T28
 Van Tassell, C. P., 261, 524
 van Valenberg, H. J. F., 615
 Van Vleck, L. D., 533
 Van Wagener, H. C., 628
 van Zijderveld, S. M., 337
 VanBaale, M. J., 88
 VanCampen, H., 749
 VandeHaar, M., TH115, 687
 Vander Pol, K., W246
 Vander Pol, M., 341
 Vanderman, K., TH88, TH89, TH90, TH91
 vanderVoort, G., 771
 Vann, C., T67
 Vann, R. C., TH205, TH207, 317, 374, 576, 577, 578
 VanRaden, P. M., 261, 522, 523, 524
 Vanzant, E. S., W253, TH75, TH79, 174, 665, 730
 Vardhanabhuti, B., W68
 Varel, V., 725
 Varel, V. H., 311
 Varga, G., 315
 Varga, G. A., T196, TH254
 Vargas-Rodríguez, C. F., 653
 Varner, G., 164
 Varona, L., W41, W52, 760
 Vasanthan, T., 710
 Vasconcelos, J. L. M., T182, W157, TH185
 Vasconcelos, J. T., TH226, 459, 608, 789
 Vasiljevic, T., 511
 Vasquez, P., W185
 Vaughn, J. O., 705
 Vazquez, E., W240, W241
 Vázquez, F., W96
 Vazquez, O., W96
 Vázquez-Añón, M., W207, W213, 33, 469
 Vazquez-Gonzalez, C., T241
 Veeger, A. I., 501
 Végvári, G., 704
 Veira, D. M., W193, 153, 814
 Veiseth, E., 559
 Velayudhan, B. T., TH108
 Velazquez, E. A., W266
 Velez, I. C., 283, 284, 715, 719
 Velleman, S. G., TH59
 Vendramini, J. M. B., TH48, TH50
 Veras, M. B., TH185
 Vereijken, P. F. G., 591
 Vernet, J., T229
 Versemann, B. A., T117, TH228
 Versteeg, C., 642, 643, 647
 Vester, B. M., 177, 178
 Vestergaard, M., T193
 Vicini, J. L., T189
 Vierck, J., 281
 Vignola, M., TH109, 694
 Viguera, J., 689
 Vilela, A. P., T103
 Villagran-Torres, D., W113
 Villalba, J. J., 383
 Villamide, M. J., T111
 Villareal, J. A., TH275
 Vines, K., TH89
 Vineyard, K. R., 447
 Viotto, W. H., TH18
 Visker, M. H. P. W., 611, 615
 Vitali, A., T4
 Vitti, D. M. S. S., T235
 Vogel, G. J., 735
 Volk, M., W98
 von Bernuth, R., W177
 von Keyserlingk, M. A. G., W193, W198, W201, 87, 153, 814
 Vonnahme, K. A., T228
 Vukasinovic, N., T32
 Vyas, D., TH267
- W**
 Waggoner, E., 130
 Wagner, B. A., 319, 484
 Wagner, E. L., TH86, 444
 Wagner, G. W., 455
 Wagner, J. J., 100, 101, 213, 218, 321, 746, 747, 748, 749, 750
 Wahlberg, M. L., 502
 Waldron, B. L., 273
 Waldron, D., 759
 Waldron, D. F., TH274
 Waldron, M. R., 121
 Walker, C. E., 218, 737
 Walker, G., 101
 Walker, N., W294
 Walker, P., TH151
 Wall, E. H., TH110, 449, 554
 Wall, R. J., TH64
 Wallace, R. L., 667
 Waller, J. C., TH40, TH41
 Walraven, T., TH127, 199, 712
 Walsh, R. B., 716
 Walters, K., 475
 Waltman, L., W222
 Walton, J. S., 716
 Wan, J., 647
 Wang, A., T34
 Wang, B. W., T130, T132, T133, W48, W129, W134, TH120
 Wang, C. M., 276
 Wang, J. K., 291, 358
 Wang, J. P., TH206
 Wang, J. Q., T2, T29, T171, T172, T205, T206, T207, T215, T218, T230, T231, T232, T255, T279, W90, W224, W277, W278, W279, W280, TH70, TH206, TH219, TH233, TH236
 Wang, J. Z., W291
 Wang, K. N., TH129, 198
 Wang, L., T132, W48, TH160, TH236
 Wang, L. Q., TH236

- Wang, M. H., TH153
Wang, Q. L., T132
Wang, S. X., TH130
Wang, W., W124, TH130
Wang, W. C., TH157, TH158, 781
Wang, Y., T145, T146, T153, T154, T160, W141
Wang, Y. C., T132, T133, W48, W134
Wang, Y. J., W234
Wang, Y. Q., 250
Wang, Y. Z., 291, 358
Wang, Z., T269, T270, 345, 410, 768
Ward, A., 181
Ward, A. M., W65
Ward, R. T., T88
Warren, L. K., W102, 447, 448, 550
Wasdin, J. G., W37, W38, W39
Washburn, S. P., W71, W153, 236, 765
Wasmuth, E., 696
Watson, C. J., 809
Watson, D. M., W71
Watson, D. W., W71
Watson, K. C., TH99
Wattiaux, M. A., W184, 367
Weaber, R., 432
Weaber, R. L., W40, 746, 747, 748, 749, 750
Weakley, D., 184
Weary, D. M., W193, 153, 814
Weaver, E., TH8
Webb, G. W., TH84, 285
Weber, T., 292
Weber, T. E., TH128, 784
Weedman, S., T73
Weeks, H. A., TH68
Weems, C. W., 477
Weems, Y. S., 477
Wehnes, C., TH10
Wei, H. Y., T2, T29, T171, T172, T205, T206, T207, T215, T218, T230, T231, T232, T255, W90, W224, W277, W278, W279, W280, TH70, TH206, TH219, TH233, TH236
Wei, X. X., T132, T133, W48, W134
Weidgraaf, K., W63
Weigel, D. J., W246
Weigel, K. A., T103, TH237, 10, 11, 83, 408, 625, 766
Weiler, H., TH109
Weimer, P. J., 37, 340
Weiss, W. P., 466
Welch, C., 389
Welch, C. M., 799
Welch, R. M., 696
Welcome, F., 481
Welkie, D. G., 340
Welles, E. G., TH133, TH134
Wells, J. E., 311
Welper, M., 114
Welsh, C., W50, 570, 759
Welsh, J. L., T66
Welsh, Jr., T. H., T173, W24, TH205, TH207, 74, 152, 317, 374, 576, 577, 578
Wen-Xuan, W., 103
Werner, J., TH91
Werner, J. R., 235
Wertz-Lutz, A. E., 668
West, J. W., 59
West, M., T69
Wester, T. J., W63
Weström, B. R., TH61, TH62
Wettemann, R. P., W146, W147, TH165
Whalon, M. E., 360
Whang, K. Y., T145, T153, W283, W284, W285, TH122, TH142
Wharton, M. D., T112
Wheeler, E. F., TH256
Wheeler, T. L., W54
Wheeler, T. T., 805, 807
Wheelock, J. B., TH161, TH163, 86, 88, 373
Whisenhunt, B., T169
Whisnant, C. S., T175, W153
Whitaker, B. D., 567
White, B. J., 392
White, H., TH150
White, M. E., TH76, TH77, TH78
White, R., 106
White, S. N., 348
White, T., W47
Whitehead, T. R., TH128
Whitley, N. C., T271
Whitlock, D. A., W164
Whitlock, R., T28
Whitlock, R. H., 482
Whitlow, L. W., W222
Whittier, J., 432
Whyte, T. D., 586
Wick, M. P., T36, TH59
Wickersham, T. A., TH49
Widel, P. W., 247
Widjaja, H. C. A., TH7
Widowski, T., 242
Wiegand, B., TH225
Wiegand, B. R., T117, TH228
Wierenga, K. T., T99
Wiggans, G. R., 261, 524
Wilcox, C. S., TH3
Wildeus, S., TH279, 759
Wilken, M. F., 798
Wilkins, D., 518
Wilkinson, J. R. C., 479, 480
Wilkinson, T. W., 170
Willard, S., T3, 389, 573
Willard, S. T., TH181, TH207, 317, 374, 576, 577, 578
Willenburg, K. L., 569
Williams, C., W182, 104
Williams, C. A., TH95, 446
Williams, C. C., 58
Williams, C. M., 765
Williams, G., 231
Williams, G. L., T186, 283, 284, 715, 719
Williams, J., TH225, 637
Williams, J. L., 630
Williams, K., W145
Williams, S., W276
Williams, S. B., 192
Williams, S. C., 565
Williams, S. M., 776
Williamson, L. M., 442
Willis, G. M., T198
Wilson, C., TH52
Wilson, D., TH225
Wilson, D. G., 125
Wilson, D. J., 249, 253, 652, 717, 718, 722
Wilson, F. A., 279
Wilson, K. R., 789
Wilson, M. E., 478
Wiltbank, M. C., W158, W165, W172, TH240
Winand, N. J., 548
Winkelman, L. A., T184
Winkler, C., 153
Winston, D. R., 110, 127, 234
Winterholler, S. J., 589
Winters, T. A., T169
Wirth, T., 304
Wise, T. H., TH170
Wiseman, J., TH16
Witherspoon, J. M., 551
Wittenberg, K. M., W100, TH52, TH264
Woda, A., T167
Wohlt, J., TH195
Wolf, C. A., 90
Wolfe, S., TH172
Wolter, B. F., 36
Wood, C. H., 546
Wood, C. M., 502, 504
Wood, K. M., TH229
Woodward, A. D., 288, 289, 551
Woodward, B. W., 403, 405
Woodward, J., 716
Woodworth, J. C., T109, T110, T113
Worku, M., T11, W85
Wormuth, J., W14, 386
Woyengo, T. A., 190
Wrenn, B., 587
Wright, C., 432
Wright, E. C., W146, TH165
Wright, J. R., T18, T19, T21, 10, 13
Wright, S. D., 572
Wu, C., 291
Wu, G., TH58, TH154
Wu, G. Y., W125, W287, W288, TH157, TH158, 781
Wu, T., W141
Wu, X., TH160
Wu, X. P., T130, W129, TH120
Wu, Y. M., 358
Wu, Z., 107, 793
Wulff, F., T268
Wuliji, T., T63, T78
Wuthronarith, V., W178
- X**
Xavier, C. V., T250, T251
Xia, N., TH236
Xia, X., TH129, 198
Xian-Lin, X., 103
Xie, C. Y., TH160
Xin, H. S., T203
Xu, C., T160
Xu, H. J., W125, W140, TH155
Xu, P. W., W140
Xu, Z., T160, W141
Xue, Y., 3, 76
- Y**
Yagci, A., T180
Yamamoto, M., 122
Yamamoto, S., 122
Yamauchi, K., W19
Yamka, R., W61
Yamka, R. M., W62, 174, 421
Yan, X., 277
Yancey, J. W. S., T109, T110, T112, T113
Yang, H., 294
Yang, J., 662
Yang, Q., 470
Yang, S. L., T205, T206
Yang, W. Z., T199, W217, W254
Yang, X., T160, 40, 662
Yang, Y., T34
Yang, Y. X., TH153
Yang, Z. B., T131
Yang, Z. G., W48
Yantis, B., 570
Yao, G., W141
Yao, J., TH162, 714
Yao, K., TH154
Yapici, O., T174
Yaquob, M., 98, 731
Yasuda, K., 696
Yasue, H., T34
Yates, D. A., 460
Yavru, S., T174
Yelich, J. V., 375
Yi, X. W., 342
Yildiz-Gulay, O., T179, T180
Yin, F. G., W125, W288, W289
Yin, Y., W123, W124, TH130, TH154
Yin, Y. L., W125, W140, W287, W288, W289, TH155, TH156, TH157, TH158, TH159, TH160, 781
Ying, Y., W216, 580, 743
Yoder, M. J., TH85
Yokoo, M. J., W45
Yokoyama, M., W177
Yoo, J. S., T142, T143, T144, T145, T147, T148, T152, T153, T154, W137, TH123, TH142, TH143, TH144
Yoon, I. K., 369
Yoon, J. H., T157
Yoon, S. Y., TH153
Young, A., T69, T70
Yu, P., T194, W227, W280
Yu, S. H., T132, T133, W48
Yuan, Z. P., 342
Yucel, U., W68
Yue, B., T132, T133, W48, W129, W134
Yun-Guo, Z., 103
Yurgec, M., 138
- Z**
Zárate-Martínez, J. P., W161
Zacaroni, O. F., 323, 324
Zachut, M., TH179
Zaghari, M., W126, 204
Zahmatkesh, D., T190, W195
Zahrán, S. E., T72
Zaman, S., 307, 341
Zamuner, F., W236
Zandi, M. B., W30, W31
Zanella, E. L., W150

Zanella, R., T28, W150
Zanton, G. I., T236, 217
Zao, H., T131
Zavala-García, F., W104, W105
Zeinali, A., T140
Zeng, S., 345
Zeng, S. S., T272, W291
Zeoula, L. M., T219, T220
Zerbini, E., 384
Zerby, H. N., 350
Zhang, C. G., T2, T29, T171, T172,
W90
Zhang, C. M., 342
Zhang, H., T50, W291
Zhang, H. T., TH70
Zhang, L., T272, 474
Zhang, M. A., T130, T132, T133,
W48, W129, W134, TH120
Zhang, Q., T132, T133
Zhang, W., T37, W128, 690
Zhang, Y., 587
Zhang, Y. J., 198
Zhang, Y. Z., W287
Zhao, B., 662
Zhao, G. Q., T29, T171
Zhao, H., TH129
Zhao, S. G., T230, T231
Zhao, Y., TH129, 198
Zhou, J. C., TH129, 198
Zhou, L., 335
Zhou, L. Y., T2, T29, T171, T172,
T205, T206, T207, T215, T218,
T230, T231, T232, T255, W90,
W224, W277, W278, W279,
W280, TH70, TH206, TH219,
TH233, TH236
Zhou, T. X., T144, T152
Zhou, Y., 686
Zhou, Y. W., 335
Zhu, C. L., 191
Zhu, D., TH33
Zhu, M. J., 277, 472, 474, 691
Zhu, Y. X., T231
Ziaei, H., T140
Ziegler, B., TH188, TH189, TH190,
TH191, TH192, TH193, TH194
Ziegler, D., TH188, TH189, TH190,
TH191, TH192, TH193, TH194
Ziegler, G. R., T100
Zijlstra, R. T., 710, 783
Zimbelman, R. B., 86, 88, 108
Zinn, R., W252
Zitnan, R., W243
Zulewska, J., TH19, TH20, TH24,
510
Zumbach, B., 532
Zwieten, J., W271, 738

American Dairy Science Association
American Society of Animal Science

Subject Index

Abstract numbers preceded by T are Tuesday posters, numbers preceded by W are Wednesday posters, and numbers preceded by TH are Thursday posters; all other numbers indicate oral abstracts.

- A**
AAT/PBV system, TH268
Abomasal infusions, TH234
Abortion frequency, T21
Abscess, TH6
Absorption, TH93, 68, 69
Acacia mangium, W91
Acclimation, 375, 376
Acclimatization, T282
Accuracy, 349
Accuracy of proofs, 619
ACE-I peptides, 423
Acetate, TH68
N-Acetyl-cysteine, 567
Acid-base balance, 357, 789
Acid-base equilibrium, 790
Acid resistance, 45
Acidifier, 707
Acidogenic, 357
Acidomatrix, 699
Acidosis, 39, 76, 339, 608, 791, 792
Active dry yeast, W203
Active nutrient transport, 698
Acute lung inflammation, TH8
Acute phase protein, 390
Acute phase response, W27
Ad libitum feeding, 547
Adaptation, 23
Additive, T94, TH224
Adenosine triphosphatase myofibrillar, T121
Adhesion, T248
Adipocytes, T169, 122, 664
Adipokines, TH164
Adiponectin, T175, 71, 72
Adipose, 70, 280, 281
Adipose tissue, TH58, 63
Adjacent monocultures, TH39
Adjusted weaning weight, T62
Adjustment factor, 14
Admixed populations, 407
 β -Adrenergic receptors, 460
Adsorbents, W213
Adsorption isotherm, W72
Advising, 501
Aerobic stability, T89, T92, T93
Aflatoxin, W213, W222
African stargrass, W107
African wildcat, 178
Age at first calving, W148
Age at sexual maturity, W29
Age at the fattening period, T106
Aggression, 381, 382
Aging, T125, 78
 β -Agonists, W259
Agricultural by-products, W230
Agricultural teaching and extension, TH100
Alcohol, T261, W220, W229
Alfalfa, T78, T79, T201, 183, 184, 185, 186
Alfalfa hay, W257, TH246, 91
Alignment, 258
n-Alkanes, TH52
Allele frequency, 522
Alpine pasture, W99
Alternative dewormer, T270
Alternative feed, T250, T251
Alternative methods, 419
Amino acid, T136, T199, T237, W61, W62, W124, W288, TH257, 56, 201, 202, 221
Amino acid digestibility, T146, W136, TH268, 588
Amino acid metabolism, 76
Amino acid supplementation, W237
Amino acid transporter, TH157, TH158, TH160, 288, 289
 δ -Aminolevulinic acid, T153, T154
Amish, TH88
Ammonia, W128, W177, TH263, 204, 310, 703
Ammonia emissions, TH256, 591
Ammonia losses from manure, 307
AMPK, T169, 277
Amylase, W204, W226
Anabolic steroid, TH76, TH77
Anaerobic digestion, 305
Analysis, 602
Anatomy, T293
Ancylostoma, W58
Anemia, 303
Angiogenesis, TH110
Angiogenic factors, 472
Animal behavior, TH37
Animal breeder, 169
Animal breeding, 172, 627
Animal ethics, 256
Animal health, T71
Animal performance, TH81, 305, 545
Animal research, 416
Animal science, 164, 255, 362, 377, 400, 401, 508, 605
Animal use, 257
Animal welfare, 243, 244, 255, 257, 377, 519, 520, 675
Anionic salts, TH241
Ant colony, 262
Ant colony algorithm, T37, 525
Anthelmintic, T270, 159
Antiadhesion, TH7
Antibiotic resistance, 395, 396, 709
Antibiotics, T72, W130, 336, 397
Antibodies, W10, W26, W260, W272, W273
Antigen-releasing device, T171
Antiinflammation, 610
Antimicrobial, T10, T12, 121
Antimicrobial activity, 26
Antioxidant, T203, W207, TH29, 302, 333, 446, 469, 567
Antioxidant micronutrients, 467
Apoptosis, 452
Apparent digestibility, W240, W241, 92
Appetite-regulating hormones, 435
Apple pomace, W111, W113
Apple waste, W112
Application, 398
Applied behavior, 377
Applied reproduction, 33
Arginine, TH58
Argonaute, W299
Artificial insemination, TH175, TH176, 11, 603, 652, 718, 722
Artificial insemination industry, 33
ASAS, 402
Assurance programs, 519
Asymmetry, W52
AT-ODN, 22
Audience, 659
Aujesky's disease, W298
Aureomycin, W6
Authenticity, TH28
Automatic milking system, 12
Autosort, 378
Availability, W114
Avena sativa, W104, W105
Average daily gain, 748
Avian nutrition, 635
Avian species, T36
B
B vitamins, TH239
Bacillus, T139, T164
Backgrounding diets, 726
Bacteria, T74, T100, 340, 653
Bacterial contamination, W174
Bacterial growth, T159
Bacterial peptidases, W75
Bacteriocin, 157
Banamine, 235
Banana plant, TH215
Barley, T137, T190, TH217
Barley grain, T233, 584
Barley straw, TH286, TH287
Barley variety, T194, W227
Barrier function, 595
Bayesian, W45
Bayesian analysis, W41, 406
Bayesian inference, T35
Bedding, TH143, 551
Bedding material, W180
Bedding treatment, W179
Beef, T62, T287, W23, TH71, TH72, TH213, TH232, 4, 61, 64, 147, 150, 373, 404, 410, 462, 464, 465, 599, 623, 638, 652, 691, 727, 804
Beef calf, W263, 392, 576
Beef cattle, T117, T247, W18, W36, W261, W267, W269, W270, TH40, TH218, TH226, TH228, 5, 148, 149, 273, 403, 412, 432, 436, 624, 629, 651, 746, 747, 748, 749, 750, 753, 756, 768, 789
Beef cow, W44, W162, W166, W170, TH165, TH225, TH229, 97
Beef heifer, W163, W168, TH41, TH198, TH199, 717
Beef model, W182
Beef quality, T60, 146
Beef quality audit, W23
Beef round, T126
Beef steer, W242, TH219
Beet pulp, T190
Behavior, W178, TH4, TH38, TH208, TH227, 240, 242, 320, 578, 754
Belly, T113
Belly flop, T112
Benzoic acid, 705
Bermudagrass, T81, T284
Betaine and CLA, T108, W136
Bifidobacterium, 45, 425
Bifidobacterium animalis ssp. *lactis*, 44
Binder, W222
Binding, W86
Bioactive peptides, W75
Bioavailability, TH126, 109, 196, 210
Bioenergetics, 215
Bioethics, 166, 167, 168, 255, 256, 257, 258
Biofuel, 151

- Biofuel co-products, 784
 Biohydrogenation, T238, T249, T256, T257, W207, 329
 Biophotonics, T3, 573
 Biopsy, TH115
 Biosecurity, 142
 Biotechnology, W183, TH17, 672
 Biotite, T148
 Birth weight, T176, 760
 Bite rate, TH203
 Blending, 140
 Bloat, W247, 383, 608
 Block-type process cheese, T47
 Blood acid-base balance, TH233
 Blood and milk, T171
 Blood gas, W4, W272
 Blood immunological, T144
 Blood indexes, T224
 Blood metabolites, 741
 Blood parameters, TH214
 Blood profile, T142
 Boar, W56, TH170, 569
 Boar production, 296
 Boar stud, 650
 Boar taint, 355
 Boar taint detection, T105
 Body, 141
 Body composition, T176, T276, T277, T281, TH64, 352, 770, 796
 Body condition score, W189, 741
 Body condition scoring, 656
 Body conformation, W300
 Body measurement, W42, W47, TH86
 Body structure, 534
 Body temperature, T5, TH207, 86, 389
 Body weight, W122, 532
 Boer cross, W239
 Bolus particles, 813
 Bone, 445
 Bone growth, TH237
 Bone lacunae, T253
 Bonnier's equation, W142
 Bootstrap, 117
 Boric acid, W177
Bos indicus, T119, TH214, TH231, 715, 719
 Bottom-up approach, T30
 Bovine, T34, T186, W143, TH12, TH74, TH75, TH177, TH244, 3, 664, 665
 Bovine α_{S1} -casein, 453
 Bovine embryo, TH181
 Bovine milk, 614
 Bovine respiratory disease, W4, W54, 390, 391, 393, 746
 Bovine temperament, 374, 578
Brachiaria brizantha, 438
 Brahman, 74
 Brahman bull, 317
 Brahman crossbred cow, 376
 Brahman crossbred heifer, W154, 375
 Brain, W55
 Bratwurst, TH150
 Bread, W112
 Breed, W17, 291, 669
 Breed effects, 630
 Breeding, 8, 173, 498
 Breeding and genetics, 170, 622
 Breeding management, 713
 Breeding season, TH198, TH199
 Breeding value, W32, W36
 Breeding value estimation, 523
 Breeds, TH277
 Brewers grain, TH142
 Broiler, T138, T140, T151, T154, W126, TH141, TH143, 204
 Broiler performance, 370
 Broilers, T152, 196
 Brown midrib, 93, T196
 Browse, 180
 Browser species, W96, W97
 BSP-A1/A2, TH172
 bST, T189, TH108
 Buffalo, W152
 Buffalo milk, W70
 Buffelgrass, TH294
 Buffer, TH293
 Buffering capacity, W74, W82
 Bulk density, 789
 Bulk milk, 483
 Bull, TH178
 Bull biostimulation, 479, 480
 Bull fertility, T20
 Butter, TH28
 BVD, 483
 BVDV, T174
 By-product, TH290, 53, 589, 798
- C**
 Caatinga, T276
 Calcium, TH120, 69, 192, 234, 330, 445, 540
 Calcium lactate crystals, T44
 Calcium oxide, TH292
 Calf, T115, T198, T201, W5, W6, W146, W221, TH68, TH69, TH70, TH187, TH205, TH217, TH258, 52, 128, 132, 155, 220, 221, 236, 319, 387, 390
 Calf health, W14, 232
 Calf starters, T193, TH190
 Calorimetry, 795
 Calpain, 290, 556, 557
 μ -Calpain, 690
 Calpain and calpastatin, 662
 Calving difficulty, W17
 Calving scheme, TH202
 Calving season, W17
 Canadian dairy breeds, 16
 Candidate gene, W53, W300
 Canine, 419
 Canola, TH288
 Canola meal, T181
 Canola oil, T115, T116, T225
Capoeta fusca, TH5
 Caprine, 249
 Capsicum, W271
 Capstone experience, 502, 504
 Captive breeding, 181
 Carbohydrase, T151
 Carbohydrate, T182
 Carbohydrate sources, 358
 Carcass, W23, W39, W245, W248, W265, 351
 Carcass characteristics, T111, T116, W259, 219
 Carcass composition, 413, 668
 Carcass gain, W236
 Carcass merit, 403
 Carcass performance, W246
 Carcass traits, W54, W275, TH134, TH148, TH222, TH275, TH276, 212, 730
 Carcass yield, 350
 Careers, 400, 401
 L-Carnitine, T109, T110
 Carnivory, 634
 Carob pulp, W127
 Carryover, TH245
 Cartilage, 700
 Carvacrol, T149
 Casein, 60, 643
 Casein genotypes, 616
 Caspase, W143
 Castration, 355
 Cat, 174, 177, 415, 421
 Cation-anion difference, TH233
 Cattle, T61, W4, W9, W10, W22, W27, W37, W38, W252, W253, W265, TH112, TH161, TH163, TH207, 96, 99, 100, 214, 302, 306, 313, 316, 320, 389, 409, 490, 575, 713, 733, 734, 735, 737, 790, 802
 Cecum flora, T132
 Ceed intake, W22
 Cell wall digestibility, T241
 Cellulase, T139
 Cellulose, W129, 37
 Centennial, 364, 552
 Central nervous system injury, 467
 Centrifugation, 285
 Cereal, T201, W118
 Cervical mucus discharge, T174
 Cervids, 572
 cGMP, T179, T180
 Challenges, 269
 Cheddar cheese, T43, T44, T45, 48, 134
 Cheese, T41, T42, T49, T54, T58, T59, T272, 49, 137, 424, 537, 539, 540
 Cheese flavor, T38, T46
 Cheese microbiology, T38, 135
 Cheese model system, 46
 Cheese ripening, T45
 Cheese slurry, 47
 Cheese yield, 538
 Chemical composition, T83, T96, T234, W230
 Chemoprevention, 41
 Chemotaxis, 334
 Chewing index, 812
 Chick weight, W49, W194
 Chicken, W48, W138
 Chickpeas, TH147, TH148
 Chinese herbal formula, W289
 Chinese yam, W287
 Chitosan, 512
 Chloride fertilization, T98
 Chlorine dioxide teat dips, 252
 Cholesterol, T122, W25, W35, W83
 Cholesterol removal, T47
 Choline, W219, TH107
 Chromium, W266, TH124, 125
 Chromium methionine, W267
 Chronic wasting disease, 572
 CIDR, W163
 CIDR insert, W191
 CIDR reuse, W159
 Cinnamaldehyde essential oil, W254
Cis-9, trans-11 CLA, T42
 Clarity, 512
 Classroom attendance, 507
 Claw lesion, 102
 Claw lesions, W296
 Climate change, 672
 Clock genes, T7, 160
 Cloning, TH17
 Close-up, T204
Clostridium, T164
Clostridium botulinum, W66
 Coastal bermudagrass, W103
 Cobalt, W274, 100
 Coccidiosis, 371
 Coconut, W137
 Coconut oil, 327, 341
 Cohesiveness, T58
 Cold stress, TH197, 321
 Colicin, 121
 Coliforms, T74
 Color, T127
 Colostrum, T100, W2, W5, W67, W85, W90, W153, TH168, 118, 128, 319, 387, 388, 648, 818, 822
 Colostrum replacer, W1
 Commercial herds, T62
 Commercial values, 15
 Common ancestors, T27
 Communications, T71
 Companion animal, 414, 416, 417, 422
 Comparative, 631, 635
 Comparative slaughter, 795
 Compensatory growth, TH117
 Competition, W198, 533, 814
 Complex I, T177
 Complex organic acid, T144
 Complex probiotics, T143
 Complexes, 516
 Composition, TH19, 180
 Compost, W175, 306
 Composted horse manure, 550
 Computer modeling, 421
 Concentrate, T239, TH247
 Conception, W157, 765
 Conception rate, T18, W158, W169, TH173, TH174, 17, 18
 Conceptus, W144
 Condensed tannins, W94, 188
 Conformation, 766
 Conjugated linoleic acid, T195, T202, T207, T214, T223, T224, W133, W134, W277, TH58, TH106, TH253, 21, 25, 47, 51, 110, 326, 682, 743
 Conservation, 399, 759
 Consumer acceptance, 61
 Consumer preferences, T43
 Contamination, 253
 Continuous culture, T249, 343
 Control, 264
 Controlled release, 426
 Conventional silage, T196
 Conversion, T161
 Cooling, 80

- Cooperative extension, 428
 Copper, W21, TH119, TH123, 66, 99, 195
 Copper amino acid chelate, 196
 Copper-molybdenum, T278
 Copra meal, T157
 Co-product, T65, T266, T273, TH225, TH291, 582
 Corn, W109, W226, TH217, TH264, 146, 147, 701, 798
 Corn dried distillers grains with solubles, TH269, 726
 Corn germ, 331
 Corn hybrids, W231
 Corn meal, T96
 Corn milling co-product, 579
 Corn oil, T109, T110, 600
 Corn particle size, W181
 Corn processing, 657, 729, 732
 Corn replacement, 803
 Corn silage, T84, T85, T86, T87, T88, T91, T92, T97, T98, W196, TH246, 91, 93, 182
 Corn stover, 238
 Cornell Net Carbohydrate and Protein System (CNCPs), T265
 Corpus luteum, W156, 477, 714
 Corpus luteum insensitivity, 714
 Correlation, W43, W47
 Cortisol, 156, 378, 479, 670, 671
 COT vascularity, 472
 Cotton mote, 799
 Cottonseed, TH288, 800
 Cow, T123, T124, W196, TH6, 60, 434, 476, 477, 597, 723
 Cow locomotion, W11
 Cow vs. sheep, 816
 CpG ODN, W150
 Crabgrass, T80
 Cream cheese, T48
 Creep feed, 778
 Creole cows, W161
 Creole goats, TH14
 Cribbing behavior, 547
 CRISPR, W80
 Crop milk, W65
 Crop residues, W244
 Crossbred, T17, 765
 Crossbred pig, W301
 Crossbred steer, T120
 Crossbreeding, W15, W16, 761, 762, 763, 766
 Cross-linked β -cyclodextrin, T47
 Cross-sucking, 236
 Crown rust resistance, W104, W105
 Crude glycerin, 784
 Crude glycerol, 292
 Crude protein, TH135, 204, 592
 CTGF, 686
 Culling, W187
 Culture, 251
 Curd moisture content, T56
 Curd size, T58
 Curriculum revision, 504
 Cutability, 295
 Cutting time, T78
 β -Cyclodextran, W83
 Cyclophosphamide, T160
 Cysteine, TH180
 Cytochrome P450, 478
 Cytokine, W8, TH128, 154, 234, 607
 Cytokine production, 368
- ## D
- Daily gain, 535
 Daily water intake, 755
 DAIReXNET, 431
 Dairy, T65, T67, T103, W178, W183, W204, TH270, 11, 70, 79, 106, 111, 130, 318, 323, 431, 492, 752, 761, 820
 Dairy breed, 485
 Dairy calf, T193, W1, TH3, TH188, TH189, TH190, TH191, TH194, 15, 666, 667
 Dairy cattle, T175, W192, TH4, TH13, 12, 80, 81, 83, 102, 108, 144, 263, 405, 457, 583, 611, 612, 613, 617, 793, 813
 Dairy cattle breed, T17
 Dairy cow, T4, T181, T199, T200, T208, T210, T216, T217, T219, T221, T225, T226, T228, T260, T261, W148, W155, W157, W164, W169, W171, W179, W180, W188, W189, W191, W217, W219, TH105, TH184, TH211, TH234, TH235, TH238, TH239, 56, 103, 145, 185, 188, 224, 233, 251, 301, 307, 337, 341, 581, 739, 742, 791, 792
 Dairy cow mortality, T1, T22
 Dairy form, 232
 Dairy goat, T211, T246, 105, 812
 Dairy heifer, TH192, TH193, TH195, 217
 Dairy Herd Improvement data, T172
 Dairy nutrition, W203, 53
 Dairy products, 642, 645
 Dairy professionals, T68
 Dairy replacements, 604
 Dairy sanitation, T69
 Dairy sheep, T212, 498, 499, 500, 821
 Dallisgrass, TH45
 Damascus goat, W67
 Darwinian selection, 395
 Database, T6
 Daughter pregnancy rate, T19, T22
 Days open, W148, 18
 DCAD, TH241, TH246, 106
 DDX3Y gene, T34
 Decision support, 90
 Deep-bedded hoop barns, 322
 Degradation, TH272, 277
 Degradation ratio, T194
 Dehorning, 235
 Delivery, 429
 Delta-like protein 1 (DLK1), TH59
 Density, T86
 Deoiled corn dried distillers grains, TH145
 Deoiled dried distillers grains with solubles, 56
 Δ^9 -Desaturase, 613
 Destoned olive cake, W228
 Development, TH63, 275
 Deworming, T268
 Dexamethasone, T7, W253, 160, 496
 Dextran sulfate, W68
 DGGE, T252
 DHA diet, W224
 Diamond V yeast culture, 742
 Dicer, W299
 Diet, T262, 353, 712
 Diet complexity, 777
 Diet density, W195
 Diet formulation, TH261
 Dietary additive, W288
 Dietary crude protein, W234
 Dietary electrolyte balance, 357
 Dietary fiber, 205, 356, 704
 Dietary protein, W140, TH137, 307
 Differentiation, 664
 Digestibility, T78, T80, T87, T95, T136, T206, T233, T240, T251, W96, W115, W116, W119, W208, W274, TH149, TH216, TH218, TH265, 38, 95, 174, 183, 184, 210, 325, 337, 344, 495, 582, 590, 598, 704, 731, 733, 799, 816, 817
 Digestibility in piglets, TH138, 206
 Digestion, T133, 420
 Digestion kinetics, 580
 Digestive tract histology, TH213
 Direct-fed microbials, TH213, 730
 Disappearance, T244, T245, W225, TH209
 Discrimination, TH238
 Disease, TH116, 115
 Disodium fumarate, 335
 Distance, 505
 Distance education, T289
 Distance learning, 170
 Distillers grains, T75, W239, TH146, TH226, TH265, TH284, 144, 148, 214, 311, 331, 344, 585, 657, 724, 727, 730, 798, 802, 803, 804
 Distillers grains with solubles, TH282
 Diurnal cut, 185, 186
 DNA methylation, 453
 Docosahexaenoic acid, T215
 Dog, W58, W59, W60, W62, W64, 175, 176, 415, 421
 Domestication, 414
 Doppler ultrasonography, TH9
 Dried bacterial cells, 774
 Dried distillers grains, TH151, TH283, 562, 565, 693, 784
 Dried distillers grains with solubles (DDGS), T99, W7, TH132, TH136, TH150, TH264, TH285, 210, 563, 564, 586, 587, 728, 786
 Drinkable yogurt, 112
 Drinking, TH2
 Drinking yogurt, TH18
 Dry matter, TH197
 Dry matter fluctuation, W273
 Dry matter intake, W223, TH52, 666, 814
 Dry matter recovery, T77
 Dry period, T185, W189, W205, 456
 Dry period length, TH116
 Dry-cured ham, 354
 Dry-rolled corn, T75
 Duck, W114
 Duodenal nutrient flow, T200
 Duration, 711
- ## E
- Early lactation, TH248
 Early-lactation cow, TH251
 Early-weaned calf, TH48, TH50
 Early-weaned steer, 211
 Early weaning, 575
 Early weaning tropics, TH200, TH201
 Economic trait, W47
 Economics, 654
 EDTA, 121
 EDTA challenge, 794
 Education, TH17, 501, 508
 Efficiency, T258, 126, 346, 670, 725
 Egg quality, T147, T153
 Egg weight, W49, W194
 Egg yolk, TH84
 Egg yolk antibodies, 695
 Eggs, T72
 EHV-1, T294
 EIA, T220
 Electron microscopy, T55
 Electronic identification, 507
 Electronic nose, T105
 Elongation, W135
 Embryo, W138, W144, TH180, TH184, 471
 Embryo developmental competence, TH177
 Embryo quality, TH230
 Embryo transfer, TH183, TH185
 Emissions, 658
 Emulsifiers, 42
 Encapsulated, T161, T162, W81
 Endocannabinoids, 477
 Endocrine, 198
 Endocrine control, TH168
 Endocrine regulation, 274
 Endocrinology, 399, 566
 EndoFighter TH41
 Endogenous, TH249
 Endophyte, 2
 Energetic efficiency, 771
 Energy, T280, T282, 207, 561, 706, 724
 Energy and protein requirements, 228
 Energy balance, T8
 Energy efficiency, TH101
 Energy intake, 702
 Energy level, W122
 Energy source, 136, 663
 Energy status, W199
 Energy value, W99, TH269, 701
 Enhanced distillers dried grains with solubles, 561
 Enriched housing, 379
Enterococcus, 709
 Enterolactone, T220
 Environment, 79, 83, 148, 361, 725
 Environmental covariance, 626
 Environmental sampling reliability, 482
 Enzyme, W204, TH69, TH146, 646, 694
 Enzyme supplementation, T165, 693

- EPA, W139
 Epithelium-free fat pad, 123
 Equine, T173, T292, T293, TH87, TH88, TH89, TH90, TH91, TH93, TH94, TH95, TH98, 28, 30, 282, 283, 284, 287, 442, 446, 546
 Equine curriculum, T288
 Equine genetics, 29
 Equine genome, 29
 Equivalency, W126
 Equivalent model, 621
 Ergot alkaloids, TH12
Escherichia coli, W85, 370, 573, 209
Escherichia coli adhesion, T159
Escherichia coli K88, TH7
Escherichia coli O157, T75
Escherichia coli O157:H7, T76, W260
Escherichia coli phytase, TH121
 Essence, 326
 Essential oils, T142, T145, W93, W94, W95, W214, W268, 738
 Esterified linolenic acid, 342
 Estradiol benzoate, 719
 17 β -Estradiol, T179, W172
 Estrogen, 78, 456
 Estrogen and progesterone, 685
 Estrous behavior, W192
 Estrous cycle, 473
 Estrus synchronization, W168, 652, 717, 718, 722
 Ethanol, 151
 Ether extract, TH82
 Ethics, 164
Euchsena mexicana Schrad, T130
 Eukaryotic expression, 781
 Europe, 416
 Excess crude protein, 565
 Excretion of copper and zinc concentrations, TH121
 Exercise, TH95, 446
 Exit velocity, 747, 748
 Exocrine pancreatic secretion, TH62
 Exogenous fibrolytic enzymes, W228
 Exopolysaccharide, T160
 Exotic species, 633
 Expected progeny differences, 7
 Experiential learning, 502
 Experimental design, 222, 223, 526
 Experimental designs, Experimental unit, 222
 Exponential model, W223
 Expression of ATP synthase and Na⁺/K⁺-ATPase, W234
 Extended lactation, 454, 617
 Extension, 34, 35, 36, 428, 429, 430, 432, 433, 651, 659
 Extension education, T70, 33
 Extension programming, 431
 Extruder-expelled soybean meal, TH254
 Extrusion, TH25
- F**
- Facility design, 241
 Faculty positions, 398
 FAMACHA, T268
 Farm animal, 246, 675
 Farm animal welfare, 259
 Farm plan, 142
 Farrowing, W34
 Fat, T204, W132, W253, TH231, 323, 324, 331, 333, 564
 Fat accumulation, W264
 Fat cow, T190
 Fat deposition, W53
 Fat feeding, T216
 Fat globule flocculation, 514
 Fat quality, T106
 Fat-soluble vitamins, 181
 Fat source, TH123
 Fat supplement, T102
 Fat supplementation, T211, 107, 332
 Fattening pig, W140
 Fatty acid, T42, T115, T122, T212, T222, T254, W55, W131, TH104, TH155, 63, 181, 324, 329, 464, 599, 600, 607, 612, 678
 Fatty acid biohydrogenation, T239
 Fatty acid composition, T108, T110, T112, T113
 Fatty acid kinetics, 329
 Fatty acid profile, T285, W25, W67, W279, TH281, 292, 517
 Fatty liver, W219
 Fatty liver weight, T132
 FDA, 266, 418
 Feather meal, TH133, TH134
 Feature selection, 262
 FEC, T271
 Fecal characteristic, T145
 Fecal malodor gas emission, T148
 Fecal microflora, T129
 Fecal noxious gas concentration, T142
 Fecal odor emission gases, TH122
 Fecal particle size, W210
 Fecal pollution, W174
 Fecal quality, 176
 Feed, 782, 815
 Feed acidifiers, TH188
 Feed additives, W203, TH188, 343, 734, 735
 Feed challenge, 740
 Feed conversion, W236, 314
 Feed efficiency, T119, W20, W182, W214, W269, W276, TH81, TH214, TH228, 728, 768, 769, 770
 Feed formulation, 783
 Feed intake, T247, W37, W38, W39, TH152, 327, 536, 624
 Feed management, T66
 Feed particles, 813
 Feed restriction, T286, W249, W250
 Feed safety, 265, 417
 Feed supplementation, TH46
 Feedbunk, 752
 Feeding, W178, TH208, 147, 637
 Feeding behavior, W276, 384
 Feeding frequency, T279
 Feeding level, 816
 Feeding management, W181, 315
 Feeding program, W121
 Feeding strategies, TH189
 Feedlot, T121, T191, W242, W245, W246, W249, W265, W268, TH222, TH285, 146, 213, 490, 729, 732, 749
 Feedlot beef cattle, 322
 Feedlot cattle, W237, W254, W266, 219, 311
 Feedlot performance, W267
 Feedlot sickness, 750
 Feedstuffs, W258
 Feet and leg structure, W300
 Feline, 419
 Feline nutrition, W63
 Female castration, T107
 Fenugreek, W202, 92
 Feral, TH85, TH171
 Fermentation, W271, TH212, 420, 738
 Fermentation characteristics, T133, W287
 Fermentation kinetics, T251
 Fermentation parameter, TH219
 Fermentation profile, T88
 Fermented milk, 41
 Fertility, T19, T33, T174, W50, W158, W194, TH279, 129, 237, 497, 568, 569, 723, 764
 Fertility and hatchability, TH166
 Fertilization, W108, 568
 Fertilizer, 131
 Ferulate cross links, 182
 Ferulic acid esterase, T95
 Fescue, TH9, 3
 Fescue toxicosis, TH11, TH12
 Fetal ovary, W143
 Fetal programming, 473
 Fiber, T266, T273, W128, W208
 Fiber diameter, T63
 Fiber digestibility, 182
 Fiber digestion, W278, 37
 Fiber measurement, TH274
 Fibrolytic enzymes, T241, W244
 Field peas, TH139
 Field studies, 224
 Field trials, 223
 FIL, 451
 Financial, T67
 Finished pig, TH156
 Finishing, TH42, TH43, 214
 Finishing cattle, 724
 Finishing phase, T118
 Finishing pig, TH133, TH134, 775, 786
 FIRE feeder station, 532
 First-calf heifers, TH200, TH201
 Fish meal, TH144, 201
 Fish oil, T202, T225, T249, W139, W277, W278, W279, 328
 Fixed-time AI, 721
 Flamingo, W65
 Flavor, T134, W71, TH20, 48, 49, 134, 777, 778
 Flavor chemistry, T46
 Flavor production, W79
 Flax product, T219
 Flaxseed, T228, 129, 325
 Fleas, W59
 Flight time, 624
 Flow cytometry, T264, TH173, TH174
 Flux chamber, 310
 Foaling, TH97
 Foam, 40
 Foliage supplements, TH102
 Follicle, W151, W152, W156
 Follicle dominance, W171
 Food, 111, 151, 543
 Food adaptation, 174
 Food animal, 167
 Food animal welfare, 256
 Food safety, T71, 113, 264, 266, 267, 418, 542
 Food safety research, 542
 Foodborne pathogens, 542
 Forage, T64, W108, W109, W274, TH43, TH223, 24, 38, 53, 271, 272, 273, 439, 464, 465, 599
 Forage allowance, TH44
 Forage-based, 269
 Forage:concentrate, 217
 Forage diets, 491
 Forage evaluation, 94
 Forage intake, TH48
 Forage level, T207
 Forage mass, TH46
 Forage nutritive value, W105
 Forage particle size, 736
 Forage proportion and particle length, T199
 Forage quality, W98, TH35, TH256
 Forage systems, 270
 Foraging, 383
 Foraging behavior, 435
 Foreign animal diseases, 267
 Formate, W218
 Formic acid, T141
 Foundation reports, 259
 Fourier harmonics, 569
 Fractionation, 657
 Free linoleic acid, T215
 Freeze-dried milk powder, T48, W72, W73
 Frequent milking, TH110, 449, 554
 Fresh cow, W195
 Frothy bloat, TH223
 Frozen-thawed boar semen, 570
 Fructan, 175
 FSH, W165, 571
 FTIR, TH22
 Functional foods, 425
 Functional genomics, 28
 Functional properties, 43
 Functionality, TH24, 20, 42, 139, 511, 538, 642, 644
 Funding, 32
 Fungi, T241, W244
Fusarium mycotoxins, W60, 301
 Future, 240, 299
- G**
- GAFS, W237
 Gain, W40
 Garlic, T269
 Gas production, W127, W238, W258, 801
 Gastrointestinal, T293, W130
 Gastrointestinal health, T138
 Gastrointestinal nematodes, T270, 494
 Gastrointestinal parasitism, TH14
 Gastrointestinal tract, TH249, 220

- GEBV reliability, 260
 Gel, 359, 515
 Gelation, 515
 Gender, 297
 Gene array, TH162
 Gene delivery, T36
 Gene expression, T37, T102, W21, W85, W141, W147, TH66, TH71, TH72, TH156, TH157, TH230, 75, 119, 120, 123, 427, 449, 457, 470, 554, 669, 678, 696, 788
 Gene frequency model, T35
 Gene regulation, 161
 Gene silencing, 553
 Genetic correlation, W33
 Genetic diversity, W57, 759
 Genetic evaluation, T25, T26, 4, 5, 10
 Genetic markers, T33, 7, 409
 Genetic parameters, T15, T24, 15, 533, 535, 612, 613, 616
 Genetic polymorphism, T2
 Genetic strain, 454
 Genetic transfer, 395
 Genetic trends, 628
 Genetic variants, 615
 Genetically modified traits, TH16
 Genetics, T6, W14, 35, 173, 263, 365, 531, 651
 Genistein, TH94, TH109
 Genome, 31, 627
 Genome selection, 7
 Genome sequence, 23
 Genome tools, 28
 Genome-wide association, 406
 Genome-wide selection, 260
 Genomic breeding values, 260
 Genomic prediction, 523, 524
 Genomic selection, T31, 6, 261, 263, 407, 521, 522
 Genomics, T8, T178, TH104, TH114, 278, 404, 410, 528, 553, 555, 605, 679, 681, 683, 770
 Genotype, TH155, TH276, 261, 522
 Genotype \times environment interaction, W46, 408
 Genotyping, 524
 Geraniol, W71
 Gestating sow, 379
 Gestation housing, TH186
 Gestation length, TH165
 Gestation stage, T21
 Gestation stall, W297
 Gestational overfeeding, TH80
 GFP, W77
 Ghrelin, 73, 496, 668
 GHRH, T186
 Gibbs sampling, 626
 Gilt, W121, W122, TH109, TH186, 534, 563, 571
 Globalization, 672
 Glucagon-like peptide-2, TH79
 β -Glucanase, T137
 β -Glucans, T170, 710
 Gluconeogenesis, TH67, TH163, 2
 Glucosamine, 744
 Glucose, TH3, TH68, TH87, TH257, 334
 Glucose absorption, 710
 Glucose metabolism, T216, T217
 Glucose transport, 44
 Glutamate, 669
 Glycemic, 442
 Glycemic response, 443, 444
 Glycerin, TH232, 490, 492
 Glycerol, T117, T198, T259, W132, TH216, TH228, 59, 489, 492, 785, 786
 Glycerol supplementation, 491
Glycine max, W235, W236
 GnRH, W169, 284, 720
 Goat, T227, T269, T274, T275, T277, T278, T280, T281, T282, T285, T286, W151, 72, 227, 228, 229, 345, 347
 Goat cheese, T254
 Goat kid, 823
 Goat milk, T272
 Goat milk cheese, T40
 Goat, Spanish Boer, 758
 Golestan and Mazandaran, T15
 Gompertz, W28
 Goose, W129
 Government agencies, 400
 GPS, 437
 GPx-1, 104
 Graduate, 171
 Graduate education, 170, 401
 Graduate students, 402
 Grain, 791, 792
 Grain legumes, 209
 Grain mixes and protein sources, TH192
 Grain processing, TH226
 Granulosa cell, 163
 Grass, W100, W106
 Grass quality, 308
 Grazing, T103, T274, W248, TH38, TH42, TH51, 130, 271, 272, 273, 325, 436, 439, 545
 Grazing behavior, W270, TH39, TH203, 73
 Grazing cages, TH52
 Grazing dairy cow, T213, T214, W197
 Grazing systems, 494
 Greenchop, T81
 Ground ear maize, T247
 Group feeding, TH187
 Growing lamb, 728
 Growing pig, T157, T158, W135, TH123, 771
 Growth, T134, T162, W2, W26, W28, W84, W146, W290, TH61, TH62, TH99, TH145, TH195, TH205, TH210, TH275, 58, 63, 132, 215, 275, 314, 351, 562, 596, 775, 776, 796
 Growth and carcass, 218
 Growth biology, 274
 Growth factor, TH180
 Growth hormone, T184, T186, T187, T188, 279
 Growth hormone gene-prokaryotic expression, 781
 Growth performance, T145, T148, W266, W283, TH121, TH122, TH127, TH133, TH141, TH142, TH147, 563
 Growth substrates for nonstarter lactic acid bacteria, 46
 Growth traits, W48
 Growth weight, W46
 Growth year, T194
 Guidelines, 674
H
Haemonchus, T269, 159
Haemonchus contortus, TH14, 758
 Hair sheep, W241, W259, TH276, TH278, TH289, TH290, TH291, TH292, TH293, TH294
 Hair sheep crosses, TH275
 Halothane genotype, W301
 Handling, T104
 Hanwoo, W42
 Haptoglobin, 235
 Hay, 96, 800
 Hay intake, 434
 Hay restriction, TH225
 Haylage, 598
 Hazard, W187
 Health, T6, W10, 87, 152, 225, 639, 823
 Health problems, 486
 Health status, 205
 Heart health, 638
 Heat, 594
 Heat detection/expression, 18
 Heat load index, 437
 Heat loss, 767
 Heat processing, W118
 Heat shock, TH164
 Heat stress, T26, TH161, TH162, TH163, TH206, TH233, 59, 80, 81, 82, 83, 84, 88, 108, 145, 373, 457, 620, 753
 Heat tolerance, 757
 Heated butter, TH34
 Heifer, T122, W153, W160, W198, W201, W249, W250, TH237, 54, 218, 601, 602, 603, 684, 720
 Heifer calf, W2
 Heifer replacement, 604
 Heifer rearing, T191
 Hepatic gluconeogenesis, TH161
 Herbage allowance, TH37
 Herbal product, W288
 Herbs, T268
 Herd expansion, T1
 Herd health, T61
 Herd performance, W295
 Herd size, T1, T60
 HERDA, 548
 Heritability, T22, T28, W30, W31, W32, W43, W45, 12, 530, 531, 615, 623
 Heterogeneous variance, 629
 Heterosis, 630, 762, 763
 Heterospermic insemination, TH176
 Hierarchical model, 757
 High-grain diet, TH290
 High-moisture corn, 191
 High-oil corn, T213, T214, W117
 High-oil sunflower meal, T245
 High pressure, 643, 644, 649
 High-pressure homogenization, TH27
 High-pressure processing, W66, 648
 High-producing Holstein cows, W165
 High-protein distillers grains, 233
 High-protein soybean meal, 208
 Hindgut, TH212
 Hippotherapy, 506
 Hispanic cheese, T39
 Histochemical staining, T121
 History, 298, 364, 441, 622, 713
 History of CES, 428
 HMBi, TH269
 Holstein, T15, T27, W220, 82, 127
 Holstein and Jersey, W199
 Holstein beef, 463
 Holstein cattle, W142
 Holstein heifers, W167
 Holstein steer, 309
 Holsteins in Japan, T24
 Hoof horn strength, 485
 Hoops, 754
 Hormones, 572
 Horse, T294, W102, TH9, TH11, TH85, TH92, TH96, 1, 31, 288, 289, 430, 441, 443, 444, 445, 547, 549, 551
 Hourly effective degradation ratio of N to CHO, W227
 Housing, W176, TH196, 87
 Housing system, W175, W180
 Housekeeping genes, TH103
 HPLC, T50, T72
 Human chorionic gonadotropin, W166, W167
 Human recombinant adenovirus, T36
 Human-animal bond, 414
 Hutch, 318
 Hyaluronan, TH183
 Hydrodynamic pressure processing, T125
 Hydrogenation, T255
 25-Hydroxyvitamin D₃, T150
 Hygiene environments, 408
 Hypercholesterolemia, 25
 Hyperelastosis cutis, 548
 Hypocalcemia, 794
 Hypothalamic-pituitary-adrenal axis, TH1
 Hysteresis effect, W74
I
 Iberian pig, T106, T107, T108, 297
 iButton, 85
 Ice cream, TH21, TH22, TH30, 649
 Ideal protein, 202
 Identification, TH88, TH89, TH90, TH91
 Ileal, W116
 Image analysis, T253
 Immune, 303
 Immune function, T173, W134, W287, 120
 Immune response, T278, W263, W285, W289, 385, 606
 Immune stress, T168
 Immune system, 822
 Immune supplement, 155
 Immunity, W221, 152, 156, 246, 323, 447, 575, 596, 811

- Immunocastration, 296
 Immunoglobulin, T100, T171, T172, W3, 118, 648
 Immunoglobulin A and immunoglobulin M, T29
 Immunoglobulin G, W1, 287, 388, 822
 Immunoglobulin G absorption, W5
 Immunomodulation, 52
 Immunosterilization in dogs, W150
 Immunosuppressed mice, T160
 Impact, 493
 Implants, 463
 Imported feed, 266
 Imported foods, 264
 In situ, T234, T236, T240, TH272, 589
 In situ degradability, T242
 In situ ruminal degradation, T99
 In vitro, T167, T240, W95, W229, TH53, TH54, TH55, TH56, 420
 In vitro culture, TH181
 In vitro digestibility, W102, W228
 In vitro fermentation, 238
 In vitro gas production, W97, W106, TH51, 440
 In vitro intestinal digestibility, T99
 In vitro model, T149, W119
 In vitro system, W262
 Inbreeding, T27, T32, 127, 628
 Inbreeding depression, W52, 760
 Incentive, T66
 Incidence, 486
 Incongruence, 258
 Incorporation, 523
 Index management, 650
 Indigenous chicken, W29
 Indigenous goat, T276
 Industry, 34
 Industry leadership, 167
 Indwelling catheters, W125
 Infant milk formulation, 513
 Infection, 811
 Inflammation, T169, 596, 606, 700
 Information, 433
 Infrared spectroscopy, TH28, 48
 Inhibition, TH112
 Innate immune activation, W11
 Innate immunity, 805
 Inoculants, T92, T97, W196
 Inoculums, W97
 Insecticide, TH203
 Insoluble aggregates, TH31
 Instructor, 505
 Insulin, T175, T182, T188, TH87, 373, 443, 478, 744
 Insulin-like growth factor-I, T187, TH76, TH77, TH182, 74, 686
 Insulin-like growth factor-I gene polymorphism, W48
 Insulin-like growth factor-I mRNA, TH78
 Intake, W271, TH11, TH47, TH102, 57, 330, 438, 579, 817
 Intake and growth, W254
 Intake pattern, 738
 Integrative vector, W77
 Intercropping, W108, W109
 Interferon, W145
 Interim evaluation, 10
 Interleukin 8, T170
 Internal marker, T77
 International, TH100
 Internet, 429, 430
 Internships, T292
 Interstate roads, W298
 Interval, 117
 Interviews, 398
 Intestinal bacteria, T73
 Intestinal epithelial cells, 610
 Intestinal inflammation, 595
 Intestinal microflora, W262
 Intestinal villi, T144
 Intestine, W129, TH156, TH160, 594
 Intramuscular fat, W44, 65
 Intravaginal device, T5
 Intravenous glucose tolerance test, W125
 Inulin, 696
 Investment analysis, 655, 656
 Involution, TH114, 687, 819
 Iodine, T54, T246, TH245
 Ionophores, TH293, 397
 Iranian Holstein, T13, T14, TH248
 Iron, TH126, 67, 99
 Iron status, T154
 Irrigation, W231, 130
 Islets, T188
 Isomer, TH250
 Isoproteic diets, W241
 IVF, TH175
- J**
 Japanese Black, W19
 Japanese quail, TH166
 JDIP, TH15
 Jersey, 763
 Jog, TH83
 Johne's disease, T28, TH15, 482, 484
Journal of Animal Science, 622
Juniperus monosperma, W93, W94
- K**
 Kalman filter, 625
 α -Ketoglutarate biosynthesis, W79
 Kids, W243
 Kinetics, 743
 Knots, 618
 Koala, 179
 Kurdi sheep, W28
- L**
 Labeling, 113
 Lactate, T127, 338, 339
 Lactating cow, T102, 584
 Lactating dairy cow, W213
 Lactating mice, 119
 Lactation, T23, T218, T258, TH104, 126, 280, 281, 536, 552, 555, 679, 807
 Lactation curve modeling, 618
 Lactation length, W295, 764
 Lactation performance, W211, W212, 583
 Lactation termination, T21
 Lactic acid, T90
 Lactic acid bacteria, W69, W75, W86, 21, 47, 641
Lactobacillus, W83, 425
Lactobacillus buchneri, T91, T93, TH224
Lactobacillus casei, 23
Lactobacillus gasseri, 22
Lactobacillus plantarum, T96
Lactococcus, W76
Lactococcus lactis, W79
 Lactoferrin, T2, T172, W90, 614, 647, 810
 Lactogenesis, 683
 β -Lactoglobulin, W68
 Lactoperoxidase, 647
 Lactose, W120, 699, 708, 787
 Lag time, 98
 Lahontan trout, 372
 Lamb, T80, W111, TH282, 332, 351, 494
 Lamb survival, 496
 Lameness, TH13, 153, 485, 751
Laminaria digitata, W286
Laminaria hyperborea, W286
 Land grant, 32
 Landes goose, T132
 Lasalocid, W6
 Lauric acid, T221, 341
 Laying hen, T146, T147, T153, TH140
 LC-MS/MS, 290
 Lead acetate, TH5
 Learning, 363, 505
 Leg action, 534
 Legal, 520
 Legislation, 518, 520
 Legume, 598
 Length of supplementation, T283
 Leptin, T183, 71, 237, 455, 668
 Levels of nitrogen, TH46
 LH, T187, W160, 283, 284
 LHRH vaccine, W150
 Light scattering, T56
 Lignin, TH57, 183, 184
 Lignocellulose, 356
 Likelihood, TH92
 Limestone, TH292
 Limited access time, 434
 Limit-feeding, 601
 Limit-feeding diets, TH193
 Limiting amino acids, TH131
 Linkage disequilibrium, 409, 410
 Linoleic acid, T207
 Linolenic acid, TH179
 Linseed, T208, T210, T212, T254
 Linseed oil, T205, T206, T209, W131
 Lipase, 70
 Lipid, T118
 Lipid peroxidation, W291
 Lipid enzymes, TH107
 Lipid oxidation, 24
 Lipid profile, T117
 Lipid secretary function, W140
 Lipid supplements, TH103
 Lipid transporter, TH105
 Lipogenesis, T218
 α -Lipoic acid, T128
 Lipolysis, T238, T256
 Lipopolysaccharides, 810
 Lipoprotein, W35
 Liquid calf feeds, W3
 Liquid diets, TH131
 Liquid hog manure, W100
 Litter size, 194, 570
 Litter weight gain, 369
 Live yeast, W212
 Liver, T227, W21, TH66, TH67, 2, 75
 Liver abscess, 608, 735
 Liver cancer, 162
 Livestock, T290, T291, 385
 Locomotion, 751
 Locomotion score, TH13
 Logistic regression, T13
 Long-chain omega-3 fatty acids, 24
 Long life, TH18
 Longevity, T16, 487
 Longissimus muscle, W44
 Longitudinal data, T25, W41, 625
 Low crude protein, T151
 Low-DCAD timothy hay, 794
 Low fat, T41, T46, T59, 134, 137, 138
 Low-fat Cheddar cheese, 136
 Low-fat cheese, T38, 135, 139, 140, 141
 Low-fat process cheese, 42
 Low-oligosaccharide soybean meal, 208
 LPS, TH94
 Lucerne, 98
 Luteolytic, TH169
 LXR, 677
 Lymphocytes, T7
 Lysine, W61, TH124, TH153, TH255, 203, 775
- M**
 Machine learning, T37, 525
 Magnetic resonance, 352
 Maintenance, 817
 Major mineral, T277
 Male effect, TH278
 Malic acid, T232, W224
 Malignant melanoma, 411
 Mammalian target of rapamycin, 279
 Mammary, TH108, 54, 552, 660, 684, 807
 Mammary cells, 678, 681
 Mammary development, TH109
 Mammary gland, TH105, TH106, TH107, TH115, 450, 452, 554, 687, 805, 819
 Mammary growth, 685
 Mammary involution, TH111, 453
 Mammary pregnancy cycle, 276
 Mammary stem cells, TH65
 Mammogenesis, 123, 687
 Management, T60, T61, T67, W176, W290, 818
 Manganese, 67
 Mannan oligosaccharide, T168
 Mannanase, T157
 Manufacture, T49
 Manufacturing protocol, 141
 Manure, W101, W173, W184, TH263, 131
 Manure composition, 189

- Manure odor, 311
 Manzarina, W111
 MAP, TH15
 Map QTL, T35
 Mapping, T43
 Marbling, 61, 62, 64, 65, 149, 691, 727
 Marker, TH149
 Marker-assisted selection, T30, 6, 261
 Marketing, 231
 Markhoz goat, W30, W31
 Mastication, T167
 Mastitis, T2, T9, T10, T12, T13, W179, 13, 143, 247, 249, 250, 251, 481, 609, 811, 820
 Maternal ability, W31
 Maternal effects, 626
 Maternal nutrition, 286
 Maternal obesity, 474
 Mathematical models, 617
 Maturity, T79
 Meal length, 444
 Meat, TH231, 227, 543
 Meat and bone meal, T253, 207
 Meat and fat quality, T114
 Meat attributes, TH280
 Meat duck, W134
 Meat goat, T283, T284, 346
 Meat quality, T104, T152, W301, 295, 558
 Meat quality and fatty acid profile, T107
Megasphaera elsdenii, 338, 339
 Melamine, 265
 Melatonin, 498
 Melengestrol acetate, TH73
 Melt character, T39
 Melt test, TH30
 Meltdown stability, TH21
 Membranes, 646
 Menadione, TH182
 Mentoring, 503
 Meta-analysis, TH102, 225, 592, 739, 742
 Metabolic, 248
 Metabolic disease, 609
 Metabolic reconstruction, 528
 Metabolic syndrome, 1
 Metabolism, T185, T235, T261, W123, W138, TH257, 67, 75, 246, 489, 679
 Metabolizable amino acids, TH267
 Metabolizable energy, W106, W117
 Metabolizable protein, T265, TH249
 Metagenomic, T231
 Metatarsal and rib bone, T156
 Methane, 79, 304, 308, 337
 Methane-producing activity, W275
 Methane release, T232
 Methanogenesis, 342
 Methionine, W218, TH147, TH148, TH239, TH250, TH255
 Methodology, 348
 Methods, TH53, TH54, TH55, 544
 Methyl donor, W218
 Metritis, W193
 Mexican dairies, 764
 Mexican hairless pig, W57
 MGA, W245, W246
- Mice, 767
 Micellar casein, TH24
 Microarray, T178, 30, 125, 289, 526, 527
 Microbial ecology, T158
 Microbial efficiency, T237
 Microbial fermentation, 740
 Microbial load, TH26
 Microbial phytase, T147
 Microbial population, T262, W282, 335
 Microbial profile, 772
 Microbial protein synthesis, T200, TH252, 745
 Microbiology, W64
 Microbiota, TH10, 136
 Microencapsulation, T149, T155, 426
 Microfiltration, TH33, 510
 Microflora, W294
 Microgravity, TH181
 Micromineral, 105
 Microparticulation, 511
 microRNA, W302, TH167, 161, 162, 163, 276
 Microsatellites, W57
 Microstructure, T55, 540, 559, 645
 Milk, T204, T246, W69, W74, W200, W222, TH26, TH27, TH247, 21, 113, 215, 233, 324, 333, 579, 644, 805, 821
 Milk and dairy products, 427
 Milk aroma, 187
 Milk coagulation ability, 616
 Milk components, TH106
 Milk composition, T209, T213, 194
 Milk digestibility, T219
 Milk ejection, TH112
 Milk fat, T215, T218, W186, W207, 51, 107, 640, 682
 Milk fat composition, 611
 Milk fat content, 812
 Milk fat depression, T195, T203, 327, 743
 Milk fat globule membrane, W86, W87, 641
 Milk fatty acids, T208, W217
 Milk fever, TH241, 234
 Milk processing, T289
 Milk production, TH115, TH185, 92
 Milk protein, W82, W186, TH255, TH267
 Milk protein composition, 615
 Milk protein production, 586
 Milk quality, T74, W88, W220, 481
 Milk recording, 500
 Milk replacer, T198, TH258, 58, 216, 221, 667, 684
 Milk replacer trace minerals, TH194
 Milk synthesis, TH114
 Milk traits, T223
 Milk urea, TH262, 591
 Milk urea nitrogen, 499
 Milk yield, T222, TH202, TH206, 89, 232, 328, 745
 Milk yield and components, TH254
 Milk yield response, 593
 Milking, TH113
 Milking frequency, T101, W195, TH111, 14, 450
- Milking interval, 14
 Milking techniques, T69
 Millennials, 363
 Mineral, W15, W16, W100, 179, 614
 Mineral composition, T40
 Mineral digestibility, 190
 Mineral metabolism, TH242
 Mitochondria, 769
 Mitochondrial efficiency, 767
 Mixed model, 4, 527, 621, 625
 Mixed probiotics, W283, W284, W285
 Mixed semen, TH176
 Mixing, 381
 Mobile nylon bag, W225, TH209
 Mobilization, T259
 Model, T244, T258, W22, TH51, TH273, 57, 126
 Model choice, W41
 Model selection, 527
 Modeling, T265, 189, 304, 308, 755, 796, 797
 Modified three-step in vitro procedure, 588
 Monensin, T286, W200, W268, W272, W273, 736
 Monensin concentration, W223
 Monitoring, 676
 Monounsaturated fatty acid ratio, W19
 Monozygous twins, W142
 Montbeliarde, 762
Morinda citrifolia, 52, 779, 780
 MorindaMax, 155
 Morning or afternoon grazing, W197
 Mortality, TH196
 Mortality rate, T4
Morus alba, W92
 MOS, T163, T166, 368
 Mothering ability, 529
 Motivation, 379
 Mouse, 682
 MPC, W89
 mRNA, W56, 104, 198, 686, 696
 mRNA expression, TH79
 mTOR signaling, TH154
 Mucuna, 159
 Multibreed, T23, W36, W39
 Multibreed evaluation, 630
 Multimedia, 365
 MultiMin W18
 Multinutritional blocks, T84
 Multiple lactations, 620
 Multiple trait random regression model, T26
 Multisubstrate, 694
 Multivariate analysis, T230
 Murine model, 250
 Muscle, T176, W19, W149, TH77, TH78, 558, 559
 Muscle cellularity, TH63
 Muscle development, TH59
 Muscle mitochondria, T177
 Muscle protein deposition, 662
 Muscle-derived cell, TH73
 Muzzle, 389
Mycobacterium avium ssp. *paratuberculosis*, 50, 154
 Mycoplasma, 143
 Mycotoxins, T98, W7
- Myoepithelial cells, 660
 Myosin, 459
 Myosin cross-linking, 560
 Myosin heavy chain, T126
 Myostatin, TH64, 691
 Myotube formation, TH59
- ## N
- NAIS, TH90
 Nano selenium, 103
 National dairy herd, T17
 Native casein concentrate, T52
 Native range, W270
 Native whey protein, TH33
 Natto, TH70
 Natural market, 463
 Natural vitamin E, 109
 Natuzyme, W126
 NBA, W293
 NEFA, 248
 Nellore, T243, W251
 Nellore cattle, T120
 Neonatal pig, 662
 Net energy, 782, 783, 795
 Net energy for maintenance, 321
 Net feed intake, T119
 Net flux, 393
 Net return, T283
 Neutral detergent fiber, T244, W95, TH56, TH57, TH227, TH260, 94
 Neutral detergent fiber digestibility, T79, W231
 Neutral detergent fiber digestion, TH53, TH54, TH55, TH56
 Neutrophil, T8, T11, 160
 Niacin, TH244, 108, 200
 Nicotinic acid, TH234
 Ningxiang barrow, W125
 Ningxiang pig, 781
 9th- to 11th-rib section, TH82
 Nitric oxide, 690
¹⁵N, T248
 Nitrogen, T229, W92, W98, TH151, TH263, 306, 589, 590, 790
 Nitrogen amendment, 550
 Nitrogen balance, TH253, TH266, 188
 Nitrogen digestibility, TH144
 Nitrogen efficiency, 189, 343, 592
 Nitrogen excretion, TH253
 Nitrogen fraction, TH272
 Nitrogen intake, 217
 Nitrogen loss, W184
 Nitrogen metabolism, T130, T226, W62, 78
S-Nitrosoglutathione, 690
 nNOS, T179, T180
 Nondomestic, 636
 Nonfiber carbohydrates, T192, TH211, 581
 Nonforage fiber, 585
 Noni, 779, 780
 Nonlinear mixed modeling, T236
 Nonlinear reaction norm, 757
 Nonprotein nitrogen, TH259, TH260, TH261, TH266, TH289
 Nonreturn rate, T18
 Nonruminant, 299, 469
 Nonstarch polysaccharide hydrolysis

- products, 695
 Nonstarter bacteria, 135
 Nonthermal, TH32
 Nonthermal processes, 642
 Northeast, 269
 Novel endophyte, 597
 Noxious gas, T143
 NPP, TH120
 NRC equation, TH99
 Number of motile sperm, 570
 Nursery, 777
 Nursery diets, TH139
 Nursery performance, TH186
 Nursery pig, T163, TH132, TH145, 773, 774
 Nutraceutical feed, W110
 Nutrient, W65, TH93, 131
 Nutrient composition, T64, 634
 Nutrient digestibility, W137, W284
 Nutrient digestion, T209
 Nutrient excretion, 199, 312, 712
 Nutrient modeling, 309
 Nutrient utilization, 797
 Nutrigenomics, T227, 125
 Nutrition, T178, W205, W256, TH85, 64, 89, 132, 278, 299, 415, 441, 606, 631, 636, 639
 Nutritional environment, 638
 Nutritional profile, 587
 Nutritional requirement, T281
 Nutritional value, W107
 Nutritional variability, 587
 Nutritive value, T82, W104, TH215, 697
 Nystatin, T11
- O**
- Obese ewe, 472
 Obesity, 1
 Obestatin, 73
 Odor, W128, TH256, 703
 Oilseeds, 332
 Oligonucleotide array, 819
 Omasal flow, 186
 Omega-3 fatty acids, T59, W135, W139, 49, 129, 447
 Omega-6, 447
 OmniGen-AF, 250
 Omnivore, 637
 On-farm research, 226
 On-farm systems, 226
 Oocyte, TH162, TH178, 145
 Oocyte quality, TH179
 Opioids, 723
 Optaflexx, 737
 Optigen, TH259, TH260, TH261, TH266
 Optigen II, TH262
 Optimization, 8
 Options, 519
 Oregano essential oils, T138
 Organ, W147
 Organ weight, T131
 Organic, T189, TH202, 89, 360, 820
 Organic acids, T45, T50, T76, T155, 705, 706, 708
 Organic beef, TH101
 Organic dairy, T68
 Organic fertilizer, W92
- Organic trace minerals, TH240, 101
 Organic zinc, 103
 Origin of heifer, TH195
 Osmolality, 176
 Osteopontin, 50
 Ovarian activity, W161
 Ovarian steroids, T180
 Ovariectomy, TH65, TH108, 660
 Ovary, 163
 Ovine, 249
 Ovine milk, 27
 Ovsynch, W164, W165, W172
 Ovulation, T185, W160, W167, 571
 Ovulatory follicle size, W168, W170
 Oxidation, 290
 Oxidative stability, 513
 Oxidative stress, W110, W261, TH95, 466, 467
 Oxygen consumption, 393
 Ozone, W98
- P**
- Palisade grass, T243, W251
 Pancreas, TH61
 Pancreatic β -cell MIF, 474
 Paneer, 541
 Panela, W78
 PAP, W25
 Parasites, T271, TH284
 Paratuberculosis, 484
 Parity, W293
 Particle size, W209, W211, TH30, TH138, 580
 Parturition, W149, TH165
 Passage rate, 95
 Passive immunity, 287
 Passive transfer of immunity, 118
 Pasteurization, W3, 653
 Pasture, T103, W193, TH42, TH43, 187, 272, 438, 448
 Pasture-based, 454
 Pasture systems, 545
 Pasture water-soluble carbohydrates, W197
 Pathogens, 481
 Paylean, T128
 PCR, T91, 288, 751
 PCR-TTGE, W294
 PCV2, 158
 PCVD, 158
 Pea protein concentrate, 206
 Peanut, TH288
 Pectin, TH291
 Pedagogy, 367
 Pedigree, TH92
 Pedigree analysis, T31
 Pedometers, TH39
 Pelibuey sheep, TH283
 peNDF, 384
Penicillium oxalicum Currie & Thom from goose, T133
Pennisetum purpureum, 440
 Perennial forage, W101
 Perennial peanut, W102
 Performance, T116, T193, W250, W252, W296, TH189, TH190, TH191, TH192, TH193, TH194, TH200, TH201, TH218, TH222, TH282, 487, 756, 773
- Perilipin, TH60
 Peripartum, 486
 Periparturient, 154, 609
 Peripheral blood mononuclear cells, W8, 607
 Peripubertal lambs, TH80
 Permeate, W89
 Persistency, 455
 Persistent follicle, W162
 Personal preparation, TH100
 Pesticide, W71
 Pet food, 418
 pH, T238, T239, W89, W255, TH221
 Phage, W76
 Pharmacokinetics, TH244
 Phenol compounds, W110
 Pheromone, 480
 Phlorizin, TH3
 Phosphorus, 601
 Phosphate, 68
 Phospholipids, W87
 Phosphorus, T66, T235, W115, TH130, TH237, 68, 551
 Phosphorus excretion, 107
 Photoperiod, 120
 Physical processing, W225, TH209
 Physiology, TH171, 566, 634
 Phytase, T150, T152, T156, 191, 192, 303
 Phytic acid, 190
 Phytobiotic, 707
 Phytoestrogens, 475
 Pig, T104, T111, T114, T128, T135, T141, T143, T150, T161, T162, T165, T166, T168, W34, W35, W50, W51, W117, W119, W120, W123, W124, W132, W136, W286, W290, W293, W299, TH2, TH61, TH62, TH125, TH128, TH130, TH131, TH135, TH136, TH139, TH142, TH146, TH149, TH153, TH159, TH160, TH167, TH171, 157, 197, 199, 201, 203, 208, 209, 241, 242, 243, 244, 291, 301, 312, 353, 354, 359, 360, 361, 378, 381, 406, 413, 468, 475, 529, 530, 561, 564, 565, 661, 693, 698, 699, 701, 702, 704, 705, 708, 710, 711, 712, 776, 779, 780, 782, 783, 787
 Pig fecal bacteria, 358
 Piglet, T134, T137, T155, W115, W118, W133, W281, W282, TH119, TH126, TH137, TH152, TH154, 190, 200, 205, 356, 707, 778
 Piglet gastrointestinal ecology, 695
 PigR gene promoter, T29
 Pine cone meal, TH140, TH141
 Placenta, W144, TH98, 470, 471
 Plant essential oil, W217
 Plant extracts, T141, W215, 220, 336, 739
 Plant materials, TH7
 Plant phenology, W107
 Plant tannins, W247
 Plasma lactose, 456
 Plasma protein supplements, TH8
- Plasmid, T3
Pleurotus, W230
 Plum curculio, 360
 PMB, T127
 Podcast, 366
 Pollutant, 658
 Polymorphisms, W53
 Polyphenols, W221
 Polyunsaturated fatty acids, TH236, 448
 n-3 Polyunsaturated fatty acids, TH230
 Pony, TH86
 Porcine adipocyte, TH60
 Porcine adipose triglyceride lipase (pATGL), W141
 Porcine plasma peptide fractions, W291
 Pork, T112, T113, 62
 Pork quality, 292, 293, 689, 785
 Portal, T229
 Portal flux, W124
 Postharvest, 150
 Postileal, W116
 Postinsemination, 716
 Postmortem, 557
 Postmortem changes, 558
 Postpartum, 479, 480
 Postpartum cow, T5
 Postweaning diarrhea, 157
 Potassium, TH242
 Potassium bicarbonate, 106
 Poultry, 371, 674
Poultry Science, 166
 PPAR- γ , 77, 681
 Prebiotic, T140, W84, 112
 Precision dairy farming, 655
 Preconditioning, 392
 Precursors, 149
 Prediction, T56
 Prediction equation, TH99
 Predictive model, T274
 Preference, TH136
 Pregnancy, 376, 470, 471, 476
 Pregnancy diagnosis, W190
 Pregnancy rate, 721
 Pregnancy success, 300
 Pregnant gilt, TH63
 Preimplantation embryos, TH182
 Prenatal nutrition, W146
 Prepartum feeding, T217
 Prepubertal, TH65
 Prestimulation, TH113
 Prevalence, W58, W59, W298, 483, 484
Prevotella, 39
 PRID, 716
 Principal component analysis, W42
 Probiotic, T140, W78, W81, W84, TH10, 44, 111, 112, 423, 424, 426, 427, 610
 Process cheese, T52, T57, 25, 138, 139
 Processing, TH32, 227, 584
 Processing stress, 749
 Production, TH19, 16, 230, 766, 793
 Production and functional traits, 405
 Production research, 34
 Productive life, T19, 13
 Productivity, 87

- Profitability, W20, TH101, TH273, 9, 593
- Progeny growth rates, TH80
- Progeny test, 10
- Progeny testing, 11
- Progesterone, T182, W154, W155, W156, W159, W162, W166, W188, TH184, 237, 473, 476, 715, 716, 720
- Progesterone catabolism, 478
- Progestin, TH169, 717
- Proinflammatory cytokines, T11, TH137
- Prolactin, TH110, 685
- Prolificacy, TH277
- Properties, 643
- Propionate, TH66, 72
- Propylene glycol, W200
- Prostaglandin, W155
- Prostaglandin-F_{2α}, W172, 714
- Protein, T280, TH31, TH49, TH155, TH159, TH247, TH265, 639, 772, 776
- Protein catabolite, 175
- Protein degradability, 499
- Protein degradation, TH271
- Protein metabolism, 203
- Protein oscillation, W242
- Protein oxidation, 560
- Protein sources, W238, W240
- Protein supplementation, W93, 593
- Protein synthesis, W243, TH154
- Protein turnover, W63
- Proteolysis, 556
- Proteolytic system, 423
- Proteome, W149
- Proteomics, W60, 559, 605
- Protozoa, T221
- Proximate components, 207
- Puberty, TH170, 316, 375, 765
- Puberty criteria, W154
- Pulse width, TH32
- Pulsed electric field, 647
- Purine derivatives, 590
- Pyrolysis, T105
- Q**
- Quality, T120, TH29, 62, 150
- Quantitative genetics, 169, 171
- Quantitative PCR, TH103
- Quantitative real-time RT-PCR, TH129, 31, 526
- Quantitative trait loci, T30, 412, 413, 611
- Quantitative trait loci mapping, T32
- Quarter horses, 548
- Queso, T49
- R**
- Rabbit, W127
- Ractopamine, 295, 382, 711
- Ractopamine hydrochloride, TH124, 218, 461
- Radiotelemetry, W192
- Ram, TH279
- Random regression model, 9
- Range, 313
- Range sheep, T63
- Rank correlation, W33
- Rank reduction, 621
- RAPD PCR, TH10
- Rare earth, TH122
- Rate of digestion, W216
- Rate of passage, W216
- Ration formulation, T65
- Ration variation, 315
- Rat, W291
- Raw, 178
- 16S rDNA, W280
- 16S rDNA gene, T230
- Reactive oxygen species, 466
- Real-time PCR, 55
- Real-time ultrasonography, W151, W152
- Rearing cost, 9
- Recalls, 265
- Receiving cattle, 391
- Receiving weight, 746
- Receptor blockers, TH78
- Recombinant bovine somatotropin, W183
- Reconstituted milk, W73
- Record, 602
- Recruitment, 501
- Rectal temperature, TH185, 374, 578
- Reduced fat, T40
- Reference, 117
- Reflective, 318
- Refractometer, 387, 388
- Regression splines, 618
- Regulatory, 417
- REML, W30
- Rennet coagulation, 514
- Replacement, 8
- Replacement growth, TH187
- Reproduction, T222, T228, W24, W171, W187, TH198, TH199, 224, 282, 302, 317, 372
- Reproductive development, 475
- Reproductive management, 90
- Reproductive performance, W121, 194
- Reproductive traits, W51, 16
- Reproductive traits in heifers and cows, T24
- Reproductive trend, T18
- Requirements, W61, 229
- Research, 32, 36, 275, 298, 345, 422, 493, 566
- Residual feed intake, T177, W24, W269, TH81, 74, 211, 212, 316, 317, 412, 623, 768, 769, 771
- Resistance, 397
- Resistant starch, W78
- Respiratory disease, 386
- Response, 659
- Restricted grazing, 591
- Restriction, TH153
- Resveratrol, W141
- Retained energy, 321
- Reticular temperature, TH204
- RFI, W276
- RFLP, W280
- Rheological properties, 516
- Rheology, T41, T48, T52, 41, 514
- Rice, TH23
- Rice protein concentrate, T16
- Rice straw, 801
- Riding courses, T288
- Ripollesa breed, 760
- Risk, 654
- RNase, 807
- Robotic milking, TH208
- Robust regression, 532
- Rotational grazing, TH45
- Roughage, 799, 802
- RT-PCR, TH167
- RU486, T173
- Rubber flooring, W11
- Rumen, T220, T235, T262, T266, TH212, TH232, TH270, 37, 340
- Rumen BAC library, T231
- Rumen bacteria, T256, W280, 336
- Rumen degradability, TH251
- Rumen-degradable protein, T192, TH50, TH252, TH259, 731
- Rumen degradation kinetic, TH254
- Rumen development, 58
- Rumen ecology, 39
- Rumen fermentation, T205, T237, T279, W202, W215, W224, W235, 737
- Rumen fill, W216
- Rumen kinetics, W202
- Rumen microbes, 342
- Rumen microbial community, T230
- Rumen microbiology, T252
- Rumen pH, 384
- Rumen protozoa, 334
- Rumen sampling, T252
- Rumen-undegradable protein, TH252, TH268, TH271, 588, 731
- Rumensin, T195
- Ruminal acidosis, 788
- Ruminal bacteria, T255, W277, TH223
- Ruminal bacterial population, W247, TH219
- Ruminal bolus, 347
- Ruminal buffer, W255
- Ruminal degradation, T97
- Ruminal disappearance, W255
- Ruminal epithelium, T260
- Ruminal fermentation, T210, 582
- Ruminal fill, 435
- Ruminal metabolism, 335
- Ruminal microbes, T248
- Ruminal papillae, TH70
- Ruminal pH, W211, W212, 344
- Ruminal synthesis and intestinal disappearance, TH235
- Ruminant, T229, T236, W256, TH79, TH215, TH250, 57, 304, 489, 491, 544, 797
- Rumination, W209
- Rural Veterinary Service, 116
- S**
- Saanen, T273
- Safety, W69, 543
- Sainfoin, T242
- Salmonella*, T3, T76, 380
- Salt, TH294
- Salt resistance, 45
- Salted goat yogurt, 517
- Sampling rate, T64
- Sandwich ELISA, W90
- Sarcomere length, T125
- Satellite cells, TH76, 122, 661
- Saturated fatty acids, 640
- Scope of inference, 222
- Scrapie, 821
- Season, T4, 497
- Season of birth, 346
- Seasonality, 283
- Seaweed extract, W120
- Seed legumes, TH271
- Selection, W182, 5, 65, 355, 439, 536
- Selenium, W261, TH97, TH98, TH129, TH243, TH245, 104, 105, 197, 286
- Selenium supplementation, TH74
- Selenium tissue concentration, TH74
- Selenized yeast, TH236, TH243
- Selenoprotein, 198
- Self-fed, TH49
- Semen, TH84, TH279, 285, 722
- Semen quality, W50
- Seminal plasma, TH172
- Sensitivity test, T9, T10
- Sensorial acceptance, T118
- Sensory, T124
- Sensory analysis, TH34
- Sensory attributes, 462, 804
- Sensory profile, T39
- Sensory quality, 296
- Separated manure solids, 305
- Separation, 510
- Sericea lespedeza*, T285
- Serotonin, TH111, 3, 451
- Serotonin receptors, 451
- Serratia marcescens*, 253
- Sertoli cell, TH170
- Serum amyloid A protein, TH60
- Serum cholesterol, TH140
- Serum cytokines, T163
- Serum parameters, T211
- Serum proteins, TH20, 510
- Service learning, 506
- Sexed semen, TH173, TH174, TH175, 603
- Shape index, TH166
- Shear force, 461
- Sheep, W145, W238, W240, W258, TH210, TH273, TH274, TH277, TH284, TH285, 76, 228, 229, 230, 314, 348, 349, 350, 383, 474, 493, 495, 497, 670, 671, 744, 759
- Sheep and goat, T54
- Sheep products, 231
- Shipping fever, 385
- Show, TH89
- Sickness behavior, 380
- Silage, T82, T89, T93, T94, T95, W91, 96
- Silage additive, W235
- Silage hybrid, T196
- Silage inoculants, T90
- Silage quality, T89
- Silvopasture, T275
- Simplified assay, W76
- Simulation, T84, W190
- Simulator, T167
- Simultaneous models, T233
- Sire, 353

- Skatole, 291, 358
Skeletal muscle, 122, 277, 278, 459, 460, 663
Skin temperature, 86
Slaughter age, T114, 354
Slaughter weight, 297
SLC1 gene expression, 665
SLC2 and SLC5 gene expression, TH75
Slick hair gene, 82
Small intestine, 665
Small ruminant, TH280, TH281
SMartNose, 187, 539, 815
SNP, T29, W9, W51, W54, 524, 525
SNP marker, 29
SNP profile validation, 403
SNP-mortality association, 408
SNP validation, 405
Sodium bisulfate, TH127, 199
Sodium gluconate, T44
Sodium selenite, TH236
Sodium-dependent Pi absorption, TH130
Soft cheese, 26
Software, 658
Soil temperature, 755
Soja feeding, W243
Solid-phase microextraction, TH34
Solid-state fermentation, W112, W113
Somatic cell count, T272, 27
Somatic cell score, T14, 13
Somatotropin, T16, T189, 274
Sorghum, 98, 462
Sorghum processing, TH210
Sorting, W198, W201, W209, 219
Source, 193
Southeast, 271
Sow, W137, W295, W296, W297, TH150, TH168, TH169, 202, 369, 468, 683
Sow longevity, W52, 531
Sow productivity, W292, 487
Soy protein concentrate, TH69
Soybean curd, W229
Soybean hulls, T83, TH132, 697, 698
Soybean meal, T181
Soybean oil, T205, T206
Soybean products, TH138, 206
Soybean protein, TH251
Spanish language training, T70
Spearmint, 26
Spectroscopy, T53
Sperm, W302, 568
Sperm preincubation, TH177
Sperm quality, T33
Spermatogenesis, W56
Spermatidhesin, TH172
Sphingomyelin, W87
Spices, 541
Spray-dried animal plasma, 595
Spray-dried egg, 773
Spray-dried milk powder, W72, W73
Spreads, 541
Sprinkler, 752
SREBP-1, 677
Stability, TH18
Stability of proofs, 619
Stabilized rice bran, W130
Staining procedure, 27
Stall design, 153
Stall waste, 550
Stallion, TH84, 285
Standardized ileal amino acid digestibility, 209
Stanniocalcin, 455
Staphylococcus aureus, T9, 247
Star probe, 293, 689
Starch, T57, T87, W123, W226, 38, 60, 583, 585
Starch availability, 736
Starch digestibility, T85, T88
Stargrass, TH48, TH50
Starter media, 538
Starter pig, 191
Statistics, 223
Stearoyl-CoA desaturase, W55
Steer, W20, W147, W234, W257, W260, W264, TH197, TH220, TH221, 213, 600, 726, 754, 800
Stem cells, 54, 553
Stereoisomers, 109
Stereoscopy, T55
Stochastic dominance, 90
Stochastic simulation, 655, 656
Stockers, TH40
Stocking density, TH4, TH45
Stocking rate, T275
Stockpiled tall fescue, 97
Stockpiling, W103
Stored swine manure, W177
Straw, W201, TH229, 495
Streptococcus bovis, T90
Streptococcus thermophilus, W77, W80
Stress, TH1, 152, 245, 594
Structured lipids, 513
Students, T290, T291, 362
Study design, 225
Subprimal yield, T123
Subproduct, TH280, TH281
Substrate, T94
Substrate regulation, TH75
Sucrose, T197, 40, 787
Sucrose and starch, TH211
Sugarbeet pulp, TH220, TH221, 703
Sugar cane, TH224
Sulfate, TH128
Sulfur, TH286, TH287
Sunflower, T202, T250
Sunflower, crushed, T83, T234
Sunflower oil, W278, W279, 328
Supplement, T284, TH49
Supplemental saturated fatty acids, TH206
Supplementation, W16, W248, TH44, TH47, TH71, TH72, 97, 313
Supplementation frequency, 733
Surface hydrophobicity, TH25
Surveys, 259
Survival, W14, 529
Sus scrofa, TH129
Susceptibility tests, T12
Sward structure, TH37
Sweet potato, T111
Swine, T73, T109, T164, W302, TH1, TH64, TH151, 35, 192, 193, 245, 352, 380, 382, 411, 433, 533, 535, 562, 567, 663, 700, 706, 785, 818
Swine jejunal epithelial cells, T170
Swine leukocyte antigen, 411
Swine nutrition, 298
Swiss cheese, T50, T53
Symbiotics, W70
Synchronization, T279, W153, W157, W159, W161, W188, W191, W227, 715, 719
Synthetic, 469
Systems biology, 528
- ## T
- 3T3-L1 cells, TH164
Tall fescue, TH38, TH40, TH41, 597
Tannin, T129, T242, T271, W96
Tannins, W275
Target, 276
Taste panel, T287
Taste receptor, T135
Teaching, T287, T289, 172, 362, 363, 364, 422, 503, 546
Teat dip, 253
Teat dipping, 254
Teat end, 252, 254
Teat fed, 236
Teat skin, 252, 254
Technological properties, W80
Technology, 282
Temperament, W37, TH205, 320, 576, 577, 629, 747
Temperature, W8, 85, 515
Temperature-humidity index, 84, 86
Temperature monitoring, TH204
Temperature tolerance, 372
Temporal variables, TH83
Temporal/spatial distribution, 436
Tenderness, W26, 212, 404, 465, 557, 560
Tennessee stiff-legged, 758
Test-day milk, 17
Test-day model, T14, 619
Texture, T57, 137
Thermal stability, W68
ThermalCare, 59
Thermochron, 85
Thermography, TH207
Thiazolidinedione, T183, T184, 77
30-kDa component, 556
Three-step, T245
Threshold linear model, 17
Threshold models, 530
Thyroid hormone, TH243
Tibet pig, TH157, TH158
Tifton 85, T81, W103, 94
Tight junction, 452
Timed AI, W163, W164, TH278
Tissue, T156
TLR9, 22
TMR particle size, W210
 α -Tocopherol, TH96
Tolerance, T28
Total gas production, T232
Total protein, 576
Trace minerals, TH125, 100, 102, 667
Training, 169, 171, 173
Trans-10, cis-12 CLA, 555
Trans fatty acids, T257, 119, 640
Transcriptional profile of *Lactobacillus casei* ATCC 334, 46
Transcriptional profiling, 30
Transcriptome, 280, 281
Transdifferentiation, TH73
Transglutaminase, 20
Transition, T259, W193, 248, 814
Transition cow, T101, T183, T184, W205, TH67, 71, 77, 330
Transition heifer, TH117
Transition management, TH191
Transition period, T197, T223, T224, W199, TH116, TH242, 81, 93
Transmission, 115
Transponder, 347, 500
Transport, 243, 361
Transport proteins, 66
Transportation, 242, 244, 374, 577
Transportation stress, 241
Traumatic reticulitis, TH6
Treated wheat straw, 803
Trends, 230
Trichoderma reesei, 238
Triticale, 586
Triticum aestivum L., 95
Trophic, 637
Tropical, T23, W34
Tropical grass, TH44, TH47, 440
Troponin-T, T126
Tryptophan, W133, 200
L-Tryptophan, TH152
Tulathromycin, 386
Tumor necrosis factor- α , W9
Tumor suppressor genes, 162
Turkish goat milk, 517
Turnip, T250
205-Day weight, W33
Type A neurotoxin, W66
Type appraisal, 761
Type traits, T16
- ## U
- Udder hygiene, 153
Ulcer, 549
Ultrasound, W15, W38, 349, 350, 645, 646
Ultrasound body composition, 577
Ultrasound treatment, TH26
Umami, T135
Uncertainty, 654
Undergraduate, T290, T291, 365, 546
Undergraduate and graduate, 503
Undergraduate education, 502, 504
Undergraduate teaching, T288
Ungulate, 636
Unsaturated fatty acids, 677
uPA, 810
Urea, TH262, TH270, TH286, TH287, TH289
Urea kinetics, T226
Urea production, W63
Urea transporter, T260
Urease screening, T231
Uterine pH, 300, 721
Uterus, W145, 573
Utilitarianism, 164
Utilization, TH159, 544

V

Vaccenic acid, T255, T257, 326
Vaccination, 247, 348, 359, 391
Vaccine, W27, 128, 158
Value added, W175, 641
Value chain, 231
Variance components, T25, T32, W43, 620
Veal calf, W262
Vegetable oil, T203
Venous blood gas, W257, TH220
Veterinarians, TH91
Veterinary shortage, 116
Veterinary technician, 116
Viable bacteria count, T264
Virginiamycin, T136, T158, W252
Viscosity, TH21
Vitamin, 179
Vitamin B₁₂ analogs, TH235
Vitamin C, W264
Vitamin D, TH238, 69, 661
Vitamin E, W263, TH96, 51, 468
Vitreous, 580
Vitrification, TH178, TH183
Volatile compounds, 539, 815
Volatile fatty acid, TH216, 312, 338
Volatile fatty acid absorption, 55
Volatile fatty acid metabolism, 55, 788
Volatile organic compounds, TH135, 310

Voluntary intake, 801
Vulva size, T131

W

Waiting time, TH113
Warm-season forage, 448
Warner-Bratzler, 293
Warner-Bratzler shear force, 689
Waste milk, 653
Waste stream, W173
Water, W174, W176, TH2, TH82, 793
Water hardness, TH5
Water intake, 213
Water quality, TH35, TH36, 437
WDGS, 725
Weaned dairy calf, 386
Weaned pig, W283, W284, W285, 368, 772
Weaned piglet, W289, 694
Weaning, W18, 156, 245, 392, 666, 823
Weaning age, W292
Weaning number, W292
Weaning weight, W32, 628
Weanling pig, T129, TH127, TH144, 195
Weather, 750
Web, 366
Web site, 432
Weigh estimation, TH86

Weight, W29, W40
Weight at candling, W49
Weight gain, T191
Welfare, W297, 674, 676, 753, 756
Welfare quality, 675
Well-being, 240, 518, 676
Western pleasure, TH83
Wet distillers grains, 729, 732
Wet distillers grains plus solubles, 734
Wheat, TH264
Wheat bran, W281, W282
Wheat distillers dried grains with solubles, T165
Wheat gluten, 216
Wheat protein, TH258
Whey and serum protein concentrate, TH19
Whey protein, TH20, 20, 40, 114, 511, 649
Whey protein concentrate, TH25, TH31, 43, 512
Whole corn grain, TH283
Whole-genome analysis, 6
Whole milk, TH33
Whole soybeans, TH248
Wildlife, 115
Wildlife species, 399
Willow, 180
Wilting, W91
Winter feeding, TH229
Wool, T63, TH274, 671
Workshop, T68, T69, T70

Writing, 508
Wulong goose, T130, TH120

X

Xylanase, T139, W114

Y

Y chromosome, T34
Yeast, T73, T159, W64, W113, W208, W294, 370
Yeast culture, T264, 88, 369, 740, 741
Yellow grease, 91
Yogurt, W70, W81, TH23, TH29, 516
Yucca, T146

Z

ZADO, 745
Zearalenone, T131
Zebu, W40, W45
Zebu beef cattle, W46
Zein, T85
Zilpaterol, T123, T124, 459, 460
Zilpaterol hydrochloride, 461
Zinc, TH119, 66, 101, 193, 195
Zinc methionine, 101
Zinc oxide, W281
Zoo, 631