ABSTRACTS
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1 Post-thaw fertility of bovine semen aged within an AI straw for 8.5 hours. J. L. Edwards*[1], M. N. Malone[1], F. N. Schrick[1], H. H. Dowlen[2], H. D. Moorehead[2], P. A. Lunn[2], and A. M. Saxton[1], [1]*The University of Tennessee, Knoxville,* [2]*Dairy Experiment Station, Lewisburg, TN, USA.*

Objective was to evaluate fertility of frozen-thawed semen aged for 8.5 h. Estrus was visually assessed three times daily for at least 30 minutes each time. Jersey heifers (age: 13.9 ± 1.4 mo; weight: 272.8 ± 19.2 kg) observed standing to be mounted between 0700 and 1200 h were randomly assigned to be inseminated with a straw of frozen semen that had been thawed and maintained in a Cito Thaw Unit (34.4°C water bath) for 8.5 ± 0.04 min (Control; range 3-14 min) or 8.5 ± 0.68 h (Aged; range 6-10 h). Heifers observed in estrus after 1200 h were inseminated with control semen. All heifers were inseminated according to AM/PM rule. To age sperm, a straw of frozen semen was thawed immediately after visual detection of a heifer in estrus and then maintained in a Cito Thaw unit until insemination approximately 8.5 h later. Frozen semen was purchased from various AI organizations (n=6). Individual Jersey bulls (n=30) were randomly and evenly distributed across treatments. Establishment of pregnancy was determined by palpation per rectum at 45 to 65 d post-insemination. Animals were monitored throughout pregnancy and upon calving, sex of offspring was recorded. Data were analyzed using Chi-Square; variables of interest included proportion pregnant, calving, and sex of resulting offspring. Effects of inseminating Jersey heifers with sperm aged within an AI straw for 8.5 h post-thaw were minimal. Fifty percent of heifers inseminated with aged semen became pregnant and delivered a live calf at term (Table). Proportion of female offspring was similar. Ability to maintain frozen-thawed semen within an AI straw for 8.5 h in a 34.4°C water bath without significant reductions in fertility demonstrates that sperm can be held post-thaw for extended time periods and suggests potential for manipulation post-thaw for sexing or performing diagnostics.

Treatment	No. Bred	Pregnant (%)	Calved (%)	Female (%)
Control	59	37(62.7)	37(62.7)	19(51.4)
Aged	56	28(50.0)	28(50.0)	11(39.3)
P-value		0.19	0.19	0.45

Key Words: Frozen semen, Aging, Artificial insemination

2 Effects of presynchronization and/or post-breeding treatment with porcine LH or hCG on pregnancy rates in dairy cows. J. P. Kastelic*[1] and J. D. Ambrose[2], [1]*Agriculture and Agri-Food Canada, Lethbridge, AB, Canada,* [2]*Alberta Agriculture Food and Rural Development, Edmonton, AB, Canada.*

The objectives were to determine the effects of presynchronization with a prostaglandin F2α analogue and/or post-breeding treatment with porcine LH (pLH) or hCG on pregnancy rates in dairy cows. In three experiments, an Ovsynch protocol was used to synchronize ovulation in lactating Holstein cows (range, 50 to 125 d postpartum). Cows were given im injections of 100 μg GnRH (Fertiline; Vetoquinol) on Days -10 and -1 and 500 μg cloprostenol (Estrumate; Schering Plough) on Day -3, with fixed-time AI on Day 0. Pregnancy was diagnosed by palpation per rectum between 45 and 60 d after AI. In Experiment 1, cows were randomly allocated to either a standard Ovsynch protocol (n=92) or to a presynchronization protocol (n=86; 500 μg cloprostenol given twice, 14 d apart) followed by Ovsynch, with the first GnRH given 12 d after the second cloprostenol. Pregnancy rates were 35 and 49%, respectively (P<0.06). In Experiment 2, cows were given im injections of 2 mL saline, 12.5 mg pLH (Lutropin-V; Bioniche Animal Health), or 2500 IU hCG (Chorulon; Intervet) 5 d after timed-AI (41, 41 and 39 cows, respectively). Pregnancy rates were 22, 33 and 37% (P=0.32). Experiment 3 was a 2 x 3 factorial, with the factors being presynchronization and post-breeding treatment (as done in Experiments 1 and 2, respectively). Pregnancy data are presently available from 86 cows, with data collection ongoing on several farms. Pregnancy rates in the six treatment groups ranged from 40 to 55% (ns). Pregnancy rates were 47 and 50% without and with presynchronization, respectively, and were 42, 48 and 55% in cattle treated with saline, pLH and hCG, respectively (P<0.6). In conclusion, pregnancy rates to timed-AI were improved by presynchronization. Post-breeding treatment with pLH or hCG 5 d after timed AI numerically improved pregnancy rate.

Key Words: Ovsynch, Fertility, Dairy cows

3 Pregnancy outcome in dairy cows fed diets supplemented with flaxseed or sunflowerseed. J. D. Ambrose*[1], J. P. Kastelic[2], R. Corbett[1], P. A. Day[1], J. A. Small[3], and H. V. Petit[4], [1]*Alberta Agriculture Food and Rural Development, Edmonton, AB,* [2]*Agriculture and Agri-Food Canada, Lethbridge, AB,* [3]*Brandon, MB,* [4]*Lennoxville, QC, Canada.*

The objectives were to determine if a diet enriched in α-linolenic acid (ALA; C18:3n-3) would enhance embryo survival and pregnancy rates in dairy cattle. Holstein cows were assigned to diets supplemented with about 2.35 kg of either rolled flaxseed (FS; 56.7% ALA, n=62) or rolled sunflowerseed (SS; 0.1% ALA, n=59) to provide approximately 750 g oil/cow/day beginning 4 wk before breeding (5522 d, meansd, postpartum). Diets continued for 32 d after timed-AI (Day 0) following a presynch/ovsynch protocol using Estrumate (cloprostenol, Schering Plough) and Fertiline (GnRH, Vetoquinol). Barley silage- and barley grain-based rations were formulated to meet or exceed NRC (2001) requirements. Metabolizable protein and NE_l concentrations were similar in diets. Based upon a mean DMI of 24.2 kg/d, cows fed FS or SS consumed >410 g or <1 g of ALA, respectively. Plasma progesterone concentrations determined on Days -10, -3, 0, 7, 21 and 24 were not affected by diet. Pregnancy was confirmed by ultrasound 32 d after AI and pregnant cows received no further oilseeds. Nonpregnant cows were placed on a second ovsynch regimen and rebred 42 d after first AI, and received oilseeds until 32 d after second AI. Relative to pre-diet levels, FS and SS diets increased the ALA content of milk by 187% and 21%, respectively. Presumptive pregnancy (plasma progesterone >1 ng/mL on Days 21 and 24) and confirmed pregnancy rates to first AI were higher in cows fed FS than in cows fed SS (72.6 vs 47.5%, P=0.01; and 48.4 vs 32.2%, P=0.07, respectively). Confirmed pregnancy rates (combined for both AI) were 67.7 vs 59.3% for FS vs SS (P>0.10). Apparent embryo survival rate was higher at Day 24 in cows fed FS, but it was not affected by diet between Days 24 and 32. Inclusion of rolled flaxseed in the diets of postpartum dairy cows improved fertility, apparently through enhanced early embryo survival.

Key Words: Pregnancy, Flaxseed, α-Linolenic acid

4 Completion of the Midwest Consortium Project: Sequencing of 21,499 reproduction ESTs and comparative mapping of 721 selected genes. C. K. Tuggle*[1], J. A. Green[2], C. Fitzsimmons[1], R. Woods[2], R. S. Prather[2], S. Malchenko[3], M. B. Soares[3], T. Kucaba[3], K. Crouch[3], C. Smith[3], D. Tack[3], N. Robinson[3], B. O'Leary[3], T. Scheetz[3], T. Casavant[3], D. Pomp[4], J. B. Edeal[4], Y. Zhang[1], Z. Hu[1], M. F. Rothschild[1], K. Garwood[5], and W. Beavis[5], [1]*Iowa State University, Ames, IA,* [2]*University of Missouri-Columbia, Columbia, MO,* [3]*University of Iowa, Iowa City, IA,* [4]*University of Nebraska, Lincoln, NE,* [5]*National Center for Genomic Resources, Sante Fe, NM.*

To accelerate genetic improvement of reproductive traits, both molecular and comparative genomic data are required. We are developing extensive sequence and mapping data for cDNAs expressed in female reproductive tissues. We have produced 25 cDNA libraries from different stages of estrus or gestation for embryo, anterior pituitary, hypothalamus, ovary, uterus, and term placenta. A total of 21,499 EST sequences from random clones have been submitted to Genbank. The average read length across this dataset is >400 base pairs. As assessed by clustering analysis, these data represent 10,574 different genes. A BLAST analysis of these clusters indicates that 4,652 are unique relative to porcine Genbank genes/ESTs (BLAST score <200). To facilitate selection of genes for comparative mapping, we have developed software to predict the cytogenetic location of pig ESTs. We identified pig EST matches (BLAST score >200) to human loci that have consistent cytogenetic and RH mapping locations, and then predicted the pig location of high-scoring ESTs based on mapping data and human:pig chromosome painting information. A total of 721 loci have been mapped across all chromosomes, concentrating on pig chromosomes (1,4,6,7,8,15,X) where litter size or other reproductive QTL have been localized. More than 90% of these loci map to the chromosome predicted by comparative data. A WWW site (http://pigest.genome.iastate.edu) has been established for access to these sequences and the analysis data. This set of sequence and map data can be immediately used to study reproductive biology and look for genes controlling quantitative reproduction traits.

Key Words: Expressed sequence tags, Porcine reproduction, Comparative mapping

5 Effect of semen packaged in 0.25 and 0.50 cc straws on conception rate of lactating dairy cows. N. Michael*, C. Marti, E. Roberts, and M. Pace, *ABS Global, Inc.*.

Cost and efficiency of semen storage can be dramatically improved by packaging semen in 1/4 cc straws. However, it is not clear if fertility of lactating dairy cows would be different by using 1/4 cc straws compared to 1/2 cc straws. This study evaluated the effect of straw packaging size (1/4 cc vs 1/2 cc straw) on conception rates in lactating dairy cows. At time of collection, semen from each A.I. sire (n = 8) was divided equally between 1/4 and 1/2 cc straws using a split collection technique. All straws were packaged and frozen using the ABS Global wind-tunnel freezing process. Numbers of sperm per straw were the same for 1/4 and 1/2 cc straws. Both straw types were equally divided by sire within each herd where herd owners chose the A.I. sires used in their herd; the number of sires used within the herds was one to four, for a total of 17 sire within herd comparisons. The fewest number of inseminations per herd x sire x straw type was 125. Cows (n = 6602) from eight herds located in Idaho and California were randomly inseminated by odd-even days of the month to receive A.I. in the uterine body from either (even day; n = 3373) or 1/4 cc (odd day; n = 3229) straws from seven professional A.I. technicians between September 2001 and October 2002. Straws were thawed in 35 # 37°C water baths for a minimum of 30 seconds and then held thermo-neutral until A.I. Pregnancy diagnoses were performed between 35 and 42 days following A.I. by the herd veterinarian in cows that had not returned to estrus during this period. Cows that were detected in estrus and re-inseminated between A.I. and pregnancy diagnosis were defined as not pregnant. All inseminations and pregnancy diagnoses information were entered into Dairy Comp 305. Data were retrieved from Dairy Comp 305 from each herd, summarized by sire comparison within herd and entered into Excel. Data were analyzed using a paired t-test on the conception rate means for each straw package type. Conception rates were similar (P > 0.05) between 1/2 (31.1 %) and 1/4 cc (31.3 %) straws. In summary, comparison of multiple A.I. sires in multiple locations indicated that fertility was not different from semen in 1/4 vs 1/2 cc straws packaged using the ABS Global wind-tunnel freezing process.

Key Words: Semen packaging, Conception rate, Dairy cows

6 Ovarian follicular development in first parity sows subject to varied split-weaning protocols. J. Barry*, W. T. Dixon, and G. R. Foxcroft, *Swine Research & Technology Centre, University of Alberta, Canada.*.

Split-weaning (SW) of first parity sows decreases the weaning to estrous interval (WEI) and advances ovarian follicular development. However, follicles ovulating soon after weaning start development during lactation when sows are often in a catabolic state. We hypothesise that an extended interval between SW and final weaning will induce atresia in this wave of disadvantaged follicles, trigger a new wave of follicle development after weaning when sows will be less catabolic, marginally increase the WEI, but improve overall sow fertility. To test this hypothesis, first parity sows with standardized litters were randomly allocated to be either Control (C; n=45) or SW (all but the lightest 6 piglets removed) at d14 of lactation (n=45). Feed intake, litter growth and sow metabolic state were monitored during lactation. Ovarian follicular development was determined morphologically after euthanizing groups of C and SW sows (n=15) on d16, 18 and 20 of lactation. A baseline of follicular development was established in an additional group of 15 sows euthanized on d14 (C14). Fewer (5/15; P<0.05) C14 sows had follicles ≥3mm diameter compared to all other groups, indicating a critical and possibly coordinated wave of follicular development between d14 and 16 of lactation. SW increased (P<0.05) the total number of follicles ≥3mm, mean size of the largest 10 follicles, maximum follicle size, mean FF volume, and the percentage of follicles in the ≥5mm category. SW increased (P<0.05) plasma IGF-1 at weaning (105±3 vs. 87±3 ng/mL) and decreased sow body mass loss during lactation (5.9±1.0 vs. 9.1±1.0 kg). Also, irrespective of treatment, plasma IGF-1 was lower (P<0.05) at d14 and weaning, and the decrease in loin muscle depth during lactation was greater (P<0.05), in sows with follicles <3mm diameter at slaughter. Increased catabolism during lactation can therefore critically limit follicle development. Refinements in SW protocols, based on a better understanding of ovarian follicular development in SW sows, have the potential to improve the fertility of weaned, first parity, sows.

Key Words: sow, lactation, ovary

7 Do calcium-mediated cellular signalling pathways, PGE_2, estrogen or progesterone receptor antagonists, or bacterial toxins affect bovine placental function in vitro? C. Weems*[1], Y. Weems[2], T. Welsh[3], G. Carsten[4], and R. Randel[5], [1,2]*Univ. of Hawaii,* [3,4,5]*Texas A&M Univ.*

The bovine placenta secretes little progesterone (P_4) when the CL is functional (Conley and Ford, J. Anim Sci 65:500, 1987), while the placenta secretes half of the circulating P_4 at day-90 of pregnancy in sheep (Weems et al Prostaglandins 46:277, 1992) and PGE_2 appears to regulate ovine placental secretion of P_4 (Bridges et al, Prostaglandins and Other Lipid Mediators 58:113, 1999). Calcium has been reported to regulate placental P_4 secretion in cattle (Shemesh et al, PNAS 81:6403, 1983). Diced placental slices from 193-243 day Brahman and Angus cows were incubated in vitro at 39.5 C under 95% air:5% CO_2 at PH 7.2 in 5 ml of M-199 for 1 hr in the absence of treatments and for 4 and 8 hr in the presence of treatments at a dose of 100ng/ml to determine regulation of placental function. Treatments were: vehicle; R24571; Compound 48/80; IP3; PGE_2; $CaCL_2$; cyclosporin A; lipopolysaccharide from Salmonella abortus, enteriditis, and typhimurium; monensin;, ionomycin; arachidonic acid, mimosine; palmitic acid; androstenedione, estradiol-17β; A23187; RU-486; or MER-25. Jugular and uterine venous plasma and culture media were analyzed for P_4, PGE_2, and $PGF_2\alpha$ by RIA. Hormone data in blood were analyzed by a one way ANOVA and in culture media by a 2x21 Factorial Design for ANOVA since breeds did not differ (P>0.05) and were pooled. PGE_2 in uterine venous blood was two fold greater (P< 0.05) in Angus than Brahman cows. PGE_2 and $PGF_2\alpha$ in the vehicle controls increased from 4 to 8 hr (P<0.05), but not P_4 (P>0.05). Progesterone in culture media treated with RU-486 increased (P<0.05) at 4 and 8 hr compared to vehicle controls and was not affected by other treatments (P>0.05). All treatments decreased (P<0.05) PGE_2 at 4 and 8 hr except treatment with PGE_2 at 4 and 8 hr and RU-486 at 8 hr (P>0.05). $PGF_2\alpha$ was increased (P< 0.05) by RU-486 at 8 hr and no other treatment affected $PGF_2\alpha$ at 4 or 8 hr (P>0.05). In conclusion, modulators of cellular calcium signalling pathways given alone does not affect placental P_4 secretion, P_4 receptor-mediated events appear to suppress placental $PGF_2\alpha$ secretion, and P_4 receptors may play a role in placental secretion of P_4 in cattle. In addition, PGE_2 does not appear to regulate bovine placental P_4 secretion.

Key Words: Placenta, Progesterone, Prostaglandins

8 Does estrous synchronization affect corpus luteum (CL) function? C. Weems*[1], Y. Weems[1], S. Tatman[2], A. Lewis[2], D. Neuendorff[2], and R. Randel[2], [1]*Univ Hawaii,* [2]*Texas A&M Univ.*

Bovine CL secretes PGE_2 and $PGF_2\alpha$ in vitro, which increases with time (Weems et al, Prostaglandins 55:359, 1998). Synchronization with Synchromate B (SMB) in Brahman heifers decreases LH, conception rates, and circulating progesterone (P_4; Rentfrow et al, Therio 28:355 , 1987). Nitric oxide (NO; Jaroszewski & Hansel, Proc Soc Expt Biol Med 224:50, 2000) and endothelin-1 (ET-1; Milvae, Rev Reprod 5:1, 2000) were reported to be luteolytic. In Expt 1, estrus in Brahman cows was synchronized with SMB and d-13 to 14 CL and caruncle slices were weighed, diced, and incubated in vitro. Treatments(100 ng/ml) were: vehicle A, L-NAME, L-NMMA, DETA, DETA-NONOate, sodium nitroprusside, or ET-1. In Expt 2, estrus was synchronized with Lutalyse, a CIDR, or natural; CL were collected and weighed on d-14; and CL slices were diced and incubated in vitro with treatments. Treatments (100 ng/ml) were: vehicle, L-NAME, L-NMMA, DETA, DETA-NONOate, sodium nitroprusside, SNAP, or ET-1. Tissues were incubated in M-199 for 1 hr without and for 4 and 8 hr with treatments. Media were analyzed for P_4, PGE_2, and $PGF_2\alpha$ by RIA. Hormone data in Expts 1 and 2, were analyzed by a 2x7 and a 3x2x8 Factorial Design for ANOVA, respectively, and CL weights in Expt 2 by a one way ANOVA. Concentrations of P_4 were similar (P>0.05) among treatments within experiments. Concentrations of PGE_2 in CL samples in Expt 1 were undetectable in 90 and 57 % of the samples at 4 and 8 hr, respectively and $PGF_2\alpha$ increased (P<0.05) with time but did not differ (P>0.05) among treatments. Secretion of PGE_2 or $PGF_2\alpha$ by caruncles increased (P<0.05) with time and was not affected by treatment (P>0.05). In Expt 2, CL weights were decreased (P<0.05) by Lutalyse. Concentrations of PGE_2 and $PGF_2\alpha$ increased (P<0.05) with time in controls of all three synchronization regimens. DETA-NONOate, SNAP, sodium nitroprusside (NO donors) and ET-1 increased (P<0.05) PGE_2 except in the CIDR group (P>0.05), and no treatment increased (P>0.05) $PGF_2.\alpha$ in any synchronization regimen. It is concluded that SMB and a CIDR alters CL PGE_2 secretion, Lutalyse lowers CL weights in the next estrous cycle, and NO or ET-1 given alone are not luteolytic agents. It is possible that NO could have indirect luteotropic effects via increasing PGE_2 secretion by luteal tissue.

Key Words: Estrous synchronization, Progesterone, Prostaglandins

9 Photoperiod and diet effects on heifer development. J. A. Small*[1], A. D. Kennedy[2], and D. R. Ward[1], [1]*Agriculture & Agri-Food Canada, Research Centre, Brandon, MB, Canada,* [2]*University of Manitoba, Winnipeg, MB, Canada.*

A 2*2 factorial arrangement of photoperiod (A vs W) and diet (C vs S) treatments was applied to spring-born crossbred beef heifers (n = 144) assigned at weaning (Sep 21; 0 wk) by body weight (247±19 kg) and age (191±12 d) to one of four pens in one of two similar open shed/drylot facilities. Supplemental light (350 lux, 1 m above ground) was used to extend photoperiod (natural + supplemental light) to 16 h for 12 wk starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant (C), or low then high (S) gain during the prepubescent (4 to 16 wk) and pubescent (16 to 24 wk) periods, respectively. One diet for moderate gain was provided to all groups from 0 to 4 and 24 to 32 wk. From 0 to 32 wk, observations of estrus were made twice daily, and estrus confirmed by progesterone in blood serum collected 8 to 12 d later, and body weight, backfat and serum prolactin were measured for each 4 wk period. Ambient temperatures averaged 3.4±12.1°C, -16.0±7.4°C and 0.3±8.0°C for the autumn (0 to 12 wk), winter (12 to 24 wk) and spring (24 to 32 wk) periods. During the prepubescent period, weight gain was greater for C than S (0.74 vs 0.66 ±0.01; P<0.05), backfat greater for A than W (1.24 vs 0.87 ±0.08; P<0.05), and only 9% of heifers attained puberty by 12 wk. During the pubescent period, diet influenced growth such that, as yearlings (24 wk), weight and backfat were lower for C than S (392 vs 381 ±3.4 kg and 2.6 vs 3.3 ±0.12 mm; P<0.05), but the proportion of heifers that had two estruses was greater for A than W (48.6% vs 30.9%; P<0.05). Prolactin, initially 16.3±1.6 ng/ml, was higher for A than W from 4 to 12 wk, and lower for A than W from 16 to 24 wk (12 wk; 10.1 vs 1.1 and 24 wk; 6.7 vs 20.0 ±1.8 ng/ml, P<0.05). Extended photoperiod in autumn advanced puberty independently of the effects of diet on growth, and acute change in photoperiod influenced prolactin, in heifers housed outdoors.

Key Words: Photoperiod, Puberty, Prolactin

10 Heat shock increases glutathione in bovine oocytes. R. R. Payton*[1], P. Coy[2], R. Romar[2], J. L. Lawrence[1], and J. L. Edwards[1], [1]*The University of Tennessee, Knoxville, USA,* [2]*The University of Murcia, Murcia, Spain.*

Heat shock increases glutathione (GSH) content in a variety of cell types including embryos. Objective of this study was to examine GSH content in bovine oocytes cultured at an elevated temperature during maturation. Cumulus-oocyte complexes were randomly allocated to one of three treatments and then cultured in the following manner: 38.5°C for 24 h (Control), 41°C for 6 h followed by 38.5°C for 18 h (HS 0-6), or 41°C for 12 h followed by 38.5°C for 12 h (HS 0-12). After 24 hours, oocytes presumed mature were denuded of cumulus by vortexing. Pools of oocytes (25-32/treatment group) were solubilized in 0.63 M phosphoric acid and frozen at -20°C until further analysis. Glutathione content was determined using a 5,5ı-dithiobis(2-nitrobenzoic acid)-glutathione disulfide reductase recycling assay and was expressed as per oocyte. Intra-assay coefficient of variation was 7.7%. Data were analyzed using an incomplete block design using mixed models of SAS after testing for normality. The experiment was replicated on 5 occasions and included a total of 8 to 11 pools of oocytes per treatment (236-330 total oocytes/treatment). Culture of oocytes at 41°C during the first 12 h of maturation increased GSH content (4.4 versus 2.7 and 1.6 pmol/oocyte for HS 0-12, Control and HS 0-6, respectively; SEM=0.57; P=0.02). Increases in an antioxidant such as GSH, suggest heat-induced increases in free radicals. Cytoplasmic perturbations involving increased free radical production may be one of several mechanisms contributing to reduced developmental competence of heat-stressed oocytes. Supported in part by USDA Initiative for Future Agricultural and Food Systems Program, "Improving Fertility of Heat-Stressed Dairy Cattle"; Grant #2001-52101-11318.

Key Words: Heat shock, Oocyte, Glutathione

11 Ovarian follicular growth and atresia: the relationship between cell proliferation and survival. S. M. Quirk*, R. G. Cowan, R. M. Harman, and C.-L. Hu, *Cornell University, Ithaca, NY*.

Growth factors and steroids play an important role in the process of ovarian follicular development. In cattle, two of the earliest detectable differences between the healthy dominant follicle selected for development to the ovulatory stage versus subordinate follicles destined to undergo atresia are the greater availability of IGF and the greater capacity to secrete estradiol. IGF-1 and estradiol stimulate proliferation of bovine granulosa cells (GC) in vitro and also promote GC survival by increasing resistance to apoptotic stimuli. Our studies show that the ability of IGF-1 and estradiol to increase resistance to apoptosis is intimately tied to their ability to promote progression through the cell cycle. Cell cycle blockade at the G1/S transition by specific inhibitors prevented the protective effects of IGF-1 and estradiol against apoptosis. The protective effect of IGF-1 against apoptosis is mediated by phosphatidylinositol 3-kinase and its downstream target, protein kinase B/Akt. Constitutively active Akt, expressed by a recombinant adenovirus, protected against apoptosis and this effect was dependent upon cell cycle progression. Therefore, the protective effect of estradiol and IGF-1 against apoptosis is dependent upon their ability to promote progression through the cell cycle. The LH surge induces terminal differentiation of GC and their withdrawal from the cell cycle. By 12 h after the LH surge, bovine GC have withdrawn from the cell cycle and become resistant to apoptosis, even in the absence of growth factors. Treatment with a progesterone receptor (PR) antagonist in vitro caused cells to reenter the cell cycle and reversed the resistance to apoptosis, suggesting that PR is required for these effects. Our studies suggest that the susceptibility of GC to apoptosis is dependent upon the cell proliferation cycle. GC from growing follicles are dependent on growth factors for survival, whereas cells that have terminally differentiated are resistant to apoptosis and relatively independent of growth factors for survival.

Key Words: Ovary, Granulosa cells, Cell cycle

12 Control of follicular growth: local interactions and nutritional influences. R. Webb*[1], P. C. Garnsworthy[1], J. G. Gong[2], and D. G. Armstrong[2], [1] *University of Nottingham, Loughborough, UK*, [2] *Roslin Institute, UK*.

Reproductive function is an integrated process encompassing both extraovarian signals and intrafollicular factors. Initiation of primordial follicle growth and the early stages of folliculogenesis can occur without gonadotropins, but FSH may affect the rate of preantral follicle growth. Antral follicle development from 2-4 mm in sheep and cattle is completely gonadotropin dependent. These recruited follicles express a range of mRNAs encoding steroidogenic enzymes, gonadotropin receptors and local regulatory factors and their receptors. As follicles continue to mature, there is a transfer of dependency from FSH to LH, which may be part of the mechanism involved in selection of follicles for continued growth. Locally produced growth factors, such as the IGFs and members of the TGFβ super-family, work in concert with gonadotropins throughout the follicular growth continuum and can have significant effects on follicle selection. Environmental influences such as acute changes in dietary intake also have an impact on ovarian activity. These changes can occur without significant variation in circulating gonadotropin concentrations and can be correlated with changes in circulating concentrations of metabolic hormones including insulin, IGF-I, GH and leptin. For example dietary energy and protein affect the expression of mRNA encoding components of the ovarian IGF system and these changes can regulate the sensitivity/response of follicles towards FSH and contribute to the observed changes in follicular dynamics. The roles of growth factors in follicular development and survival are dependent on gonadotropin status and differentiation state of the follicle, including the extracellular matrix. In conclusion, it is the integration of these extraovarian signals and intrafollicular factors that determine whether a follicle will continue to develop or be diverted into atretic pathways. Funded by DEFRA, SEERAD and BBSRC.

13 Uterine and placental factors regulating conceptus growth in domestic animals. T. E. Spencer* and F. W. Bazer, [1] *Texas A&M University*.

All mammalian uteri contain endometrial glands that synthesize or transport and secrete substances essential for survival and development of the conceptus (embryo/fetus and associated extraembryonic membranes). Analyses of the ovine uterine gland knockout (UGKO) model support a primary role for endometrial glands and, by default, their secretions in conceptus survival and development during the periimplantation and pregnancy recognition period. Endometrial adenogenesis, the process whereby glands develop in the uterus, is primarily a postnatal event in domestic and laboratory animals as well as humans. Endometrial adenogenesis involves differentiation and budding of glandular epithelium (GE) from lumenal epithelium (LE) followed by invagination and extensive tubular coiling and branching morphogenesis throughout uterine stroma to the myometrium. In sheep, endometrial adenogenesis is regulated by pituitary prolactin acting on prolactin receptors that are expressed by the GE. In contrast, expression and functional activation of estrogen receptor alpha in the uterus is a primary regulator of endometrial adenogenesis in the pig. In sheep and pigs, extensive endometrial gland hyperplasia and hypertrophy occur during gestation, presumably to provide increasing histotrophic support for conceptus growth and development. A servomechanism has been proposed in sheep and pigs to regulate endometrial gland development and differentiated function during pregnancy that involves sequential actions of ovarian steroid hormones, pregnancy recognition signals, and lactogenic hormones from the pituitary or placenta. The fact that disruption of uterine development during critical organizational periods can alter the functional capacity and embryotrophic potential of the adult uterus reinforces the importance of understanding uterine developmental biology. Unexplained, high rates of peri-implantation embryonic loss in domestic animals and humans may reflect defects in endometrial gland morphogenesis due to unrecognized defects of uterine growth and development. Knowledge of the basic mechanisms regulating uterine development is expected to develop tools to increase uterine capacity, litter size and neonatal survivability as well as ameliorate certain types of infertility.

Key Words: Conceptus, Growth, Uterus

14 Regulation of the development of fetuses from in vitro produced and cloned embryos. C. E. Farin* and P. W. Farin, *North Carolina State University, Raleigh*.

The establishment of in vitro fertilization and culture systems for mammalian embryos has facilitated the application of embryo technologies in research, industry and clinical settings. Furthermore, the advent of cloning by nuclear transfer has significantly enhanced the potential for genetic modification of livestock. Based on studies in cattle, sheep and mice, it has become apparent that embryos produced using these systems can differ in morphology and developmental potential compared to embryos produced in vivo. Referred to as 'large offspring syndrome', these abnormalities in the development of fetuses, placentas and offspring are particularly evident following transfer of cloned embryos but also occur in pregnancies from embryos produced using in vitro culture alone. The objective of this presentation will be to examine the effects of in vitro production and cloning on embryo and fetal development. Particular emphasis will be placed on exploring physiological and genetic mechanisms that likely contribute to large offspring syndrome.

15 The impact of oocyte quality on development. R. L. Krisher*, *Purdue University, West Lafayette, IN USA*.

Oocyte quality affects early embryonic survival, the establishment and maintenance of pregnancy, fetal development, and even adult disease. Quality, or developmental competence, is acquired during folliculogenesis as the oocyte grows, and during the period of oocyte maturation. Assisted reproductive technologies involving ovarian superstimulation, or collection of immature oocytes followed by maturation in vitro, perturb this process and result in oocytes with reduced quality. In domestic livestock species, offspring have been produced using in vitro oocyte maturation, although only a small percentage of the original pool of immature oocytes is capable of developing to the blastocyst stage and subsequently resulting in pregnancy. In vitro maturation, as it is currently

undertaken, does not support the correct development of oocyte competence. Follicle size affects oocyte quality, potentially implicating mRNA or protein stores as factors involved in oocyte competence. Oocytes from preantral follicles grown in vitro are competent to resume meiosis, although development to the blastocyst stage is reduced. An offspring from oocytes produced using this technique was normal at birth but experienced delayed onset health issues, highlighting the importance of oocyte quality long after embryogenesis. Metabolism may play a critical role in oocyte quality, as glycolytic activity in mature oocytes is correlated with increased embryonic development. Communication between the oocyte and its surrounding cumulus cells is also important for the development of a competent oocyte. Ovarian stimulation causes delayed embryonic development, increased abnormal blastocyst formation, fetal growth retardation and increased fetal loss. Thus, although meiosis and even early development may be completed successfully, there are a variety of processes occurring within the cytoplasm of the oocyte that are required for complete developmental competence. However, the cellular mechanisms that impart oocyte quality are unclear. Until the mechanisms involved in oocyte quality are elucidated, any effort to utilize assisted reproductive technologies in animals for production or biomedical purposes will be inefficient at best.

Key Words: Gamete, Embryo, Assisted reproduction

16 Pre-ovulatory, post-ovulatory and post-maternal-recognition factors that affect establishment and retention of pregnancy in cattle. E. K. Inskeep*, *West Virginia University, Morgantown WV/USA*.

Although fertilization rate is very high when male fertility is normal in most situations that have been studied, pregnancy rates are well below expectations when defined by the birth of live offspring in response to first service. Factors that affect establishment and retention of pregnancy include: (1) preovulatory influences on the follicle and oocyte, (2) early postovulatory uterine and luteal function, (3) concentrations of hormones associated with trophoblastic and endometrial function during maternal recognition of pregnancy, and (4) less-well understood factors during the peri-attachment period. For example, decreased concentrations of progesterone during preovulatory follicular development lead to increased frequency of episodic secretion of LH, increased secretion of estrogen by a persistent follicle, premature resumption of meiosis and a high incidence of embryonic death between the 2- and 16-cell stages in the cow. Using the early-weaned postpartum cow as a model, absence of previous exposure to progesterone causes increased secretion of PGF2α during days 4 to 9 of the first estrous cycle. The elevated PGF2α not only causes luteolysis, but also has a direct embryotoxic effect during the morula to blastocyst transition. Ideal conditions during the peri-attachment period are not clearly defined and factors in pregnancy wastage may vary with species. Nominal increases in secretion of PGF2α between days 30 and 35 may be important for completion of attachment and placentation in the cow. Lower survival of embryos from day 30 to days 45 to 60 in the cow is associated with lower circulating concentrations of progesterone, but association with concentrations of estrogen has varied among experiments.

Key Words: Embryonic mortality, Follicular development, Luteal function

Breeding & Genetics Symposium: Molecular genetics: Lessons from past/new directions

17 Commercial application of marker- and gene-assisted selection in livestock: strategies and lessons. J. C. M. Dekkers*[1], [1]*Iowa State University*.

During the past decades, advances in molecular genetics have led to the identification of multiple genes or genetic markers associated with genes that affect traits of interest in livestock, including genes for single gene-traits and genes or genomic regions that affect quantitative traits (quantitative trait loci or QTL).This has provided opportunities to enhance response to selection, in particular for traits that are difficult to improve by conventional selection (low heritability or traits for which measurement of phenotype is difficult, expensive, only possible late in life, or not possible on selection candidates), as has been demonstrated in a number of simulation studies. The objective here is to review strategies for the use of genes or markers in genetic improvement, to assess the extent to which and how marker and gene information has been used in commercial livestock improvement programs, to assess the successes and limitations that have been experienced in such applications, and to discuss strategies to overcome these limitations. Focus will be on the use of QTL information from experimental populations, on detection, verification, and estimation of effects in commercial breeding populations, and on the integration of molecular data in methods for genetic evaluation and in selection strategies. Types of molecular information that will be considered include gene tests for causative mutations and linked markers in population-wide linkage equilibrium or disequilibrium with the QTL.

Key Words: Marker-assisted Selection, Genetics, Selection

18 Lessons from QTL analyses in mice. D Pomp* and E. J. Eisen, *University of Nebraska,* [2]*North Carolina State University*.

Most phenotypes with economic relevance are multifactorial traits controlled by complex contributions of genetics and environment. Genetic predisposition results from combinations of relatively small effects of sequence variation within a large number of polygenes, known as quantitative trait loci (QTL). Nearly 200 QTL have been reported for growth and body composition traits in the mouse, likely representing 50-100 distinct genes. Molecular biology has yielded significant advancements in understanding these traits at the metabolic and physiological levels. However, little has been learned regarding the identity and nature of the underlying polygenes due to the inherent inaccuracy of QTL localization and the inability to differentiate between co-localization and co-incidence when comparing QTL with potential candidates. This wide gap between our knowledge of physiological mechanisms underlying complex traits and the nature of genetic predisposition significantly impairs QTL discovery. Identification and genetic mapping of key transcriptional, proteomic, metabolomic and endocrine events will uncover large lists of significant positional candidates. However, integration of experimental approaches to jointly evaluate predisposition and physiology will increase success of QTL identification by combining the power of recombination with functional analysis. Measuring physiologically relevant sub-phenotypes (e.g. 10,000 expression phenotypes on an array) within a structured gene mapping population will facilitate pathway-specific prioritization among candidate genes. This would advance our understanding of the genetic architecture of complex traits by testing the hypothesis that genes controlling predisposition to a trait are primarily involved in trans-regulation of the physiological pathways that directly regulate the trait. An integrated ?polygene discovery database? will enable QTL identification and characterization. This will be critical for the success of marker assisted selection in livestock, given the inherent advantages of using directly predictive assays relative to within-family, linked-marker tests.

Key Words: Mouse, QTL, Marker assisted selection

19 Potential use of microarrays and related methodologies in animal breeding. B. Walsh*, *University of Arizona*.

The age of genomics offers biologists with powerful tools few could even dream of twenty years ago. Biology is being transformed by such tools, and animal breeding is no exception. Genome-wide studies of levels of mRNA expression in specific tissues and/or over time can be monitored by microarrays. The rigorous statistical analysis of such arrays is still being fine-tuned, and we will explore some of the resolved, and unresolved, issues. While microarrays offer an approach to gene discovery (i.e., candidate genes), they likely face many of the same issues as QTL mapping in moving from a powerful genetic tool to a particular tool for applied breeding. Microarrays are one tool of functional genomics, a discipline seeking to understand gene and metabolic networks. Another tool are two-hybrid screens that look for interactions between proteins

within a cell. Analysis of these data provide a crude estimate of gene networks, and these may prove to be of some interest to future breeders. Finally, an old tool from evolutionary genetics, Burns-Kascer sensitivity analysis for flux through biochemical pathway, is discussed. In conjunction with hopefully forthcoming data on gene and protein networks, sensitivity analysis may provide breeders with a powerful analytic approach to detect key points in pathways of interest. Knowledge of such points obviously serves a starting point for searches for useful genetic variation in traits of interest.

Key Words: Microarrays, Protein-protein interaction networks, Burns-Kascer sensitivity analysis

Food Safety Symposium: Food safety for animal agriculture: What producers need to know

20 Animal and egg production food safety: Introduction.

G. M. Jones*[1], B. Eastwood[2], and J. Mattison[3], [1] *Virginia Tech, Blacksburg, VA,* [2] *USDA CSREES, Washington DC,* [3] *The ADDS Center, Verona, WI.*

An on-farm food safety program has been developed for Extension specialists and agents and other food animal professionals to use for their own information or in developing educational programs for animal producers. The program consists of modules on various topics related to food safety, a database with selected references, and links to other food safety related websites and is available on CD-ROM through the ADDS Center. Its development and distribution was funded by USDA Food Safety and Inspection Service. Oversight was provided by a steering committee that included Extension agents and specialists representing food science, veterinary medicine, and animal and poultry science. Modules discuss importance of food safety and use of HACCP in development of quality assurance production practices. Specific modules include: causes of foodborne disease, drug use, residues, and resistance, HACCP, management practices that also involve feeds, and control of flies and rodents, farm advisory teams, and commodity assurance programs for aquaculture, beef, chick and poultry, egg, turkey, dairy, goat, veal, pork, and sheep. Primary emphasis was given to commodity programs. The modules and database were evaluated by the animal science committee of the National Association of County Agricultural Agents and the steering committee.

Key Words: Animal production food safety, Training/teaching modules, Extension education

21 Food safety for animal agriculture: What producers need to know about causes of foodborne illness.

D. B. Griffin*, *Texas A&M University, College Station, TX.*

This module reviews CDC foodborne disease incidence, types of foodborne illness and prevalence, trends in causes of foodborne illness over past century, symptoms and susceptibility, and specific pathogens and sources found in animal products using baseline data of USDA FSIS. Brief discussions are provided of: *E. coli, Salmonella, Staphylococcus aureus, Listeria, Campylobacter, Yersinia, Bacillus cereus, Clostridium botulinum, Giardia, Cryptosporidium*, and BSE. The relationship between *Mycobacterium paratuberculosis* and Johne's disease with Crohn's disease in humans is explored. The module outlines the roles of pasteurization and irradiation in preventing disease outbreaks.

Key Words: Animal production food safety, Foodborne illness, Extension education

22 Food safety for animal agriculture: What producers need to know about drug use, resistance, and residues.

B. Jayarao*, *Pennsylvania State University, University Park, PA.*

This module reviews uses of antibiotics in animal agriculture, extent of residues and causes, benefits of subtherapeutic drug use, antibiotic resistance and relation to drug use in food-producing animals, extra label drug use, and role of animal producers in minimizing risk. The module looks at the importance of antibiotics to animal production, while discussing why antibiotics are of concern to public health. It discusses the extent of drug residues, using USDA FSIS residue test results, and summarizes some of the causes and/or errors in drug use. Relationship between drug use in food producing animals and antibiotic resistance in humans is examined. Extra label drug use is defined and requirements for use are listed. The role of antibiotic susceptibility tests is outlined. The advantages of subtherapeutic (for growth promotion), prophylactic (disease prevention), and therapeutic (treatment of infections) antibiotic use in animals are presented as well as concerns over excessive use.

Key Words: Animal production food safety, Drug use, Extension education

23 Food safety for animal agriculture: What producers need to know about HACCP and management practices.

G. M. Jones*, *Virginia Tech, Blacksburg, VA.*

HACCP (hazard analysis critical control points) is a system that identifies specific hazards, implements effective control measures, and monitors procedures used to prevent hazards. It is a tool used to protect food against microbiological, chemical, and physical hazards. An illegal drug residue in milk or meat is a hazard. HACCP is a process that collects and analyzes information on hazards and conditions leading to their presence and to decide which are significant. Critical control points are the steps at which control can be applied and are essential to prevent or eliminate a food safety hazard or to reduce it to an acceptable level. Quality assurance programs are generally based on HACCP concepts and these are embedded in residue avoidance programs. HACCP includes keeping records to trace problems and to measure effects of intervention strategies and the monitoring of progress in controlling hazards. The HACCP module includes: definition/description, potential hazards and their significance, on-farm critical control points, corrective actions, role of quality assurance programs and their benefits, and brief introduction to various commodity Quality Assurance Programs. The management practices module includes sources of hazards and stressors on the farm, on-farm critical control points, animal health (immune system, nutrition, environment), management strategies and practices, biosecurity, transportation of animals, handling disabled animals, and dead animal disposal.

Key Words: Animal production food safety, HACCP, Management practices

24 Food safety for animal agriculture: What producers need to know about quality assurance programs.

J. W. Oltjen*, *University of California, Davis, CA.*

Virtually all food animal commodity organizations have implemented quality assurance education programs (QAP) to maintain or increase food safety, wholesomeness, and quality. The goal of all food animal industries is to produce high quality, safe products. QAP focus on helping producers supply products that are as free as possible of microbial hazards and drug and chemical residues, although QAPs originally focused on residue avoidance. Benefits of QAP include improved management practices, avoidance of violative drug residues, decreased production costs, and increased awareness of food safety concerns. QAPs are important because they: promote animal health and welfare, ensure proper drug and antibiotic use, provide records to assure purchasers of good production practices, are proven to reduce residue violations, potentially reduce pathogens through good hygiene and animal health, and improve production efficiency and quality of animals. QAPs take into consideration feedstuffs (additives, medications, mycotoxins, pathogens, clean mixing equipment), cleanliness and ventilation of facilities, appropriate drug use and records, extralabel drug use, identification and tracking of treated animals, injection site blemishes and hazards, and biosecurity. Self-review is important in QAPs, and some utilize third party verification. This module reviews basic concepts behind quality assurance programs, benefits, residue violations, drug withdrawal times, preharvest testing, sensitivities and specificities, false positive and false negative test results, and presents a brief introduction to commodity QAPs.

Key Words: Animal production food safety, Quality assurance programs, Extension education

25 Usefulness of in vitro and in vivo experimental models. J. Novakofski*[1], [1] *University of Illinois, Department of Animal Sciences.*

Use of experimental models is the foundation of experimental biology. A critical question is always; "how well does the model reflect in an actual animal?" The real answer of course is that models are in fact models: extremely useful for specific purposes but much less so for others. Because of this, carte blanche denial, or acceptance, of models is equally likely to impede progress. Models should be evaluated with scientific method and usefulness decided on the basis of results, not opinion. Adipose tissue research provides a useful context for examining issues surrounding this problem because regulation of adipose growth and metabolism has important economic implications for livestock production, product quality and product yield. This presentation will compare the usefulness of models for aspects of adipose research. Much of the progress in understanding adipocyte biology has depended on cell culture experiments. Perhaps surprisingly, a large amount of this progress has used a few established cell lines with well known "eccentricities." Comparison of established cell lines with primary adipocyte culture will demonstrate that primary culture has played a minor role despite many advocates. This comparison will be less clear for research on adipose metabolism. Cultures have been less useful for examining metabolism but essential for examining intracellular signaling pathways. Cell cultures, examined in regulatory isolation have even provided a few notable misconceptions, for example the insulin-like effect of growth hormone that is irrelevant in vivo. Gene knockouts, a technical variation of classic ablation models, have proven to be extremely useful in adipose research. Lethality problems have been limited because variations in lipid metabolism are seldom life threatening. Knockouts have revealed many functions, redundant pathways and unrecognized regulation. In contrast, "gene chip" experiments have been disappointing. While not a model per se, but a technology to examine models, gene chips emphasize the importance of model selection. Even expected changes may be difficult to see in experimental models because current chips lack adequate sensitivity relative to normal variations in lipid metabolism.

Key Words: Adipose tissue, Primary cell culture, Established cell lines

26 Role of fatty acids in adipocyte growth and development. M.J. Azain*[1], [1] *University of Georgia.*

The most common association of fatty acids with adipose tissue is related to their storage as triglycerides in mature adipocytes and the consequences of excess accumulation in obesity. There is considerable evidence from cell culture experiments and studies in rodents that fatty acids can also regulate adipocyte development. In this role, fatty acids have hormone like effects and can be shown to regulate gene expression in pre-adipocytes that can have effects on both proliferation and differentiation. Long chain, saturated and polyunsaturated fatty acids have been shown to regulate transcriptional factors, such as CAAT / enhancer binding protein (C/EBP), peroxisome proliferator activated receptor (PPAR), and other adipose-specific genes, very early in adipocyte development. These effects have the potential to affect fat cell number at maturity. Specifically, there is evidence that the fatty acids in fish oil, such as docosahexaenoic (DHA) and eicosopentaenoic (EPA) acids, and fatty acids in the conjugated linoleic acid (CLA) series, reduce pre-adipocyte proliferation in cell lines and reduce adiposity in rodents. Conversely, diets high in saturated fatty acids have been shown to increase adipose tissue mass. There is little direct evidence of the ability of fatty acids to manipulate adipocyte development in non-rodent species. However, it should be noted that only recently has the importance of essential fatty acids, such as arachidonate and DHA, for brain development been documented. This has led to introduction of human infant formula supplemented with these fatty acids. The genetic, nutritional, and pharmacological manipulation of adipose tissue in meat animals has been a long term interest of animal scientists. An understanding of the ability of fatty acids to regulate such factors as adipocyte number, particularly in meat animals, would be of great interest. The evidence for regulatory roles of fatty acids in development from rodent and in vitro studies and their potential application to meat animals will be reviewed.

Key Words: Dietary fat, Fish oil, Conjugated linoleic acid

27 Adipose tissue angiogenesis. G. J. Hausman, *USDA-ARS.*

A review of adipose tissue angiogenesis includes discussion of the morphological and cytochemical development of adipose tissue vasculature and the concept of primitive fat organs. Spatial and temporal relationships between vascular and fat cell development in the fetus are also discussed including depot and genetic dependent arteriolar differentiation. The relationship between connective tissue deposition and elaboration of adipose tissue vasculature is discussed with respect to regulating adipocyte development in a depot dependent manner. In vitro studies indicate that depot dependent vascular traits may be attributable to intrinsic growth characteristics of adipose tissue endothelial cells. These studies indicate that adipogenesis may be regulated by factors that drive angiogenesis. Fundamental aspects of angiogenesis including basement membrane breakdown, vasculogenesis, angiogenic remodelling, vessel stabilization and vascular permeability are reviewed. Critical angiogenic factors including vascular endothelial growth factor (VEGF), VEGF receptors, angiopoietins, metalloproteinase enzymes and the plasminogen enzymatic system are also discussed. VEGF is the most critical factor since it initiates the formation of immature vessels and disruption of a single VEGF allele leads to embryonic lethality in mice. Expression of VEGF is influenced by hypoxia, insulin, growth factors and several cytokines. Angiogenic factors known to be secreted and / or produced by adipocytes or preadipocytes are discussed. VEGF expression and secretion by adipocytes is regulated by insulin and hypoxia and is associated with adipose tissue accretion. VEGF accounts for most of the angiogenic activity of adipose tissue. The proposed role of leptin as an angiogenic factor is reviewed with respect to efficacy on various aspects of angiogenesis relative to other angiogenic factors. Potential links between VEGF and leptin gene expression have not been examined but both genes are induced by hypoxia. Finally, several studies including a study of mice treated with anti-angiogenic factors indicate that adipose tissue accretion can be controlled through the vasculature per se.

Key Words: Angiogenesis, Adipose tissue, Leptin

28 The adipocyte as an endocrine cell. J. L. Miner* and K. M. Hargrave, *University of Nebraska.*

It has been hypothesized since at least since the 1940s that communication between adipose and other tissues may be bidirectional. Despite this expectation, early progress in our understanding of adipose tissue function was largely limited to its role in metabolism and storage of fatty acids, its development, and its response to endocrine and neural cues. However, the last decade has witnessed identification of several molecules that are secreted from adipocytes apparently for the purpose of signaling to other tissues. Cloning of the mouse obesity gene in 1994 is perhaps the most famous impetus for recognition that adipocytes are active in regulation of multiple body functions. The product of this gene, leptin, has since been found to inhibit feeding, enhance energy expenditure, and stimulate gonadotropes. Evidence for the roles other adipocyte-derived signals is being generated. Resistin is a protein that can cause whole body insulin resistance. Its expression is correlated with body fat and is inhibited by thiazolidinediones, perhaps mediating the association of diabetes with obesity, and the effectiveness of these drugs. It and a related molecule, RELMa, also can inhibit differentiation of preadipocytes. Tumor necrosis factor-a is secreted from adipocytes and antagonizes insulin action. Adiponectin/Acrp30 secretion from adipocytes is diminished in obese states. This protein can enhance use of fatty acids in lean tissues, and reduce both blood glucose and body weight. Secretion of complement proteins has been observed in adipocytes and these interact to generate a signal called acylation stimulating protein which can promote triacylglycerol synthesis. Similarly, adipocytes secrete renin-angiotensin system components and adenosine, both of which are anabolic in adipose tissue. It is unlikely that all of the adipocyte's endocrine signals have been identified. Certainly, much is yet to be learned about how these signals function. However, it is clear that these new discoveries comprise a useful model for our study of growth and development in livestock.

Key Words: Adipose tissue, Secretion, Hormone

29 Metabolism and development of bovine brown adipose tissue. S. B. Smith* and G. E. Carstens, *Texas A&M University, College Station, TX.*

Angus newborn calves have a greater ability to generate heat by nonshivering thermogenesis than Brahman newborn calves. We have worked to document the biochemical basis for this phenomenon. Brahman perirenal brown adipose tissue (BAT) contains two-to-three times as many -receptors as Angus BAT, although the dissociation constant is not different between breed types. Mitochondrial uncoupling protein (UCP1) mRNA concentration is greater in newborn Brahman BAT than in Angus BAT, whereas lipogenesis from acetate is greater in Angus BAT than in Brahman BAT. We obtained fetuses of each breed type at 96, 48, 24, 14, and 6 d before expected parturition, and at parturition. Glycerolipid synthesis from palmitate declined by 85% during the last trimester, but still contributed 98% to total lipid synthesis at birth. The concentration of UCP-1 mRNA tripled during gestation in both breed types. Uncoupling protein-1 mRNA initially was elevated in tailhead s.c. adipose tissue, but was barely detectable by birth, and tended to be higher overall in Angus than in Brahman s.c. adipose tissue. In a third experiment, male Angus and Brahman calves were assigned to one of three groups; (1) newborn; (2) 48 h of warm exposure starting at 15 h of age; and (3) 48 h of cold exposure starting at 15 h of age. The calves in the newborn treatment were euthanized at 15 h of age. The warm-treatment calves (22C) and cold-treatment calves (4C) were maintained euthanized after 48 h at each temperature. Brahman BAT adipocytes were smaller than Angus BAT adipocytes initially and shrank with cold exposure, whereas Angus BAT adipocytes did not. The production of CO_2 from palmitate and acetate increased with cold exposure. Lipogenesis from acetate and palmitate was greater in BAT from calves held at warm or cold temperatures than in BAT from newborn calves. Also, BAT from Angus calves had greater rates of lipogenesis from palmitate than BAT from Brahman calves. The data indicate that BAT from Brahman calves mobilizes stored lipids more rapidly than BAT from Angus calves, but resynthesizes lipids more slowly. Thus, BAT from Brahman calves may be exhausted of lipid shortly after birth during times of cold exposure, leading to reduced thermogenesis during times of extended cold stress.

Key Words: Brown fat, Bovidae, Lipid metabolism

ADSA Dairy Foods Graduate Student Paper Competition and Dairy Foods

30 Altered growing conditions can inhibit nisin production in lactic cultures by disrupting the signal transduction pathway. H. Li* and D. O'Sullivan, *University of Minnesota.*

A signal transduction pathway controls the production of the nisin bacteriocin by Lactococcus lactis. In this system, external nisin can signal the nisin genes to be switched on in a dose dependent fashion, involving the membrane bound kinase (NisK) and the intracellular regulator, NisR. Phosphorylated NisR initiates transcription of the genes involved in nisin production. However, we have found that nisin production can be switched off under certain conditions. These conditions are: 1) growth of L. lactis at it maximum growth temperature of 40(C; 2) transfer of the nisin gene cluster into a dairy Enterococcus strain; 3) electroporation of plasmids into certain nisin producing L. lactis strains. In these three cases, Northern and RT-PCR analysis confirmed that the nisA gene was not expressed, but the immunity genes were. This suggested the lack of nisin production under these conditions was possibly due to a blockage in the signal transduction pathway. To address this hypothesis, gel shift experiments were conducted with a nisA promoter fragment using crude cell extracts from cultures growing under these conditions. A shift was observed for cell extracts from the positive control, L. lactis ATCC 11454 grown at 30°C, but not for crude extract from L. lactis ATCC 11454 grown at 40°C or the dairy Enterococcus strain containing the nisin gene cluster. Furthermore, a protein with the same size as NisR (26 kDa) was isolated by nisA competitive heparin-affinity column chromatography from crude extracts from L. lactis ATCC 11454 grown at 30°C, but not from cell extracts under the non-nisin producing conditions. This suggested the lack of an activated, phosphorylated NisR, under these conditions. In addition, RT-PCR and Northern hybridization confirmed the presence of the nisRK transcript, indicating that NisRK was most probably produced. Therefore, the nisin gene expression was likely blocked from the reduced inability of external nisin to initiate the signal transduction pathway during these conditions. This is the first evidence of a specific mechanism for inhibition of nisin production in lactic cultures. This novel finding should enable culture users to more reliably predict nisin production kinetics of cultures during specific culture uses.

31 Invasion of *Mycobacterium avium sub sp paratuberculosis*in bovine epithelial cells and bovine mammary epithelial cells. D. Patel*[1], L. Goddik[1], and L. Bermudez[2], [1]*Food Science and Technology, Oregon State University, Corvallis, OR 97331-6602,* [2]*Department of Biomedical sciences, College of Vet Med, Oregon state Univ, Corvallis OR 97331-4804.*

Main objective of our experiment was to investigate invasion characteristics of *M*ycobacterium avium sub sp. paratuberculosis (MAP)against bovine epithelial cells and bovine mammary epithelial cells as targets. Johne's disease is a chronic infectious disease of ruminants caused by a bacterium *M*ycobacterium avium sub sp. paratuberculosis (MAP). It is estimated that about 30 % of dairy herds are infected with Johne's disease in the US. It is known that MAP infects the host by the oral route and young calves are infected at early age. Intestinal epithelial cells thus become primary site of infection. For current experiment we hypothesized : 1. Mammary epithelial cells can be a reservoir for MAP and therefore invasion could take place by apical or basolateral surface ; 2. MAP can enter intestinal epithelial cells. To test the above hypothesis we evaluated invasion employing immortalized epithelial cell lines, namely Bovine epithelial cell(MDBK purchased from ATCC) and Mammary epithelial cell (MACT, given by Dr. Sheffield, Univ of Wisconsin). MAP strain ATCC 19698 was used in our study. Invasion assay protocol was standardized in our lab. Based on the statistical analysis of data we found that MAP invades MAC-T and MDBK cells successfully, albeit poorly. MAP showed markedly higher rate of invasion in case of MDBK compared to MAC-T. Exposure of basolateral surface did not have marked influence on invasion in case of mammary epithelial cells, suggesting that the apical surface is the main route of entry however, exposure of basolateral surface of bovine epithelial cells significantly increased the uptake of bacteria., a puzzle that we cannot explain without further studies. MAP is a pathogen that is extremely resistant to wide spectrum of antibiotics. Its control lies in breaking its transmission cycle by inhibiting molecular interaction with epithelial cell surfaces. In this endeavor, in-vitro invasion assay described here can serve as a useful model in screening interesting MAP mutants with reduced or altered invasion efficiency. Main conclusion of our study is- MAP can successfully invade bovine epithelial cells and mammary epithelial cells. Exposure of basolateral surface significantly increases invasion rate in case of bovine epithelial cells.

Key Words: Mycobacterium avium sub sp paratuberculosis, Invasion assay, Bovine mammary epithelial cells

32 Epidemiology and ecology of *Listeria monocytogenes* at the pre-harvest food level. K. K. Nightingale*, E. D. Fortes, C. R. Nightingale, Z. Her, Y. H. Schukken, Y. T. Grohn, and M. Wiedmann, [1]*Cornell University.*

Listeria monocytogenes is a human foodborne pathogen and causes severe systemic infections in animals. *L. monocytogenes* is responsible for a significant portion of dairy product Class I recals. Raw milk may harbor *L. monocytogenes* and pasteurized dairy products may be contaminated if the pathogen become established in processing plant environments. A case-control study involving 22 case farms (13 dairy cattle, 1 beef cattle, 4 goat, and 2 sheep) and 22 pair-matched controls was conducted to probe the epidemiology and ecology of *L. monocytogenes*. A total of 1652 fecal (n=424), feed (n=420), and environmental samples (soil, n=397; water, n=411) were cultured for *L. monocytogenes*. While prevalence of *L. monocytogenes* was not significantly different (p=0.1492) in bovine case (23.13%) and control (19.58%) farms, the pathogen was more common ($p<0.0001$) in small ruminant (caprine and ovine pooled) case farms (26.41%) than controls (4.40%). The prevalence of *L. monocytogenes* was not significantly different ($p>0.05$) in fecal, soil, feed, and water samples from bovine case and control farms. Small ruminant case farms showed a significantly higher prevalence ($p<0.05$) of *L. monocytogenes* in all sampling categories than small ruminant controls. Molecular subtyping (*Eco*RI ribotyping) of clinical (n=15) and farm isolates (n=310) differentiated 49 unique ribotypes.

Ribotype DUP-1038B was associated with case farms and DUP-1045A was linked to control farms ($p<0.05$). Ribotype DUP-1038B was associated with feces while DUP-1045A was more common in the environment ($p<0.05$). *L. monocytogenes* subtypes isolated from clinical cases or fecal samples were more frequent in environmental than feed samples, indicting that case or carrier animals are important to *L. monocytogenes* dispersal. We determined that *L. monocytogenes* was abundant in preharvest food systems. Our data indicate that the epidemiology and ecology of *L. monocytogenes* differs between host species. While some *L. monocytogenes* subtypes may cause disease, others may protect against disease by stimulating host immunity or competitive exclusion. A complete understanding of the *L. monocytogenes* epidemiology and ecology is needed to implement effective control strategies and ultimately ensure food safety.

Key Words: Listeria monocytogenes, Molecular epidemiology, Preharvest food safety

33 The influence of sweet cream buttermilk on the compositional and rheological properties of a stirred-curd cheese. T. Lin*[1], J. Lucey[1], R. Govindasamy-Lucey[2], M. Johnson[2], and J. Jaeggi[2], [1]*Department of Food Science, UW Madison,* [2]*Wisconsin Center for Dairy Research.*

Sweet cream buttermilk (SCB) is a by-product from the butter-making process and has been used as an ingredient for cheesemaking. The objective of this research was to determine how the addition of SCB might affect the cheese composition, melt, stretch, and free oil of cheese when used on a pizza. Three trials were done in which stirred-curd cheese was made from partially skimmed milk with the addition of 2, 4, and 6% (w/w) condensed SCB. Cheeses were assessed for composition, meltability using the UW Melt Profiler, free oil using modified Babcock test, and stretchability by the fork test, over a four-week ripening period. Cheese moisture content increased significantly ($P<0.05$) with increasing SCB levels, and ranged from 45% (w/w) for control cheese to 51% for the 6% SCB fortified cheese. Cheeses with 6% SCB had significantly ($P<0.05$) lower pH than control cheese during entire ripening period. Fat content in cheeses decreased from 23% for control to 20% for 6% SCB fortified cheese. Cheeses with no added SCB had the highest % recovery of its indigenous phospholipids (40%). Cheeses, made with 2, 4, and 6% SCB had total phospholipid recoveries of 32, 33 and 31%, respectively. The extent of flow, or cheese metability, was significantly higher ($P<0.05$) for cheeses made with SCB than control cheese during the ripening period. This may be due to the high moisture and low pH of these cheeses. Free oil release was significantly reduced ($P<0.05$) for all the cheeses made with added SCB for the first week of ripening; however, there was no significant difference between treatments at the second and fourth week. Visually, no significant free oil formation was observed when cheeses were baked on pizza. Cheese stretchability was significantly reduced ($P<0.05$) with increasing level of SCB. The stretchability of control cheeses increased during ripening, but decreased in cheeses with added SCB. Results showed the use of high level of SCB resulted in cheese with soft body, poor shredding, high extent of flow, low pH, and high moisture. Whether the physical and rheological changes in SCB added cheeses were due to the compositional changes in the cheese or to the disruption of SCB components in the cheese network is currently under investigation.

Key Words: Buttermilk, Pizza, Phospholipids

34 Characterization of proteolysis in Cheddar cheeses produced with isogenic, thermolytic starters expressing various cell envelope proteinases. S. Myaka, L. Metzger*, K. Baldwin, and L. McKay, *MN-SD Dairy Food Research Center, University of Minnesota, St. Paul, MN.*

If the use of thermolytic starter strains for accelerating Cheddar cheese ripening is coupled with the use of the extracellular starter proteinase with desired cleavage specificity a more controlled acceleration of ripening and improved flavor formation might be expected. The objective of this research was to investigate how the specificity of the cell envelope proteinase (CEP) in conjunction with the early released peptidases affects the accumulation of proteolytic products. In a previous study Cheddar cheese was manufactured with thermolytic isogenic lactococcal starters expressing CEPs from groups a, c, d, and g. Sensory evaluation revealed no flavor differences except for bitterness. In this study the peptide profiles of the cheeses were compared by RP-HPLC analysis of the 70%-ethanol soluble fractions and the most abundant peptides in the major chromatographic peaks were identified by Mass Spectrometry (MS). MS data were analyzed with Sequest® and peptides were matched against the casein sequences. The major peaks of the non-bitter cheeses eluted from the RP column in the first half of the chromatogram and from the bitter control cheese more towards the end of the run. The intermediate bitterness of treatment g coincided with an even spread of its major peaks from the beginning to the end of the elution time. Thus a correlation between bitterness and elution from a hydrophobic column was observed. Bitter peptides αS1(f1-13) and β(f193-209) accumulated to high levels in both bitter and non-bitter cheeses suggesting that these peptides are not the only compounds imparting bitterness. Peptides resulting from the specific CEP cleavage of αS1(f1-23) were found in all the cheeses but only in treatment g did they accumulate to higher levels and appear as separate peaks. Consequently the most abundant peptides in the major peaks are not necessarily traced back to the cleavage specificities of the different CEPs.

Key Words: Cell envelope proteinase, Proteolysis, Peptides

35 Identification of fecal/mothball flavor in Cheddar cheese. M. E. Carunchia Whetstine*[1], Y. Yoon[1], and M. A. Drake[1], [1]*North Carolina State University.*

Flavor of Cheddar cheese is a key parameter for consumer acceptance and marketing. The application of analytical sensory and instrumental methods to identify and characterize specific flavors and the chemicals that cause specific flavors enhances our understanding of cheese flavor chemistry. Some Cheddar cheeses have been found to exhibit a fecal/mothball (F/M) flavor. The objectives of this research were to identify and characterize aroma-active compounds that contribute to F/M flavor in Cheddar cheese. Blocks of Cheddar cheeses (6 to 15 months old) were collected and screened for F/M flavor by a descriptive sensory analysis panel (n=14). Two cheeses with F/M flavor and two cheeses of similar age without F/M flavor were selected and analyzed for volatile aroma compounds. Duplicate samples (300g) with internal standards (2-methyl pentanoic acid, 2-methyl-3-heptanone, and 1-pentanol) were extracted with diethyl ether, followed by isolation of volatile material by high vacuum distillation. Volatile extracts were analyzed by gas chromatography-olfactometry (GCO) and the most odor active compounds were determined using aroma extract dilution analysis (AEDA). Additionally, 5g of each cheese were frozen, grated, and subsequently analyzed using dynamic headspace purge and trap. Compounds were identified by comparison of retention indices, odor properties and GC-MS data against reference standards. Selected compounds were quantified by standard addition. Sensory analysis of model systems was used to confirm the relationship between selected compounds and specific flavors. Sensory analysis determined that F/M flavor was independent of cheese age; present in 6 month cheeses as well as 15 month cheeses. The 15 month cheeses had more intense brothy and sulfur notes while the 6 month cheeses had more whey, cooked, and milkfat/lactone flavors. Based on GC-O AEDA results, key volatile flavor compounds in both sets of cheeses were acetic acid (vinegar), hexanoic acid (sweaty), maltol (sweet), furaneol (burnt sugar), 3-methylindole (F/M), o-aminoacetophenone (grape), and g-dodecalactone (coconut). Increased concentrations of 3-methyl-indole and butyric acid were observed in both cheeses exhibiting F/M flavors compared to those cheeses without this flavor.

Key Words: Cheddar flavor, Fecal/mothball flavor, Aroma extract dilution analysis

36 Analysis of physico-chemical changes during early ripening of cheese utilizing FTIR Spectroscopy. P. Upreti* and L. E. Metzger, *MN-SD Dairy Foods Research Center, University of Minnesota, St. Paul, MN.*

The objective of this study was to evaluate the feasibility of Fourier Transform Infrared (FTIR) Spectroscopy for measurement of lactose and lactic acid in cheese/cheese curds and to monitor lactose fermentation in cheeses during the first few days of ripening. A Nicolet 560 FTIR Spectrometer with a ZnSe Attenuated Total Reflectance (ATR) crystal accessory was used, and a protocol for sampling cheese/cheese curds was developed. Cheese/cheese curds were ground to a paste and then mounted on the ATR crystal. Proper contact between the sample and the crystal was ensured using the pressure pad assembly. The sample

was left under these conditions for 5 min before the start of data collection. The spectrum was collected in the region between 4000 and 650 cm^{-1} at a resolution of 4 cm^{-1}, and a rate of 256 scans per sample. The crystal was cleaned between samples using distilled water, propanol, and distilled water, and then wiped to complete dryness. The spectrum obtained after subtraction of water spectrum from the sample spectrum was used to analyze for lactose and lactic acid. Cheeses spiked with lactose and lactic acid showed a shift in spectrum in the regions of 1200 to 1050 and 1700 to 1500 cm^{-1} respectively. In the next phase of the study, three replicates of cheeses with two different levels of residual lactose and calcium were manufactured. The levels of lactose and lactic acid were measured by HPLC and the FTIR spectra were collected for the cheese curds prior to salting, and cheese at day 1, 3, 5, 7, and 9 during ripening. The level of residual lactose and calcium in the cheese at day 1 was significantly ($p \leq .05$) different for the two treatments (.73 and 1.93% for lactose; .85 and .66% for calcium), and the level of lactose decreased in both treatments during the first 9 days of ripening. Subsequently partial least squares and principal component analysis will be used to characterize changes in lactose fermentation to the shifts in the FTIR spectrum during initial cheese ripening.

37 Evaluation of salt whey as an ingredient in process cheese. R. Kapoor* and L. E. Metzger, *MN-SD Dairy Food Research Center, University of Minnesota, St. Paul, MN.*

Salt whey refers to the whey stream obtained during the salting and mellowing step of a cheese manufacturing process. Due to its high salinity level, it is underutilized and also leads to disposal costs. Consequently, alternative uses need to be pursued. The major components of salt whey (salt and water) are used as ingredients in process cheese. The objective of this research was to determine if salt whey, obtained from a traditional Cheddar cheese manufacture process, could be used as an ingredient in process cheese. Three replicates of Process Cheese (PC), Process Cheese Food (PCF) and Process Cheese Spread (PCS) with two treatments each were manufactured. Treatment 1 (C) used the control formula and treatment 2 (T) involved the modified formula using salt whey to replace salt and water. Salt whey was collected during the salting and pressing steps of the Cheddar cheese procedure at the University of Minnesota, followed by mixing and pasteurization. There were no significant differences ($p \geq .05$) in process cheese composition between the treatments. Texture Profile Analysis (TPA) and Rapid Visco Analyzer (RVA)-melt analyses were performed on all the process cheeses. Schrieber melt test was performed on PC and PCF and the tube melt test on PCS. The mean TPA-hardness values obtained respectively for the C and T were 126 N and 115 N for PC, 61 N and 59 N for PCF, and 12 N and 12 N for PCS. The mean melt diameter obtained for C and T process cheeses were 48.5 mm and 49.4 mm for PC, and 61.6 mm and 63 mm for PCF. The tube-melt for PCS (C and T) was 75.1 mm and 79.8 mm respectively. There were no significant differences ($p \geq .05$) in the TPA-hardness and the RVA hot viscosity for PC, PCF and PCS between the treatments. The Schreiber melt of C and T for PC and PCF and the tube melt values for C and T in PCS also showed no significant differences ($p \geq .05$). The replacement of salt and water with salt whey in PC, PCF and PCS had no significant effect on their functionality.

Key Words: Process cheese, Salt whey

38 Strategies to improve stability and performance of calibration samples for infrared milk analyzers. K. E. Kaylegian* and D. M. Barbano, *Northeast Dairy Foods Research Center, Cornell University.*

Infrared milk analyzers are traditionally calibrated using sets of 10 to 12 raw milk samples from individual farms. Although taken from the local milk population, these sets of samples are limited by a short shelf-life, a short and variable range in component concentration, nonuniform distribution of concentrations within the range, and correlation in concentration changes among components. An alternate approach using ultrafiltration (UF) to produce calibration samples provides a means to overcome these weaknesses and improve calibration performance. UF calibration samples were produced by gravity separating pasteurized milk, centrifugally separating the gravity skim to remove residual fat, and ultrafiltering the skim milk. The gravity cream (ca. 25% fat), UF retentate (2X), UF permeate, lactose α-monohydrate, and water were combined to make calibration sets designed to have a large range and incremental changes in each component and to uncouple the fat and protein correlation. The 12 sample UF calibration set had a range of 2.0-6.0% fat, 2.0-4.3% true protein, and 4.0-5.3% anhydrous lactose. Shelf life of preserved UF calibration samples was 4 wk compared to 2 wk for individual farm samples. Comparison of performance of individual farm and UF calibration sets was by standard deviation of the difference (SDD) between chemistry and infrared prediction, the stability of the instrument slope and bias with time, set to set variation in these values, and the frequency of high leverage samples within calibration sets. UF calibration sets had smaller SDD within sets and were more consistent among sets, indicating better calibration performance with respect to agreement with chemistry. The UF calibration samples exhibited a more stable slope and bias for each component and fewer high leverage samples than for farm milk calibration samples, both within calibration sets and among sets over several months of operation.

Key Words: Infrared milk analysis, Calibration, Ultrafiltration

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ADSA/ASAS Northeast Graduate Student Paper Competition

40 Effects of *trans*-8, *cis*-10 CLA and *cis*-11, *trans*-13 CLA on milk fat synthesis. J. W. Perfield II*[1], A. Sæbo[2], and D. E. Bauman[1], [1]*Cornell University, Ithaca, NY,* [2]*Natural ASA, Hovdebygda, Norway.*

Conjugated linoleic acid (CLA) supplements that cause a reduction in milk fat secretion in dairy cows have typically been comprised of 4 isomers (*trans*-8, *cis*-10; *cis*-9, *trans*-11; *trans*-10, *cis*-12; *cis*-11, *trans*-13 CLA). Abomasal infusion of pure isomers has shown that *trans*-10, *cis*-12 CLA is a potent inhibitor of milk fat synthesis, whereas *cis*-9, *trans*-11 CLA has no effect (Baumgard et al. 2000, Am. J. Physiol. 278:R179-84). However, there appear to be additional fatty acid intermediates that inhibit milk fat synthesis based on infusion of various CLA enrichments (Chouinard et al. 1999, J. Dairy Sci. 82:2737-45) and studies with rumen-protected CLA (Perfield et al. 2002, J. Dairy Sci. 85:2609-17). The objective of this study was to investigate the effects on milk fat synthesis of additional CLA isomers present in the rumen-protected supplements. Four rumen fistulated Holstein cows (141 $\pm$ 8 DIM, mean $\pm$ SE) were randomly assigned in a 4 X 4 Latin square experiment. Treatments were abomasal infusion of 1) skim milk (negative control), 2) *trans*-10, *cis*-12 CLA supplement (positive control), 3) *trans*-8, *cis*-10 CLA supplement, and 4) *cis*-11, *trans*-13 CLA supplement. Treatments 2 to 4 were targeted to provide 4 g/d of the CLA isomer of interest and the daily dose provided by infusion at 6 h intervals. Treatment periods were 5 d in length with 7 d washout periods. The *trans*-8, *cis*-10 CLA had no effect on milk fat yield whereas *trans*-10, *cis*-12 CLA reduced milk fat yield by 35% ($P < 0.01$). The *cis*-11, *trans*-13 CLA supplement contained some *trans*-10, *cis*-12 CLA and when data were corrected to account for this, it was obvious that *cis*-11, *trans*-13 CLA also had no effect on milk fat synthesis. Milk fat content (g/100 g fatty acids) of specific CLA isomers was significantly elevated within respective treatment groups (*trans*-8, *cis*-10 CLA (0.27); *trans*-10, *cis*-12 CLA (0.18); *cis*-11, *trans*-13 CLA (0.23); $P < 0.001$). Milk yield ($P < 0.37$), DMI ($P < 0.44$) and milk protein yield ($P < 0.22$) were unaffected by treatment. Overall, abomasal infusion of *trans*-10, *cis*-12 CLA reduced milk fat synthesis, while the other major isomers present in rumen-protected CLA supplements (*trans*-8, *cis*-10 CLA and *cis*-11, *trans*-13 CLA) had no effect.

Key Words: CLA, Milk fat depression, Dairy cow

41 Effect of prepartum dietary carbohydrate source and monensin on dry matter intake, milk production and blood metabolites of transition dairy cows. M. M. Pickett*, T. W. Cassidy, P. R. Tozer, and G. A. Varga, *The Pennsylvania State University, University Park, PA.*

Ninety-four multiparous Holstein cows (3.39 $\pm$ 0.05 BCS) were used in an complete randomized block design to evaluate the effects of carbohydrate source and monensin on dry matter intake, milk production and blood metabolites of transition cows. Two diets with (+) or without (-)

supplemental monensin (0 or 330 mg/d) were evaluated in a 2 X 2 factorial arrangements. The prepartum CONV diet contained 70% forage and the NFFS diet contained nonforage fiber sources such that 28% of the forage was replaced with cottonseed hulls and soyhulls. Treatments were designated CONV-, CONV+, NFFS-, and NFFS+. The prepartum diets were formulated to contain 1.55 Mcal/kg NE_L, 40% NDF, and 14% CP. Dietary treatments began at dry off and continued until parturition. Monensin was top dressed daily starting 28 d prior to expected calving date. Prepartum dry matter intake (DMI) was significantly higher for cows fed the NFFS diet compared to cows fed the CONV diet (P $\leq$0.05; 12.5, 11.2, 15.5, 15.1 $\pm$ .5 kg/d). There were no differences in postpartum DMI (21.2 $\pm$ .7 kg/d) or milk yield (43.1 $\pm$ 2.1 kg/d). Body condition score did not differ prepartum (3.38 $\pm$ .05) or postpartum (2.94 $\pm$ 0.05). CONV treatment had higher plasma nonesterified fatty acids (NEFA) prepartum than NFFS treatment (P $\leq$0.05; 236.2, 199.4 $\pm$11.7 μE/L). At d 3 and 5 prepartum NFFS diet had lower plasma NEFA concentrations than the CONV diet (P $\leq$0.05; 171.1 vs. 264.2 $\pm$ 25.1; 255.6 vs. 385.5 $\pm$ 23.3 μE/L). Postpartum NEFA were not affected by treatment (411.6 $\pm$ 22.4 μE/L). Monensin supplementation prepartum did not affect postpartum DMI, milk production or plasma NEFA concentrations. The inclusion of nonforage fiber sources in the prepartum diet increased prepartum DMI and decreased NEFA prepartum but had no affect on postpartum DMI or milk production.

Key Words: Nonforage fiber, Monensin, Transition cow

42 Photoperiod Manipulation affects milk yield and mammary growth in pubertal heifers induced to lactate.

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Cows exposed to a short day photoperiod during the dry period produce more milk, but the mechanisms behind this effect are unclear. We hypothesized that exposure to short days during hormonal induction of lactation would stimulate milk production and mammary growth. To test this hypothesis, Holstein heifers (n=12; 14 mo old) were assigned to either long day photoperiod (LDPP; 16h light:8 h dark), or short day photoperiod (SDPP; 8h light:16h dark) treatment and were fed melengesterol acetate (MGA) for 14 d to synchronize estrous. Heifers were then treated with estrogen and progesterone (E+P; .1 and .25 mg/kg/d) for 7d to induce lactation. Twenty-one days after the initial E+P injection, twice-daily milking was initiated, all heifers were placed on LDPP, and biweekly treatment with rBST (Posilac®) commenced. Mammary tissue was obtained by biopsy at 0, 5, and 10 d relative to initial E+P injections and explants were used to quantify rates of [^{3}H]-thymidine incorporation into DNA *in vitro*. Milk yield and composition were also measured. Milk yield was low initially in both groups but began to diverge after 19 DIM and averaged 16.3 $\pm$ 1.2 vs 12.6 $\pm$ 1.3 kg/d (P=.05) at 63 DIM for SDPP and LDPP, respectively. Milk composition and SCC did not differ between treatments (P>.10). Averages across groups for milk protein (3.17 $\pm$ .04%), milk fat (4.44 $\pm$ .14%), and SCC (3.27 $\pm$ .44%) indicated that milk composition was relatively normal. Incorporation of [^{3}H]-thymidine *in vitro* did not differ between treatment groups (P>.10). In both groups, cell proliferation increased over time (P<0.01), averaging 199 $\pm$ 54, 726 $\pm$ 71, and 558 $\pm$ 68 dpm/ug DNA on days 0, 5, and 10, respectively. We conclude that SDPP treatment during induced lactation in pubertal dairy heifers resulted in higher milk yields but did not affect cell proliferation at the times sampled.

Key Words: Photoperiod, Induced lactation, Mammary growth

43 Abnormal udder conformation in pubertal heifers induced into lactation.

E. Wall*, R. Thomason, D. Maynard, E. Brunst, and T.B. McFadden, *University of Vermont, Burlington, VT.*

Hormonal induction of lactation in pubertal heifers could provide a potential means to enhance economic efficiency, but effects on mammary development and conformation have not been reported. Twelve, 14 mo old Holstein heifers were assigned to either long day (LD; 16h light:8 h dark), or short day (SD; 8h light:16h dark) photoperiod treatment and were fed melengesterol acetate (MGA) for 14 d to synchronize estrous. Heifers then received daily injections of estrogen (E; 0.1mg/kg/day) and progesterone (P; 0.25mg/kg/day) for 7 d to induce lactation. Twenty-one days after the initial E+P injection, twice-daily milking was initiated, all heifers were placed on LD, and biweekly treatment with rbST (Posilac® commenced. Varying degrees of abnormal udder conformation were observed. In general, heifers exhibited highly sloped udder floors with long teats pointing forward. Apparent differences in capacity of individual quarters were quantified by quarter milking at 60, 180 and 300 DIM. Quarter milking yields did not differ between treatments (P>.10) but confirmed apparent size differences per quarter (P<.09). Among quarters, the left rear produced more milk than the left front (P= .01) with the other quarters not significantly different. To assess conformation, udders were scored using the linear scoring system at 300 DIM. Total linear udder scores did not differ by treatment and, except for three heifers, were below breed average. To further assess conformation, quartering was assessed on a scale of 1-45, where 1=no demarcation between quarters, 25=desirable conformation, and 45=extreme quartering. Quartering score averaged 37 $\pm$2.1 and was not different between treatments (P>.10). We conclude that induction of lactation resulted in abnormal udder conformation. This effect could be related to the short length of hormone treatment compared to a natural pregnancy. Heifers will be monitored in their subsequent parturient lactation to determine whether abnormalities are corrected.

Key Words: Pubertal heifers, Udder conformation, Induced lactation

44 A comparison of the effects of microbial inoculants designed to improve the aerobic stability of corn silage.

D. H. Kleinschmit*, R. J. Schmidt, J. E. Lynch, J. M. Ladd, M. Reddish, K. E. Stratton, J. G. Carr, and L. Kung, Jr., *University of Delaware, Newark, DE.*

Whole plant corn was harvested at 1/2 milk line (32% DM) and ensiled in 20-L laboratory silos for 108 d to measure the effects of microbial inoculants on fermentation and aerobic stability. Fresh forage was assigned to one of the following treatments: 1) Untreated (U), 2) *Lactobacillus buchneri*11A44 (Pioneer Hi-Bred Intl., Des Moines, IA, 100,000 cfu/g of fresh forage weight) (PLB1), 3) *L. buchneri* 11A44 (400,000 cfu/g) (PLB4), 4) *L. buchneri* 40788 (Lallemand Animal Nutrition, Milwaukee, WI, 400,000 cfu/g) (LLB), and 5) Biomax 5 (L. plantarum PA-28 and K-270, 100,000 cfu/g, Chr. Hansen Biosystems, Milwaukee, WI), (B5). After ensiling, the pH of all silages were similar to U except for PLB4, which was greater ($P < 0.05$). The concentration of lactic acid in B5 (5.88%) was greatest of all treatments, whereas PLB1, PLB4, and LLB (4.75, 3.72, and 4.40%, respectively) had a lower concentration of this acid than U (5.27%). The concentration of acetic acid was greatest in PLB4 (7.59%), whereas PLB1 and LLB (6.31 and 6.29%, respectively) had greater levels of this acid than U and B5 (3.29 and 2.92%, respectively). Yeasts were undetected in all silages except B5 (4.95 $\log_{10}$ cfu/g). Aerobic stability was determined by exposing silage to air and recording the number of h before silage temperature increased 2C above ambient room temperature. The aerobic stability of B5 (52 h) was worse compared to U (73 h), whereas, PLB1, PLB4, and LLB remained stable after > 210 h. In conclusion, the aerobic stability of silage treated with PLB1, PLB4, and LLB may be attributed to the absence of yeasts and high levels of acetic acid present in these silages.

Key Words: Silage, Inoculants, Aerobic stability

45 WITHDRAWN. , .

46 Effect of feeding high-linoleate safflower seeds on reproductive endocrine dynamics in postpartum beef females. M. H. J. Grant*[1], B. W. Hess[1], D. L. Hixon[1], E. A. Van Kirk[1], B. M. Alexander[1], T. M. Nett[2], and G. E. Moss[1], [1]*University of Wyoming, Laramie, WY,* [2]*Colorado State University, Fort Collins, CO.*

The objective of this study was to determine if fat supplementation immediately postpartum influenced serum concentrations of progesterone, LH, FSH, estradiol, and PGF-metabolite (PGFM). Twenty-four three-year-old beef cows were individually fed hay and low-fat control (C, beet pulp pellets) or high-fat (HL, high-linoleate safflower seed) supplements from d 1 to 80 postpartum. Diets were formulated to be isonitrogenous and isoenergetic and HL was formulated to provide 5 % dietary fat. Cows were treated with 100 μg GnRH on d 40 to 45 postpartum (d 0) and $PGF_{2\alpha}$ 7 d later (7 d). Concentrations of progesterone did not differ ($P = 0.9$) between dietary treatments prior to ovulation. Magnitude of the GnRH-induced LH ($P = 0.8$) and FSH ($P = 0.9$) surges did not differ between dietary treatments. The interval from the GnRH-induced preovulatory surge release of LH to a significant increase in serum concentrations of progesterone tended ($P = 0.1$) to be longer in HL than C cows. By d 7, however, concentrations of progesterone (ng/mL) were greater ($P = 0.02$) in HL (1.1 $\pm$ 0.1) than C (0.7 $\pm$ 0.9) cows. Peak concentrations of estradiol (pg/mL) during the ensuing proestrus were lower ($P = 0.04$) in HL (5.7 $\pm$ 1.2) than C (9.4 $\pm$ 1.2) cows. Concentrations of PGFM (pg/mL) were greater ($P = 0.01$) in HL (469 $\pm$ 24) than C (328 $\pm$ 23) from d 25 to 80 postpartum. First service conception rates tended ($P = 0.1$) to be greater in C (66.7%) than HL (33.3%), however, conception rates were identical by the end of the breeding season. Conception occurred earlier ($P = 0.02$) postpartum in the C (60 $\pm$ 5 d) than HL (81 $\pm$ 6 d) cows. Fat supplementation with high-linoleate safflower seeds detrimentally affected early postpartum fertility possibly because of the elevated production of prostaglandin $F_{2\alpha}$.

Key Words: Fat, Cow, Postpartum

47 Effects of barley processing, bulk density and oil type on feedlot performance and carcass characteristics of finishing beef steers. M. F. McDonnell*, J.G.P. Bowman, L.M.M. Surber, J. J. Kincheloe, M. A. Thompson, K. A. Anderson, and T. K. Blake, *Montana State University, Bozeman, MT.*

Eighty crossbreed beef steers weighing 385 kg ($\pm$ 5.77 kg) were fed a finishing diet (83% barley, 6% chopped straw, 3% oil and 8% supplement) in a study examining the effects of barley processing (whole vs. cracked), barley bulk density (**BD**; heavy vs. light; 63.1 kg/hL and 50.8 kg/hL, respectively) and oil type (soybean vs. high linoleic acid safflower oil) on animal performance (ADG, DMI, and DMD) and carcass characteristics. A processing by BD interaction ($P < 0.01$) was detected for final weight, ADG, DMI, and feed efficiency (**FE**). Final weight was highest ($P = 0.005$) for steers fed cracked heavy barley (**CH**) and cracked light barley (**CL**; avg. 573 kg), intermediate for steers fed whole light barley (**WL**; 505 kg) and least for steers fed whole heavy barley (**WH**; 468 kg). Average daily gain was highest ($P = 0.001$) for steers fed CH and CL (avg. 1.65 kg/d), intermediate for steers fed WL (1.06 kg/d), and least for steers fed WH (0.75 kg/d). Dry matter intake was greatest ($P = 0.01$) for steers fed CH and CL (avg. 11.6 kg/d), intermediate for steers fed WL (9.7 kg/d), and least for steers fed WH (8.1 kg/d). Feed efficiency (gain/100 units of feed) was highest ($P = 0.002$) for steers fed CH (14.7), followed by CL (13.9), WL (9.7), and WH (8.1). Cracked barley (**CB**) had higher ($P = 0.001$) NE_m and NE_g values than whole barley (**WB**; avg. 2.06 vs. 1.69 Mcal/kg for NE_m; avg. 1.42 vs. 1.09 Mcal/kg NE_g). There was no effect ($P = 0.40$) of BD on NE_m or NE_g values. No differences ($P > 0.08$) in carcass characteristics were detected for BD, processing, or their interaction. No effects ($P > 0.07$) of oil on ending weights, ADG, or carcass characteristics were found. In summary, barleys with BD of 63.1 and 50.8 kg/hL had similar energy contents, while NE_m and NE_g for cracked barley were 22 and 30% higher, respectively, than for whole barley fed to finishing steers.

Key Words: Barley, Processing, Bulk density

48 Evaluation of time to AI with a modified Co-Synch protocol and calf removal in postpartum beef cows. R. S. Walker*[1], P. D. Burns[2], G. E. Sides[3], and D. D. Zalesky[1], [1]*San Juan Basin Research Center, Hesperus, CO, USA,* [2]*Colorado State University, Fort Collins, CO, USA,* [3]*Intervet, Inc., Millsboro, DE, USA.*

The objective of this study was to evaluate optimal timing for timed AI using a modified Co-Synch protocol with or without a second injection of GnRH and calf removal. Suckling, multiparous Composite and Hereford beef cows (n=202, postpartum interval (PPI) = 67 d, body condition score (BCS) = 5) were synchronized for AI in two different calving seasons. Early calving cows (ECC; n=79, PPI=67 d, BCS=5.2) and late calving cows (LCC; n=123, PPI=67, BCS=4.9) were randomly assigned to one of four treatments. All cows were injected with GnRH (100 g; i.m.) on day 0, followed by an injection of $PGF_{2\alpha}$ (25 mg; i.m.) on day 7. Calves were removed at time of PG injection and returned to nurse at time of insemination. Half of the cows were time-inseminated (TAI) 48 h post PG injection, with (48-TAI-G) or without (48-TAI) a second injection of GnRH. The second half of the cows were inseminated 72 h post PG injection, with (72-TAI-G) or without (72-TAI) a second injection of GnRH. Pregnancy rates to TAI were higher for cows inseminated at 72 h compared to cows inseminated at 48 h post PG injection ($P < 0.05$) for both ECC and LCC. Pregnancy rates at 48 and 72 h were improved when GnRH was incorporated at the time of insemination ($P < 0.05$) for both ECC and LCC. However, pregnancy rate was no longer significant when sire was used as a random variable in the statistical model ($P > 0.05$). Pregnancy rates for Sire A (31.3 %) and Sire B (49.4 %) across all treatments accounted for the variability in pregnancy rates between treatments. We concluded that semen from the two sires used, affected pregnancy rates over all treatments, but delaying TAI to 72 h with a second injection of GnRH may improve pregnancy rates for mass mating programs.

Key Words: Estrous synchronization, GnRH, Calf removal

49 Glucose half-life decreased in young postpartum range cows from spring to summer. R. L. Endecott*, D. L. Dunlap, R. C. Waterman, A. C. Fitzgerald, V. A. Munn, K. L. Shirley, S. H. Cox, J. A. Hartung, C. A. Loest, and M. K. Petersen, *New Mexico State University.*

Young beef cows experience a negative energy balance after parturition and during lactation when grazing dormant New Mexico range. As a result, sensitivity to insulin may be decreased due to the physiology of lactation and poor forage quality. However, with adequate precipitation during the growing season, forage quality improves, and insulin sensitivity may increase. An experiment was conducted to investigate seasonal changes in nutrient status of young range cows (n = 22) at the New Mexico State University Livestock Research Center and the Corona Range and Livestock Research Center. Two glucose tolerance tests (GTT) were conducted, one at 35 d postpartum (spring) and one at 165 d postpartum (summer). At the time of the spring GTT, 2-year-old cows were group fed a mixture of wheat straw and alfalfa hay (7 to 8% CP, OM basis) similar to New Mexico native range in March and April. Cows were grazing New Mexico green forage at the time of the summer GTT. For each GTT, 50% dextrose solution was infused at 0.5 $mL \cdot kg^{-1}$ BW via indwelling jugular catheter and serum was collected at 14 intervals for 180 min beginning 3 min post-infusion. Serum glucose and insulin areas under the curve were calculated using trapezoidal summation. Glucose half-life was estimated by determining the time required for a 50% decrease in peak serum glucose concentration. Glucose area under the curve was smaller ($P < 0.05$) in the summer (9606 $\pm$ 573) than in the spring (11337 $\pm$ 541). This relationship also existed ($P < 0.01$) for insulin area under the curve (445 $\pm$ 25 vs. 302 $\pm$ 27 for spring and summer, respectively). Glucose half-life was 50% shorter ($P < 0.01$) in the summer when compared to the spring (87 vs. 45 $\pm$ 6 min). Cows grazing green summer forage were more insulin sensitive than cows consuming a poor quality diet. Differences in cow performance between late winter and summer may be due to hormonally regulated differences in energy metabolism.

Key Words: Glucose, Insulin, Season

50 WITHDRAWN. , .

51 Explant culture supports survival and proliferation of Bovine spermatogonial stem cells. J. M. Oatley*, D. J. McLean, D. M. de Avila, and J. J. Reeves, *Washington State University*.

ABSTRACT: Spermatogonial stem cells (SSC) continually give rise to mature spermatozoa; at this time SSC can only be identified and evaluated by their ability to colonize in a recipient testis. Support of these cells in culture may lead to an ability to genetically modify livestock. The present study was designed to evaluate the survival and proliferation of bovine SSC in an explant culture system over a 3wk period. Explants of calf (1-2mo) testicular parenchyma were placed on 0.45um pore membranes in culture and maintained for 1-3wk in DMEM containing 10% fetal bovine serum at 32°C. Histological examination of fresh (t0) and cultured tissues revealed intact seminiferous tubules. Germ cell numbers/tubule increased ($P \leq 0.05$) after culture vs. t0, yet maturation was not observed. Testosterone was detected in medium throughout the culture period, 6.4±2.7 (1wk), 3.3±1.3 (2wk), and 2.5±1.1 ng/ml (3wk), indicating functional Leydig cells. Sertoli cell and spermatogonial viability was sequentially evaluated by RT-PCR for cell specific gene expression of stem cell factor and protein gene product 9.5, respectively. Results demonstrated the expression of both genes at 1, 2, and 3wk of culture. Single cell suspensions were prepared from the testicular tissues at t0 and during culture and transplanted into nude mouse recipient testes to investigate SSC viability. One-month after transplantation, colonies of round bovine cells were identified in all mouse testes analyzed, indicating survival of SSC. Time in culture enhanced ($P \leq 0.05$) resulting colony numbers after wk2 and 3 of culture, 30±2.3 (t0), 35±4 (1wk), 48±9.5 (2wk), and 70±3.7 (3wk). This increase in colony numbers over time in culture indicates SSC proliferation in vitro. Bovine Leydig cells, Sertoli cells, spermatogonia, and SSC remain viable during explant culture for at least 3wk. This explant culture system appears to provide an environment for enhanced proliferation of bovine spermatogonial stem cells.

Key Words: Bovine, Culture, Spermatogonial stem cells

52 Undegradable true protein, and not ruminally-protected methionine, increases nutrient utilization by growing beef heifers. V. A. Munn*, C. A. Loest, C. P. Mathis, M. K. Petersen, P. J. Defoor, J. E. Sawyer, and C. A. Rogers, *New Mexico State University, Las Cruces, NM*.

Eight Charolais-cross heifers (266 ± 18 kg) were used in a replicated 4 × 4 Latin square to determine whether supplementation of ruminally-protected methionine or undegradable true protein would improve nutrient utilization when allowed ad libitum access to a mixture of wheat straw and alfalfa to supply 8.2% CP (DM basis). Treatments were 1.18 kg DM/d of: 1) soybean hull-based supplement (NC; 13% CP); 2) NC containing degradable intake protein (DIP; 22% CP, 6.4 and 3.3% of CP equivalent from urea and sodium caseinate, respectively); 3) DIP containing rumen-protected methionine (MET; 22% CP, supplied 10 g/d methionine); and 4) DIP containing undegradable intake protein (UIP; 40% CP, 21% of CP equivalent from undegradable true protein sources). Periods were 21 d; 14 d for adaptation, 1 d for blood collection (data not presented), and 6 d for collection of forage and supplement, total orts, and total urine and fecal output (using fecal bags). Representative samples were composited for each heifer by period and analyzed for DM, OM, and N. Supplementation did not affect ($P > 0.10$) forage OM intakes (4.00, 4.04, 3.84, and 4.03 ± 0.12 kg/d for NC, DIP, MET, and UIP, respectively) and retention of OM (57.4, 58.9, 57.9, and 58.8 ± 1.1% for NC, DIP, MET, and UIP, respectively). Intakes of total N (89.9, 105.6, 103.0, and 140.3 ± 2.0 g/d for NC, DIP, MET, and UIP, respectively) were lowest for NC, intermediate for DIP and MET, and greatest for UIP ($P < 0.05$). Total N excretion (54.2, 58.2, 58.3, and 77.6 ± 2.1 g/d for NC, DIP, MET, and UIP, respectively) was greater ($P < 0.01$) for UIP, and tended ($P < 0.20$) to be greater for DIP and MET compared to NC. Retention of N (35.7, 47.4, 44.8, and 62.7 ± 2.7 g/d for NC, DIP, MET, and UIP, respectively) was greater ($P < 0.05$) for DIP and MET when compared to NC, but increased further ($P < 0.05$) for UIP. Results suggest that supplementation of rumen undegradable true protein, and not rumen-protected methionine, improves nutrient utilization over rumen degradable protein for cattle consuming average quality forage.

Key Words: Heifers, Methionine, Nutrient retention

53 *Salmonella* destruction in frankfurters using hydrostatic pressure and bacteriocins. A. W. Wolf*, S. Bandyopadhyaay, N. Kalchayanand, B. Ray, and W.J. Means, *University of Wyoming, Laramie, WY, USA*.

Two to four million cases of salmonellosis occur in the U.S. annually. High hydrostatic pressure (HHP) is a non-thermal processing technique used to control pathogens. Our goal was to determine if HHP, in conjunction with bacteriocins of lactic acid bacteria, could destroy *Salmonella* in vacuum-packaged frankfurters. Ten strains of *Salmonella*, isolated and grown to early stationary phase, were subjected to HHP. Five pressure-resistant strains were mixed in an equal-ratio cocktail. Cocktail treatments were 345 MPa for 5 min at 50C (HHP50) with or without bacteriocin (2500 au nisin/2500 au pediocin) mixture (BMIX). Survivors were enumerated by serial dilution in sterile water followed by pour plating on TSY agar and incubation at 37C for 48 h. Twenty-eight packs of two 27 g frankfurters were inoculated with 7 log/ml of cocktail and subjected to HHP50 or HHP50+BMIX. Forty-eight packs were inoculated with 4 log/ml of cocktail and subjected to HHP50 or HHP50+BMIX and stored for 1, 14, or 28 days at 4C. Survivors were enumerated by serial dilution with sterile water followed by pour plating on TSY and XLD agars and incubation at 37C for 48 h. Controls did not differ (P=0.2066) for 1, 14, and 28 d. In 7 log-inoculated packs, HHP50 resulted in 4.71 and 5.39 log reduction on TSY and XLD, respectively; while HHP50+BMIX resulted in a 5.29 and 6.76 log reduction on TSY and XLD, respectively. HHP50 in 4 log-inoculated packs showed 2.99 and 3.96 log reduction on TSY and XLD, respectively; while HHP50+BMIX resulted in a 3.96 log reduction on TSY and XLD. HHP, in conjunction with bacteriocins, effectively controls *Salmonella*in low-heat processed meat products.

Key Words: *Salmonella*, Hydrostatic pressure, Pediocin

54 Increasing dietary high-linoleate safflower oil affects duodenal flow of esterified linoleate in wethers. R. L. Atkinson*, E. J. Scholljegerdes, S. L. Lake, V. Nayigihugu, B. W. Hess, and D. C. Rule, *University of Wyoming*.

We hypothesize that lambs fed a high-concentrate diet with high-linoleate safflower oil will have increased duodenal flow of 18:2c9,c12 (18:2, linoleic acid) due primarily to flow of esterified 18:2. Four cross-bred wethers (BW = 44.3 ± 15.7 kg) fitted with ruminal and duodenal cannulae were used in a 4 × 4 Latin square experiment to determine duodenal fatty acid flow when fed an 80% concentrate diet with increasing levels of high-linoleate (77%) safflower oil (oil; 0, 3, 6, or 9% of DM). Wethers were fed diets, at 2% of BW, that were formulated to be isonitrogenous and included bromegrass hay, cracked corn, corn gluten meal, urea, limestone, plus oil. Duodenal digesta, collected to represent every 2 h in a theoretical 24-h period, was extracted with chloroform, methanol, and water (1:2:0.8) in tubes containing tritridecanoate as internal standard. Half of each lipid extract was used for methyl ester preparation using 1.09% HCl in methanol to catalyze methyl esterification of total (both free and esterified) fatty acids. The other half of each lipid extract was transesterified with 0.2 M KOH in methanol to catalyze methyl esterification of only esterified fatty acids. Fatty acid intake increased (linear, $P < 0.005$) with increased dietary oil. Duodenal flow of both total (linear, $P = 0.03$) and esterified (linear, $P = 0.06$) fatty acids increased from 0 to 9% dietary oil. Total to esterified fatty acid ratio of duodenal digesta increased (cubic, $P = 0.02$) with increased dietary oil, indicating greater ruminal lipolysis with increased dietary oil. Ratio of total 18:2 to esterified 18:2 in duodenal digesta increased (linear, $P = 0.01$) from 0 to 9% dietary oil. However, within each treatment, duodenal flow of total 18:2 was not different ($P \geq 0.27$) than that of esterified 18:2. Ratio of 18:0 to 18:2 in duodenal digesta decreased (linear, $P = 0.04$) and duodenal flow of 18:1t-11, a major biohydrogenation intermediate, increased (linear, $P = 0.01$) as dietary oil increased suggesting that biohydrogenation was less complete as dietary oil increased. We conclude that the increase in duodenal flow of 18:2 that occurred from increased dietary oil could be accounted for by increased flow of esterified 18:2.

Key Words: High concentrate diet, Sheep, Fatty acid flow

55 Effect of dietary organically bound selenium and D-α-tocopherol acetate bolus on serum antioxidants status of transit stressed wether lambs. N. K. Chirase*[1,2], J. B. Taylor[3], T. Thelen[3], and L. W. Greene[1,2], [1]*Texas Agricultural Experiment Station, Amarillo,* [2]*West Texas A&M University, Canyon,* [3]*Agriculture Research Service, Dubois, ID.*

Animals often encounter many stressors and pathogens associated with current production systems which could compromise the antioxidant and immune defense systems. An experiment was conducted to determine the effects of pretransit dietary Se (provided by wheat grain; Se = 6.1 mg/kg) and daily D-α-tocopherol acetate bolus (TOCO; 3.8 IU/kg BW) on pre- and postransit serum free retinol (VitA), α-tocopherol (aVitE), γ-tocopherol (gVitE), Se concentrations (ug/ml), and partial antioxidant capacity (PACA) of wether lambs. Twenty-nine lambs (BW = 27 0.36 kg) of similar type and origin were weaned, stratified by BW; assigned randomly to and fed one of the following treatments: adequate Se (< 0.3 mg/kg), no TOCO (CON; n = 9); high Se, no TOCO (HSE; n = 9); adequate Se, TOCO (HVE; n = 5); high Se, TOCO (SEVE; n = 6). Diets for all treatments were of similar nutrient composition, isonitrogenous and isocaloric. Lambs were fed the diets for 20 d pretransit and fed a common diet for an additional 21 d posttransit. Blood samples were taken on d 0, 7, 14 and 20 d and the serum harvested was used for Se, VitA, aVitE, gVitE and PACA assays. On d 21, lambs were transported (864 km) by truck and a trailer for 12 h after 24 h of fasting. Sampling and analysis procedures were repeated every 7 d for 21 d posttransit. The data were analyzed using Mixed Models procedures of SAS. Weaning stress (7 d post weaning) depressed ($P < 0.05$) serum aVitE concentrations and PACA of all treatment groups, except those fed SEVE. Lambs fed HVE and SEVE had 1.6 and 2.0 times greater ($P < 0.01$) serum aVitE concentrations than those fed CON or HSE pretransit, respectively but decreased ($P < 0.05$) posttransit. Serum Se increased linearly pretransit, and subsequently decreased posttransit in HSE and SEVE fed groups. Weaning and transit stress altered serum antioxidant concentrations of lambs.

Key Words: Lambs, Organically bound selenium, α-tocopherol

56 Intracellular glutathione concentration in bovine natural killer cells after infection with bovine respiratory syncytial virus or bovine viral diarrhea virus. L. A. Matulka*[1], L. Wilkie[2], C. Kuszynski[2], S. Justice[1], D. Wylie[1], K. M. Eskridge[1], D. R. Brink[1], and C. L. Kelling[1], [1]*University of Nebraska, Lincoln, NE,* [2]*University of Nebraska Medical Center, Omaha, NE.*

Glutathione (GSH), a cysteine-containing tripeptide, is found in millimolar concentration in all mammalian cells. Cellular glutathione concentrations may be altered nutritionally, since cysteine availability is markedly influenced by diet. Glutathione deficiency contributes to immunological dysfunction in human immunodeficiency virus-infected patients. A similar mechanism may underlie pathogenesis of bovine respiratory disease complex (BRDC). In BRDC, *Mannheimia haemolytica* colonization of lungs resulting in pneumonia may be triggered by impaired host immunological responses following infection with bovine respiratory syncytial virus (BRSV) and/or bovine viral diarrhea virus (BVDV). Bovine peripheral blood mononuclear cells (PBMC) were infected with BRSV and BVDV to determine effect on intracellular glutathione concentration. Peripheral blood was obtained from a donor animal and mononuclear cells by Ficoll-Paque density centrifugation. Cells were infected with either BRSV, BVDV, or left untreated and incubated for 48 h at 37° C and 5% CO_2. Samples were enriched for natural killer (NK) cells (1000U/ml of interleukin-2 during 48 h incubation). After incubation, cells were stained with antibodies to identify NK cells (CD2+, CD3-). NK cells were stained with monochlorobimane and intracellular GSH levels were determined as the fluorescence produced from the GSH-S-transferase conjugation of monochlorobimane with GSH. Intracellular GSH levels were decreased in the BRSV and BVDV infected NK cells compared to the control (P<.01). Reduced GSH levels in NK cells may contribute to development of BRDC.

	Control	BRSV	BRSV+IL-2	BVDV	BVDV+IL-2	SE
MFU[c]	48.7[a]	15.9[b]	17.0[b]	14.7[b]	14.6[b]	4.6
						n=4

[a],[b]Means with different superscripts differ (P<.01) [c]Mean Fluorescence Units

Key Words: Glutathione, Natural killer cells, Bovine

57 Effects of intravenous infusion of triglyceride emulsions varying in lipid source on lymphocyte functions in the bovine. D. Scalia[1], U. Bernabucci*[1], D. G. Mashek[2], B. Ronchi[1], R. R. Grummer[2], and N. Lacetera[1], [1]*Universit della Tuscia, Viterbo, Italy ,* [2]*University of Wisconsin, Madison.*

Previous in vitro studies from our laboratory have shown that fatty acids represented in plasma NEFA affect immune functions both in sheep and bovine. However, little is known in ruminants about the effects of fatty acids in vivo. Therefore, our objective was to assess the effects of intravenous infusion of triglyceride (TG) emulsions derived from different lipid sources on peripheral blood mononuclear cell (PBMC) functions during a period of fatty liver induction. Six multiparous, non-pregnant, non-lactating Holstein cows were used in a replicated 3x3 Latin Square design. For 4 d, cows were fasted and infused intravenously with a 20% TG emulsion derived from linseed oil (LO), fish oil (FO), or tallow (Ta). The emulsions were administered for 20 to 30 min every 4 h throughout the 4 d fast at a rate of 0.54 g TG/kg BW/d. Blood samples were taken before the first infusion, and then every 24 h during the fast. Cows were fed ad libitum for 24 d between the fasts. After isolation, the PBMC were stimulated by phytohemagglutinin (PHA), concanavalin A (ConA), or pokeweed mitogen (PWM). For all the three mitogens, DNA synthesis was lower ($P < 0.05$) for Ta than for LO and FO. A significant time*treatment interaction was pointed out. Seventy two and 96 h after first infusion of FO, the DNA synthesis stimulated by PHA increased ($P < 0.01$). Regardless the mitogens, the infusion of Ta was responsible for a transient and dramatic reduction ($P < 0.01$) of DNA synthesis, which was evident on 48 and 72 h after first infusion. Infusion of LO did not affect ($P > 0.10$) the DNA synthesis of PBMC. Results reported here confirm those of in vitro studies and indicate that fatty acids can modify the immune cell functions of cows in a way, which depends primarily on the type of fatty acids.

Key Words: Lymphocyte, Fatty acids, Bovine

58 Lymphocyte functions in obese cows during transition period. U. Bernabucci*[1], D. Scalia[1], B. Ronchi[1], D. Pirazzi[1], A. Nardone[1], and N. Lacetera[1], [1]*Universit della Tuscia, Italy.*

A previous study carried out in our laboratory has shown negative relationships between the intensity of lipomobilization and the immune response in sheep. However, little is known about the relationships between body score and immune functions in cows. Therefore, the objective of this study was to evaluate the effects of body score on lymphocyte functions in transition dairy cows. The study was carried out in 21 Holstein cows. Thirty days before the expected calving, the 21 cows were categorized as thin (n = 6), medium (n = 8), and obese (n = 7) on a condition score basis. Fourteen and 7 d before and 14 and 35 d after calving, blood samples were taken, and peripheral blood mononuclear cells (PBMCs) were isolated. After isolation, the PBMCs were stimulated, and DNA synthesis, immunoglobulin M (IgM), and interferon gamma (IFN-gamma) secretion were evaluated. The DNA synthesis was measured after stimulation with phytohemagglutinin (PHA), concanavalin A (ConA), or pokeweed mitogen (PWM); the IgM secretion was measured after stimulation with PWM; the IFN-gamma secretion was measured after stimulation with ConA. Data referred to the 21 cows, indicated that the DNA synthesis was lower ($P < 0.01$) on day 7 before calving, that the IgM secretion on day 7 before calving was lower ($P < 0.05$) than that recorded after calving, and that the IFN-gamma secretion did not change ($P > 0.05$) during the experimental period. Either on day 14 or 35 after calving, the IgM secretion in obese cows was lower ($P < 0.01$) compared to that recorded in thin cows. Seven days before calving, the IFN-gamma secretion was lower ($P < 0.001$) in obese cows compared to thin and medium cows. In conclusion, the immunodepression taking place in cows around calving would be more evident in overconditioned cows.

Key Words: Body score, Lymphocyte, Cow

59 In vitro modulation by beta-glucan and ascorbic acid of blood leukocyte toll-like receptor and acute phase cytokine expression. S. D. Eicher*[1], T. R. Johnson[2], and K. A. McMunn[1], [1]*USDA-ARS, West Lafayette, IN,* [2]*Purdue University, West Lafayette, IN.*

In a previous study, neutrophil functions were decreased for calves fed a non-water soluble beta-glucan product derived from Sacchromyces cerevisiae in conjunction with ascorbic acid at day 7 and 28 post-transport. The objective of this study was to determine if in vitro stimulation of whole blood leukocytes with that beta-glucan plus ascorbic acid was dependent on the age of the calf. Blood samples were taken from 12 non-transported Holstein calves at 1, 3, 7, 10, 14, 18, 21, 24, and 28 days-of-age. Leukocytes were stimulated with ascorbic acid (0.3 ug/ml) and beta-glucan (0.4 ug/ml) for 1 hour, red blood cells were lysed, and RNA extracted. The RNA was subjected to real-time RT-PCR for quantification of the expression of interleukin-1 (IL-1) and its receptor antagonist (IL-1Ra), tumor necrosis factor-alpha (TNF), and toll-like receptors 2 and 4 (TLR2 and TLR4). TLR2 and TLR4 had treatment effects ($P<.05$), but not day or treatment by day interactions. TLR2 was greater ($P<.05$) for treated cells on day 7, 14, and 24 and tended ($P<.10$) to be greater on day 10. In contrast, TLR4 was only greater for treated cells on day 7 ($P<.05$) and tended to be ($P<.10$) on day 24. IL-1 had a treatment main effect and a treatment by day interaction ($P<.05$), but IL-1Ra had main effects for treatment and day ($P<.05$)and only a trend ($P<.10$) for a treatment by day interaction. IL-1 was greater for treated cells ($P<.05$) on all but day 4. IL-1Ra was greater ($P<.05$) for treated cells only on days 1, 7, 10, and 24. TNF was only different for a main effect of day ($P<.05$), but not for treatment or treatment by day interaction. Only IL-1 and its receptor antagonist expression were stimulated on day 1. On days 7 and 24 all tested receptors and cytokines had increased RNA expression. So, it appears that there are periods during which the blood leukocytes may be refractory for increased RNA expression of cytokines and toll-like receptors in response to beta-glucan and ascorbic acid stimulus.

Key Words: Innate immunity, Ascorbic acid, Beta-glucan

60 An evaluation of rumen-protected choline and a monensin controlled release capsule on the health and metabolic function of periparturient dairy cows. L. C. Zahra*[1], T. F. Duffield[1], S. J. LeBlanc[1], K. E. Leslie[1], T. Overton[2], and D. Putnam[3], [1]*Department of Population Medicine, Guelph Ontario, Canada,* [2]*Department of Animal Science, Ithaca NY,* [3]*Balchem Corporation, Slate Hill NY.*

During early lactation, high-producing dairy cows undergo a phase of negative energy balance. This can lead to metabolic disorders and subsequently cause losses in production. To prevent this, ionophores are often administered to ruminants. Administration of monensin controlled release capsules (CRC) in early lactation cows improves energy balance, while choline aids in fat metabolism and transport. Choline, however, can be a limiting nutrient in lactating dairy cows. The objective of this study was to determine whether there is an interaction between these two supplements on metabolic parameters. In this study, 53 primaparous and multiparous Holsteins were randomly assigned to receive a monensin CRC 3 weeks before their expected calving date, or a topdress of 56g rumen-protected choline (RPC; Reashure® choline, Balchem Encapsulates, New Hampton, NY) once daily from 3 weeks before calving until 28 DIM, or both (RPC & CRC), or neither (CON). Blood samples were collected from the tail vein at enrollment, one week before calving, and in the first and second weeks post-calving. Body condition (BCS) was scored at enrollment and in the second week after calving. Liver biopsies were obtained from multiparous cows randomly selected from each treatment group within 48 hours of calving and 3 weeks post-calving. Daily milk records up to 60 DIM and health records were obtained. Adjusting for parity and BCS at enrollment, beta-hydroxybutyrate (BHB) levels in the first week post-calving were lower in the RPC and CRC groups than controls (934, 916 and 1466 μmol/L respectively, $P=0.05$). Non-esterified fatty acids (NEFA) in the first week post-calving were lower in each group than in controls (CON $= 0.76$, RPC $= 0.38$, CRC $= 0.47$, RPC & CRC $= 0.63$ mEq/L, $P \leq 0.03$). Plasma aspartate transaminase (AST) in the RPC group was 73 U/L compared to 103 U/L in the RPC & CRC group at the first week post-calving ($P=0.01$). Overall, urea levels were lower in the CON group (3.95 mmol/L) than either the RPC (4.53 mmol/L) or the RPC & CRC groups (4.65 mmol/L) ($P \leq 0.05$). There were no significant differences in blood glucose or cholesterol levels between the treatment groups.

Key Words: Dairy, Choline, Metabolism

61 Metabolism and gastric transport of ergot alkaloids in ruminants grazing endophyte-infected tall fescue. N. S. Hill*[1], A. W. Ayers[1], J. A. Stuedemann[2], F. N. Thompson[1], P. T. Purinton[1], and G. Rottinghaus[3], [1]*University of Georgia,* [2]*USDA-ARS, J. Phil Campbell Natural Resources Laboratory,* [3]*University of Missouri.*

Livestock grazing endophyte-infected (E+) tall fescue suffer from chronic ergot alkaloid toxicity. Ergovaline is repeatedly implicated as the toxin causing the anomaly, but little or no credible evidence exists as such. Towards that end our objective was to examine gastric metabolism and transport of ergot alkaloid in E+ tall fescue. First, in vitro ruminal digests of E+ and E- tall fescue were conducted for 0, 6, 12, 24, and 48 h and alkaloids in the aqueous fraction analyzed by ELISA and HPLC. Extracted alkaloids from the ruminal digests were tested for in vitro transport across ruminal and omasal tissues using parabiotic chambers. Secondly, three sheep each grazing E+ and E- tall fescue were anaesthetized and their right ruminal, right gastric, and mesenteric veins surgically catheterized. Whole blood was collected, plasma alkaloids extracted, and analyzed by ELISA. ELISA analysis from the ruminal digests found no alkaloids in ruminal fluids from E- tall fescue, but alkaloids in ruminal fluids from E+ tall fescue increased with time ($P<.01$). HPLC speciation of alkaloids in E+ ruminal fluids found only 9 ppb ergovaline at 0 h, which decreased to 1 ppb at 6 h. Conversely, lysergic acid concentration increased from 20 ppb at 0 h to 240 ppb at 48 h ($P<.01$). Lysergic acid was the only ergot alkaloid that transported across ruminal or omasal tissue. More lysergic acid transported across ruminal tissue than omasal tissue ($P<0.1$) in the in vitro system. In the in vivo study, there were no differences ($P>.05$) in plasma ergot alkaloids from mesenteric or gastric veins regardless of whether sheep were grazing E+ or E- tall fescue. However, plasma sampled from the ruminal vein of sheep grazing E+ tall fescue had more (13.9 ppb) than that of sheep grazing E- tall fescue (0.56 ppb) ($P<.01$). These data indicate lysergic acid, not ergovaline, is the toxin causing fescue toxicosis and its site of absorption is the rumen.

Key Words: Fescue toxicosis, Tall fescue, Alkaloid metabolism

International Animal Agriculture

62 Transhumance and dry-season supplementation for cattle in the Sahel. S. Fernandez-Rivera*, A. Salla, P. Hiernaux, and T. Williams, *International Livestock Research Institute, Addis Ababa, Ethiopia.*

We assessed the effect of dry-season supplementation and seasonal transhumance on ADG and weaning rates of cattle in the Sahel. 108 cows (60 in Katanga and 48 in Guro-Yena, 50 km East of Niamey, Niger) were allotted to 6 treatments, i. e. factorial combinations of 3 supplement levels (0, 360 and 720 g DM/d of millet bran, 16% CP) and two management systems (year-long sedentary management and transhumance to the pastoral zone during the rainy season and to intensely cultivated areas after grain harvest). The study lasted 4 years (1999-2002) in Katanga and 3 years (2000-2002) in Guro-Yena. Cows were individually supplemented for 103-134 d each year and weighed monthly, at the start and end of supplementation and at departure to and return from transhumance to the pastoral zone (98-124 d) and to the intensely cultivated areas (33-55 d). Weight loss (g/d) of non-lactating, non-late-gestating cows in the dry season was highest (-380±13) in 2002 and lowest (-258±16) in 1999 ($P<0.01$). Over 4 years, cows receiving 0, 360 and 720 g supplement/d had ADG during the dry season of -384±10, -321±12 and -282±12 g/d, respectively ($P<0.01$). Providing 1 kg millet bran/d decreased ($P<0.01$) weight loss by 145±21 g/d. ADG (g/d) during the rainy season was lowest (428±20) in 2002 and highest (704±19) in 2001 ($P<0.01$). Cows receiving 0, 360 and 720 g/d supplement during the previous dry season had ADG during the rainy season of 605±16,

590±17 and 547±18 g/d, respectively (P<0.05). Supplementing with 1 kg millet bran/d in the previous dry season decreased (P=0.02) ADG during the rainy season by 78.5±3.3 g/d. Cows in transhumance tended to gain more weight during the post-harvest season than those under the sedentary system (435±23 vs 383±22 g/d, P=0.09). Cows receiving 0, 360 and 720 g/d supplement during the end of the dry season weaned 0.37, 0.44 and 0.49 calves/yr (SEM=0.04; P=0.09). Supplementation decreases weight losses in the dry season and this effect is partially offset by lower gains during the following rainy season. Transhumance of cattle complements feed resources between the cultivated and pastoral zones, but does not affect weight changes or reproductive performance.

Key Words: Transhumance, Supplementation, Cattle

63 Effects of the recessive naked gene on postweaning fryer performance and thermo-tolerance characters in rabbits. A. D. Rogers* and S. D. Lukefahr, *Texas A&M University-Kingsville*.

This study investigated the effects of the naked gene on postweaning trait performance and thermo-tolerance characters in rabbit fryers during a 42-d growth phase in the summer of 2002 in subtropical south Texas. In 1999, a rare naked rabbit was born in El Campo, TX. "Fuzz", a Mini Lop rabbit, was mated to commercial New Zealand White does at Texas A&M University at Kingsville, which resulted in 16 F_1 litters and 113 offspring, all of which had normal fur coats. To reproduce the recessive naked gene in the homozygous state, F_1 x F_1 *inter se* matings were made between half-siblings to create an F_2 generation. In the F_2 generation, 91 weaned fryers from 18 fraternal litter groups were produced. Based on an expected 3:1 phenotypic ratio (furred to naked classes), 70 rabbits had normal fur coats and 21 rabbits were naked. Most litters produced some naked and furred kits. Fryers were randomly assigned to growing pens containing either two or three non-littermate furred or naked rabbits. Individual fryer traits included initial and final body weights and ADG, as well as respiratory rate, rectal body temperature, and ear length, which were recorded at the end of the study. Pen traits included feed intake as an indicator of feed appetite. Data were blocked for effects of fraternal-litter, random pen (within naked and furred groups), age batch, gender, and initial age of fryer as a linear covariate when analyzing body weight traits. Results consisted of naked fryers being 212 g heavier and having 2.69 g/d more rapid ADG than furred rabbits (P<0.001). Initial ear length was generally associated (P<0.01) with more rapid ADG (linear regression of 0.165±0.05 cm per g/d). Naked fryers had lower rectal body temperature (38.9 and 39.7°C; P<0.001) and had lower respiratory rate (119.7 and 160.6 bpm; P<0.001) at 1400 h compared to furred rabbits, respectively. In addition, pens of naked fryers had higher daily feed appetites by 28.8±4.5 g per fryer than pens of furred rabbits (P<0.001). Our results indicate that naked rabbits had better thermo-regulation ability than furred rabbits. Based on these promising results, plans for developing a new breed of naked rabbits is justified, which has the potential to contribute more meat and income for subsistence families in tropical regions.

Key Words: Rabbits, Thermoregulation, Tropical Agriculture

64 Study of some socioeconomic factors affacting small ruminant production in upland ranges of Balochistan. A. U. Hyder*[1], A. S. Lodhi[2], and O. U. Haider[3], [1]*Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan,* [2]*Department of Clinical Medicine and Surgery, University of Agriculture, Faisalabad, Pakistan,* [3]*Department of Agriculture, Qutta, Pakistan*.

This study comprised 120 sample farmers who were interviewed, out of which 32, 70 and 18 were from nomads, transhumants and sedentary people, respectively. The literacy rate of nomads, transhumants and sedentary respondents were 1.4 percent, 18.6 percent and 27.8 percent in the study areas, while overall percentage of educated individuals was 15.8. The mean family size of the nomads, transhumants and sedentary respondents was 10.6, 12.5 and 17.3 family members, respectively. Their mean family size for all categories of respondents was 12.7 heads with the standard deviation of 5.73 heads. Almost all the roads were unpaved and unsafe in the rainy season. The overall mean distance from the metallic roads was 24.7 km. The overall mean distance from the livestock market was 32.2 km while the veterinary hospital on an average was 28.1 km away from the sample farmers in the study area. Surface wells, tube-well and karez were the major source of water in the target areas. Only 6.6 percent respondents had off farm income source while 26.2 and 67.2 percent were obtaining from agriculture and from livestock in sample areas, respectively. Nomads have no irrigated land, transhumant and sedentary respondents on average had 14.6 acres and 26.9 acres respectively. Overall, sailaba (rainfed) and khuskaba (small dams are constructed for irrigation) land holdings were 24 acres while irrigated land was 12.6 acres. Goats and sheep farming was dominant in the study area.

Key Words: Socioeconomic factor, Small ruminants production

65 Small ruminant production in upland ranges of Balochistan-cost of enterprise. A. U. Hyder*[1], A. S. Lodhi[2], and O.U. Haider[3], [1]*Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan,* [2]*Department of Clinical Medicine and Surgery, University of Agriculture, Faisalabad, Pakistan,* [3]*Department of Agriculture, Qutta, Pakistan*.

A survey study for the economic evaluation of different husbandry systems being practiced in Balochistan province of Pakistan was carried out during the year 2001-02. This study comprised 120 sample farmers out of which 32, 70 and 18 were from nomad, transhumant and sedentary husbandry systems, respectively. The stratification was based on the proportion of the farming population. The overall total annual production cost per flock was Rs. 46403.6 (1 US dollar = Rs. 58) . The feeding/fodder, shepherd, grazing, health cover, shearing, marketing and miscellaneous costs were Rs. 24622.8, Rs. 12359.0, Rs. 2751.8, Rs. 3542.3, Rs. 844.1, Rs. 1430.8 and Rs. 892.6, respectively. Overall average consumption and social use was 9.0 percent of the total mean flock size. Nomads, transhumants and sedentary were marketing 27.5, 24.0 and 25.9 percent of mean flock size. Overall animals marketed were 25.0 percent of the total mean flock size. Nomads marketed 27.5 percent of their total flock, while sedentary and transhumant 24.0 percent and 25.9 percent, respectively. The overall total income from the mean flock size was calculated as Rs. 112282.0/annum. Overall average gross income was Rs. 112282.0. The Net income became Rs. 65878.4 per annum. The gross income, cost and net revenue per-animal under nomadic husbandry systems was Rs. 827.5, Rs. 294.2 and Rs. 560.1; under transhumant husbandry system, it was Rs. 918.8, Rs. 331.5 and Rs. 587.4; and under sedentary husbandry system it was Rs. 1258.5, Rs. 515.6 and Rs. 741.6, respectively. Overall benefit cost ratio was 2.4:1, however, for nomad, transhumant and sedentary husbandry systems, the benefit cost ratio were 2.8:1, 2.8:1 and 2.4:1, respectively. The poverty alleviation tools like government assistance in the form of micro-credit schemes during off season can play dramatic role in economic uplift of these lifestyles.

Key Words: Small ruminant production, Cost of enterprise

Nonruminant Nutrition: Sow nutrition

66 Nucleotides in sows colostrum and milk at different stages of lactation. C. D. Mateo*, H. H. Stein, and D. N. Peters, *South Dakota State University, Brookings, SD*.

An experiment was conducted with the objective of measuring the concentrations of CP and 5' monophosphate nucleotides (i e., 5'AMP, 5'CMP, 5'GMP, 5'IMP, and 5'UMP) in sows' colostrum and milk. Twelve multiparity sows (Landrace x Yorkshire x Duroc) were used in the experiment. Litter size was standardized at 11 piglets for all sows on the day of farrowing. Sows were fed an 18% CP corn-soybean meal diet throughout lactation. The experimental period comprised the initial 28 d of lactation with colostrum being collected within 12 h of farrowing and milk being collected on d 3, 7, 14, 21, and 28. Milk samples were analyzed for CP and 5'AMP, 5'CMP, 5'GMP, 5'IMP, and 5'UMP. The CP linearly decreased (P < 0.01) from 16.6% in colostrum to 7.7,

6.2, 5.5, 5.7, and 6.3% in milk collected on d 3, 7, 14, 21, and 28, respectively. The concentrations of 5' AMP, 5'CMP, 5'GMP, and 5'IMP increased from d 0 to d 3 and d 7 and then decreased during the remaining lactation period (cubic effect, $P < 0.05$). The concentration of 5'UMP decreased linearly ($P < 0.01$) from d 0 to d 28 of lactation. In colostrum, 5'UMP represented 98% of all 5' monophosphate nucleotides and in milk, 5'UMP accounted for 86-90% of all nucleotides, regardless of d of lactation. The results of this experiment indicate that the concentration of 5' monophosphate nucleotides in sows milk decline as lactation advances. In addition, 5' UMP is the most abundant nucleotide in colostrum and milk from lactating sows.

	Day of lactation						*P-values*		
Item	0	3	7	14	21	28	Linear	Quadratic	Cubic
CP	16.6	7.8	6.2	5.5	5.7	6.3	<0.0001	<0.0001	<0.0001
5'AMP	4.0	11.3	12.8	6.8	4.3	3.0	0.0181	0.0435	0.0152
5'CMP	1.5	7.2	7.1	3.5	2.3	2.5	0.1245	0.1312	0.0041
5'GMP	5.4	14.7	14.0	10.2	6.0	7.1	0.0818	0.0675	0.0024
5'IMP	1.1	1.8	2.6	1.4	0.9	0.4	0.0217	0.0526	0.0439
5'UMP	555.6	305.5	263.1	144.0	122.8	104.0	<0.0001	<0.0001	0.0002

Key Words: Nucleotides, Sow, Milk

67 Impact of milk supplementation on primiparous and multiparous females' performance and piglets' growth during pre and post-weaning periods.

M. E. Johnston[1], R. Cabrera*[2], R. D. Boyd[1], and J. Vignes[3], [1] *The Hanor Company,* [2] *Ralco-Mix Products, Inc.,* [3] *Advanced Birthright Nutrition, Inc.*

This study was conducted to determine the impact of milk supplementation on gilts, sows, and their progeny's performance during lactation and post-weaning. A total of 112 females (56 gilts, 56 sows) were allotted to one of two treatments: milk supplemented (MS) or non-supplemented (NS) with 28 gilts and 28 sows in each treatment. All litters were standardized to 11.1 pigs/litter. Milk supplementation of litters started 12-24 h after farrowing with acidified, medicated milk replacer fed ad libitum. Gilts and sows' BW and backfat depth were measured 24 h after farrowing and at weaning. ADFI was recorded. Lactation length was 18.2 d for gilt litters and 19.2 d for sow litters. Pigs were weighed 24 h after birth and at weaning. Pre-wean mortality and ADG were recorded. MS and NS gilts weight change, backfat depth change, and ADFI did not differ between treatments ($P > 0.05$). The number of pigs weaned did not differ ($P > 0.05$) between MS and NS gilt litters (10.1 vs. 10.0, respectively). Birth and weaning weights (5.62 vs. 5.35 kg) were 0.09 and 0.27 kg heavier, respectively ($P < 0.05$) for MS compared to NS gilt litters. MS and NS sows' BW change and ADFI did not differ between treatments ($P > 0.05$). However, MS sows lost 1.3 mm more backfat than NS sows ($P < 0.05$) during lactation. The number of pigs weaned for MS sow litters was 0.9 pig/litter higher ($P < 0.05$) than NS sow litters (10.6 vs.9.7 pigs/litter, respectively). Birth and weaning weights (6.58 vs. 5.99 kg) were 0.09 and 0.59 kg heavier, respectively ($P < 0.05$) for MS sow litters when compared to NS sow litters. After a 42-d nursery period, MS pigs were 0.8 kg heavier ($P < 0.001$) than NS pigs (23.4 vs. 22.6 kg, respectively). These data suggest milk supplementation during lactation reduces piglet loss and increases piglet weaning weight. The advantage in weaning weight for milk supplemented pigs is maintained through the nursery period.

Key Words: Milk supplementation, Pig wean weight, Pre-wean mortality

68 Effects of reducing particle size of corn in lactation diets on performance and nutrient utilization in multiparous sows.

E. C. Baudon*, J. D. Hancock, M. D. Tokach, and J. F. Gabarrou, *Kansas State University, Manhattan.*

Eighty multiparous sows (parities one to four) were used to determine the effects of particle size of corn in lactation diets on sow and litter performance. The sows were fed corn-soybean meal-based diets with targeted corn particle sizes of 1,500, 900, and 600 m (actual mean particle sizes during the experiment were 1,609, 849, and 630 m). Particle size did not affect BW gain and survivability in piglets and BW loss, weaning to estrus interval, and fecal moisture in sows ($P > 0.10$). However, loss of backfat (quadratic effect, $P < 0.001$) was lowest in sows fed the diet of intermediate particle size. Average daily water intake increased as particle size was decreased from 1,500 to 600 m (linear effect, $P < 0.03$). Also, intakes of DM, N, and GE were increased by 11, 8, and 12% and apparent digestibilites of DM, N, and GE were increased by 5, 4, and 5%, respectively, as particle size of corn was decreased (linear effects, $P < 0.007$). There was greater feed intake (linear effect, $P < 0.04$) and daily absorption of DM, N, and GE were increased by 16, 12, and 17% (linear effects, $P < 0.001$) as corn particle size was reduced from 1,500 to 600 m. Finally, excretion of DM in the feces was decreased (linear effect, $P < 0.09$) by 84 g/d as particle size was reduced. In conclusion, reducing particle size of corn did not affect sow and litter performance but increased digestibility of nutrients and reduced nutrient excretion.

	Particle size, μm				Probability	
Item	1,500	900	600	SE	Linear	Quadratic
No. of observations	29	23	28	-	-	-
ADFI, kg	5.30	5.33	5.84	0.17	0.04	NS
Daily water, L	33.9	40.4	50.6	5.1	0.03	NS
Sow BW loss, kg	9.8	3.2	6.6	2.5	NS	NS
Litter BW gain, kg	42.9	43.5	46.0	1.8	NS	NS
DM dig, %	80.0	82.5	83.6	0.7	0.001	NS
N dig, %	82.9	85.4	85.9	0.8	0.007	NS
DM excretion, g/d	931	821	847	35	0.08	NS
N excretion, g/d	27.2	24.4	24.7	1.2	NS	NS

Key Words: Particle size, Sows, Nutrient digestibility

69 The effect of canola on reproductive performance in sows.

M. R. Smiricky-Tjardes*, H. H. Stein, and D. N. Peters, *South Dakota State University.*

Studies in Europe have reported increases in the litter size of sows when canola-based diets are fed. Therefore, it was the objective of this experiment to investigate the effects of including either full fat canola or canola meal in diets fed to gestating and lactating swine. A total of 60 gestating sows (avg. parity = 3) were randomly allotted to one of three treatment groups: 1) corn and soybean meal control diet; 2) corn and canola meal diet; and 3) corn and full fat canola diet. Gestation diets were formulated to contain 14% CP and lactation diets to contain 18% CP. During gestation, all sows were fed 7,000 kcal/d of their respective treatment diet. During lactation, all sows were allowed ad libitum access to their treatment diets. Feeding of the experimental diets began right after breeding and continued through two reproductive cycles. Reproductive performance parameters were collected through both reproductive cycles. There was no effect of reproductive cycle on any of the response criteria measured in this study. Sows consuming the full fat canola diet gained less weight ($P < 0.05$) during gestation than sows consuming the other two diets. However, they also lost less ($P < 0.05$) weight during lactation when compared to sows consuming the canola meal diet. The number of pigs born alive was higher ($P < 0.05$) for sows consuming either the corn-soybean meal or corn-full fat canola diet when compared to sows consuming the corn-canola meal diet. The number of stillborns, mummies, weight of pigs born alive, and litter birth weight did not differ ($P > 0.20$) between dietary treatments. The number of pigs weaned and the litter weaning weight was greater ($P < 0.05$) for sows consuming the corn-soybean meal than sows consuming the canola meal diet. Lactation feed intake was lower ($P < 0.05$) in wk 2, 3, and overall for sows consuming the corn-canola meal diet when compared to the other two diets. Finally, return to estrus interval was not affected ($P > 0.20$) by dietary treatment. In conclusion, full fat canola-based diets performed similarly to standard corn-soybean meal diets when fed to gestating and lactating sows. The deleterious effects of the corn-canola meal diet warrant further investigation prior to incorporation into sow gestation and lactation diets.

Key Words: Canola, Sows, Reproduction

70 Exogenous enzyme effects on the digestibility of gestation-lactation swine diets.

A.L.P. de Souza*, M. D. Lindemann, and G. L. Cromwell, *University of Kentucky, Lexington.*

The effects of two commercial enzyme products on the ileal and total tract nutrient digestibilities in crossbred sows (n=8; BW=196 15 kg) fitted with ileal stainless steel T-cannula were evaluated. The enzyme products contained cellulase and protease activities (Enz 1; VegPro®, Alltech) or xylanase activity (Enz 2; Fibrozyme®, Alltech). A fortified corn-soybean meal control diet (0.81% lysine, 0.73% Ca, and 0.61% P) was fed during gestation and lactation. Trt 1 was the control diet; Trt 2 was the control plus Enz 1 (7,700 HUT of protease activity/kg diet, and 75 CMC of cellulase activity/kg diet), and Trt 3 was the control plus Enz

2 (100 XU of xylanase activity/kg diet). Ileal and fecal samples were collected at Wk 6-7 and Wk 12-13 of gestation and Wk 2-3 of lactation. Females were randomly allotted to a diet in each wk of the collection period. After 5 d adaptation to the diet, ileal samples were collected for a period of 12 h on each of 2 d. Diets were then changed and another collection was made (providing a total of 5-6 observations/diet). Fecal sample collection took place between d 4-7. Apparent digestibility of DM, N, GE, ADF, and NDF was determined using Cr_2O_3. There were no effects ($P > 0.10$) of the enzyme products on nutrient digestibility during gestation. Ileal digestibilities (%) of DM, N, GE, ADF, NDF during lactation were 77.3, 79.3, 81.7; 81.2, 82.5, 84.3; 79.5, 81.5, 83.8; 37.3, 36.5, 42.3; 75.4, 77.9, 78.6 for Trt 1, 2, and 3, respectively. Total tract digestibilities (%) of DM, N, GE, ADF, and NDF during lactation were 89.8, 90.7, 90.8; 89.0, 90.0, 90.6; 90.7, 91.4, 92.0; 75.0, 66.0, 77.8; 88.2, 89.8, 89.4. Ileal DM ($P < 0.02$), GE ($P < 0.02$), and NDF ($P < 0.08$) as well as total tract DM ($P < 0.11$) and GE ($P < 0.04$) digestibilities were improved by Enz 2, and total tract NDF ($P < 0.11$) was positively affected by Enz 1. Gestational enzyme supplementation was not beneficial; however, the enzyme product containing xylanase activity appears to have potential to increase digestibility of nutrients during lactation.

Key Words: Sows, Digestibility, Enzymes

71 Impact of increased valine:lysine ratio during lactation on sow and piglet performance. A. M. Gaines*[1], M. E. Johnston[2], G. L. Allee[2], R. D. Boyd[2], J. L. Usry[3], and K. J. Touchette[4], [1]*University of Missouri-Columbia,* [2]*The Hanor Company, Inc.,* [3]*Ajinomoto Heartland, Inc., Chicago,* [4]*Merrick's Inc., Union Center, WI.*

This study was conducted to determine the effects of increased valine levels during lactation on sow and piglet performance. A total of 279 PIC C22, C23, and C24 sows (parities 1-5) were allocated by parity to one of four dietary treatments. Diets 1 and 3 were formulated using corn and a fixed inclusion of soybean meal (16.73%). The dietary valine content was increased by adding L-valine with additional synthetic amino acids supplied as necessary to meet minimum amino acid ratios. The total valine:lysine ratio in diets 1 and 3 were 0.73 and 1.25, respectively. Diets 2 and 4 were typical corn- soybean meal diets containing 0.05% L-lysine HCl, with a fixed inclusion of soybean meal (22.68%). The total valine:lysine ratios in diets 2 and 4 were 0.86 and 1.25, respectively, with L-valine used to increase valine content. All diets contained 0.90% total lysine and fed in meal form. Sows were fed ad libitum from d 112 of gestation through a 19-d lactation period and feed intake recorded. Sow body weight was recorded at d 112, after farrowing, and at weaning. Litter size was standardized by 24 h post-farrowing (10.6 0.2 pigs) and pigs were individually weighed at birth and weaning. There was no difference ($P = 0.30$) in sow feed intake across all dietary treatments. Sows consumed an average of 6.3 kg/d during the 19-d lactation period. Sow weight loss during lactation ranged from 9.4-12.5 kg and was not significantly different ($P = 0.61$) due to valine:lysine ratio. No dietary treatment effects were observed for body weight at weaning ($P = 0.48$) or piglet gain ($P = 0.38$). Furthermore, the number of pigs weaned was not different ($P = 0.37$) due to valine:lysine ratio. Based on the results of this study, there is no advantage in sow or piglet performance from increasing the valine:lysine ratio.

Key Words: Valine, Lactation, Sows

72 Effect of protected n-3 polyunsaturated fatty acids (Fertilium^{TM}) on litter size in sows. S. K. Webel*, E. R. Otto, D. M. Webel, R. L. Moser, J. D. Spencer, and D. E. Orr, *United Feeds, Inc.*

The effect of diet supplementation with a protected n-3 polyunsaturated fatty acid source (Fertilium^{TM}, United Feeds, Inc. Sheridan, IN) on subsequent reproductive performance in sows (York x Landrace) was evaluated. At a commercial swine farm in Indiana, primiparous and multiparous sows were blocked by parity and randomly assigned to one of two dietary treatment groups (control, n=173 or Fertilium^{TM}, n=165) when entering farrowing rooms, 5 d ± 2 d prior to farrowing. Corn-soybean meal based diets served as control treatments (control lactation diet, 1.22% lysine, 3.22 Mcal/kg ME; control rebreeding diet, 0.80% lysine, 3.11 Mcal/kg ME). Fertilium^{TM} group sows were fed control diets supplemented with 85 g topdress of Fertilium^{TM} once daily. Dietary treatments were administered to sows entering farrowing room, during lactation, and up to 7 d post weaning during re-breeding period (total 35 d). Sows were weaned after 21 d ± 3 d lactation and bred at the first estrus. All sows received a common diet (0.80% lysine, 3.11 Mcal/kg ME) throughout gestation until subsequent farrowing. Subsequent litter size (total born and live born) of farrowed sows was measured and results are presented in Table 1. The number of total born and live born pigs was greater ($P<0.05$) at the subsequent farrowing for sows topdressed Fertilium^{TM} compared to control sows. The wean to estrus interval and farrowing rate were not different ($P>0.10$) between treatments. These results show that dietary supplementation of protected n-3 polyunsaturated fatty acids increased litter size when fed to sows for 35 d prior to breeding.

Treatment	Sows Allotted	Sows Farrowed	Days Fed	Subsequent Total Born	Subsequent Live Born
Control	173	117	35	11.0^a	10.3^a
Fertilium^{TM}	165	121	35	11.6^b	10.8^b

^{a,b} Means within column lacking common superscripts differ significantly ($P<0.05$).

Key Words: Sow, Litter size, n-3 Polyunsaturated fatty acids

Production, Management, & the Environment

73 Evaluation of two evaporative cooling systems for dairy cattle under semi-arid conditions. R. J. Collier*, E. L. Annen, D. E. Armstrong, and A. L. Wolfgram, *University of Arizona,Tucson, AZ.*

Cows(N=80) balanced for parity,stage of lactation and milk yield were randomly assigned to Korral Kool (KK) or oscillating fan and spray (OS) cooling systems from 6/26-9/26,2002. Each pen included a shade structure(7.3 m by 18.3 m)oriented north/south. The KK pen had three overhead coolers, with computer driven variable speed fans and variable pressure water injection into the airstream. The OS pen had three (0.9M)computer driven variable speed fans with variable airstream water injection placed below the western edge of the roof. The arc of the OS fan was 270 °. Both systems varied fan speed and water injection according to THI. Water and electrical use was metered on each system. Water use (L/d)was higher in OS compared to KK (7330 vs 4989, P≤.03). Electrical use (KW/d) was lower for OS compared to KK (76.4 vs 93, P≤.03) Temperature and humidity recorders established THI outside and under each shade. Mean THI outside the shades was 80. Mean THI was higher under OS compared to KK (78 vs 77, P ≤.001). Thermal status of cows was established via infrared gun and visual observation of respiration rate (rr). Average cow surface temperature (°C) was higher for OS compared to KK (34.3 vs 26.6, P≤.001). Likewise rr/min was higher in OS cows compared to KK cows(65.5 vs 56.7, P≤.001) Milk yield (kg/d)N=79, did not differ in OS compared to KK, (36.2 vs 36.7). We conclude that KK improved cow comfort over OS but this did not result in a milk yield difference.

Key Words: Heat stress, Cooling systems, Dairy cattle

74 Effects of sprinkler, shade, and fan cooling of preparturient Holstein cows on postparturient milk performance during summer heat stress. J. H. Urdaz*, M. W. Overton, D. Moore, and J. E. Santos, *Veterinary Medicine Teaching and Research Center University of California, Davis Tulare, CA/USA.*

The purpose of this study was to examine the effects of shades, fans, and sprinklers on the last three weeks of gestation of Holstein cows during summer heat stress. Outcome variables included postparturient milk production, rectal temperatures, body condition score(BCS), and incidence of postparturient disorders. Four hundred and thirty prepartum multiparous cows 250-257 days pregnant were randomly allocated to two identically structured pens. Treatments consisted of sprinklers over the feedbunk (CONTROL, n=209); and sprinklers, fans, and shades over the feedbunk (COOLED, n=221). To be eligible for analysis, cows

were required to spend a minimum of 14 days in their assigned pen before parturition. After calving, both groups were housed in the same freestall facilities. Computerized data recorders in each pen recorded environmental temperature every half hour. Rectal temperatures were measured twice weekly for three weeks before parturition. Body condition scores were taken at study enrollment, parturition, 60 days in milk (DIM), and 150 DIM. Following calving, the presence of parturient paresis, retained placenta, and metritis were recorded for the first 10 DIM. Milk production was measured using twice-monthly DHIA tests for the first 150 DIM. Descriptive statistics were used for environmental temperatures. Data on rectal temperature, BCS, and milk production were analyzed by the MIXED procedure of the SAS (2001) program. Chi-square analysis was used for postparturient disease outcomes. Average daily environmental temperature in the control group was 79.6 F 19.1 vs. 77.2 F 16.5 in the cooled group during the length of the trial. There was no significant difference in rectal temperatures (P= 0.62), BCS (P= 0.57), incidence of parturient paresis (P= 0.99), or retained placenta (P=0.69). A treatment by test date interaction was detected for milk production (P= 0.03) and cows in the cooled group produced more milk than controls in the first 15 days in lactation (79.6 vs. 75.0 lbs/d; P<0.05). Cooling pre-parturient cows with shade, fans, and sprinklers may increase milk production immediately after parturition. Further analyses are needed to assess the economic feasibility of adding cooling systems to preparturient cows.

Key Words: Cooling, Preparturient Holstein cows, Heat stress

75 A large-scale survey evaluating the effect of cooling Holstein cows on productive and reproductive performances under sub-tropical conditions. I. Flamenbaum*[1] and E. Ezra[2], [1]*Ministry of Agriculture, Extension Service,* [2]*Israel Cattle Breeders Association.*

The effect of cooling dairy cows was studied during four years (1998 #2001). The survey included 14 farms, located in the costal part of Israel and classified into three different groups according to the intensity of cooling in summer. Cows of group 1 (six farms, intensive cooling), were cooled in the holding and feeding area for a total of 10 cooling periods and 7.5 cumulative hours per day. Each cooling period combined cycles of sprinkling (0.5 min.) and forced ventilation (4.5 min.). Cows of group 2 (three farms, moderate cooling), were cooled in the holding area only, and were provided a total of six cooling periods and 4.5 cumulative hours per day. Cows of group 3 (five farms, no cooling) were not cooled at all. Milk production (kg/d) and conception rates (%), were calculated for summer (July-September) and winter (December-February). The analysis included 125,000 milk recordings (> five recordings for each cow per lactation) and 17,000 inseminations. Average four years daily low and high temperatures (C) were 8.4 and 19.3, and 22.0 and 31.8, for winter and summer, respectively. The effect of the interaction between season and cooling system was significant (P<0.001). The ratios between summer and winter production were 98.5%, 96.2% and 93.4%, in intensive, moderate, and no cooling regimes, for primiparous cows and 98.5%, 96.1% and 90.7% for multiparous cows, respectively. Conception-rates were 55.8%, 53.5% and 53.9%, and 40.4%, 34.0% and 14.6%, for primiparous cows under the intensive, moderate, and no cooling regimes, inseminated in winter and summer, respectively (P<0.01). Conception-rates were 46.6%, 45.8% and 43.5%, and 33.8%, 34.5% and 16.7% for multiparous cows in the same groups inseminated in winter and summer, respectively (P<0.01). The results indicate that intensive cooling significantly reduces the seasonal variations in productive and reproductive performances of dairy cows under sub-tropical conditions.

Key Words: Cooling cows, Milk production, Conception rate

76 Effect of low-pressure soaking frequency and high-pressure misting on respiration rate, body surface temperature and body temperature of heat stressed dairy cattle. M. J. Brouk*, J. P. Harner, J. F. Smith, A. K. Hammond, W. F. Miller, and A. F. Park, *Kansas State University.*

Ten lactating Holstein cows (5 primiparous and 5 multiparous) were arranged in a replicated 5x5 Latin Square design to evaluate the effect of low-pressure soaking frequency and high-pressure misting on respiration rate, body surface temperature, and body temperature of heat stressed cattle. Animals were housed in freestall barns and milked 2x. During testing, cattle were moved to a tiestall barn for a period of 2 hours starting at 13:00 on five days of intense heat stress. During the testing periods, respiration rates were determined every five minutes by visual observation. Body surface temperature of three sites (shoulder, thurl and rear udder) were measured with an infrared thermometer and recorded at 5-minute intervals. Body temperature was recorded with a data logger and vaginal probe every minute and averaged over 5 minute intervals. Treatments were control (C) a lower-pressure soaking cycle every 5 (5+F), 10 (10+F) or 15 (15+F) minutes and continuous high-pressure misting (HP+F). Similar amounts of water were used in each soaking treatment. Soaking and misting treatments included supplemental airflow. The skin of cattle receiving the soaking and misting treatments became soaked over the course of the treatment period. Average respiration rates of cattle studied were 111.7, 98.7, 95.3, 84.4, and 87.6 breaths/minute for C, 15+F, 10+F, 5+F and HP+F, respectively. Treatments differed (P<0.01) from each other and the 5+F treatment showed the greatest reduction in respiration rate. Cooling treatments reduced (P<0.01) body surface temperatures. Average shoulder surface temperatures were 37.7, 34.6, 33.9, 32.2 and 31.4 °C. Average rear udder surface temperature followed a similar pattern (37.9, 37.8, 37.6, 37.3 and 36.4 °C, respectively) differed (P<0.01) among treatments. Cooling heat stressed dairy cattle with either low-pressure soaking or misting that soaked the dorsal body surface was effective in reducing respiration rates and body surface temperatures. These data show that more frequent soaking and high-pressure misting that soaks the body surface increases heat abatement of dairy cattle.

Key Words: Heat abatement, Environmental modification, Facilities

77 Hair coat color may influence longevity of Holstein cattle in the tropics. C. N. Lee*[1], K. S. Baek[1,2], and A. Parkhurst[3], [1]*University of Hawaii-Manoa,* [2]*National Livestock Research Institute, Suwon, S.Korea,* [3]*University of Nebraska.*

Previous studies from FL and AZ suggested that Holstein cows with white hair coat produced more milk in hot climates. However, over a decade of observations of dairy herds in Hawaii and Asia suggest that majority of the animals in commercial herds are of black hair coat. Hence, a simple study to determine the accuracy of the observation was conducted in 2 large commercial herds in Hawaii. Cows were classified into 3 groups: a) black (B,>90%); b) black/white (BW,50:50)and c) white (W,>90%). Cows with other hair color distribution were excluded from the study. In Farm A, 215/960 lactating cows with 4-7 or more lactations were identified and in Farm B, 690/1,350 lactating cows with 2-5 or more lactations were identified for the study. The W cows in both herds had higher milk production (kg), but it was not statistically different; Farm A:B-11,511, BW-11,098, W-11,806; Farm B:B-9,593, BW-9,899, W-9,907 (SE 230). Regression analyses of the data based on % distribution for each hair coat within a lactation showed that the population of W cows decreased with increasing lactations for both farms (p<0.05). The W cows distribution decreased from 17.5% to 6.3% in farm A and from 15.7% to 7.4% in farm B as the number of lactations increased. The B cow population increased from 51% to 78% for farm A for 4th to 6th lactation while in farm B, this population increased from 45% to 55.4% for 2nd to 5th lactation. Further analyses by Wilcoxon test for homogeneity of survival curves confirmed this; Farm A (p<0.05) and Farm B (p<0.06). Minimum changes in the distribution of BW population were observed. Analyses of B vs W hair coat in cows (ug/cm^2) yielded 8.2 vs 18.4 respectively (n=22). The data suggested that W cows had greater risk of survival in the tropics. Factors contributing to this phenomenon are currently being investigated.

Key Words: Hair coat, Survival, Milk production

78 The impact of cooling ponds in north central Texas on milk production and culling. M. Tomaszewski*[1], M. de Haan[2], J. Thompson[1], and E. Jordan[1], [1]*Texas A&M University,* [2]*Wageningen University.*

Heat stress is a major impediment to efficient production of milk in the Southern part of the US. One method of cooling cows is the utilization of cooling ponds during periods of high temperatures. The objective of this study was to determine if differences existed for production and culling data between farms with and without cooling ponds. Data from 55 herds located in north central Texas were selected. Monthly production and culling data from 1999 through 2002 were obtained from the DHI database. Twenty-two herds had installed cooling ponds, while 33 herds had not. Data were analyzed using the PROC MIXED procedure of SAS with cooling pond, season, and their interactions analyzed as

fixed effects and herd as a random effect. Seasons were grouped as August, the two months prior to August, the two months after August, and all other months. Least square means for differences between herds with and without cooling ponds in August showed an increase ($P \leq 0.001$) of 2.62 kg of milk/milking cow/d for herds with cooling ponds. When herds were compared within their pond status category for the two months pre- and post- August, there were no significant differences between the least square means. However, herds with cooling ponds increased production by 1.52 kg of milk/milking cow/d ($P \leq 0.05$) in the pre-August season and 1.47 kg of milk/milking cow/d ($P \leq 0.05$) in the post-August season when compared to herds without cooling ponds. During months in which cooling ponds were not used, there was no significant difference. When percent of cows that left the herds was evaluated to determine if differences in culling existed, no significant difference was found. In conclusion, cooling ponds had a significant impact on maintaining milk produced/cow/d during periods of heat stress and there was no difference in culling between farms with and without cooling ponds.

Key Words: Cooling pond, Heat stress, Culling

79 Evaluation of drought management strategies for cow-calf enterprises. R. E. Kruse*[1], M. W. Tess[1], R. K. Heitschmidt[2], J. A. Paterson[1], and B. F. Sowell[1], [1]*Department of Animal Science, Montana State University, Bozeman, MT 59717,* [2]*USDA-ARS, Fort Keogh Livestock and Range Research Laboratory, Miles City, MT 59301.*

Abstract: The objective was to evaluate alternative drought management strategies for their effects on profitability based on early detection of drought. A bio-economic model was parameterized to represent a range-based cow-calf production system in the Northern Great Plains. The base management system was characterized by inputs required to maintain herd size of 511 cows during an average climatic year with a fixed forage base of 4,329 AUM of range forage, plus 571 t grass and 189 t alfalfa hay. Treatments were factorially arranged where management (early vs normal) and intensity of drought (moderate, 20% reduction in available forage vs severe, 40% reduction in available forage) were evaluated for effects on system performance. The early management (EM) scenario included detecting drought by July 15th and decreasing the average age at weaning to 90d. The normal management (NM) scenario included no "early" management changes to emerging drought, but nutritional management was modified as needed to maintain in animal performance. A second bio-economic computer model was used to simulate drylot performance for early-weaned calves. Outputs from the two models were combined and treatments were evaluated based on feed costs, average weaning weight, ranch gross margin (gross margin # variable costs, RGM), and cumulative gross margin (ranch gross margin + revenue from drylot calves, CGM). During average climatic conditions CGM under the base management system was $137,730. During drought CGM was reduced compared to the base system: EM (17.6 and 48.8%) and NM (33.6 and 72.3%) for moderate and severe drought, respectively. For both levels of drought, EM had lower purchased feed costs and higher CGM than NM. Directly feeding EM calves proved more efficient than feeding NM cows to produce milk to maintain calf performance. Early weaning should effectively reduce the negative effects of drought on gross margin.

Key Words: Beef cattle, Drought management, Early weaning

80 Genetic analysis of the growth performance of Bhagnari and Droughtmaster x Bhagnari crossbred cows in Pakistan. A. U. Hyder*[1], A. Waheed[2], and M. S. Khan[3], [1]*Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan,* [2]*Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan,* [3]*Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan.*

Pedigree and performance records of 296 Bhagnari and Droughtmaster x Bhagnari crossbred cows maintained at Beef Production Research Centre, Sibi (Balochistan) accumulated over a period of 30 years from 1969 to 1999, were utilized for the present study. The least squares means for birth weight, weaning weight and pre-weaning average daily gain were 23.49±3.76, 107.46±19.00 and 0.39±0.097 kg having coefficients of variation of 12.89, 13.75 and 13.75 percent. Year of birth significantly influenced birth weight, weaning weight and pre-weaning average daily gain, season of birth appeared to be a non-significant source of variation for all of the performance traits studied. Genetic group of the cows had a significant effect on birth weight, While other traits including weaning weight, pre-weaning average daily gain, were non-significantly affected by the genetic group of the cow. Genetic group of the dam had a non-significant influence on body weights at birth and weaning ($P>0.05$). The heritability estimates of birth weight, weaning weight, and pre-weaning average daily gain were found to be 0.09±0.02, 0.09±0.01, and 0.01±0.01, respectively. The estimates of phenotypic and genetic correlation between birth weight and weaning weight were -0.23 and -0.74, respectively. The estimated breeding values ranged from #171.44 to 242.48 kg for birth weight and from #171.44 to 22.48 kg for weaning weight. Estimated breeding values obtained were used to compute the genetic trends for various performance traits. The genetic trends for birth weight was negative and for weaning weight it was, however, slightly positive. All phenotypic trends were negative with the exception of the one for weaning weight, which was slightly positive.

Key Words: Growth, Heritability, Genetic trend

81 The effect of protein intake on milk protein efficiency in heat-exposed cows. A. Arieli*[1] and I. Bruckental[2], [1]*Hebrew University of Jerusalem, Rehovot, Israel,* [2]*Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel.*

A trial was conducted using 42 mid-lactating (134 DIM) cows to evaluate the effect of dietary CP concentration on the production, composition and efficiency of milk production under hot ambient conditions. The trial was conducted from May until August 2002, in Bet Dagan, Israel. The mean, and maximal ambient temperature, relative humidity and thermal humidity index prevailing throughout the trial were: 27 and 32 oC, 70 and 88%, and 76 and 81, respectively. Cows had 3 showers daily; each lasting for 20 min. Cows were individually fed, and were randomly blocked into 2 dietary treatments. Group LP and HP were respectively fed with diets containing 15.1 or 16.7% CP. Other dietary constituent were: 36% RUP (% of CP), 32% NDF (54% of which from forage), 1.72 Mcal/kg NEL. Feed intake, milk yield, and body weight were measured daily. Milk composition was measured every two weeks. Body condition was weekly scored. During the 4th, and 8th wks of trial, blood was sampled before the morning meal. On these weeks six fecal samples were obtained in two succeeding days for digestibility evaluation by the indigestible NDF method. Digestibility of CP was lower in LP (64%) than in HP (66%) diet, while the DM digestibility was higher in the LP (65%) than in the HP (63%) diet. Intake of DM (23 kg/d), milk production (35 kg/d), milk protein (3.1%), fat (3.3%), and lactose (4.7%) were similar between treatments. The efficiency of milk protein production was higher in LP (0.30) than in HP (0.28) diet. Plasma concentrations of glucose (58 mg/dl), NEFA (0.13 meq/l), BHBA (9.7 mg/dl), total protein (8.2 g/l), and albumin (3.8 g/l) were not affected by dietary CP level. Milk urea was lower in LP (14.9 mg/dl) than in HP (16.3 mg/dl). Body weight gain and BCS accretion tended to be higher by 135 g/d, and by 0.1, respectively, in the LP as compared with the HP diet. It was concluded that a dietary CP concentration of 15% might be adequate to maintain production in heat-exposed dairy cows producing 35 kg of milk.

Key Words: Dietary CP, Heat stress, Milk protein efficiency

677 Milking procedures and udder health management on U.S. dairy operations: Results from NAHMS dairy 2002 study. J. E. Lombard*[1], B. J. McCluskey[2], and L. P. Garber[2], [1]*Integrated Livestock Management, Colorado State University, Fort Collins,* [2]*National Animal Health Monitoring System:CEAH:USDA, Fort Collins, CO.*

The National Animal Health Monitoring System's Dairy 2002 surveyed dairy operations in 21 states representing 82.8% of U.S. dairy operations and 85.5% of U.S. dairy cows. One component of the study investigated procedures associated with milking and udder health management practices aimed at decreasing mastitis incidence. The objective of this report is to describe current milking procedures and other management practices associated with udder health on U.S. dairy operations. Predip teat preparation methods were used on 59.1% (S.E.2.1) of all operations. Predips were used most frequently on operations with 100-499 cows. The most commonly used predips contained iodophores (70.3% (S.E.2.4) of operations using a predip) and chlorhexidine (10.4% (S.E.1.8) of operations using a predip). The most commonly reported teat wash method

for operations not using a predip were single-use cloth/paper towel. Operations that used a teat wash method most frequently dried teats using a single-use cloth/paper towel (51.2% (S.E. 3.8) of operations that used a teat wash method). Neither a predip or teat wash method was used on 5.3% (S.E. 1.0). Automatic takeoffs were used on 36% (S.E. 1.8) of all operations with use increasing with increasing herd size. More than 94% (S.E. 1.0) of operations used a post-milking teat disinfectant (postdip). Iodophores and chlorhexidine were the most commonly used disinfectants in postdips. Most operations reported milking cows twice daily (93.6% (S.E. 0.8) of operations representing 78.6% (S.E. 1.7) of cows). Coliform mastitis vaccines were administered to the majority of cows on 35.8% (S.E. 2.0) of operations representing 57.1% (S.E. 1.8) of all cows. Intramammary dry cow therapy was administered to all cows at dry off on 75.2% (S.E. 1.9) of operations. The majority (42.1% (S.E. 1.8) of cows) was treated with a dry cow product containing cephapirin, followed by the combination of penicillin G/dihydrostreptomycin (31.7% (S.E. 2.0) of cows).

Ruminant Nutrition: Dairy calves and replacement heifers

82 Responses to feeding Apex plant extracts to neonatal calves via the milk replacer and starter. T. M. Hill*[1], J. M. Aldrich[1], and R. L. Schlotterbeck[1], [1]*Akey.*

Feeding Apex plant extracts improved 0 to 42-day gains by 8 percent when included in an all milk protein milk replacer (MR) and 17 percent when included in a milk plus soy protein MR (no Apex in the starter) in a previous trial. In this trial 48, approximately 3 day old calves (40 kg), were fed a milk plus soy protein MR (20 percent CP and 20 percent fat, 454 g per head daily) with and without .05 percent Apex and an 18 percent CP starter with and without .05 percent Apex. All MR and starters contained decoquinate. Starter and water was fed from 0 to 56 days and MR was fed from 0 to 42 days. Calves were housed in a naturally ventilated nursery with no heat in individual pens. Data were analyzed as a completely randomized block design with factors in the model of block (row in nursery), MR (Apex or no Apex), starter (Apex or no Apex), and MR by starter. There were no significant ($P > .1$) interactions of MR by starter. Calves fed Apex via the MR had higher rates of gain, consumed more starter, and had better feed efficiency ($P < .05$) from 0 to 42 days. They also had firmer fecal scores and required fewer medical treatments ($P < .05$) from 0 to 42 days. Calves fed Apex via the starter had higher rates of gain and better feed efficiency ($P < .1$) from 0 to 56 days. Calves fed Apex via the MR consumed more ($P < .1$) starter from 0 to 56 days. Calves fed Apex via the starter consumed more ($P < .1$) starter and had greater hip width changes post-weaning. Compared to calves not fed Apex from 0 to 56 days, gains were 4.9 kg, 5.4 kg, and 8.0 kg greater and starter intakes were 9.4 kg, 8.3 kg, and 11.3 kg greater when Apex was in the MR, starter, or both feeds, respectively. Apex is a trademarked product of Braes Feed Ingredients.

Key Words: Calf, Milk replacer, Plant extract

83 Effect of feeding neonatal calves milk replacers containing a blend of vegetable and animal fats. T. M. Hill*, J. M. Aldrich, and R. L. Schlotterbeck, *Akey.*

Milk replacers (MR) for herd replacement calves commonly contain all animal fat, which contain fatty acids with predominately 16 and 18 carbons. Shorter chain fatty acids may be more digestible and have antimicrobial properties, while C18:2 and C18:3 fatty acids might aid in immune function. In two trials, a MR formulated with a portion of the animal fat replaced with a blend of vegetable fats high in 8 to 14 carbon fatty acids, plus C18:1 and C18:2 fatty acids (MRV) was compared to a MR formulated with all animal fat (MRA). In each trial, 24 calves (approximately 3 days old and 43 kg) were fed 454 g per head daily of a 20 percent all milk protein and 20 percent fat MR from 0 to 42 days and an 18 percent CP starter and fresh water from 0 to 56 days. Both feeds contained decoquinate. Data were analyzed as a completely randomized design. In trial 1, daily gains and starter intakes for calves fed MRV were improved ($P < .05$) 7% from 0 to 42 days compared to calves fed MRA. Daily gains and starter intakes for calves fed MRV were improved ($P < .05$) 6 and 10 percent, respectively, from 0 to 56 days compared to calves fed MRA. There were 26 percent fewer total abnormal fecal score days (fecal scores >2 on a 1-5 system; 1 being normal, 5 being watery) for calves fed MRV vs. MRA. In trial 2, daily gains and feed efficiency for calves fed MRV were improved ($P < .05$) 6 and 7 percent, respectively, from 0 to 42 days, compared to calves fed MRA. Daily gains for calves fed MRV were improved ($P < .05$) 6 percent from 0 to 56 days compared to calves fed MRA. There were 21 percent fewer total abnormal fecal score days for calves fed MRV vs. MRA. Calves fed MRV were approximately 2 kg heavier after the 56-day trials and scoured less than calves fed MRA.

Key Words: Calf, Milk replacer, Fatty acids

84 Characterization of a colostrum replacer containing IgG concentrate and growth factors. C. J. Hammer*[1], J. D. Quigley[2], L. Ribeiro[2], and H. D. Tyler[1], [1]*Iowa State University, Ames,* [2]*APC, Inc., Ames, IA.*

Objective of this study was to characterize absorption of colostrum replacer (CR) or supplement (CS) containing fractions of bovine plasma. Immunoglobulin concentrate (IGC) was prepared from bovine abattoir blood to a final purity of approximately 90%. Bovine blood was also processed to produce a fraction containing elevated concentrations of IGF-1 and TGF-β (GF). Both IGC and GF were spray-dried and blended with other ingredients to produce CR (30% IgG) or CS (15% IgG) containing 0 or 5% GF. Holstein bull calves (n = 40) were removed from the dams immediately after birth and assigned to one of five treatments: 1.9 L of maternal colostrum at 1 and 8 h of age (MC); 1.9 L of CS at 1 and 8 h of age to provide 150 g of IgG (LC); 1.9 L of a CS with GF at 1 and 8 h of age to provide 150 g of IgG (LG); 1.9 L of CR at 1 h of age to provide 150 g of IgG and 1.9 L of a commercial milk replacer (MR) at 8 h of age (HC); and 1.9 L of a CR with GF at 1 h of age to provide 150 g of IgG and 1.9 L of a commercial MR at 8 h of age (HG). Blood was collected by jugular venipuncture at 0 and 24 h for determination of plasma IgG. Six calves fed HG, HC, and MC received an oral xylose solution (0.5% g/kg body weight) at 2 d of age. Jugular blood samples were obtained at 0 and 2 h after xylose ingestion. Apparent efficiency of IgG absorption (AEA) was higher ($p=.02$) for calves fed HC and HG compared to those fed LC and LG and was lower ($p=.03$) for calves fed LG and HG compared to those fed LC and HC. IgG concentrations at 24 h were highest ($p<.0001$) in calves fed MC compared to other calves and were higher ($p=.048$) in calves fed HC and HG compared to LC and LG. Calves fed LG and HG had lower ($p=.02$) IgG concentrations at 24 h of age compared to those fed LC and HC. Xylose absorption was not influenced by treatment. These results indicate that 150 g of IgG provided in one dose soon after birth is superior to 150 g of IgG fed in two doses 7 h apart.

Key Words: Colostrum, Calf, Xylose

85 Inclusion of vegetable fats in calf milk replacers. M. L. O'Brien, K. J. Touchette, J. A. Coalson, and R. M. Costello*, *Merrick's Inc. Union Center, WI USA.*

Due to increased concern over feeding species to species feeds and to new manufacturing technology, the use of vegetable fats in milk replacers may be an alternative to feeding animal fats. Two studies were conducted to evaluate the performance of calves fed milk replacer containing vegetable fat. Both experiments utilized a randomized complete block design with initial weight as the blocking factor. Calves on Exp. 1 were assigned to a diet of all animal fat (**ANIMAL**), 100% vegetable fat containing Palm Oil as 85% of the fat and Coconut Oil as 15% of the fat (**PALM**), or a 100% vegetable fat diet containing Soy Oil as 85% of the fat and Coconut Oil as 15% of the fat (**SOY**). Calves on Exp. 2 were assigned to a diet of all animal fat (**ANIMAL**), as ANIMAL with 15% of the fat from Coconut Oil (**15%COCO**), or 100% vegetable oil containing 85% of the fat as Soy Oil and 15% of the fat as coconut oil (**SOY**). For both experiments, milk replacers were formulated to contain protein and fat levels at 20% of DM and were fed at 454 g/d reconstituted to 12% DM. Holstein bull calves (n=60 for Exp. 1, n=120 for Exp. 2) were purchased from an area sale barn. Calves were housed in individual hutches with water available free choice from d 0. A high quality, commercial calf starter was available free choice beginning on d 1. Feed intake, incidence of scours and antibiotic treatments were recorded daily. Calves were weighed weekly. Calves were

weaned at a minimum of 42 d with weaning dependent on the calf eating a minimum of 454 g of calf starter for 3 consecutive d. For Exp. 1, calves fed the PALM diet had greater average weekly weight gains, ADG, ADFI, and feed efficiencies (P<0.05) than calves fed ANIMAL. Calves fed SOY were intermediate for all performance characteristics. For Exp. 2, there were no significant differences in average weekly weight gains, ADG, ADFI or feed efficiency between calves fed ANIMAL, 15%COCO, or SOY. These results indicate that vegetable fats can be used as an effective alternative fat source in commercial calf milk replacers.

Key Words: Calves, Milk replacer, Fat

86 Effect of feeding a novel direct fed microbial in a calf milk replacer. M. L. OBrien[1], K. J. Touchette[1], J. A. Coalson[1], R. M. Costello*[1], T. Rehberger[2], and B. Galbraith[2], [1]*Merrick's Inc. Union Center, WI,* [2]*Agtech Products, Inc. Waukesha, WI.*

The objective of this study was to determine the effect of feeding a novel direct fed microbial (DFM) in a calf milk replacer (CMR). Holstein bull calves (n=120), less than 7 d of age were purchased from an area sale barn in two groups of 60 calves. Two experiments were conducted using a randomized complete block design. Calves were assigned by weight to either a control diet (**CON**) or a diet containing the novel DFM (**DFM**). All calves were fed a CMR formulated to contain protein and fat levels at 20% of DM and were fed 454g/d. Calves were housed in individual hutches with water available free choice from d 0. A commercial calf starter was available free choice beginning at d 1. Feed intake, scour scores and antibiotic treatments were recorded daily. Calves were weighed weekly. Calves were weaned at d 42 dependent on a minimum intake of 454 g of calf starter for 3 consecutive d. Experimental data were analyzed separately due to treatment by trial interactions. Initial serum IgG level for calves in Exp. 1 was 50% lower than that for calves in Exp. 2 (3.9 vs. 7.9 mg/ml, P<0.10). Calves fed the DFM in Exp.1 were significantly heavier than calves fed the CON diet beginning on d 7 and maintained the difference through d 42. Average daily gains were significantly greater for the first six weeks of the study for calves fed the DFM diet compared to those fed the CON diet (465g vs. 393g respectively). In Exp. 1, calves fed the DFM had a lower percent scouring than calves fed the CON diet (27.5% vs. 39.3%, respectively, P=0.35). In Exp. 2, there was no significant difference in average weekly weight gains, ADG, feed intake or gain:feed between calves fed the DFM or CON diet. For calves fed the DFM, the percentage of calves that scoured was significantly (P=0.05) less than calves fed the CON diet (17.9% vs. 41.4%, respectively). These results suggest that the novel DFM utilized in this study can be beneficial for the reduction in percentage of calves scouring when fed in a calf milk replacer and may improve calf performance.

Key Words: Calves, Direct fed microbials

87 Performance of Holstein and Holstein-Jersey crossbred heifer calves from birth to 84 days of age. M. L. Raeth-Knight*[1], J. G. Linn[1], D. G. Johnson[2], L. B. Hansen[1], A. J. Seykora[1], B. J. Heins[1], and R. M. Templeton[1], [1]*University of Minnesota, St. Paul, MN, USA,* [2]*West Central Research and Outreach Center, Morris, MN, USA.*

Forty-two Holstein and forty-four Holstein-Jersey crossbred heifer calves were included from studies conducted at the University of Minnesota, St. Paul (Site A) and the West Central Research and Outreach Center, Morris, Minnesota (Site B). All crossbred calves had Holstein dams and Jersey sires. Calves were fed colostrum twice daily the first three days after birth and then milk replacer (22% CP, 20% fat) at approximately 10% of birth weight until weaning at day 42. Calf starter was offered ad libitum from day 3 to day 84. Calves at Site A were housed individually in hutches while calves at Site B were housed individually and in groups. Housing at Site B did not affect performance measures or feed intake of Holstein or crossbred calves. All calves at both sites were grouped on day 57. Body weights and hip heights were recorded at birth, day 28, 56 and 84. At both sites, Holstein calves consumed significantly ($P < 0.01$) more total kg of milk replacer dry matter from day 3 to 42 (Site A (18.3) Site B (17.24)) as compared to crossbred calves (Site A (14.7) Site B (13.5)). At Site A, Holstein calves numerically consumed more total kg of starter from day 3 to 56 (76.4 vs. 70.2) compared to crossbred calves. At site B, crossbred calves (n=8) numerically consumed more total kg of starter from day 3 to 56 (63.1 vs. 55.1) compared to Holstein calves (n=4). At both sites, Holstein calves weighed significantly ($P < 0.01$) more at birth than crossbred calves, (41.6 kg vs. 34.4 kg). The average body weights at day 84, for Holstein and crossbred calves, were 109.5 kg and 91.2 kg ($P < 0.01$) for Site A and 91.4 kg and 82.3 kg ($P < 0.01$) for Site B. In summary, there was no difference in the feed efficiency or comparative performance (weight gain expressed as a percentage of birth weight) of Holstein or crossbred calves.

Key Words: Crossbreeding, Calf, Growth

88 Effect of feeding fatty acids to prepubertal heifers on first lactation milk production. J. M. Smith*[1] and M. E. Van Amburgh[2], [1]*University of Vermont,* [2]*Cornell University.*

We previously observed a reduction in pubertal mammary DNA content in Holstein heifers that had been fed a Ca salt of CLA. In this study, first lactation milk yields and components were compared among Holstein cattle that had been fed diets containing either a Ca salt of CLA (CaCLA), a Ca salt of palm fatty acids (CaPalm), sunflower oil (SUN), or no supplemental fatty acids (control; CTRL) between weaning and puberty. Treatments were randomly assigned to pens of 10 heifers as they were weaned. There were two replicate pens per treatment. Treatment diets began at about 3 mo of age. Heifers were limit-fed total mixed rations (TMR) composed of haylage, corn silage, and concentrate formulated using the Cornell Net Carbohydrate and Protein System to provide 1.01 ME- and 1.07 MP-allowable gain (kg/d). Fatty acid supplemented diets averaged 5% total fat. Heifers were weighed weekly and blood was collected twice weekly if over 250 kg to determine onset of puberty by measuring plasma progesterone. Of the 80 heifers enrolled in the study, 67 were followed through 280 d in milk. Heifers were housed together, milked 3x/d, and given bST per label. Monthly milk samples were analyzed for fat, protein, and urea nitrogen. Daily milk weights were used to calculate actual 280-d production. Means of the data were analyzed by ANOVA. Average daily gains between the start of treatment diets and puberty (0.99 ± 0.03 kg/d), ages at puberty (9.2 ± 1.3 mo) and first calving (22.1 ± 1.9 mo), and hip height (144 ± 3.5 cm) were not different, but body weight (BW) at the start of treatment, puberty, and conception differed ($P = 0.001$, $P = 0.01$, and $P = 0.1$, respectively). The BW at the beginning of the treatment period were 95, 101, 95, and 113 (± 1.7) kg for CTRL, CaCLA, CaPalm, and SUN, respectively. Puberty was attained at 286, 280, 269, and 305 (± 4.0) kg and heifers conceived at 377, 386, 363, and 392 (± 4.6) kg for CTRL, CaCLA, CaPalm, and SUN, respectively. Actual 280-d milk production (10720 kg ± 135), percentages of milk fat (3.6 ± 0.42), protein (2.8 ± 0.20), and urea nitrogen (13.0 ± 1.5 mg/dl) were not different among treatments. Fatty acids supplemented at 1% of ration DM to prepubertal heifers did not affect first lactation milk yield.

Key Words: Heifers, Fatty acids, Milk production

89 Altering protein degradability and solubility on rumen fermentation, blood urea nitrogen, and nitrogen balance in 16-18 month-old heifers. G. I. Zanton* and A. J. Heinrichs, *The Pennsylvania State University.*

The objective of this study was to assess the effects of varying protein fractions, fed in diets containing two forage levels (medium, 72.3% and high, 91.7%), to 16-18 month-old dairy heifers, on rumen fermentation, blood urea nitrogen (BUN), nitrogen (N) and phosphorus (P) balance. Diets were formulated to deliver equal ratios of crude protein to metabolizable energy and arranged in a 2 × 2 factorial with high or low levels of soluble (HSP or LSP) and rumen undegradable protein (HRUP or LRUP). Soluble protein was increased by the inclusion of urea to the appropriate rations, while RUP was increased by the inclusion of fish meal, each to rations in which soybean meal or Soy-Plus comprised the main source of protein concentrate. Treatments were administered in two 4 × 4 Latin squares to eight rumen-cannulated, Holstein heifers over four, 21-d periods (417.6 ± 24.0 kg. initial body weight). When fed in the medium forage diet, there were no treatment effects on mean daily rumen pH or VFA molar proportions ($P > 0.05$). The mean concentration of rumen NH_3 was significantly increased ($P = 0.04$) by HSP, however there were no significant differences in BUN for any treatment. Apparent digestibility of N ($P = 0.02$) and P ($P = 0.05$) was improved by the inclusion of HSP, although organic matter (OM) apparent digestibility was unaltered by treatment. A treatment interaction improved apparent digestibility of N in the HSP and HRUP ration ($P = 0.04$). When fed in a high forage diet, no significant differences were detected in the molar proportions of VFA, NH_3, or BUN ($P > 0.05$), while peak NH_3 was highest for HSP and HRUP rations ($P < 0.05$). The highest level of

apparent N and OM digestibility occurred with the diet that contained the HSP and HRUP, leading to a significant interaction between SP and RUP (P = 0.05), while P was apparently more digestible for HRUP (P = 0.02). Diets that are balanced to contain high SP and RUP appear to improve the apparent N digestibility when fed to 16-18 month-old Holstein heifers in both medium and high forage diets.

Key Words: Protein, Heifers, N digestibility

Ruminant Nutrition: Growing cattle

90 Influence of energy source and RDP on intake and digestion in beef steers fed grass hay based diets.

T. A. Baumann*, G. P. Lardy, J. S. Caton, W. W. Dvorak, and V. L. Anderson, *North Dakota State University, Fargo ND.*

A 5 x 5 Latin square was used to determine effects of supplemental energy source (ENG; corn vs soyhulls) and rumen degradable protein (RDP) addition on intake and digestion in steers fed grass hay. Steers (686.2 ± 51.4 kg BW) were housed in individual pens during each 14 d adaptation period and individual stalls during each 7 d collection period. Treatments were arranged as a 2 x 2 factorial plus one and consisted of control (CON; grass hay, 7% CP); grass hay plus 0.4% BW soyhulls (SH; 13.5% CP); grass hay plus 0.4% BW SH and 0.15% BW sunflower meal (35% CP); grass hay plus 0.4% BW corn (9.5% CP); and grass hay plus 0.4% BW corn and 0.2% BW sunflower meal. Diets supplemented with RDP were formulated to have a 0 RDP balance with the NRC model. Preplanned contrasts included main effects of ENG and RDP, ENG x RDP interaction, and CON vs supplemented (SUP) treatments. Supplementation increased total DMI compared to CON (1.67 vs 1.45% BW; $P < 0.001$), but forage DMI was greater ($P < 0.001$) for CON compared to SUP (1.45 vs 1.25% BW). Addition of RDP to SH increased ($P = 0.02$) forage DMI, while addition to corn decreased ($P = 0.02$) forage DMI. No time x treatment interaction was present for ruminal pH ($P = 0.79$). Ruminal pH was higher ($P < 0.001$) for CON vs SUP (6.69 vs 6.56). There was an ENG x RDP interaction ($P < 0.001$) for ruminal pH; pH increased with RDP addition to SH (6.58 vs 6.63), but decreased with RDP addition to corn (6.60 vs 6.46). Supplementation increased ammonia compared with CON ($P < 0.001$; 0.46 vs 1.46 mM). Likewise, addition of RDP increased ruminal ammonia ($P < 0.001$; 2.46 vs 0.35 mM). Total tract DM digestibility (TTDMD) was higher ($P = 0.01$) for SUP compared to CON (55.4 vs 50.7%). Addition of RDP to SH decreased TTDMD ($P = 0.04$; 57.86 vs 55.11%), while RDP addition to corn increased DM digestion ($P = 0.04$; 52.56 vs 56.14%). An ENG x RDP interaction occurred ($P = 0.03$) for total tract NDF disappearance that was similar to DMD. Rates of in situ DM disappearance were not different ($P = 0.34$). For moderate quality forages, intake and digestion appear to respond differently to RDP addition depending on energy source. Additional research is needed to determine RDP level and responses in diets using SH as the supplemental energy source.

Key Words: Soybean hulls, Protein supplementation, Digestion

91 Protein utilization of pearl millet grain supplements by growing steers.

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Bermudagrass hay (H; 'Tifton 85') was fed with supplement treatments (TRT) to steers to determine effects of corn-soybean meal or hybrid pearl millet grain (PM; 'TifGrain 102') on post-weaning transition performance and protein utilization. Supplements (SUP) contained rolled corn, soybean meal, PM (90.9% DM, 15.2% CP; finely ground), and vitamin/mineral premix, respectively (%): SCS = 87.8, 10.0, 0.0, 2.2; SPM = 0.0, 0.0, 97.8, 2.2. The DM, CP, and TDN (% DM), respectively, of SUP were: SCS = 88.0, 15.3, 84.5; SPM=88.8, 15.2, 82.5. Each SUP had salt (0.75%), $CaCO_3$ (0.75%), and provided premix vitamins A, D and E (24,000, 8,000, and 400 IU/d, respectively), lasalocid (150 mg/d) and Se (2.0 mg/d). Steers were randomly assigned to TRT, and initial (IBW) and final BW were means of two daily unshrunk weights. Steers (n = 42; 3 pens of 7 steers/TRT; age 11 mo; BW 310.6 ± 33.8 kg) of British (BR), Charolais × BR, Brahman × BR breeding were fed each SUP (1.945 kg DM/d) with free-choice H (91.5% DM; 10.3% CP) in a feedlot. Steer performance was unaffected (P > 0.10) by TRT (Table). Plasma urea nitrogen (PUN, mg/100ml; 4 steers/pen), plasma amino acids (PAA) and total essential amino acids (TEAA, umol/100ml; 3 steers/pen) were determined at 4h and 8h after SUP feeding. Both PUN and PAA were unaffected ($P > 0.10$) by sampling time and TRT × time interactions. Similar performance, higher PUN, and similar PAA for SPM indicate that PM was comparable to corn-soybean meal as a SUP for transition steers fed hay as the basal diet.

	Steer	performance	(34-d)	
Item	SCS	SPM	SE	$P <$
IBW, kg	309	311	7.37	ns
ADG, kg	0.95	0.96	0.08	ns
DMI, kg	7.40	7.33	0.22	ns
DM/gain	7.90	7.68	0.71	ns
Plasma	PUN and	PAA	(D 28)	
Item	SCS	SPM	SE	$P <$
PUN	3.54	5.92	0.26	0.01
LYS	17.31	16.65	0.71	ns
MET	6.24	5.20	0.45	ns
THR	21.75	19.24	0.96	ns
TEAA	218.1	215.67	4.91	ns

Key Words: Steer, Millet, Hay

92 Use of rice mill feed and soyhulls in backgrounding diets for beef calves.

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Rice mill feed compared favorably with broiler litter for producing economical gains when blended with corn and fed to stocker calves. Two trials were conducted to evaluate the use of soyhulls in broiler litter and rice mill feed (RMF)-based diets. Trial 1. Forty continental cross steers (initial BW = 257 kg) were fed one of four diets over a 112-day period (five steers/pen; two pens/diet). On a dry matter basis, diets were as follows: 1) 47% broiler litter:53% soyhulls, 2) 70% RMF:30% soyhulls, 3) 60% RMF:40% soyhulls and 4) 50% RMF:50% soyhulls.All diets were fed free-choice, and bermudagrass hay also was offered free-choice. Daily gains were higher (P<.05) for diet 4 than for the other 3 diets (1.1, 1.0, 1.2 and 1.5 kg/d, respectively). Trial 2. Sixteen Angus x Charolais steers (initial BW = 292 kg) were fed the same four diets while housed in individual metabolism stalls for a 10-day period. Nutrient digestibilities for the four diets were determined. Daily dry matter intake was lower (P<.01) for diet 1 (5.0 kg/d) than for diets 2, 3 and 4 (7.8, 7.9 and 7.9 kg/d, respectively). Nutrient digestibilities for the four diets were as follows: DM; 72.8, 64.2, 73.2, 69.2, OM; 74.3, 67.8, 75.6, 71.0, CP; 73.0, 72.6, 81.6, 70.8, NDF; 71.7, 55.8, 66.6, 63.6 and ADF; 66.2, 51.3, 62.0, 63.6. Digestibilities for DM, OM and ADF did not differ among diets (P.>10). However, CP digestibility was greatest (P<.10) for diet 3 and NDF digestibility was lowest (P<.10) for diet 2. Soyhulls can be blended with rice mill feed to produce acceptable backgrounding diets for growing beef calves.

Key Words: Beef cattle, Rice mill feed, Soyhulls

93 Effects of supplementing corn or soybean hulls to steers consuming bermudagrass hay on intake and apparent nutrient digestibilities.

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Effects of supplementing bermudagrass hay with corn or soybean hulls (SBH) on nutrient digestibility was evaluated using six crossbred steers (initial BW 182 ± 24.8 kg) fitted with rumen cannulae. Steers were placed in a latin rectangle arrangement and allowed ad libitum access to bermudagrass hay and assigned to one of three treatments: no supplement; supplemented with SBH; or supplemented with corn. Corn and SBH were fed to provide 161% of the maintenance energy requirement. In addition, soybean meal was added to the ration to meet National Research Council protein requirements because of the increased energy intake due to supplementation. For each of the three periods, steers were acclimated to their respective treatments for 14 days; after which, they were placed into individual stalls for 14 days. Steers were given

their respective supplements each morning and allowed ad libitum access to hay day. Dry matter intake of hay was not different (P > 0.2) among the treatments, ranging between 2.19 and 2.60 kg/d. However, total DMI of steers receiving SBH and corn was increased (P < 0.01; 3.60 and 3.50 kg/d, respectively) compared to steers not supplemented (2.27 kg/d). Steers not supplemented digested less DM and OM (P < 0.01; 52.9 and 53.4%, respectively) than those consuming corn (62.0; 62.8%, respectively) or SBH (65.7 and 66.7%, respectively). Crude protein digestibility for steers consuming hay only was decreased (P < 0.01; 49.2%) compared to steers consuming corn or SBH (64.7 and 67.5%, respectively). Neutral detergent and acid detergent fiber digestion was increased with SBH supplementation, (P < 0.01; 63.9 and 64.4%, respectively) compared to corn supplementation (52.8 and 49.6%, respectively) and non-supplemented steers (53.9 and 50.3%, respectively). Hemicellulose digestibility ranged between 55.5 and 61.1% and was not different (P > 0.05) among the three treatments. Supplementation of SBH or corn increased the digestibility of OM and protein by steers consuming bermudagrass hay. Additionally, supplementing bermudagrass hay with SBH increased fiber digestion compared to corn supplementation.

Key Words: Bermudagrass hay, Energy supplementation, Soybean hulls

94 Effect of level of added bypass protein to corn and citrus pulp supplements on performance of growing cattle. D. O. Alkire*, B. R. Austin, T. A. Thrift, and W. E. Kunkle, *University of Florida, Gainesville, FL USA*.

Fifty individually fed Angus x Brahman crossbred steers and heifers (250 kg initial BW) were utilized to evaluate the effects of citrus pulp or corn supplementation with varying levels of bypass protein on performance. Calves were stratified by weight, sex, and breed type and randomly assigned to treatment. Treatments consisted of corn or citrus pulp supplements with added bypass protein (SoyPLUS®). Five levels of bypass protein were evaluated including 0, .055, .11, .165, and .22 kg per head per day. These levels were utilized in both corn and citrus pulp supplements for a total of ten isonitrogenous and isoenergetic treatments. All calves were offered a basal diet of low quality bahiagrass hay (ad libitum) and fed the assigned supplement once a day. Hay and supplement were individually fed for 84 days using Calan gates. Average daily gain (ADG) and body condition score (1-9 scale) was evaluated every twenty eight days. Hay and supplement intake were recorded daily and refusals were recorded weekly. All data were analyzed using the proc GLM function of SAS. ADG increased linearly (P=.001) as level of supplemented bypass protein increased. ADG for the highest level of added bypass was improved by .393 kg over the control ADG. Type of supplementation had a significant effect (P=.0006) on total hay intake. Calves supplemented with corn consumed .7 kg more hay per animal per day than those supplemented with citrus pulp. Increasing levels of bypass protein caused a significant decrease in hay intake (P=.005). Hay intake for the highest level of bypass was .8 kg less per animal per day than the control. Body condition was not affected by type of supplementation or inclusion level of bypass protein. Adding bypass protein to corn and citrus pulp supplements fed to growing cattle increased gain.

Key Words: Beef Cattle, Bypass protein, Supplementation

95 Effect of supplemental energy form and frequency on forage intake and digestibility. T. W. Loy*, J. C. MacDonald, T. J. Klopfenstein, and G. E. Erickson, *University of Nebraska, Lincoln*.

Ten ruminally canulated heifers (BW = 416 kg, SD = 24) were used to test the effect of supplemental energy form and frequency on forage DMI and digestibility. Five treatments were arranged in a replicated 5 x 4 Latin rectangle (n = 8), and included no supplement (CON); DRC fed daily (DRC-D); DRC fed on alternate d (DRC-A); dry distillers grains (DDG) fed daily (DDG-D); and DDG fed on alternate d (DDG-A). Supplements were fed at 0.40% BW, with alternate heifers fed 0.80% BW every-other d. Chopped grass hay (8.2% CP) was fed to attain ad libitum DMI, and intake pattern was measured. Rumen fluid samples were collected prior to feeding, and at 2, 4, 6, 8, and 10 h post-feeding; and pH was measured. Rate and extent of in situ disappearance were calculated, with two incubations per period on heifers in alternate-d treatments. The 48-h time point began on a supplement d for one incubation, and a non-supplement d for the other. Data were analyzed using the mixed procedure of SAS. Contrasts of CON vs supplemented, daily vs alternate, and DRC vs DDG were included. Control heifers had higher ($P < 0.01$) hay DMI than supplemented heifers (1.88% vs 1.66% BW, respectively); although total DMI was lower ($P < 0.01$) for CON. Hay DMI did not differ ($P = 0.45$) between DRC and DDG treatments. Hay DMI tended to be lower ($P = 0.08$) for DDG-A and DRC-A than for treatments supplemented daily. Hay and total DMI were lower ($P < 0.01$) on supplementation d for DDG-A and DRC-A. Heifers in alternate-d treatments ate fewer ($P < 0.01$) and larger ($P < 0.01$) meals, and spent less ($P < 0.01$) time eating than those supplemented daily. Average rumen pH was greater ($P = 0.05$) for CON than supplemented heifers (6.30 vs 6.19, respectively). CON heifers had higher ($P \leq 0.04$) rate and extent of NDF disappearance than supplemented heifers. Rate of hay NDF disappearance was lower ($P = 0.02$) for DRC than for DDG. Supplementation decreased hay DMI, and changed digestion kinetics. Supplementation frequency affected amount and pattern of DMI. Rate of hay NDF disappearance was greater for DDG than DRC.

Key Words: Supplementation, Forage, Intake

96 Nitrogen metabolism of beef steers fed either Gamagrass or Orchardgrass hay with or without a supplement. K. Magee*, M. Poore, J. Burns, and G. Huntington, *North Carolina State University*.

This experiment evaluated ruminal protein:energy synchronization in steers fed either gamagrass (Tripsacum dactyloides) or orchardgrass (Dactylis glomerata) hays with or without a soyhull/corn supplement. A N balance trial was conducted to compare the effects of the supplement and hay on N intake, N digestion, and N metabolism. The supplement consisted of 50:50 corn:soyhulls mix with 50 g molasses per kg of corn:soyhulls mixture. The supplement contained 11.3% CP, 33.4% NDF, 25.1% ADF, and 0.87 kg was fed at 0830 and 1600 followed by hay offered in two equal portions. Steers had ad libitum access to water and a trace mineralized salt block throughout the study. Hay compositions were 8.3% CP, 46.6% NDF, and 26.7% ADF for gamagrass and were 11.9% CP, 46.25 % NDF, and 26.55% ADF for orchardgrass. Steers were individually fed, blocked into two weight groups, and randomly assigned to either gamagrass or orchardgrass hay (4 steers per hay). Within hays, steers were assigned to receive supplement or no supplement in a switch back design. Ad libitum DM intake for each steer was equal to their intake during the last 8d of the 21-d adaptation period. Steers were then placed in metabolism crates for an 8-d adjustment followed by a 5-d balance trial. During the balance trial, steers were fed 90% of ad libitum intake. Effects were significant at P ≤ 0.10. Compared with gamagrass, orchardgrass had a lower ad libitum DMI (4.62 vs 5.37 kg/d), higher N intake (96.6 vs 81.1 g/d), similar fecal N (36.1 vs 34.5 g/d), higher N digestibility (62.4 vs 57.4 %), similar N retained (27.2 vs 27.7 g/d), and lower digestible DMI (3.20 vs 3.53 kg/d). Compared with no supplement, supplement increased digestible DM intake (3.70 vs 3.03 kg/d), total DM intake (5.87 vs 5.07 kg/d), N intake (96.9 vs 80.8 g/d), fecal N (39.4 vs 31.1 g/d) and N retained (31.7 vs 23.2 g/d). Supplement (1.74 kg/d) decreased hay ad libitum intake by 0.73 kg/d. Supplement tended (P < 0.11) to improve N retained as a percentage of N intake or percentage of N digested more for orchardgrass than for gamagrass hay. We believe that the increase in digestible OM intake is due in part to the presence of soyhulls in the supplement.

Key Words: Beef cattle, Forages, Nitrogen metabolism

97 Supplemental protein to enhance nutrient utilization of steers fed high fiber hay. N. N. Paiva*, M. A. Froetschel, and G. M. Hill, *The University of Georgia, Athens, Georgia*
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A metabolism trial was conducted to determine effects of incremental levels of rumen undegradable protein (RUP) on nutrient utilization of growing steers fed bermudagrass hay (10.2% CP, 76.4% NDF). Six Holstein steers (217 13.8 kg) were used in a replicated 3 x 3 Latin Square designed experiment. Incremental levels of RUP (26.5, 35.3 and 44.0% of CP) were fed as supplements at 1.63 kg/hd/d. Supplements were isonitrogenous (25.9% CP) and fed in the form of pressed molasses blocks. RUP was controlled by feeding different ratios of SBM, corn gluten feed, poultry protein meal and soy hulls. Steers were fed treatments for 14 d. On d 10 to 14, steers were placed in metabolism crates for total fecal and urine collection. Jugular blood was sampled before and after feeding on d 10 and 14, respectively. Hay and DM intake increased (3.95 to 4.27 kg DM/d and 5.56 to 5.92 kg/d) with RUP (P < 0.05). Fiber digestion responded linearly to RUP supplementation (P < 0.05);

however DMD, OMD and DE were not affected (P > 0.10). Treatment did not affect N retention (P > 0.10; 49.46 5.22 g/d) but there was a trend for more digested N to be retained. Blood urea nitrogen (BUN) increased after feeding (P < 0.05; 14.15 vs. 16.3 mg/dl) and tended to be negatively related to RUP. In a 63-d 2 x 2 factorial feedlot trial, British and Brahman x British steers (n = 48; 556 2 kg initial BW; age 9 mo.) were ranked by BW, randomly allocated to one of 8 pens and fed two levels of RUP (26.5 vs. 44 % of CP) and two types of supplement form (meal and pressed blocks). Bermudagrass Hay (13.1% CP) was offered free choice and supplements were fed at 1.5 kg DM/hd/d. Blood samples were collected on d 21 and 63. Intake was not affected by treatments. Steer ADG (0.67 0.05 kg) did not respond to RUP or form. BUN was lowered with RUP (14.1 vs. 12.1 mg/ dl; P < 0.01). A trend for interaction between RUP levels and form was also observed. Despite indications that RUP improved nutrient metabolism of cattle fed high fiber hay, animal performance was not affected.

Key Words: Protein supplementation, Fiber, Growing steers

98 Effects of ammonia load on methionine utilization in growing steers limit-fed soybean hull-based diets. M. S. Awawdeh*, E. C. Titgemeyer, K. C. Candler, and D. P. Gnad, *Kansas State University, Manhattan*.

Six ruminally cannulated Holstein steers (203 kg BW) housed in metabolism crates were used in a 6x6 Latin square to study effects of rumen ammonia load on methionine (Met) utilization. Steers were fed the basal diet (83% soybean hulls, 8% wheat straw, and 0.3% urea) twice daily at 2.5 kg DM/d. Periods were 6 d, with 2 d for adaptation and 4 d for fecal and urine collection to determine N retention. Treatments were arranged as a 3x2 factorial and were continuously infused into the rumen (0, 40, or 80 g/d urea to supply ammonia load) and into the abomasum (2 or 5 g/d Met). Basal ruminal infusions contained 200 g/d acetate, 200 g/d propionate, and 50 g/d butyrate to provide energy without increasing microbial protein supply. Basal abomasal infusions contained: a mixture (255 g/d) of all essential amino acids except Met, 10 mg/d vitamin B-6, 10 mg/d folate, 0.1 mg/d vitamin B-12, and 300 g/d glucose. Rumen ammonia concentrations were 4.5, 21.5, and 19.7 mM when 0, 40, and 80 g/d urea were infused, respectively. Urea infusions linearly increased plasma urea (P<0.01) from 4.5 to 7.8 mM for 0 and 80 g/d urea, respectively. Fecal N was similar among treatments. There was no urea x Met interaction for fecal, urine, or retained N. Urea infusions did not (P=0.2) affect retained N (25.2, 23.4, and 25.7 g/d for 0, 40, and 80 g/d urea, respectively), but increased (P<0.01) urine N excretion (48.5, 67.3, and 84.6 g/d for 0, 40, and 80 g/d urea, respectively). Increasing Met from 2 to 5 g/d decreased (P<0.01) urinary N excretion and increased (P<0.01) N retention from 22.0 to 27.5 g/d. Serum insulin and IGF-1 concentrations were similar among all treatments. The efficiencies of deposition of supplemented Met between 2 and 5 g/d were 22.5% and 18.4% when steers received 0 or 80 g/d urea, respectively. In our model, regardless of whether Met was limiting, increasing ammonia load did not impact whole body protein deposition in growing steers. (Supported by NRI Competitive Grants Program/CSREES/USDA, Award No. 2003-35206-12837.)

Key Words: Methionine, Ammonia, Amino acids

Teaching/Undergraduate & Graduate Education

99 A partnership of universities and agri-business for an effective dairy herd management learning experience for undergraduates: the Dairy Challenge. M. Tomaszewski*[1], M. S. Weber Nielsen[2], D. K. Beede[2], D. Thorbahn[3], M. Budine[4], and D. Selner[5], [1]*Texas A&M University, College Station,* [2]*Michigan State University, East Lansing,* [3]*Select Sires, Plain City, OH,* [4]*Cargill Animal Nutrition, Mentone, IN,* [5]*Shawano, WI*.

The North American Intercollegiate Dairy Challenge contest allows undergraduate students to apply knowledge gained in the classroom in an evaluation of the management practices of commercial dairy farms. University faculty partnered with industry representatives to develop the competition. Participants in the Dairy Challenge do the following: 1) visit local dairy farms and gain knowledge of different farms' management practices; 2) evaluate herd records, and utilize knowledge of dairy herd management software and computer presentation tools; 3) critically evaluate dairy herd management practices and make recommendations for improvements; 4) test their speaking, presentation, and problem-solving skills; 5) work as a team to build consensus and tag-team speaking formats; and 6) meet and interact with potential employers from the dairy industry during the contest. Teams of four undergraduate students critically evaluate a commercial dairy farm using herd records, a description of farm operations, and tour of the farm facilities. The farmer answers questions pertaining to management of the farm in a group interview with all teams and in a separate interview with each individual team. Teams give a 20-minute presentation that is scored on the description and assessment of the management practices and recommendations for improvements in management and facilities. Additionally, scoring is based on apparent level of preparation, speaking, presentation skills, and responses to judges' questions. The judges are university specialists and dairy industry professionals. This capstone experience allows students to interact with dairy farmers and representatives from the dairy industry, and expands their knowledge and skills gained during their academic career.

Key Words: Undergraduate, Dairy herd management, Industry

100 Undergraduate research: a win-win proposition. C. M. Wood*, *Virginia Tech*.

Experiential learning is an important component of the undergraduate program in the Animal and Poultry Sciences (APSC) Department at Virginia Tech. Undergraduate research has become an increasingly important facet of that learning. Reasons include: many students are interested in the sciences, specifically veterinary medicine, and they are encouraged to gain such experience; faculty have become more aware of the valuable resource these students represent; and students can earn credit toward their degrees. Undergraduate APSC students become involved in research projects on and off campus via several routes: volunteering in research labs and at the animal units; interning at branch stations throughout Virginia; participating in programs at other universities and institutions; and studying abroad. To earn direct credit for undergraduate research, students must have junior standing and at least a 2.75 GPA. They must take ownership of their project, from planning the design, to conducting the research, to final write up and presentation. Students that do not meet those criteria, but put substantial effort into on-going research projects, can earn independent study credit. All such proposals must meet quality standards before they are approved. In five years (Fall 1998 - Spring 2003), 81 students working with 18 APSC faculty will have earned 157 credits for undergraduate research. Of those students, 18 were non-majors. Projects have ranged from botanicals in poultry feed to conformation analysis in horses. Students have presented the results of their research projects at regional and national meetings. One student will present results in Europe this summer. At least 40 of the 81 have continued on to graduate or professional school. Involving undergraduates in research conducted by faculty members can be beneficial to both parties. Faculty gain help in conducting research, and can recruit outstanding students into graduate programs. Students learn to apply principles learned in the classroom, gain valuable work experience, obtain a wider exposure to career possibilities; and often get a jump start in graduate school.

Key Words: Research, Undergraduate education

101 Biotechnology for the animal science classroom - Development of an inquiry-based curricula for undergraduate and graduate students. S. T. Willard*, T. R. Smith, and P. L. Ryan, *Mississippi State University, Mississippi State, MS*.

The objective of this educational program was to develop a pilot course to instruct graduate and undergraduate students on the theories and practices behind laboratory-based biotechnological procedures. A course was created under the "Special Topics" option to accommodate both graduate (n = 6) and junior/senior level undergraduate (n = 6) students as a split-level course. Graduate students were randomly paired with an undergraduate student as laboratory partners. The six laboratories consisted of (I) Restriction Digest of DNA, (II) DNA Fingerprinting, (III) PCR, (IV) Protein Fingerprinting, (V) Bacterial Transformation and (VI) an Immunocytochemistry laboratory. After each module,

students were asked to complete a laboratory report and an evaluation form to assess usefulness of the lecture and laboratory material, and to evaluate the working relationship between graduate and undergraduate students. Evaluations were conducted based on a 1 to 5 scale (1 = Strongly Disagree and 5 = Strongly Agree), and were analyzed to ascertain differences between modules and graduate versus undergraduate student respondents. At the conclusion of the course, a final overall course evaluation was conducted to assess student perceptions of the course as a whole. The overall course evaluation revealed that the students felt the course was relevant to the animal sciences (4.3 ± 0.14), the lecture and laboratory materials complimented one another (4.3 ± 0.13), that they learned a lot from the course (4.1 ± 0.23), and that what they learned would be useful later in life (4.2 ± 0.17). There were no cases where undergraduate students and graduate students differed across scoring categories (Agree vs. Disagree) on the individual modules or the overall course evaluations. Students agreed that pairing graduate with undergraduate students was beneficial (3.9 ± 0.26), and agreed that they worked well with their laboratory partner (3.8 ± 0.33). However, most disagreed that this type of course should be mandatory at the undergraduate level (2.8 ± 0.31). In summary, both undergraduate and graduate students agreed that this type of course was beneficial and complimented their current academic programs. [This study was supported, in part, by a William White Special Projects grant].

Key Words: Teaching, Biotechnology, Science education

102 Adding value to education: an undergraduate animal sciences internship program. K. E. Fike* and A. K. Lahmers, *The Ohio State University*.

Internship experiences became a required component of the undergraduate curriculum in the College of Food, Agricultural and Environmental Sciences at The Ohio State University in 1998. With approximately 450 undergraduate students in the Department of Animal Sciences, a structured and centrally-coordinated internship program was developed to: 1) facilitate the development of new internship opportunities for students, 2) incorporate a more substantial preparation and evaluation component to the internship experience, 3) facilitate ease of management by academic advisors, and 4) enhance the career development of students. Students are required to complete 200 to 400 work hours in an advisor-approved internship experience for 3 to 5 credit hours, graded satisfactory/unsatisfactoy. Upon completion of the internship, students are required to present their internship experience to students, faculty, and staff at a quarterly Internship Forum. During the fall of 2002, approximately 75 students presented their experiences at the Internship Forum in areas ranging from avian research to dairy nutrition to emergency veterinary medicine. Internship job descriptions and supervisor contact information are maintained within the Department's Student Advising Center and student-initiated internship contacts are available for use by other students evaluating internship opportunities. Weekly emails provide students and advisors current information on available positions and application information. The Department's Student Services Coordinator assists students with internship searches, resume and cover letter development, interview and job search skills, and career planning. Preliminary observations indicate that participation in the Internship Forum has facilitated increased awareness, by students and advisors alike, of the variety of career opportunities available for Animal Sciences majors. Students also gain valuable communication experience through development and presentation of their internship experience to faculty and fellow students.

Key Words: Internship, Career, Teaching

103 Experiential learning through a short-term dairy internship program. A. Ahmadzadeh*[1], M. A. McGuire[1], and R. Hatch[2], [1]*University of Idaho, Moscow,* [2]*Kowz R Us Dairy, Castleford, ID*.

Experiential learning is essential in preparing future graduates to advance knowledge and technology. The objective of this five-day course is to enhance students' learning experience in dairy management. To accomplish this objective we developed this program to enhance student knowledge, communication skills, and hands-on experience to better prepare them for the challenging dairy industry. This one-credit short-internship course is designed to expose animal and dairy science lower classman to modern dairy facilities, management strategies and practices of a dairy herd, and to allow them to interact with herd health veterinarians and representatives of allied dairy industry. During the five-day period, students: a) tour several progressive dairy farms, a feed mill, and a dairy processing plant; b) work for two days on separate dairy farms and become intimately involved with all aspects on daily activities of a dairy (e.g. artificial insemination, balancing feed rations, assisting with animal treatments); c) travel with a representative of allied dairy industry (e.g. nutritionists, technical service personnel); and d) spend one day with a herd-health veterinarian and review all aspects of the herd health program while assisting the veterinarian. Furthermore, there are two evenings of round table discussion to share experiences and challenge students about the dairy industry. All students are required to submit a report after completion of the internship in order to earn the credit. This course provides students with the means to apply, analyze, synthesize and evaluate the knowledge they construct in the context of real-world situations. The project utilizes cognitive methods, which merge students into authentic practices through activity and social interaction in a way similar that of learning by craft apprenticeship.

Key Words: Dairy education, Experiential learning, Partnership

104 Recent advances in animal welfare: a Purdue-Michigan State long distance video course. E. A. Pajor*[1] and A. J. Zanella[2], [1]*Purdue University,* [2]*Michigan State University*.

The field of animal welfare includes various scientific disciplines. Graduate courses in animal welfare that reflect its interdisciplinary nature and expose students to the latest scientific advances are lacking. In order to address this deficit we have developed the first long distance, multidisciplinary, multi-instructional course for senior undergraduates and graduate students at Purdue and Michigan State University. Multiple lecturers allowed us to take advantage of the expertise available at both universities. Lecturers addressed a variety of issues relevant to animal welfare including, animal ethics, physiology, cognition, companion animal issues, euthanasia, and economics. Lectures originated at Purdue or MSU and were video-linked to the partner university. This course was offered as a 2 credit course and consisted of a 1-h lecture and 1-h discussion of a recent scientific paper Course objectives included; a) developing an understanding of the intricacies associated with animal welfare science b) introducing students to the ethical issues associated with animal use and c) developing skill to critically evaluate the scientific literature as well as their own research in animal welfare. Evaluation included a midterm and a final examination. Students also submitted a written evaluation of each week's assigned paper and were awarded a significant number of points for their contribution to the weekly discussion. In addition, students prepared a term paper and gave a presentation based on their term paper or their graduate research project at a joint meeting at MSU during the last week of class. Student evaluations of the course at both institutions were fairly positive with all students encouraging the course organizers to offer the course again. Criticisms of the course included concerns over the effectiveness of distance learning and a desire to have met the students at the partner universities at least twice, at the beginning and the end of term.

Key Words: Distance education, Animal welfare, Teaching

105 Animal welfare judging: multimedia training material. D. R. Hains* and E. A. Pajor, *Purdue University*.

The welfare of farm animals is an issue of increasing societal concern. Training students in the objective assessment of animal welfare should be a goal of animal science departments. Using the traditional animal science livestock judging team as a model, the animal welfare judging teams have recently been developed (Heleski et al., 2001). In order to help teams comprehend animal welfare concepts and to prepare for competition we have developed a) a series of computer-based educational modules b) reading lists, and c) other animal welfare orientation activities. There are presently 6 modules in the computer based training package. The first is an introduction to the basic concepts and definitions used in the field of animal welfare. The next 5 modules are species specific covering swine, dairy, equine, poultry and beef cattle. Each module provides an overview of animal welfare related recommendations, indicators and issues associated with each of the various production stages, specific to that species. In order to clarify behavioral indicators of stress, Quick Time video clips have been integrated within the power point presentation. Examples include such abnormal behaviors as tongue rolling in cattle, cribbing in horses, bar biting in swine and feather pecking in poultry. Other topics within each species module

include transportation, handling, facility management and euthanasia. After each module is completed, students can assess a question set that can be used to evaluate their comprehension. In addition a list of discussion points is also provided. Within each species module, a sample scenario is included to allow students to practice evaluating welfare. After each scenario, an example of an oral presentation of welfare assessment "reasons" is provided using quick time video. Students are also given a set of seminal papers on animal welfare and behavior as well as a reference bibliography and a glossary of terms. As a final educational activity students visit the Purdue research farm and assess the welfare all major farm animal species.

Key Words: Animal welfare, Judging team, Behavior

106 Performance and cognitive level of questions asked by rural and urban students in a beginning Animal Science course. E. A. Buescher* and D. R. Brink, *University of Nebraska-Lincoln*.

Animal Science departments are seeing an increase in urban student and a decrease in rural student enrollment. This provides a challenge for educators to reach students at both levels of animal agriculture knowledge. For two months (24 class periods) we have observed and evaluated the questions students (n=67) asked in Animal Management 250. We were interested in the cognitive level and performance on the final examination as related to student's background and experience in the animal industry. Each class period students were chosen at random to ask a question and it was recorded and evaluated using Blooms Taxonomy. Cognitive level of the questions was then compared with individual performance in the class and how it related to their peers from urban or rural backgrounds. A survey was distributed to obtain the demographics of the students along with the extent of their agriculture background. Rural students (n=45) and urban students (n=22) received approximately the same grade on the short answer part of the final exam. The average level of question asked was 2.6, indicating student's questions were between the comprehension and application levels of Blooms Taxonomy. No difference in the cognitive level of questions asked by urban or rural students was observed. Students indicated knowing they may be asked a question helped them stay more alert in class (average = 4.0) on a scale where 5=strongly agree, 3=no opinion, and 1=strongly disagree. Students that asked higher level questions scored higher on the final exam (r=.56). Sixty-six percent of the students said they prepared more for class, because they may be asked a question. In conclusion, students that asked higher level questions scored higher on the final exam. Students indicated they prepared more for class, because they may be asked to provide a question. Animal agriculture background did not influence class performance or cognitive level of questions students asked.

Key Words: Cognitive, Question, Background

107 Heptachlor contamination of Oahu's fluid milk supply: A case study to teach contemporary ethical issues to undergraduate animal science majors. D. Vincent*, *University of Hawaii, Honolulu*.

A course with a focus on contemporary ethical issues is a new requirement for all undergraduates at the University of Hawaii. Use of case study methods is encouraged to expose students to these issues. Cases can be used in discussion, in small groups and in role-playing to expose students to current issues in animal agriculture and assist in developing critical thinking skills. The 1982 contamination of the Oahu fluid milk supply with the PCB pesticide, heptachlor is an excellent case for introductory students. In 1981, ensiled pineapple "green chop" (tops of the pineapple plants after fruit were harvested), contaminated with heptachlor, was fed to Oahu's dairy cattle as a low cost alternative feed. Feeding green chop resulted in contaminated milk being sold to consumers from both of Oahu's milk processors. The Hawaii State Department of Health (HDOH), in routine screening of milk in January 1982, discovered Heptachlor epoxide (HE) contamination of the milk supply. HDOH continued to permit sale of dairy products while waiting for verification of results and internal efforts to reduce the HE levels until March 1982, when homogenized milk supplies were pulled from grocery shelves. This was the first of many recalls of dairy products from store shelves and a near complete loss of confidence in the HDOH's ability to protect the public health. Cows could not be slaughtered and dairy farmers were forced to "milk" the HE out of the cows in order to reach EPA action levels. On some dairies, it took over 12 months before processors would accept milk. Following the contamination, high levels of HE were discovered in human breast milk. The contamination resulted in political scandal, a large class-action lawsuit, dairy bankruptcies and a continuing concern about the long-term health effects of exposure to HE in Oahu's population. The case illustrates a situation where animal scientists were called upon to assist the local dairy industry to find alternative feeds. However, when problems arose, unethical behavior on the part of several critical individuals resulted in the compounding of the problem to the detriment and distrust of a "wholesome" product and created public health fears and uncertainty among Oahu's milk drinking consumers.

Key Words: Heptachlor epoxide contamination, Case study, Dairy

Animal Health Symposium: Laminitis in dairy cattle

108 Subclinical laminitis, or not? The aetiology and early pathogenesis of sole and white line lesions in dairy heifers. A. J. F. Webster* and J. F. Tarlton, *University of Bristol, Langford, Bristol BS405DU, UK*.

The existence of the condition known as acute laminitis in cattle, and associated with improper feeding, especially of starchy concentrates, is not in dispute. The chronic condition variously called aseptic pododermatitis or subclinical laminitis, featuring haemorrhagic lesions of the sole and white line (SWLL), has a more complex aetiology. The major risk factors are phenotype, physical environment, diet, season and stage of lactation. The main predisposing factors may be described mechanistically as direct strains and stresses within the foot, disorders of rumen function, and physiological changes inherently associated with parturition and the onset of lactation.

At this conference, Bill Stone will review the importance of disorders of rumen function. Christoph Lischer will present anatomical evidence to describe the changes within the internal structures of the foot that accompany and precede the superficial sole lesions of aseptic pododermatitis. Our paper will describe the pathogenesis of SWLL in dairy heifers around the time of parturition and the first 6 months of lactation, and review the extent to which these are determined by housing type, nutritional changes accompanying the onset of lactation, and/or the physiological consequences of parturition and lactation per se.

In our studies SWLL appeared in nearly all heifers within 4 weeks of calving. Their subsequent development and severity were influenced both by diet and housing. The incidence of severe SWLL (i.e. sole ulcers) was greatly reduced by housing heifers in straw yards rather than cubicles for 12 weeks following calving. Movement into cubicles thereafter did not cause foot damage. This is consistent with the hypothesis that physiological events associated with parturition and the onset of lactation are an inevitable but transitory high risk factor for SWLL.

We have measured biochemical and biomechanical properties of the connective tissue attaching the third phalanx (P3) to the laminated wall of the hoof. Biomechanical changes occurring in early lactation include an increase in laxity permitting increased movement of P3.

109 Environmental influences on laminitis and Sub-Acute Ruminal Acidosis (SARA) in dairy cows. N. B Cook* and K. Nordlund, *University of Wisconsin-Madison, School of Veterinary Medicine*.

Sub-acute ruminal acidosis (SARA), and hormonal changes occurring around parturition, have been suggested as trigger factors for bovine laminitis. This paper will review the environmental risk factors present on North American dairy herds, which may influence the onset of SARA, contribute to the changes in claw architecture observed around parturition, and significantly impact cow behavior and resultant claw lesions and lameness.

The mean prevalence of lameness measured on 30 well managed Wisconsin dairy herds using a system of locomotion scoring was 22.5%. The lameness treatment rate for a sub-sample of 10 herds averaged 69.1 foot

treatments per 100 cows per year, with a range from 15.1 to 132.7. Lesions typically associated with laminitis were responsible for 34% of foot treatments, with the remainder due to infectious causes.
Existing data regarding the significance of risk factors such as overcrowding, limited access to feed, heat stress, exposure to concrete, stall usage and pen design will be reviewed. New data from two surveys of lameness on well managed Wisconsin dairy farms will be presented, demonstrating significant differences in lameness prevalence between different housing systems and different stall surfaces.
Preliminary cow behavior and locomotion scoring data from current research conducted on herds utilizing freestall housing, using 2 or 3 row pen designs, and either sand or a rubber crumb filled mattress stall surface will be presented, which will test the working hypothesis that the environment in which we place the cow is the final determinant of the prevalence of lameness and laminitis on the farm.

Key Words: Lameness, Laminitis, Environment

110 Nutritional approaches to minimize subacute ruminal acidosis in dairy cattle.

W. C. Stone*, [1]*Cornell University Ithaca, NY.*

Subacute ruminal acidosis (SARA) is very costly to the United States dairy industry. Reduced ruminal efficiency, liver and lung abscesses, and laminitis are all thought to be related to SARA. Both the nutritionist and the dairy's management are responsible for the delivery and consumption of a ration that is likely to be ruminally pH healthy. Nutritionists should consider the expected amount of physically effective NDF provided by ration ingredients, along with their expected ruminal fermentabilities and resultant microbial acid production. Environmental conditions, such as heat stress, over-crowding, and uncomfortable stalls, which may alter feed intake patterns and animal behavior should also be considered in ration formulation. Additional physically effective NDF, and/or a reduction in ruminal NSC availability, may well be warranted during times of increased animal stress. Higher levels of intake may also predispose the rumen to SARA, since buffer production may not adequately compensate for additional acid production. The addition of dietary buffers, biotin, and organic zinc may also aid in reducing acidosis and laminitis. Dairy managers and feeders are responsible for delivering the formulated ration. Forage dry matters should be taken biweekly, or more frequently if results vary by more than five percent of the DM value. Ration variability can be further reduced by premixing individual forages, or at least attempting to make each loader bucket of feed a uniform mix obtained from the entire height of the silo. Dairies should consider investing in electronic feed recording systems. These systems record the precision of ration manufacture by the feeder, and foster the development of healthy competition among feeders, resulting in enhanced mixing accuracy. Ingredient sequencing and mixing time should be standardized on a given dairy. Techniques to minimize sorting, including frequent feed pushups, the addition of water or a low dry matter byproduct, and appropriate forage processing, should be adopted by managers.

Key Words: SARA, Laminitis, Dairy cattle

111 Biomechanical aspects of the pathogenesis of claw horn disruptions in dairy cattle.

C. Lischer*[1], K. Nuss[2], S. Nacambo[2], S. Meyer[2], and P. Ossent[3], [1]*Equine Clinic, University of Zurich,* [2]*Farm Animal Clinic, University of Zurich,* [3]*Institute of Veterinary Pathology, University of Zurich.*

Despite intensive study, knowledge of the precise aetiology and pathogenesis of bovine laminitis is still incomplete. It is often hypothesized that changes in the microcirculation of the corium (dermis) of the bovine claw contribute significantly to the development of laminitis. The cause of laminitis should be considered as a combination of predisposing factors leading to vascular reactivity and inhibition of normal horn synthesis. Nutrition, disease, management and behaviour appear to be closely involved in the pathogenesis of bovine laminitis. The only consistent feature in chronic laminitis is the sinkage of the pedal bone that compresses the corium in the sole and heel. However, the relationship between the development of these lesions and the anatomical structures of the distal phalanx or the supportive heel cushion under the bone are unclear. These structures were therefore examined in 19 cows with an ulcer at the typical site. There was a direct relationship between displacement of the third phalanx and ulceration of the sole or heel; the third phalanx had dropped in all the ulcerated claws and the corium and the subcutis under the bone were thinner than in the controls. The supportive cushions of the ulcer group contained less fat tissue. There was no histological evidence of damage to the epidermis or the corio-epidermal junction in the ulcerated claws nor were the lamellae elongated. Similarly, there were no morphological alterations in the connective tissue layer (submural dermis). The lack of support for the theory that the separation of tissue layers at the laminar interface is an essential requirement for the third phalanx to sink leaves the only alternative explanation; the properties of the connective tissue of the suspensory apparatus must have undergone a change that resulted in excessive flexibility of the dermal segment. Details on the biochemistry of the connective tissue of the suspensory apparatus are presented by Webster and Tarlton at this conference.

Key Words: Laminitis, Dairy cattle, Claw horn disruption

112 Monitoring techniques to minimize laminitis.

K. V. Nordlund* and N. B. Cook, *University of Wisconsin-Madison, School of Veterinary Medicine.*

Lameness in dairy cows includes many disease conditions caused by a wide variety of infectious, nutritional, traumatic, genetic, housing, and behavioral factors. Laminitis and its sequelae are the most common conditions in several surveys of dairy cow lameness. While laminitis is a multi-factorial disease, many dairy operators and advisors focus prematurely on ruminal acidosis as a primary cause. Accordingly, nutritionists frequently find themselves in a default defensive position while servicing herds with lameness problems. In the last decade, a variety of practical field tools have been developed that can differentiate lameness conditions in a specific herd and identify primary risk factors.
Lameness prevalence can be quantified using a modification of a published lameness scoring system. Entire herds can be scored quite easily as they walk access lanes. Hoof health record systems have improved and are used by many professional hoof trimmers, which has made it easier to monitor the prevalence of digital dermatitis, laminitis, and other conditions. If laminitis is a herd problem, the primary risk factors of subacute ruminal acidosis (SARA), excess standing time on concrete, and replacement heifer management should be evaluated.
Stall usage indexes are being developed to estimate time spent lying down in stalls. Recent research is providing information on factors related to freestall design which influence lying time. Time in holding areas and parlors can be assessed, with an emphasis on the longest times for the last individual cows to come through the parlor.
Field tests for ruminal acidosis have emerged to compliment ration analyses. Rumenocentesis is a direct measure that provides diagnostic information when adequate samples are collected. Visual evaluations of washed screened feces provide useful information about rumen passage rates. Production records, combined with clinical signs of SARA such as diarrhea, irregular and reduced dry matter intake, laminitis, multifocal hepatic and pulmonary abscess, and hemoptysis or epistaxis, can provide useful diagnostic information.

Key Words: Laminitis, Ruminal, Acidosis

Food Safety Symposium: Emergence of antimicrobial resistance and implications to animal agriculture

113 Epidemiological principles relating to the study of antimicrobial resistance in animal agriculture.

Randall Singer*, *University of Illinois, Urbana, IL.*

The emergence and spread of antimicrobial resistance among bacterial populations has major health and economic consequences in both human and animal populations. Of particular concern is the impact of animal agricultural antimicrobial use on human health. Understanding the epidemiology and ecology of antimicrobial resistance and finding solutions to counter this problem will be difficult, primarily due to the complexity of the issue. The purpose of this presentation is to highlight key epidemiological principles that are often overlooked and always problematic in antimicrobial resistance studies. One key epidemiological principle that must be considered is the background level of antimicrobial resistance. For example, to state that a certain antimicrobial use causes changes in

antimicrobial resistance, we must estimate the level of resistance in the absence of this use. Another difficulty in comprehending antimicrobial resistance relates to the diversity of ways in which antimicrobial resistance can be defined. Elevated MIC of the bacterial isolate, presence of a resistance gene in the bacterial isolate, or presence of a resistance gene in the total community DNA of the sample have all been used as resistance definitions and each necessitates a different study design and warrants different conclusions. Implicit in the methods of epidemiology is the ability to describe and predict distributions, trends and patterns; these methods can be problematic in relation to antimicrobial resistance. One difficulty is determining whether fluctuations are due to real changes in the prevalence of resistance mechanisms or simply due to changes in the prevalence of a single resistant bacterial clone. Assessing trends is also made more difficult by the presence of genetic linkages, thus enabling genes that are not under selection pressure to persist or even increase in prevalence. In conclusion, there are many factors that can dramatically affect antimicrobial resistance investigations and their inferences made from these studies. Research into the effects that these factors have on perceived outcomes and the means by which these factors can be controlled is essential if we are to make accurate inferences about the dynamics of antimicrobial resistance.

Key Words: Antimicrobial resistance, Epidemiology, Molecular

114 Transfer of antibiotic resistance genes from farm animals to man - how likely, how dangerous? A. A. Salyers*, *University of Illinois, Urbana, IL*.

A safety issue that has been central to the debate over agricultural use of antibiotics has been the possibility that antibiotic-resistant bacteria or antibiotic-resistance genes would move through the food supply and into the human intestine. A number of studies have shown that bacteria from the intestines of animals are unlikely to be able to colonize the human intestine and would persist only transiently in that site. Transfer of resistance genes, however, is more likely and thus more problematic. The concern is that resistance genes could move into human intestinal bacteria that persist in the human colon for years and are capable under some conditions of causing human disease. Most of the literature on the movement of resistance genes through the food supply and into the human intestine has focused on bacteria such as *E. coli* or *Enterococcus* sp., which are minor components of the human colonic microbiota, accounting for <1% of bacteria in the colon. The more numerous species such as *Bacteroides* species or the Gram-positive anaerobes, which account for 25% and >70%, respectively, of colonic bacteria are the species most likely to encounter incoming bacteria and acquire genes from them. The colonic anaerobes are opportunistic human pathogens that can cause disease if they escape from the colon, e.g., during surgery or trauma to the abdominal area, and enter blood or tissue. A recent survey of *Bacteroides* isolates revealed that a surprising amount of horizontal gene transfer takes place among *Bacteroides* strains in the colon. The gene transfer elements most often involved in these resistance gene transfer events were conjugative transposons, a type of conjugal elements that has not received much attention until recently. Another more recent survey has revealed two new conjugative transposons that may have entered *Bacteroides* species from Gram-positive bacteria. Thus, results obtained to date support the hypothesis that there are few, if any, limits on resistance gene transfer among colonic bacteria. Although these transfers appear to have occurred relatively recently, in most cases the genes are expressed in their new hosts. These studies have provided information about the movement of DNA into one group of colon bacteria, *Bacteroides* species. Nothing is known about gene transfer elements of the Gram-positive anaerobes, the other major group of colonic bacteria.

Key Words: Antimicrobial resistance, Food safety, Bacteria

115 Antimicrobial use in food animals and the search for potential alternatives. K. M. Bischoff*, T. R. Callaway, T. S. Edrington, T. L. Crippen, and D. J. Nisbet, *USDA-ARS, Food and Feed Safety Research Unit, College Station, TX*.

Antimicrobials have been used for over fifty years in food animal production to maintain herd health and to increase productivity. But the resulting increase in antimicrobial resistance among enteric bacteria has created two principal concerns: 1) the emergence of drug-resistant pathogens leaves the producer with fewer tools to manage disease, and 2) a reservoir of antimicrobial-resistant bacteria has the potential for transmission to humans via the food chain. The most logical intervention strategy to combat the increase in antimicrobial resistance is to reduce the selection pressure. Prevention and control measures seek to promote prudent use of antimicrobial drugs through educational programs and to limit the availability of antimicrobials through regulatory actions. But such measures may not be sufficient to reduce the prevalence of resistance, as linkages of resistance genes allow the selection pressure of a single antimicrobial to co-select for resistance to multiple agents. Thus, simultaneous reductions in the selection pressures of all co-selecting agents may be required to reverse the persistence of antimicrobial resistance in the animal production environment. This necessitates the development of alternative, non-antimicrobial methods to maintain animal health and productivity. Some of the products currently under development include the following: 1) chlorate, to reduce certain populations of the family Enterobacteriaceae in the gut, including *Escherichia coli* O157:H7 and *Salmonella*; 2) immune modulators, to protect against infection through preventive activation of the innate immune system; and 3) competitive exclusion cultures, to prevent gut colonization with pathogens by first treating the gastrointestinal tract of neonates with healthy gut microflora. The application of alternative pathogen control measures will decrease the total usage of antimicrobial drugs and will likely have the greatest impact on reduction of antimicrobial resistance among enteric bacteria in food animals.

Key Words: Antimicrobial resistance, Food safety, Animal health

116 Antimicrobial resistance in commensal and pathogenic bacteria from swine and their implications for the swine industry. J. T. Gray* and P. J. Fedorka-Cray, *USDA-ARS, Antimicrobial Resistance Research Unit, Athens, GA*.

Resistance to antimicrobials is an increasingly common problem in both veterinary and human medicine and its management is the subject of an important debate. Considering antimicrobial resistance on a broad scale, across an entire industry, can be a complex and daunting task. However, to consider all antimicrobials, all bacteria and all antimicrobial use as respective equals, creates a skewed view of the problem. Therefore a more systematic approach is warranted. The development of antimicrobial resistance in swine pathogens, which can have a direct impact on the health and well being of the animals as well as on production costs, is important to consider. Antimicrobial resistance in zoonotic pathogens is an important occurrence identified worldwide and the industry has a role in the control of these organisms. Additionally, development of antimicrobial resistance in commensal organisms may play an important role in the ecology of resistance overall, thus cannot be ignored. The antimicrobial resistance problem has a broad landscape, however it is important to understand why an organism has become resistant and consider the consequences of the particular antimicrobial resistance. Programs that are in place to answer these questions will be explored as well as a presentation of data resulting from some of these programs. Antimicrobial resistance has had some important impacts on animal production industries, including the swine industry. The swine industry has put forth important efforts to understand antimicrobial resistance in its production systems. With the wide reaching impact of this problem, it is important that efforts to understand and control antimicrobial resistance in all organisms and host species are refined and continued.

Key Words: Antimicrobial resistance, Swine, Bacteria

International Animal Agriculture Symposium: Sustainable animal agriculture, national and international prospective

117 A global overview of sustainability in animal agriculture systems. C. de Haan*, *World Bank*.

The strongly increasing demand for animal products in developing countries presents exciting opportunities, but also serious challenges to the socio-economic and environmental sustainability of four main global animal agriculture production systems. This paper will argue that in those systems, the policy and institutional framework will largely define the sustainability of the technology being adopted. In arid range lands, institutional failures in the management of resource access, climatic variability and markets, are serious threats, but new forms of risk management and enhanced integration of animal agriculture with environmental services, offers interesting opportunities, as will be shown in the paper by examples from East Africa. In smallholder mixed farming, animal agriculture is a key contributor to sustainable nutrient and energy flows of about 100 million smallholdings, but labor productivity and land tenure are key conditions for long term sustainability of those systems, as will be demonstrated in the paper by the example of smallholder dairy in India. Animal agriculture is a serious threat to some of the worlds most valuable ecosystems in the humid savannahs and tropical rainforests, but innovative systems for payment of environmental services can result in "win-win" situations, as demonstrated by the increase in income and contribution to bio-diversity conservation and global climate change on small ranches in Central America. Finally, probably the most serious threat to environmental sustainability is nutrient loading of land and water, caused by emerging large scale intensive production units, favored by skewed incentive systems and poorly enforced zoning regulations. Different policy instruments, being developed in East Asia, will be presented to "level the incentive playing field" between small holders and large scale farmers, and arrive a more sustainable spatial distribution of these units.

Key Words: Global livestock systems, Sustainability, Policies and technologies

118 Is rangeland agriculture sustainable?. R. K. Heitschmidt*, L. T. Vermeire, and E. E. Grings, *USDA-ARS, Fort Keogh LARRL, Miles City MT*.

Agricultural enterprise sustainability is most often assessed by examining long-term ecological sustainability, short- and long-term economic viability, and social acceptance. From an ecological perspective, rangeland agriculture (i.e., managed grazing) is deemed fully sustainable providing the rangeland resource is sustained. This is because grazing is a natural ecological process that has impacted the evolutionary history of all natural ecosystems. Because the magnitude of the evolutionary impacts of grazing by large herbivores varied greatly among ecosystems, sustainable levels of livestock use vary greatly, and, in turn, alter levels of ecological and economic risks. These risks can be diminished by the infusion of exogenous energies, primarily fossil fuels, into the system, but the long-term economics of this strategy are questionable. The sustainability of rangeland agriculture is further challenged by economically viable alternative uses of rangelands (e.g., expansion of suburbia, ranchettes, single use recreation, etc.) and economics of scale with low diversity, medium-sized ranching enterprises facing the greatest challenges. The challenges associated with social acceptance of rangeland agriculture also continue to increase as various factions of society vigorously oppose rangeland agriculture, particularly on Western U.S. public lands. Some view this position as largely driven by emotion, but in reality it is simply a reflection of differing value systems. Thus, we doubt this position will be abandoned in the near future and, as a result, a shift in the geographical span of rangeland agriculture across the U.S. may occur. However, this conclusion may become folly if the cost of fossil fuels increased to a level whereby substitute feeding of grains would become cost prohibitive, thereby encouraging a return to more "natural" animal production systems that rely largely on grazing of rangeland ecosystems.

Key Words: Ecology, Economics, Grazing

119 Contribution of animal agriculture to sustainable systems. E.R. Orskov, *Macaulay Institute*.

The contribution of animals to sustainable agriculture is discussed with emphasis on the animal in their natural interactions with soil and plants. The separation of animals in particular ruminants from this interaction in many countries is not sustainable and lead to poor resource management i.e. manure becomes a waste product rather than a resource and crop residues in arable areas with no animals become poorly utilised. Examples of animal production systems in positive interaction with plants and soil will be illustrated as well as animals contributing to the many diverse animal products which must be considered in the context. On a global scale the animal contribution to security is probably the largest product. Sustainable agriculture, Animal contribution

120 Sustainable animal agriculture: Economic perspectives. M. Garcia-Winder*, *Inter-american Institute for Cooperation in Agriculture, Costa Rica*.

Livestock production is an important component of the rural sector in the developing countries. Its importance goes beyond the traditional concept of economic/financial gains. It is estimated that over one sixth of all international agricultural trade is accounted by trade of livestock and livestock products. The pressure to liberalize world trade is producing dramatic changes in the way livestock production takes place as industrialized countries continue to use excessive amounts of subsidies, less developed countries are forced to find alternatives for their animal production systems. The most notable changes will be brought about by the need to comply with international agreements, pressure to preserve and improve the environment, and pressure from consumers. As consequence the development of economically, socially and environmentally sustainable production systems will be based in exploiting local comparative advantages.

Key Words: Sustainable animal agriculture, Economics

121 Redirecting government policies to ensure agricultural sustainability. J. Ikerd*, *University of Missouri*.

American agriculture is in crisis. Without current farm subsidies, which are among the largest in the world, the financial situation today would be no better than during the farm financial crisis of the 1980s. The Farm Security and Rural Investment Act of 2002 does little more than formalize the annual "emergency bail out" process of the failed Freedom to Farm Act. The "lions share" of subsidies and benefits will continue to go to wealthy landowners and corporate agribusiness, not to family farmers.

Current U.S. farm and agricultural trade policies are based on the faulty assumption that American farmers can compete in a global free market. In fact, U.S. farmers have lost their global competitive advantage. Land and labor costs are far lower in other major agricultural areas of the world and are likely to remain so. Agribusiness corporations are shifting their capital and production technology to those areas. Current farm policies, coupled with global free trade policies, could mean the end of American agriculture, thus threatening American's food security.

Thankfully, a different philosophy of farming is emerging in response to the growing economic, ecological, and social problems arising from the industrial agricultural paradigm. Thousands of farmers, calling themselves organic, holistic, practical, or just family farmers, are creating "the new American farm." New livestock producers may promote their products as grass-fed, free-range, hormone and antibiotic free, or humanely raised. But these farmers are all pursuing approaches to agriculture that are more ecologically sound, economically viable, socially responsible, and thus, more sustainable.

Free markets provide no incentives for farmers to take care of the land, to maintain a rural culture of stewardship, or to provide food security for all, in times of crisis or tranquility. Thus, farm programs should be redirected to encourage these "public benefits", to reward farmers for their contribution to long run food security. Trade policies should be redirected to ensure the rights of all nations to protect their resources and their people from exploitation. American farm and trade policies must be fundamentally changed.

Key Words: Sustainable agriculture, Farm policy, World trade

122 Manipulation of rumen fermentation, microbial population and blood metabolites of Holstein neonatal calves using Yeast Culture as a microbial additive. Behnam Saremi* and Abasali Naserian, *Ferdowsi University of Mashhad, Khorasan, Iran*.

Yeasts have synergism effects on some strains of bacteria and antagonism affects on the others. These days, yeasts such as strains of Saccharomyces cerevisiae are widely used as additives in ruminant nutrition and could alter end products or substrates, which are used by other microorganisms and subsequently alter the feed digestibility. So the objective of this study was to determine if Bakery's yeast product could affect calves rumen fermentation, microbial population, blood metabolites and feed digestibility. Eighteen female Holstein neonatal calves were used in this study and randomly placed on treatments and fed colostrums at 10% of birth weight and milked until 45 days old. All calves were fed calf starter (NRC 2001) containing high quality alfalfa (15%) from seven days of age and weaned at 45 days. Calf starter was offered until 90 days old and the yeast was added at 0, 0.5 and 1% to the calf starter, which was, used daily. Rumen (pH, Ammoniated nitrogen (N-NH3), Microbial population (MP)) and blood samples (Total protein (TP), Glucose (GLS), Blood urinary nitrogen (BUN)) were taken from 0 to 90 days in regular periods. In day 90, feed and feces samples obtained to determine, nutrient digestibility. Data were analyzed using General Linear Model procedures of SAS v6.12 to evaluate differences among experimental groups. The design was completely randomized. Means were compared with Duncan test. Data showed that Yeast culture could not significantly alter protein, NDF, ADF and Ash digestibility, also have no effect on MP, pH, N-NH3 of the rumen. Indeed it couldn't affect TP and GLS in blood plasma. But BUN, Organic matter and Dry matter digestibility were significantly different between treatments ($P \leq 0.05$). Results of this experiment showed that addition of yeast culture to calves starter could improve DM and OM digestibility and also reduced BUN. We suggested that better weight gain and reduced DMI (Data not shown) could be result of better digestibility and the less losses of ammonia in the rumen.

Key Words: Bakery's yeast, Rumen and blood manipulation, Neonatal calves

123 The effects of cottonseed hulls added to diets with and without live yeast or mannanoligosaccharide in Holstein calves. S. R. Hill*, B. A. Hopkins, S. Davidson, S. M. Bolt, C. Brownie, T. Brown, G. B. Huntington, and L. W. Whitlow, *North Carolina State University*.

The objective of this study was to investigate the effects of fiber from cottonseed hulls (CSH) added to the starter and of live yeast (YST) or mannanoligosaccharide (MOS) added to milk, on growth, intake, rumen development, and health parameters in calves. Bull and heifer calves (n=116) were assigned randomly at birth to one of six treatments for 63 d. Calves were dehorned at 42 d. Bulls were elastrated by 14 d. Calves were fed 3.8 L of colostrum once daily for the first 2 d and then 3.8 L of whole milk supplemented with either no additive, 4g YST, or 3g MOS once daily through weaning at 42 d. Treatments included: 1) a corn/soybean meal based starter, 20% CP, 6% ADF (CON), 2) a blend of 85% starter and 15% CSH, 18% CP, 15% ADF (CON + CSH), 3) starter and MOS (CON + MOS), 4) starter with CSH and MOS (CON + CSH + MOS), 5) starter and live yeast (CON + YST), and 6) starter with CSH and live yeast (CON + CSH + YST). Starter diets were offered from 1 d and daily amounts were increased by 0.09 kg when orts were 0 kg. Weekly measurements included body weight (BW), wither height, hip width, and dry matter intake from starters (DMI). Daily measurements included rectal temperatures, fecal, and respiratory scores. Twelve steers (2 per treatment) were sacrificed for rumen tissue samples. Data were analyzed for the main effects of CSH, YST, and MOS. Average DMI was greater for calves consuming CSH diets (0.41 kg) than diets without CSH (0.34 kg). Calves fed CSH treatments (54.9 kg) had greater BW than those fed diets without CSH (53.3 kg) ($P<0.05$). Average daily gain was greater for calves fed CSH diets (0.58 kg/d) than diets without CSH (0.51 kg/d) ($P < 0.05$). However, calves fed diets without CSH had a greater feed efficiency (0.67 kg feed/kg BW gain) than those fed CSH diets (0.73 kg feed/kg BW gain) ($P < 0.05$). There were no significant effects of YST or MOS on DMI, gain, or feed efficiency ($P > 0.05$).

Key Words: Dairy calves, Cottonseed hulls, Yeast

124 Using Controlled Internal Drug Release (CIDR®) inserts for estrus synchronization in dairy heifers. A. K. McLean*, W. M. Graves, R. C. Smith, B. C. Lance, and L. E. Mckee, *University of Georgia, Athens*.

Two experiments were conducted to evaluate using CIDR® inserts for estrus synchronization in dairy heifers. Our objective in Experiment 1 was to compare day 6 versus day 7 prostaglandin $F_{2\alpha}$ injections used with CIDR® inserts (Eazi-Breed™, CIDR®, Pharmacia & UpJohn Company, Kalamazoo, MI) placed intravaginally for seven days. A total of 55 heifers were assigned to two treatment groups. All even numbered heifers were assigned to treatment 1 and received $PGF_{2\alpha}$ (Lutalyse®, Pharmacia & UpJohn Company, Kalamazoo, MI, 5 mg; i.m.) on day 6. Odd numbered heifers were assigned to treatment 2 and received $PGF_{2\alpha}$ on day 7 at the time CIDR® inserts were removed. In Experiment 1, 98.2% of the 55 heifers exhibited signs of estrus and were bred. Pregnancy was determined by rectal palpation on day 35 and 53.7% of the 54 were pregnant. Fifteen out of 26 heifers (57.6%) injected with $PGF_{2\alpha}$ on day 6 and 14 of 28 heifers (50.0%) injected on day 7 were pregnant ($P>.05$). In Experiment 2, our objective was to evaluate using estradiol cypionate (ECP®) or gonadotropin releasing hormone (GnRH) in a timed artificial insemination (TAI) protocol using the CIDR® insert for 7 days followed by $PGF_{2\alpha}$ on day 7. Sixty-nine heifers were randomly assigned to three different treatment groups. In treatment 1, 2 and 3, CIDR®'s were inserted for 7 days followed by removal and injection of $PGF_{2\alpha}$. Heifers in treatment 2 were injected with ECP® (Pharmacia & UpJohn Company, Kalamazoo, MI, 0.5 mg; i.m.) on day 8. Heifers in treatment 3 were injected with GnRH (Factrel®, Fort Dodge Animal Health, Fort Dodge, Iowa, 2 mg; i.m.) on day 9. All heifers were bred by timed artificial insemination (TAI) on day 10. In Experiment 2, 50.7 % of the 69 heifers were pregnant on day 39. A total of 56.5% of 23 heifers timed bred with only CIDR® inserts and $PGF_{2\alpha}$, 45.5% of the 22 injected with ECP®, and 50.0% of the 24 injected with GnRH were pregnant ($P>.05$). In both experiments, a total of 124 CIDR® inserts (100.0%) were retained.

Key Words: CIDR, Estrus synchronization, Dairy heifers

125 Implantation of a pellet containing TGF-β increases BrdU-labeling in mammary stromal cells of prepubertal heifers. S. Musters*, T. McFadden, T. Mulvey, K. Coughlan, R. Maple, and K. Plaut, *University of Vermont, Burlington, VT USA*.

In vitro and *in vivo* studies in mice have shown that transforming growth factor-β (TGF-β) inhibits mammary epithelial cell growth and stimulates proliferation of mammary stromal cells. However no studies have been conducted to measure the effects of exogenous TGF-β1 *in vivo* in cows. Our objective was to determine if TGF-β1 affects mammary epithelial and stromal cell proliferation during mammogenesis in 9 month old heifers (approximately 225 kg body weight). Slow release pellets, containing 5 μg TGF-β1 and 20 mg BSA, were implanted in the parenchyma of the right rear quarter of 4 heifers. A control pellet containing 20 mg of BSA was implanted in the left rear quarter. Bromodeoxyuridine (BrdU), used to measure DNA synthesis, was administered intravenously 4.5, 12 and 22 hours after implantation at a concentration of 2.25 mg/kg body weight. The heifers were slaughtered 24 hours after implantation and the mammary glands were recovered. Tissue samples were taken from an area within 0.6 cm around the pellet, fixed for 4 hours, embedded in paraffin, sectioned and stained for immunohistochemistry with a BrdU monoclonal antibody. Total number of epithelial cells, stromal cells, BrdU-labeled epithelial cells and BrdU-labeled stromal cells was quantified. An average of 3000 epithelial cells and 3000 stromal cells was counted per TGF-β treated and control quarters. Exogenous TGF-β1 increased the percentage of stromal cells in S-phase from 3.3% to 5.8%, approaching significance ($P \leq 0.11$), supporting previous data that TGF-β1 increases DNA synthesis of stromal cells. We observed no significant difference in the percentage of BrdU-labeled epithelial cells for the TGF-β treated tissues in comparison to the control tissues. However the numbers of cells in S-phase were

very low. We conclude that exogenous TGF-β1 increases proliferation of mammary stromal cells in prepubertal heifers.

Key Words: TGF-β, Mammary gland, Proliferation

126 Behaviors of transition dairy cows and heifers.

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Management strategies are critical for a successful transition period and may differ for cows and first calf heifers. The objective of this study was to compare behaviors between transition cows and heifers, emphasizing feeding behaviors and the relationship of these behaviors with DMI and milk yield. Five multiparous Holstein cows (C) and five Holstein heifers approaching first calving (H), were housed in tiestalls from 28d prior to expected calving and provided feed *ad libitum*. The C and H were videotaped 24 h/d, using time-lapse video recording, beginning 15d prior to expected calving until 14d after calving. On d-6, d-2, d2 and d8 relative to actual calving the durations of the following behaviors were measured: standing (S), lying (L), resting (Re), feeding (F), ruminating (R) and ruminating while lying (RL). Daily DMI and postpartum milk yield were recorded. The model selected for analyses included effects of parity group (C and H), day and interactions. There were no significant differences between C and H in L, F or RL. For both parity groups, L ($P<.01$) differed across d and there were d by parity group interactions for F ($P<.05$) and RL ($P<.01$). For all animals, L decreased through d2 and then increased on d8. For C, F decreased through d2 and then increased on d8; while for H, F increased until d-2, decreased at d2 and then increased on d8. Through d2, RL decreased for C and then increased on d8; but for H, RL did not decrease until d2 and then increased on d8. As expected, C had greater milk yield ($P<.05$) and DMI ($P<.01$) than H. Milk yield on d8 was significantly affected by Re on d-6 ($P<.01$). The DMI on d8 was significantly affected by F on d2 ($P<.01$). Behaviors, DMI and milk yield differed for transition C and H, indicating that managing them differently during the transition period may be beneficial.

Key Words: Dairy cattle, Transition, Behavior

127 Relationship of dystocia to dairy cow health and productivity.

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The objectives of this study were to evaluate dystocia rates on Colorado dairies and the subsequent health and production effects on cows. A total of 6,528 calvings were recorded on 3 well-managed Front Range Colorado dairies from October 2001 to October 2002. Each cow was assigned a dystocia score (standard 1 to 5) based on calving ease. Cows were followed for health events, milk production and reproduction parameters that occurred subsequent to the calving event. Data collection will continue until all cows have completed the current lactation or leave the herd for any reason. Odds ratios were calculated for cow health events for animals with no assistance at calving (score 1) compared to animals with any assistance at calving (scores 2 to 5). Productivity parameters were evaluated using a logistic regression analysis. For the regression analysis, animal with dystocia scores of 4 and 5 were collapsed because of the small number of animals within dystocia score 5. The percent of animals requiring assistance was significantly ($P<0.0001$) greater for primiparous animals (53%) than multiparous animals (29%). Cows with any assistance at calving were significantly more likely to receive hypocalcemic therapy (OR, 6.2), experience uterine disease (RFM, metritis, pyometra) (OR=1.7), respiratory disease (OR=1.3), digestive disease (OR=1.2) and death within 2 weeks of calving (OR=2.0). Cumulative milk production at 30 days, milk production to 90 days, projected 305 day production and mature equivalent 305 day production were significantly decreased as dystocia score increased except between scores 3 and 4 ($P<0.05$). Although days in milk at first breeding was significantly increased for dystocia score 4 ($P<0.05$), the number of days open and number of times bred was not significantly different between any of the dystocia score groups. Dystocia was strongly associated with decreased productivity, increased morbidity and increased mortality.

Key Words: Dystocia, Cow health, Cow productivity

128 Effects of grazing fresh forages on milk fat CLA.

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The objective was to determine effects of grazing different forages on concentrations of *cis*-9, *trans*-11 conjugated linoleic acid (CLA) in milk fat of Jersey and Holstein cows. Two treatment groups were utilized for each of three studies: control (C) or pasture (P). Cows on C were fed a total mixed ration (TMR) ad libitum, and P cows were fed pasture and supplemental feed, which was limited to 60% of ad libitum dry matter intake (DMI). In Experiment 1, Holstein and Jersey cows on P grazed ryegrass pasture. Milk samples from each cow were taken at the end of two three-week periods for four consecutive milkings. In Experiment 2, Holstein and Jersey cows on P grazed dwarf hybrid pearl millet pasture. Weekly milk samples were taken at four consecutive milkings for the six-week study. In Experiment 3, Jersey cows on P grazed rye pasture. Weekly milk samples were taken at four consecutive milkings during two five-week periods. Linolenic acid (C18:3) content was higher in P diets compared to C (31% and 4%, respectively). Saturated fatty acid content (C16:0 and C18:0) was higher in C diets than P (51% and 30%, respectively). For all three forages, C18:3 was the fatty acid in highest concentration, ranging from 48% of total fatty acids (TFA) in dwarf hybrid pearl millet, 49% in ryegrass, to 57% in rye. Palmitic (C16:0) and linoleic (C18:2) acids concentrations were each approximately 11% of TFA. DMI from pasture ranged from 54% to 77%. Milk fat CLA as a percentage of TFA were significantly higher for P cows in all experiments. In Experiment 1, milk fat CLA for cows on P was 0.47% of TFA for Holsteins and 0.42% for Jerseys. In Experiment 2, milk fat CLA for cows on P was 0.57% of TFA for Holsteins and 0.45% for Jerseys. In Experiment 3, milk fat CLA for cows on P was 0.44% of TFA. Substitution of fresh forage for a portion of TMR in dairy cows significantly increases CLA concentrations to twice that of the control, as well as differences between Jersey and Holstein breeds. Cows responded similarly to all three forages.

Key Words: Pasture, CLA, Dairy cows

129 Lactation performance and milk fatty acid composition of Holstein cows fed various forms of oleic acid.

J. E. Delahoy*, L. D. Muller, F. Bargo, T. W. Cassidy, and G. F. Schroeder, *The Pennsylvania State University.*

The objective of this study was to evaluate the effects of feeding various forms of oleic acid on dry matter intake, milk yield, and milk fatty acid (FA) content. Twenty-five Holstein cows were paired according to milk yield (50 kg/d), and DIM (85d), and used in a 5 x 5 Latin square design. A control group (CON) was fed a total mixed ration (TMR) with no added fat (17.5% CP, 39% NSC, 33% NDF, 2.9% fat). Four forms of oleic acid were mixed into a TMR to target 400 grams of oleic acid intake/cow/d (18.2% CP, 36% NSC, 32.5% NDF, 5.3% Fat). Fat treatments included canola oil (CO), hydrogenated fat (HF), calcium salts of oleic acid (CAO), and oleamide (OM). Dry matter intake was lower for OM than all other treatments, and CAO was lower than for CON, CO and HF. Milk yield was lowest for OM compared to all other treatments. Milk fat percentage was reduced for CO and CAO compared to CON and HF and was depressed in cows fed oleamide. Saturated fatty acids in milk were reduced by 22% and 13% for OM and CAO, compared to CON. Milk C18:1 was increased 33% and 16% for OM and CAO respectively compared to CON. Milk CLA was increased in CO and CAO compared to CON with an intermediate increase with OM. Feeding CAO and OM decreased saturated fatty acids and increased CLA in milk, however DMI and milk yield were reduced.

Item	CON	CO	HF	CAO	OM	SEM
DMI, kg/d	27.3^{c}	27.8^{cd}	28.4^{d}	26.4^{b}	23.8^{a}	0.32
Milk yield, kg/d	42.6^{a}	45.2^{b}	45.3^{b}	43.1^{a}	42.3^{a}	0.97
Milk fat, %	3.53^{c}	3.11^{b}	3.51^{c}	3.01^{b}	2.85^{a}	0.119
Milk Protein, %	3.13^{b}	3.11^{b}	3.09^{ab}	3.03^{a}	3.04^{a}	0.028
Saturated FA, g/100g milk fat	68.1^{c}	61.3^{b}	67.7^{c}	60.1^{b}	53.1^{a}	0.91
C 18:1, g/100g milk fat	21.2^{a}	25.8^{c}	22.3^{b}	25.3^{c}	31.9^{d}	0.57
Milk CLA, g/100g milk fat	0.47^{a}	0.84^{c}	0.41^{a}	0.87^{c}	0.65^{b}	0.058

^{abcd} $P< 0.05$

Key Words: Oleic acid, Oleamide, Calcium salts

130 Effect of cereal grain characteristics on production performance of lactating dairy cattle. J.A. Meier*[1], P. Yu[1], J.J. McKinnon[1], and D.A. Christensen[1], [1]*University of Saskatchewan.*

The objective of the study was to evaluate the effect of feeding two different cultivars of barley (cv. Harrington and Valier) and oat (cv. Derby and Assiniboia) grain on feed intake, milk yield and milk constituents. As secondary objective was to investigate particle size and starch characteristics of the Harrington and Valier barley. Eight lactating cows (86 17 DIM) were assigned one of four treatments using a double 4x4 Latin square design. Dietary treatments consisted of Valier Barley (VB), Harrington Barley (HB), Derby Oats (DO) or Assiniboia Oats (AO). The treatment grains constituted 50% of the cereal grain in the concentrate of the TMR. Data was analyzed for significance (P<0.05) using the Mixed Procedure of SAS. Milk yield for the DO and AO were significantly higher than VB. Milk fat was significantly decreased in the Assiniboia treatment compared to all other treatments. In general, it appears that oats may be a suitable replacement for barley grain in the concentrate of dairy diets. Bushel weights of the HB and VB were similar (56 lb/bu and 57 lb/bu respectively) and of the kernel size did not appear different. Particle size analysis was conducted on dry rolled (0.533 mm gap) on HB and VB using the ASAE Ro-tap method (Screen gap sizes of 4.00, 2.362, 1.70, 1.40, 1.19, and 0.84 mm). Particle size data was analyzed using as a completely randomized design using the GLM of SAS. Significant differences (P<0.05) were noted between treatments for all screenings. VB had the highest percentage (77%) of particles on the 2.362 mm screen, indicating that VB is much more resistance to processing than HB. The difference in shattering under identical processing conditions may be of concern when milling different cultivars and bushel weights of a single cereal grain. Subsequent to particle size analysis, scanning electron micrographs were prepared. Scanning electron microscopy revealed that VB had starch granules more tightly embedding into the protein matrix than HB. This difference in starch structure may lead to decreased availability for digestion and nutrient assimilation.

Key Words: Barley, Grain, Dairy

131 Tight junction (TJ) protein expression during engorgement of rat and bovine mammary glands. C. V. Cooper*[1,2,3], K. Stelwagen[2], C. D. McMahon[2], K. Singh[2], V. C. Farr[2], and S. R. Davis[2], [1]*Dexcel Ltd., Hamilton, New Zealand,* [2]*AgResearch, Hamilton, New Zealand,* [3]*Massey University, Palmerston North, New Zealand.*

The pattern of expression of TJ proteins was investigated during engorgement of rat and bovine mammary glands. An increase in mammary TJ permeability was previously shown to occur within 24 h of milk accumulation. The expression of occludin and claudin-1, the major integral transmembrane components of TJ, was determined in two experiments. In experiment 1, Sprague-Dawley rats at peak lactation (d 16) had three abdominal inguinal glands on one side sealed to induce mammary engorgement, the remaining glands were not sealed and acted as suckled controls. Mammary tissue was collected post-mortem at 0, 6, 12, 18, 24 and 36 h after teat sealing (n = 6 rats per time point). In experiment 2, alveolar mammary tissue was collected post-mortem from 42 mid-lactation Holstein Friesian dairy cows at 0, 6, 12, 18, 24, 36 and 72 h following the last milking (n = 6 cows per time point). Immunoblotting showed a characteristic multiple banding pattern for occludin between 60 and 80 kDa. The higher molecular weight (MW) bands were highly phosphorylated and resistant to NP-40 detergent extraction, suggesting they predominantly derive from the tight junction complex. Occludin expression declined during mammary engorgement in rat and bovine glands (P<0.05). Claudin-1 migrated in SDS-PAGE as two bands at 22 and 28 kDa. In rats, expression of the 28 kDa band declined within 12 h of mammary engorgement (P<0.05), while that of the 22 kDa band, along with lower MW degradation products, increased (P<0.05). Both bands were expressed at low levels by 36 h of mammary engorgement. In contrast, claudin-1 protein expression did not alter with engorgement in bovine mammary glands (P>0.05). Occludin and claudin-1 expression showed large individual animal to animal variation. Furthermore, the response to mammary engorgement was locally regulated as no changes were detected in suckled control rat mammary glands. Between species variation in the pattern of TJ protein expression suggest that the increase in TJ permeability during milk accumulation is regulated differently between rats and dairy cows.

Key Words: Tight junction, Lactation, Mammary engorgement

132 Effects of glucose concentration and presence of EGF and hormones on bovine oocyte maturation. D. J. Walker*, J. F. De La Torre-Sanchez, and G. E. Seidel, Jr., *Colorado State University Fort Collins, CO 80523.*

The purpose of this study was to examine effects of glucose concentration, epidermal growth factor (EGF), and hormones (FSH, LH, and estradiol 17 β) during bovine oocyte maturation on in vitro production of blastocysts. Oocytes from slaughterhouse ovaries were divided among the 12 factorial combinations of 3 glucose concentrations (0.5, 2.0, and 5.5 mM), presence or absence of 50 ng/ml of EGF, and presence or absence of LH, FSH, and E_2 in CDM-1, a chemically defined medium similar to SOF. Oocytes were matured at 38.5C in 5% CO_2 in air for 23 1 h. After maturation, oocytes were fertilized at 1 X 10^6 sperm/ml in 6 replicates in F-CDM (0.5 mM glucose), and then cultured 2 days in CDM-1 (0.5 mM glucose) and 4 days in CDM-2 (2 mM glucose). Glucose concentration in maturation medium at 0.5, 2.0, and 5.5 mM had no effect on blastocyst rates per oocyte, 33%, 32%, and 31% respectively. However, 0.5 mM glucose resulted in a cleavage rate of 87%, higher than 81% seen for both 2 and 5.5 mM glucose (P=.004). EGF and hormones independently enhanced cumulus expansion, but there was no synergism between them, and they had no affect on cleavage or blastocyst rates. Both cleavage (P=.0003) and blastocyst rates (P=.02) were affected by which of 3 bulls was used for fertilization.

Key Words: Bovine, Embryo, Oocyte

133 The effects of cottonseed hulls added to diets with and without live yeast or mannanoligosaccharide in Jersey calves. S. R. Hill*, B. A. Hopkins, S. Davidson, S. M. Bolt, C. Brownie, T. Brown, G. B. Huntington, and L. W. Whitlow, *North Carolina State University.*

The objective of this study is to investigate the effects of fiber in the form of cottonseed hulls (CSH) added to the starter and of live yeast (YST) or mannanoligosaccharide (MOS) added to milk, on growth, intake, rumen development, and health parameters in neonatal Jersey calves. Newborn Jersey bull and heifer calves (n=46) were assigned randomly at birth to one of six treatments and continued through 63 d. Bulls were elastrated at 14 d. Calves were fed 3.8 L of colostrum for the first 2 d once daily and then 2.8 L of whole milk supplemented with either no additive, 4g YST, or 3g MOS once daily through weaning at 42 d. Treatments included: 1) a corn/soybean meal based starter, 20% CP, 6% ADF (CON), 2) a blend of 85% starter and 15% CSH, 18% CP, 15% ADF (CON + CSH), 3) starter and MOS (CON + MOS), 4) starter with CSH and MOS (CON + CSH + MOS), 5) starter and live yeast (CON + YST), and 6) starter with CSH and live yeast (CON + CSH + YST). Starter diets were offered from 1 d and daily amounts were increased by 0.09 kg when orts were 0 kg. Weekly measurements included body weight (BW), wither height (WH), hip width (HW), and dry matter intake from starters (DMI). Daily measurements included rectal temperatures, fecal, and respiratory scores. Calves fed either YST or MOS had greater BW (37 kg) than calves fed no supplement (35 kg) ($P < 0$ .05). There were no significant effects of CSH, YST, or MOS on DMI, WH, or HW ($P >$ 0.05).

Key Words: Jersey calves, Cottonseed hulls, Yeast

134 Leptin, body condition, and intake regulation of lactating dairy cows in the transition phase. D. Kumar*[1], M. A. Froetschel[1], T. D. Pringle[1], D. Keisler[2], and J. K. Bernard[1], [1]*The University of Georgia,* [2]*The University of Missouri.*

Leptin may be responsible for decreased intake and milk production of lactating dairy cows fed fat during transition. Experimentation was conducted to correlate leptin with body fat and stage of lactation in dairy cattle, and investigate the role of leptin in intake regulation during transition. In the first experiment, jugular blood samples were obtained from, and body fat measured with ultrasonography, in 16 lactating dairy cows that varied in body condition score (n=8 < 2.5 BCS and n=8 > 3.5 BCS), and days in milk (range d 88 to d 725). Backfat (r^2=0.64,

P < 0.01), rumpfat (r^2=0.60, P < 0.01), and days in milk (r^2= 0.48, P < 0.01) were positively related to serum leptin. In the second experiment, twelve Holstein cows, fed anionic salts 2 weeks before calving were given three levels of supplemental fat (0, 3, and 6% added fat using MEGALAC-R®) post- calving. Dry matter intake and milk production were measured for 4 weeks post-calving. Leptin was analyzed on jugular blood samples taken two days before calving, two days after calving and at weekly intervals 1h before and 2h after feeding. Serum leptin increased (P < 0.01), 7.2% (4.54 vs. 4.87 0.07 ng/ml) in cows post-calving as compared to pre-calving. Leptin was negatively related to level of dietary fat(linear and quadratic, P < 0.01), decreasing 16.2 - 28.4% (4.75, 3.33, and 3.98 0.41 ng/ml). In the first four weeks after calving, milk production decreased (linear, P < 0.01) 8.6 to 21.6% due to fat in the diet. Dry matter intake increased (quadratic, P < 0.05) from 1.5 to 7.0% and leptin tended to follow a similar trend (P < 0.14). DMI increased (linear, P < 0.01) from 18.1 to 23.6 kg/d and milk production increased (linear, P < 0.01) from 27.3 to 43.1 kg/d during the first four weeks of lactation. Serum leptin did not change during this period. Although serum leptin is correlated with body condition of dairy cattle, it remains to be identified as a major determinant of intake regulation in transition cows fed dietary fat.

Key Words: Leptin, Intake, Transition cow

135 The ability of amide versus calcium salts of soybean oil to increase unsaturated fatty acid concentration in omasal and continuous culture samples. F. P. Lundy III*, T. C. Jenkins, W. C. Bridges Jr, and J. A. Bertrand, *Clemson University, Clemson, SC, 29634*.

Two studies were conducted to determine the ability of two forms of soybean oil to resist biohydrogenation by mixed ruminal microorganisms in vivo and in continuous culture. Four TMR consisting of forage and concentrate (1:1 DM basis) contained either; 1) soybean oil (SBO) added at 2.45% of DM, 2) amide of soybean oil (AMD) added at 2.75% of DM, 3) calcium salt of soybean oil (CAS) added at 2.75% of DM, and 4) a mixture (20:80, w/w) of the amide and calcium salts of soybean oil (MIX) added at 2.75% of DM. The four diets were fed ad-libitum to four multiparious lactating (103 DIM, SD 38) Holstein cows (fitted with ruminal cannulae) in expt 1, and were fed (30 g/d) in expt 2 to four dual flow continuous culture systems in a 4X4 Latin square design. The ability of the fat supplements to resist biohydrogenation was expressed as C18:1 or C18:2 concentrations (mg/g DM) in omasal (expt 1) or fermenter outflow samples (expt 2) divided by their concentrations (mg/g DM) in the feed. For C18:2, the omasal/feed concentrations in expt. 1 were 0.078, 0.098, 0.108, and 0.125 and in expt. 2 were 0.187, 0.261, 0.283, and 0.337 for the SBO, MIX, CAS, and AMD diets, respectively. Similar results for C18:1 were 0.296, 0.32, 0.321 and 0.67 in expt. 1 and 0.458, 0.52, 0.507, and 0.592 in expt 2. Concentrations of C18:1 and C18:2 were higher for the CAS and AMD diets when compared to SBO. In expt 2, the AMD diet had higher (P=0.016) concentrations of C18:2 in overflow contents than CAS (8.99 vs 6.62). The concentration of C18:1 was higher (P=0.018) in the omasum in expt. 1 and higher in the fermenter outflow (P=0.016) in expt. 2 for AMD vs CAS. These experiments demonstrate greater ability of fatty amides and calcium salts to increase the delivery and concentration of unsaturated fatty acids postruminally compared to triacylglycerols. Fatty amides generally provided greater protection of unsaturated fatty acids from biohydrogenation compared to calcium salts, which was more prevalent for oleic acid than for linoleic acid.

Key Words: Biohydrogenation, Amide, Calcium Salt

136 Comparison of three estrus detection systems during summer heat stress in a large commercial dairy herd. O. A. Peralta*, R. E. Pearson, and R. L. Nebel, *Virginia Polytechnic Institute and State University, Blacksburg*.

Our objective was to compare the efficiency and accuracy of three estrus detection systems on a large commercial dairy (1000 lactating cows) during the summer of 2002. At ∼45 DIM, 282 cows were fitted with a HeatWatch (HW) device (HeatWatch® ; DDx Inc., Boulder, CO), an activity (A) sensor (ALPRO™; DeLaval Inc., Kansas City, MO), and observed visually (V) twice daily. Indicators of estrus included three standing events within 4 h for HW an activity level of 3 for A, and observed standing to be mounted for V. Onset of estrus was the first standing event both for HW and V. For A, onset of estrus was the hour after 3 consecutive h of twice baseline activity for that cow during the previous 10-d period. Pregnancy status was determined by uterine palpation 35 to 49 d following AI. The effects of DIM, parity, physical activity, standing events, months, AI technician, and interval from onset of estrus and AI on % pregnant were determined using linear contrast and logistic regression. Efficiencies for detection of estrus, determined by comparing detected periods of estrus with a theoretical total of 694, were 49.9% (V), 34.4% (A) and 41.6% (HW). Efficiency for the combination of all three methods was 76.4%. Percentage of inseminations resulting in a pregnancy (±SE) by method of detection was 20.6±4.9 for HW, 20.0±5.6 for A, 9.8±2.6 for V, 16.0±5.6 for V & A, 30.3±5.3 for V & HW, and 23.4±5.4 for A & HW. For estrus periods detected by HW, the probability of pregnancy increased as DIM and standing events increased (P<0.05). Estrus periods having 4 to 9 standing events recorded by HW had a lower (P<0.05) pregnancy outcome (19.8±2.8) compared with cows with estrus periods consisting of >10 standing events (34.0±5.0%). For estrus periods detected by A, the interval from the onset of estrus to AI had a direct effect on the probability of pregnancy (P<0.05); the highest % pregnant occurred between 13 and 18 h after the onset of estrus (38.5±7.9). The combination of all three systems resulted in ∼75% efficiency and the highest % pregnant occurred with the combination of V & HW, which confirms that multiple systems enhance both the efficiency and accuracy of detection.

Key Words: Detection of estrus, Estrous detection efficiency, Heat stress

WSASAS Graduate Student Paper Competition

137 Evaluation of perennial ryegrass straw as a forage source for ruminants. M. J. Fisher*[1], D. W. Bohnert[1], C. J. Ackerman[2], C. S. Schauer[1], T. DelCurto[1], A. M. Craig[2], D. L. Harmon[3], and N. F. Schrick[4], [1]*Eastern Oregon Agriculture Research Center, Burns,* [2]*Oregon State University, Corvallis,* [3]*University of Kentucky, Lexington,* [4]*The University of Tennessee, Knoxville*.

We conducted a 25-d metabolism trial to evaluate digestion and physiological variables in steers offered perennial ryegrass straw containing increasing levels of lolitrem B. Sixteen ruminally cannulated Angus × Hereford steers (231 ± 2 kg BW) were blocked by weight and assigned randomly to one of four treatments (TRT). Steers were provided perennial ryegrass straw at 120% of the previous 5-d average intake at 0730. Prior to straw feeding (0700), soybean meal was provided to meet the estimated requirement for degradable intake protein (0.1% BW; CP basis). Mixtures of a low (L) and high (H) lolitrem B straw (<100 and 1550 ppb, respectively) were used to formulate TRT diets. The TRT were Low (100% L), Low Mix (67% L:33% H), High Mix (33% L:67% H), and High (100% H). Intake and digestibility of DM and OM, along with ruminal pH and NH_3, were not affected by increasing lolitrem B concentration (P > 0.10). Ruminal indigestible ADF (IADF) fill increased linearly (P = 0.02) and IADF passage rate (%/hr) decreased linearly (P = 0.04) as lolitrem B level increased. Alkaloid concentration did not influence serum prolactin or heart rate (P > 0.31); however, a quadratic effect (P = 0.03) was noted for respiration rate, with the greatest values occurring with the Low Mix and High Mix diets. These data suggest that feeding perennial ryegrass straw containing up to 1550 ppb lolitrem B does not adversely affect nutrient digestion or physiological response variables.

Key Words: Lolitrem B, Perennial ryegrass, Straw

138 Risk factors associated with culling females in a composite beef herd. P. Rogers*[1], C. Gaskins[1], K. Johnson[1], and M. MacNeil[2], [1]*Washington State University,* [2]*USDA-ARS LARRL*.

Our goal was to identify factors affecting risk of a beef female being culled. Data were from the CGC composite herd (Red Angus, Charolais, Tarentaise) at Miles City, MT in which heifers were exposed as yearlings. Binary logistic regression was used to assess factors affecting probability of calving as a two-yr-old **(P(C2))**, including heifer (n =

1,756) phenotypes and breeding values **(BV)**. March-born heifers were more likely to calve at two than heifers born thereafter ($P < 0.01$). As birth weight of the heifer increased P(C2) tended to decrease ($P < 0.10$). Conversely, P(C2) tended to increase as BV for cow weight increased ($P < 0.10$). Neither phenotype nor direct and maternal BV for preweaning gain affected P(C2) ($P > 0.10$). Relationships of age at culling with first calving measurements (n = 1,254) and genetic profiles (n = 1,382) of females were assessed in separate analyses using Cox regression. Independent variables were coded into evenly spaced categories. Records from pregnant cows that were sold and from cows in the herd in 2001 were treated as censored (33%). Age at first calving and birth weight and 200-d preweaning gain of her first calf did not influence age at culling ($P > 0.10$), but heifers experiencing dystocia were at 36% greater risk than cohorts that did not ($P < 0.01$). As BV for cow weight increased, risk of being culled decreased ($P < 0.01$). Cows with intermediate direct BV for preweaning gain were at lower risk of being culled than those with extreme BV ($P < 0.01$). On average, increasing maternal BV for preweaning gain increased risk of being culled ($P < 0.01$). Date of birth was more important than phenotype or genetic profile in determining whether or not a heifer calves at two years of age. Genetic profile of a female is a better indicator of age at culling than traits measured on her first calf.

Key Words: Longevity, Survival analysis, Beef cattle

139 LHRH fusion protein vaccines block estrous cycle activity in beef heifers. J. D. Stevens*, J. M. Sosa, D. M. deAvila, J. M. Oatley, J. A. Hernandez, K. P. Bertrand, and J. J. Reeves, *Washington State University, Pullman, WA*.

Two LHRH fusion proteins, thioredoxin (TL) and ovalbumin (OL), each containing seven LHRH inserts were tested. The objective was to evaluate immune and biological response from alternating the two fusion proteins in an immunization schedule. One hundred and ten heifers were equally divided into 11 groups. Control groups were spay and intact non-treated animals. Heifers in the other nine groups were immunized on wk 0, 4 and 8. Treatments were immunizations of the same protein throughout or alternating the proteins in different sequence. Blood was collected weekly for 22 wk and serum assayed for progesterone and LHRH antibody binding. At slaughter, reproductive tracts were removed from each heifer and weighed. Heifers with progesterone ≥ 1 ng/ml were considered to have a functional corpus luteum and thus have estrous cycle activity. All LHRH immunized groups of heifers had lower ($P \leq 0.05$) numbers of cycling animals after wk 6 when compared to the intact non-treated control group. There was no difference ($P \geq 0.05$) in number of heifers cycling between the immunized groups and the spayed heifers during wk 9 to 22. Luteinizing hormone releasing hormone antibody binding did not differ among immunized groups during wk 1 to 9 ($P \geq 0.05$). Starting wk 10 and continuing through the conclusion of the study, there was an overall difference among treatment groups for LHRH antibody binding ($P \leq 0.05$). Uterine weights differed between treatments ($P \leq 0.05$) with intact control animals having heavier uteri than all other groups ($P \leq 0.05$). Uterine weights were significantly negatively correlated with LHRH antibody binding ($r = -.51$). In summary, these LHRH fusion proteins were as effective as surgical spaying in suppression of estrous cycle activity, however, alternating the two proteins in an immunization schedule did not enhance the immunological or biological effectiveness of the vaccine.

Key Words: Immunization, LHRH, Heifers

140 Effects of fluxin meglumine on embryonic loss in stressed beef cows. M. L. Merrill*[1], R. P. Ansotegui[1], N. E. Wamsley[2], P. D. Burns[2], and T. G. Geary[3], [1]*Montana State University, Bozeman, MT,* [2]*Colorado State University, Fort Collins, CO,* [3]*USDA-ARS, Miles City, MT*.

The objective of this study was to determine if flunixin meglumine reduces early embryonic death in cows subjected to stress. Approximately 14 d following synchronization of estrus and artificial insemination (AI), 97 cows were assigned to one of three treatments by AI sire, AI date, and AI technician. Treatments were control (CON), induced stress (S), and induced stress with flunixin meglumine (1.1mg/kg, i.m; SFM). Rectal temperatures were recorded and blood samples collected (caudal venipuncture) for measurement of cortisol, and PGF metabolite (PGFM) concentrations before and after induced stress. Control cows remained at the ranch with their calves and had access to water but not feed, while S and SFM cows were loaded on semi-trucks and transported for 4 h (mean ambient temperature 24^o C). Cows were not exposed to clean-up bulls until after treatment. Transrectal ultrasonography was used to determine AI pregnancy status 55 to 57 d post AI. Pregnancy rates to AI tended ($P = 0.17$) to be higher among SFM cows (84%) than S cows (69%) while AI pregnancy rate of CON cows was intermediate (76%). Cortisol concentrations before and after treatment were 21 and 24 ng/ml, 23 and 17 ng/ml, and 18 and 8 ng/ml, for CON, S, and SFM cows, respectively. Change in cortisol concentration was different ($P < 0.06$) between CON and S or SFM, but not S versus SFM ($P > 0.10$). No changes ($P > 0.10$) in PGFM were detected among the three groups between the sampling periods. Body temperature decreased between the sampling periods for all treatments, but the change in temperature was greater ($P < 0.03$) for S and SFM cows compared CON. Across treatments, change in cortisol concentration between sampling periods did not influence ($P > 0.10$) AI pregnancy status, however, PGFM increased ($P<0.09$) 24.72 pg/ml or decreased 5.19 pg/ml in cows diagnosed open or AI pregnant. In summary, flunixin meglumine appears to decrease the stress-induced embryonic loss, but the role of PGF and cortisol remain unclear.

Key Words: Pregnancy, Stress, Cortisol

141 The effects of cattle gender on feedlot performance, carcass characteristics and muscle tenderness. W. T. Choat*[1], J. A. Paterson[1], B. M. Rainey[1], M. C. King[1], R. J. Lipsey[2], K. E. Belk[3], and G. C. Smith[3], [1]*Montana State University,* [2]*American Simmental Association,* [3]*Colorado State University*.

Effects of gender on rate of gain, carcass traits, shear force and trained sensory panel ratings of beef palatability were evaluated using 202 progeny of Angus or Simmental sires. Steers (n=99), heifers (n=57) and intravaginally spayed heifers (n=46) were commercially fed (161d). No implants were administered and heifers were not fed melengestrol acetate to suppress estrus. Steers had faster ($P < 0.01$) daily gains than spayed and intact heifers. The heavier ($P < 0.01$) final live weights of steers resulted in 25 kg heavier ($P < 0.01$) hot carcass weights at similar ($P = 0.86$) levels of fat thickness compared with heifers. Spayed heifers had a 5.7% smaller longissimus muscle area ($P < 0.05$) compared with steers and intact heifers, which were similar. Calculated yield grades and USDA quality grades were similar ($P = 0.21$) among treatments, although marbling scores were lower ($P < 0.01$) for steers compared to intact and spayed heifers. In order to directly examine gender effects on tenderness, shear force and sensory panel data were analyzed using an ANOVA model with marbling score as a covariate. Shear force values after 7 and 14 d of aging were lower ($P < 0.01$) for steers compared to intact and spayed heifers, which were not different from each other. Mean shear force values at 7 and 14 d of aging were 3.3 and 3.3 (steers) 3.8 and 3.6 (intact heifers) and 3.6 and 3.5 (spayed heifers), respectively, and did not differ ($P = 0.11$) among genders after 21 d of aging. A trained sensory panel evaluated steaks (aged 14 d postmortem) from 193 of the cattle for juiciness, muscle fiber tenderness, connective tissue amount and overall tenderness using an 8-point structured rating scale. Steaks from steers received more favorable ratings ($P < 0.01$) for muscle fiber tenderness, connective tissue amount and overall tenderness, compared with spayed and intact heifers. Under the genetic and environmental conditions of this experiment, steers had faster daily gains and produced heavier carcasses at similar levels of subcutaneous fat, compared to heifers. Intact and spayed heifers produced strip loin steaks that had higher average shear force values (i.e., were less tender) and lower average ratings for sensory panel overall tenderness than those for steaks from steers.

Key Words: Cattle, Gender, Tenderness

142 Influence of protein supplementation frequency on cows consuming low-quality forage: performance, grazing time, distance traveled, distance from water, and distribution. C. S. Schauer*[1], D. W. Bohnert[1], and D. C. Ganskopp[2], [1]*Eastern Oregon Agriculture Research Center, Oregon State University, Burns, OR,* [2]*Eastern Oregon Agriculture Research Center, ARS-USDA, Burns, OR*.

Our objective was to determine the influence of CP supplementation frequency (SF) on cow performance, grazing time, distance traveled, maximum distance from water, and cow distribution within three 810-ha pastures. One hundred-twenty pregnant (approx. 60 d) cows (467 ±

4 kg BW) were used in a 3 x 3 Latin square for one 84-d period in each of three years. Cows were stratified by age, body condition score (BCS), and weight and assigned randomly to one of three pastures. Treatments (TRT) included an unsupplemented control (CON), daily supplementation (D; 0.91 kg/d; DM basis), and supplementation once every six d (6D; 5.46 kg/6d; DM basis). Cottonseed meal (43% CP; DM basis) was provided as the supplemental CP source. Water, mineral/salt, and supplement placement within each pasture were maintained in the same location each year of the study. Four cows from each treatment (each year) were fitted with global positioning system collars to estimate grazing time (hr/d), distance traveled (m/d), maximum distance from water (m/d), and cow distribution (% ha occupied·pasture^{-1}·yr^{-1}). Cow weight and BCS change were more positive ($P \leq 0.03$) for supplemented TRT compared with CON. No weight and BCS differences ($P \geq 0.14$) occurred between D and 6D. Grazing time was greater ($P = 0.04$) for CON compared with supplemented TRT with no difference ($P = 0.26$) because of SF. Distance traveled, maximum distance from water, and cow distribution were not affected ($P \geq 0.40$) by supplementation or SF. Results suggest that CP supplementation, provided daily or once every 6 d, of cows grazing low-quality forage increases weight and BCS gain, while decreasing grazing time. Additionally, cow distribution may not be affected by CP supplementation or SF.

Key Words: Protein supplementation, Frequency, Distribution

143 Livestock response to rest-rotation, deferred-rotation, or continuous grazing systems on forested rangeland.

L. G. Wood*, K. C. Olson, R. D. Wiedmeier, and J. E. Bowns, *Utah State University, Logan, UT*.

A 6-yr study was conducted to evaluate the influence of rest-rotation, deferred-rotation, and continuous grazing on the performance of cow-calf (*Bos taurus*) and ewe-lamb (*Ovis aries*) units on mountain rangeland in southern Utah. Treatments were arranged in a 3 grazing method (continuous, deferred-rotation, or rest-rotation) by 6 yr factorial using a randomized-complete block design with 2 blocks. All animals were individually weighed and cows received a body condition score (BCS) at the beginning, mid-point, and end of each grazing season. Average daily gain (ADG) was greater (P<0.05) for calves, lambs, and ewes grazed continuously (1.12, 0.26, and 0.095 kg d^{-1}, respectively) or under deferred-rotation (1.09, 0.25, and 0.096 kg d^{-1}, respectively) than under rest-rotation grazing (1.06, 0.24, and 0.077 kg d^{-1}, respectively). There was no difference in ADG for calves, lambs, or ewes grazed continuously or with deferred-rotation (P>0.05). Cows gained more (P<0.05) in continuous pastures (0.71 kg d^{-1}) than in deferred- (0.58 kg d^{-1}) or rest-rotation (0.54 kg d^{-1}) pastures. Cow ADG was similar (P>0.05) in deferred- and rest-rotation pastures. Change in BCS by cows was similar among grazing treatments (P>0.05). Calves, lambs, and ewes gained more per ha (P<0.05) in continuous (9.95, 18.43, and 4.52 kg ha^{-1}, respectively) and deferred-rotation pastures (9.84, 17.11, and 4.21 kg ha^{-1}, respectively) than in rest-rotation pastures (7.98, 12.95, and 2.61 kg ha^{-1}, respectively). Gain per ha was similar (P>0.05) between continuous and deferred-rotation grazing for calves, lambs, and ewes. Cows gained more per ha (P<0.05) in continuous (6.21 kg ha^{-1}) than rest-rotation pastures (4.18 kg ha^{-1}). Cow gain ha^{-1} under deferred-rotation (5.07 kg ha^{-1}) was intermediate and similar (P>0.05) to both continuous and rest-rotation. Rest-rotation grazing reduces animal production per ha and weaning weights of calves and lambs, resulting in lower profits for livestock operations.

Key Words: Beef Cattle, Sheep, Grazing Systems

144 Impact of trace mineral supplementation and source on grazing beef cattle over a two-year period.

J. K. Ahola*, T. E. Engle, D. S. Baker, L. R. Sharpe, P. D. Burns, R. M. Enns, and R. G. Mortimer, *Colorado State University, Fort Collins, CO USA*.

Over a two-year period, crossbred, multiparous beef cows (n=164/year) were used to determine the effect of trace mineral supplementation from 90 d prior to parturition through 120 d post parturition on cow performance. Cows were blocked by expected calving date, body weight, body condition score, and liver mineral status, and assigned to one of three treatments: 1) control (no supplemental copper (Cu), zinc (Zn), or manganese (Mn)); 2) ORG (50% organic and 50% inorganic Cu, Zn, and Mn); and 3) ING (100% inorganic CuSO4, ZnSO4, and MnSO4). Mineral treatments were provided ad libitum in free choice mineral feeders. At the end of year one, liver Cu, Zn, and Mn concentrations were higher (P<0.01) in supplemented relative to control cows and liver Cu concentrations were higher (P<0.01) in ORG relative to ING cows. At the end of year two, supplemented cows had higher liver Cu (P<0.01) and Mn (P<0.02) concentrations relative to controls. Overall 60 d pregnancy rate tended (P=0.10) to be higher for supplemented cows relative to controls. A year by treatment interaction was present (P<0.05) for pregnancy rate to artificial insemination (AI). In year one, there was a trend (P=0.07) for ORG cows to have a higher pregnancy rate to AI than ING cows. In year two, supplemented cows had higher (P<0.05) pregnancy rates to AI vs. control cows. When AI was based on estrus, supplemented cows had higher pregnancy rates (P<0.05) than control cows. From this large, two-year study it can be concluded that trace mineral supplementation and source has an effect on fertility if Cu, Zn, and Mn are not supplemented for more than one year.

Key Words: Trace mineral supplementation, Beef cattle, Performance

145 Effects of supplemental high-linoleate or high-oleate safflower seeds on production and lipogenesis by adipose tissue of postpartum cows.

S. L. Lake*, B. W. Hess, D. C. Rule, C. M. Murrieta, E. J. Scholljegerdes, V. Nayigihugu, and R. L. Atkinson, *University of Wyoming*.

Three-year-old Angus × Gelbvieh rotationally crossed beef cows (n = 36) nutritionally managed to achieve a body condition score (BCS) of 4.2 ± 0.3 (BW = 481.2 ± 29.3 kg) or 6.0 ± 0.3 (BW = 554.3 ± 39.3 kg) at parturition were used to determine the effects of dietary supplemental fat on production and adipose tissue fatty acid metabolism. Within BCS, and beginning 3 d postpartum, cattle were randomly assigned to be individually fed native grass hay (CP = 8.7%) and a low fat control supplement (C) or supplements consisting of high-linoleate safflower seeds (L) or high-oleate safflower seeds (O) until d-60 of lactation. Safflower seeds were cracked and supplements were formulated to provide 5% DMI as fat. Rations were formulated to be isonitrogenous and isocaloric. Adipose tissue biopsies were collected near the tail-head region of cows on d-30 and d-60 of lactation. Body condition score was not affected ($P = 0.43$) by dietary treatment, nor did BCS change ($P = 0.53$) from d-3 through d-60 of lactation; however, cows were heavier ($P = 0.04$) at d-30 than d-60. Milk production ($P = 0.24$) and milk fat percentage ($P = 0.80$) were not influenced by dietary treatments. Milk protein percentage was greater ($P = 0.03$) for cows with BCS 6.0 than BCS 4.2. Dietary treatment did not affect ($P \geq 0.12$) adipose tissue lipogenesis. Rates of palmitate incorporation into diacylglycerol and acetyl-CoA carboxylase activity were greater ($P = 0.001$) at d-30 than d-60, suggesting a proclivity for greater substrate esterification and biosynthesis by adipose tissue at d-30 of lactation. Lipoprotein lipase activity ($P = 0.01$) and palmitate incorporation ($P = 0.02$) into triacylglycerol were greater in BCS 4.2 compared to BCS 6.0. Hence, cows in sub-optimal condition retained a higher propensity to incorporate circulating triacylglycerol into stored adipocyte lipid.

Key Words: Beef cows, Fat supplementation, Lipid metabolism

146 Balancing supply of essential amino acids to the small intestine in cattle consuming restricted amounts of forage plus supplementary ruminally undegradable protein.

E. J. Scholljegerdes*, B. W. Hess, F. S. D'Angieri, and P. A. Ludden, *University of Wyoming, Laramie*.

Twelve Angus crossed cattle (avg BW = 594 ± 44.4 kg) fitted with ruminal and duodenal cannulae were used in a 4 × 4 Latin square double cross-over designed experiment to determine intestinal supply of essential amino acids (EAA) when consuming restricted amounts of forage plus a ruminally undegradable protein (RUP) supplement. Cattle were fed chopped (2.54 cm) bromegrass hay (11.4% CP, 57% NDF) at 30, 55, 80, or 105% of maintenance. Cattle fed below maintenance were given increasing amounts of RUP supplement (6.8% blood meal, 24.5% feather meal, and 68.7% fish meal; DM basis) in an effort to equalize duodenal EAA flow to that of the 105% of maintenance diet. Experimental periods were 19 d in length with 17 d of adaptation followed by 2 d of intensive sample collection. Due to greater amounts of supplemental RUP provided to cattle as forage intake decreased, total and individual EAA intake increased linearly ($P < 0.0001$) as forage intake decreased to 30% of maintenance. However, total duodenal flow of EAA did not differ ($P = 0.39$) across all levels of forage intake. The variation

in duodenal EAA proportions ranged from as low as 11.1 to 11.2% of total EAA for phenylalanine to 12.3 to 14.3% of total EAA for lysine. Although profile of EAA (individual EAA as a % of total EAA) reaching the duodenum differed ($P = 0.02$) for all 10 of the EAA, duodenal flow did not differ ($P = 0.10$ to 0.65) for 8 out of the 10 EAA. Specifically, duodenal flow of arginine increased linearly ($P = 0.01$) whereas duodenal flow of tryptophan decreased linearly ($P = 0.002$) as forage intake decreased from 105 to 30% of maintenance. Our results demonstrated that balancing intestinal essential amino acid supply in beef cattle can be accomplished with proper RUP supplementation.

Key Words: Restricted intake, Amino acids, Supplementation

Breeding & Genetics: Dairy cattle breeding for production traits

147 Individual curve fitting of Italian Simmental cow milk test day data. N.P.P Macciotta*[1], D. Vicario[2], G. Pulina[1], and A. Cappio-Borlino, [1]*Universitá di Sassari,* [2]*Italian Association of Simmental cow Breeders.*

The evolution of milk production over time can be modelled by several mathematical linear and non-linear functions. Observed differences in fitting of average lactation curves of homogeneous groups of animal for the most commonly used lactation models are rather small. On the other hand, a very wide range of goodness of fit can be observed for individual lactation pattern, essentially due to the random biological variation between cows and not to the inadequacy of the mathematical model used. Therefore, in order to study the effects of some systematic environmental factors on the shape of lactation curves, it is more useful to fit a simple model whose parameters possess a clear, technical significance to curves that are not too far from the typical lactation pattern. In this study, the incomplete Wood's gamma function $y=a(b\hat{t})\exp(ct)$ was fitted to 13,739 lactations of Italian Simmental cows, with at least 7 records each and with the first recorded test day within the 15th days in milking, of six parity classes (1 to 6). The overall mean adjusted r-square was 0.71. A reduced data set of 6830 regular lactation curves was extracted with the constraints of having the b parameter positive and the adjusted r-square greater than 0.75. Values of parameter a, b and c were analysed with a linear model in order to evalue the effect of herd, parity, year and season of calving on the lactation curve shape. Parity affected all the three parameters, with primiparous cows having the lowest values for the a (12.82) and c (-0.00417) parameter, thus indicating a lower level of production and a higher persistency of lactation in comparison with older cows. Also calving season affected all the parameters, with highest values of the scale parameter a for cows calving in March and April. Finally an increasing trend for the level of production and lactation persistency has been observed during the period considered (1989-1999).

Key Words: Lactation curve, Italian Simmental

148 Estimates of genetic parameters and lactation curves with a cubic spline model for Holstein cows treated with bovine somatotropin. B. J. DeGroot*[1], J. F. Keown[1], S. D. Kachman[1], and L. D. Van Vleck[2], [1]*University of Nebraska, Lincoln, NE,* [2]*USDA, ARS, USMARC, Lincoln, NE.*

The objective was to estimate genetic parameters and response to bovine somatotropin (bST) from individual test-day milk yields with a cubic spline model for first three lactations. A total of 263,034 test-day milk records of Holstein cows treated with bST and 405,265 test-day records of untreated cows that calved between 1996 and early 2002 were obtained from Dairy Records Management System, Raleigh, North Carolina. Estimates of (co)variances for a cubic spline with five knots were obtained with REML. Estimates of heritabilities for test-days and estimates of genetic and phenotypic correlations between test-days were obtained from estimates of variances and covariances from the cubic spline analysis. Genetic parameters were estimated at the average day within each of the ten 30-d test day intervals. The cubic spline model included herd test-day, age at first calving, treatment, and treatment by linear as fixed effects and treatment by spline as random effects. Cubic splines were fitted for the overall lactation curve within treatments, additive genetic effects, and permanent environmental effects. The cubic splines used five intervals determined by days 0, 50, 135, 220, and 310. The treatment differences were measured for bST treated and untreated cows. Estimates of heritability for test-day one to test-day ten ranged from 0.09 to 0.16, 0.10 to 0.17, and 0.10 to 0.18 for lactations one, two, and three. Estimates of genetic correlations for milk yield at pairs of test-days ranged from 0.99 to 0.45 for lactation 1, 0.99 to 0.32 for lactation 2, and 0.99 to 0.35 for lactation 3. The differences of 3.17, 2.27, and 2.30 kg between treated and untreated cows at day 100 were maintained until about day 220 of lactations one, two, and three. Estimates of heritability increased over the course of the lactation and estimates of genetic correlations decreased for pairs of test-days further apart.

Key Words: Heritability, Genetic correlations, Milk yield

149 Environmental sensitivity of genetic merit for milk, fat and protein yield estimated by a random regression model. M. P. L. Calus* and R. F. Veerkamp, *ID-Lelystad.*

Environmental sensitivity of genetic merit for milk, fat and protein yield was estimated using a random regression model to evaluate the effect of combining these traits in an economic index for different herd environments. To describe herd environments fourteen environmental parameters were defined based on the data available. Variance components and breeding values of sires for milk, fat and protein yield were modeled as a function of an environmental parameter. Up to the third order polynomial random regressions were applied. Fixed linear and quadratic regressions were included for age at calving and fixed effects to account for herd-year-season groups. A fixed polynomial regression was applied to the environmental parameters, to account for the average level in each herd. The residual variance was modeled for ten different groups, to account for heterogeneous residual variances in the model. ASREML was used for all analyses. Herd-year peak date of calving, herd average protein, body condition score, calving interval and age at calving gave most environmental sensitivity, mainly resulting from a change in scale of the genetic and residual variances for extreme herds and little re-ranking. The sire variances of milk, fat and protein yield followed more or less the same pattern across the environmental scale. Most genetic correlations across environments were close to unity for each individual trait. The change in variances had a large scaling effect on the economic weights, but the effects were similar for milk, fat and protein yields. Therefore, also very little re-ranking occurred based on the economic index, but the use of high merit bulls seemed more beneficial in herds with peak date of calving in the fall or winter, high average protein, high body condition score, short calving intervals and young age at calving.

Key Words: Environmental sensitivity, Random regression model, Environmental parameter

150 Estimation of genetic parameters for test-day records of French Holstein cows with an AI-REML algorithm. T. Druet*, F. Jaffrézic, and V. Ducrocq, *Station de Génétique Quantitative et Appliquée, INRA.*

Genetic parameters for lactation test-day records of French Holstein cows were estimated as a first step towards the implementation of a national genetic evaluation with a test-day model. Test-day records were considered up to 335 days in milk. The fixed part of the lactation curve was modeled with regression splines with 6 knots. Genetic parameters were estimated with an Average Information REML algorithm where the average information matrix and the first derivatives of the likelihood functions were pooled over 10 samples. This approach made it possible to handle larger data sets. The logarithm of the residual variance was modeled with several parametric functions of days in milk such as polynomial function or regression splines. Quartic Legendre polynomials were used to estimate (co)variances of random effects. The estimates were within the range of most other studies and were very close to those obtained in a previous study where lactation length was limited to 305 days. The largest genetic variance was in the middle of the lactation while residual and permanent environmental variances mostly decreased during the lactation. The resulting heritability ranged from 0.17 to 0.37. For a large part of the lactation genetic correlations were higher than 0.90. For both the genetic and permanent environmental variances, the first two eigenvalues represented more than 90 % of the total variation. The corresponding eigenvectors seemed to make sense biologically. They were used as covariables to estimate the genetic

parameters in the three first lactations. Flexible functions were used to model the residual variance in order to take into account the extra residual variation not explained by the eigenvectors. Resulting genetic correlations among lactations were high.

Key Words: Genetic parameters, Test-day model

151 Estimation of genetic correlations among production, body size, udder, and productive life traits over time in Holsteins. S. Tsuruta[1], I. Misztal[1], T. J. Lawlor*[2], and L. Klei[2], [1]*University of Georgia, Athens GA,* [2]*Holstein Association USA Inc., Brattleboro VT.*

Genetic parameters can change over time for several reasons. The use of a random regression model allows us to account for changes in a large number of variances and covariances over time and does not require any prior assumptions about how the parameters will change. Genetic correlation among milk, fat, productive life, body size, and udder traits in 40,838 Holsteins were estimated over a 15 year time period (cows born from 1979 to 1993). The model included registration status, herd-year, age group, and stage of lactation as fixed effects; additive genetic effects with random regressions on year of birth using the third order Legendre polynomials; and residual effects with heterogeneous variances using the interval method via Gibbs Sampler. Additive genetic variances for milk, fat, and body size increased over time while those for productive life and udder traits were constant. Residual variances for milk, fat, body size, and udder traits also increased over time, but those for productive life were relatively constant. As a result, heritability estimates for milk, fat, productive life, and body size were constant, and those for udder composite slightly decreased. Genetic correlations between milk production with fat yield and productive life have decreased, while the correlation of milk with body size and udder composite has increased over the years. Genetic correlations between productive life and the other traits decreased for the last decade. These changes can largely be explained by changes in selection emphasis that has taken place within the Holstein breed.

Key Words: Genetic parameters, Random regressions, Selection

152 Identification of environments for AI progeny testing schemes that yield the highest heritability and correlation with second-crop evaluations for yield and type traits. N. R. Zwald* and K. A. Weigel, *UW-Madison, Madison, WI.*

The objective of this study was to determine if differences in heritability and correlation with second-crop evaluations existed between progeny-test environments, and to identify optimal herd characteristics for testing of AI young sires. Without a proper environment, animals may not be given the opportunity to express their true genetic potential and genetic evaluations of sires progeny tested in these environments could be inaccurate. Missing and inaccurate identification adds to this problem in some herds. To examine this problem, data from all first classifications of young sire daughters were examined from 1993 to 2001. Data from 480,927 animals in 20,650 herds from 16,844 AI sires were used for this analysis. Only 254,891 animals (47%) had a sire-identified dam, and only 132,953 (27.6%) had a classified dam. Herd average phenotypic score was divided into three equal groups, defined as high phenotypic average score ($>$ 80 points), intermediate phenotypic average score (74-80), and low phenotypic average score ($<$ 74 points). Correlations between sire PTAT and actual daughter score for the three environments were (0.15, 0.11, 0.09) respectively. Actual daughter classification scores were regressed on sire PTAT to determine the differences between environments. Regression coefficients were (1.05, 0.78, 0.48) respectively. This research shows that there are considerable differences between progeny testing environments and that every effort should be made to progeny test bulls in environments with acceptable herd average phenotypic score. This will allow animals to more fully express their genetic potential. The current situation favors bulls proven in environments with a higher herd average phenotypic score.

Key Words: Progeny test, Type evaluation, Genotype by environment interaction

153 Accuracy of foreign dairy bull evaluations in predicting US evaluations for yield. R. L. Powell*, A. H. Sanders, and H. D. Norman, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA.*

The addition of foreign daughter data to domestic dairy bull genetic evaluations has been shown to improve prediction of future domestic evaluations in a study of mainly US bulls. This study evaluates the accuracy of Interbull evaluations, based only on foreign daughters, in predicting the latest US yield evaluations, based only on US daughters, thus focusing on foreign bulls. February and August Interbull evaluations from 1995 through 2002 were used. For 652 Holstein bulls, the most recent Interbull evaluations solely from foreign daughter data were matched with February 2003 USDA evaluations based only on US daughters, thus providing a pair of evaluations based on different daughters. For the Interbull evaluations, mean reliability on the US scale was 84% and the mean US reliability for February 2003 evaluations was 78%. Correlations between these Interbull and US evaluations were .88, .82, and .88. for milk, fat, and protein, respectively. Interbull evaluations overestimated the US PTA by an average of 34, 0.4, and 0.7 kg, with standard deviations of the difference of 197, 7.5, and 5.5. Considering only those 153 bulls with US reliability of 90% or higher, correlations were similar to those seen overall for milk (.87) and protein (.88), but higher for fat (.87). Expected correlations were .81 for all 652 bulls and .91 for the 153 bulls. Thus, the actual correlations were higher than expected for all bulls but lower than expected for bulls with the highest US reliabilities. For the higher US reliability bulls, Interbull evaluations underestimated milk, fat, and protein by an average of 7, 0.3, and 0.4 kg, respectively, with standard deviations of differences, 167, 6.2, and 4.6. None of these mean differences between evaluations from foreign and US daughters are large and the correlations indicate that Interbull evaluations based solely on foreign daughters are good predictors of the US evaluations for yield.

Key Words: Genetic evaluation, Interbull, Evaluation accuracy

154 Standardization of lactation records for variance of Mendelian sampling to reduce bias in evaluations of bull dams. G. R. Wiggans*, P. M. VanRaden, and J. L. Edwards, *Agricultural Research Service, USDA, Beltsville, MD.*

Evaluations of bull dams may be biased upward because of preferential treatment or contemporaries with extremely low yields. Variance of Mendelian sampling (**MS**) was standardized to determine if such an adjustment of lactation records could improve accuracy of estimated breeding values (**EBV**) of bull dams. For Holstein data included in February 2003 USDA evaluations, MS variances were calculated within herd and 5 yr of first calving group. To regress estimates for small herds, the population estimate was included with a weight of 20. The ratio of the population MS standard deviation to the within herd-5 yr group value was used to adjust phenotypic yields. This ratio was limited to a maximum range of 0.5 to 2.0, with the range further limited based on mean herd yield to avoid over adjustment. To minimize effect of unreliable evaluations of females, MS was calculated using maternal grandsire EBV instead of dam EBV. At each round of iteration, this male index was subtracted from current EBV, and the result was adjusted for amount of information. To assess effect of the MS variance adjustment, EBV were calculated excluding records from calvings after 1997. Means of parent EBV were calculated for recent bulls using subset EBV with and without MS variance adjustment. Correlations (**r**) between February 2003 bull EBV and parent mean for the subset were higher with adjustment. Similarly, regression (**b**) of EBV on parent mean was closer to 1 with adjustment, and mean EBV minus parent mean (bias) was lower. Mean EBV of the top 100 cows was reduced with adjustment. Twenty percent in the top 50,000 cows for milk yield were different with adjustment. The largest drop was 1324 kg EBV. Standardization of MS variance improved accuracy of EBV.

	MS variance adjustment							
Yield	Correlation		Regression coefficient		Bias		Mean EBV of top 100 cows	
trait	No	Yes	No	Yes	No	Yes	No	Yes
Milk	0.773	0.782	0.742	0.787	-75.8	-58.5	2716.2	2565.9
Fat	0.721	0.727	0.693	0.763	-3.3	-2.5	110.3	94.7
Protein	0.807	0.816	0.715	0.779	-2.5	01.9	88.8	77.9

Key Words: Heterogeneous variance adjustment, Evaluation bias, Mendelian sampling

155 Development of a selection index for the Reggiana dairy cattle breed. M. Fioretti[1], V. Palucci*[1], and F. Miglior[2], [1]*Associazione Italiana Allevatori, Rome, Italy,* [2]*Agriculture and Agri-Food Canada, CDN, Guelph, ON, Canada.*

The Reggiana population is a dairy cattle breed reared in the province of Reggio Emilia, located in the Italian Po Valley. Milk from this breed has been mainly used for the production of Parmigiano Reggiano cheese. The Reggiana breed has shrunk from 84,000 cows in 1940 to 200 animals in 1984, having being replaced by much more productive Holstein-Friesian cows. Thanks to government support the breed was recovered in the last two decades, and currently close to 1000 cows are milk recorded. Selection has been based mainly on milk yield and produced moderate genetic progress for production (60 kg milk/yr, 2.5 kg fat/yr and 1.5 kg protein/yr) and phenotypic and genetic decrease for protein percent. In order to invert the negative genetic trend for protein percentage, unsuitable for Parmigiano Reggiano production, a selection index was developed that accounted for milk price for cheese production. The new index with economic weights of -26%, +7% and +67% emphasis for milk, fat and protein yield respectively, was found to increase protein percentage 10-yr genetic progress, and to greatly increase protein yield genetic progress (3.3 kg/yr), leaving milk and fat yields at current levels (61 kg milk/yr and 2.5 kg fat/yr).

Key Words: Dairy cattle, Selection index

156 Analyses of heat tolerance for milk in Holsteins using different sources of heat-stress information. I. Misztal*, S. Oseni, and S. Tsuruta, *University of Georgia, Athens, GA, USA.*

The purpose of this study was to evaluate parameters of alternative models for analysis of test day milk under various levels of heat stress. Data included 81,674 first parity milk test days on 10,162 cows in FL. Also available were daily temperature-humidity indices (THI) from public weather stations in FL. Models included the effects of herd-test day, age class, days in milk class, frequency of calving, and additive and permanent environment implemented as linear random regressions. Models differed by the choice of covariables used in random regressions. The choices were: a) THI during the test day measured at the nearest public weather station, b) average THI across all weather stations for the month of test day, and c) solutions of month of test-day computed in a fixed model. The last model would correspond to a norm reaction model. Lowest production in models a) and b) corresponded to July, and lowest production in model c) corresponded to August-September. Constant terms in the random regression could be interpreted as regular effects, and linear terms as heat-tolerance effects. Genetic correlations between the constant and linear additive effects were -0.42 for a), -0.46 for b), and -0.76 for c). Correlations between additive effects in a) and b) were 0.96 (regular) and 0.94 (heat-tolerance). The same correlations in a) and c) were 0.95 and 0.56. Genetic variance for the heat-tolerance effect corresponding to the peak of heat stress was 20% higher for c) than for b). For genetic analyses of heat tolerance, average monthly THI per state provided comparable information to daily THI from nearby weather stations. The heat tolerance effect in the norm reaction model accounts not only for the effect of heat stress due to current THI, but also for additional factors such as accumulated effects of heat stress or varying forage quality over time.

Key Words: Dairy cattle, Heat stress, Random regression

157 Comparison of Holstein, Holstein-Jersey crossbred, and Holstein-Normande crossbred first-parity cows for milk, fat, and protein production and SCS during the first 150 days of lactation. B. J. Heins[1], L. B. Hansen*[1], and A. J. Seykora, [1]*University of Minnesota, St. Paul.*

First-parity Holsteins (n = 247), Holstein-Jersey crossbreds (n = 97), and Holstein-Normande crossbreds (n = 68) were compared for milk, fat, and protein production and SCS during the first 150 days of lactation. Cows were housed in six commercial dairies in California and calved from June 2001 to December 2002. Dependent variables for analysis were test-day observations from DHI. Independent variables were breed composition (H, HxJ, HxN), random effect of cow within breed composition, stage of lactation (4-30 d, 31-60 d, 61-90 d, 91-120 d, or 121-150 d), herd (1 to 6), milking frequency (2X or 3X), and interaction of breed composition and milking frequency. Breed composition was significantly different for milk and fat production and approached significance for protein production; however, there was not a significant difference of breed composition for SCS. Least-squares means for test-day milk production were 32.7 kg (H), 30.3 kg (HxJ), and 29.1 kg (HxN). For test-day fat production, least-squares means were 1.13 kg (H), 1.20 kg (HxJ), and 1.09 kg (HxN). Least squares means for protein production were 0.96 kg (H), 0.95 kg (HxJ), and 0.93 kg (HxN). Although not significantly different, least squares means for SCS were 2.3 (H), 2.8 (HxJ), and 2.5 (HxN).

Key Words: Crossbreeding, Production, SCS

Dairy Foods: Processed cheese, milk powder, and microbiology

158 Comparison of pilot-scale and RVA process cheese manufacture. L. E. Metzger*, P. Lehtola, and R. Kapoor, *MN-SD Dairy Foods Research Center, University of Minnesota, St. Paul, MN.*

Numerous formulation and processing parameters influence the functionality of process cheese. Consequently it is sometimes difficult to predict the functionality of process cheese based on the formulation used. However, a small-scale manufacturing and analysis method could be used to evaluate the influence of formulation parameters on the functionality of process cheese. The objective of this study was to compare process cheese produced on a small scale (20 g) in a Rapid Visco Analyzer (RVA) to process cheese produced on a pilot-scale (4.5 kg) Blentech twin screw (BTS) cooker. Three different formulation of process cheese (PC) and process cheese food (PCF) were produced in a RVA and in a BTS cooker. Each formulation was produced in triplicate in the RVA and in duplicate in the BTS cooker. In the RVA the temperature of the heating block was maintained at 80°C and the stirring speed was sequentially increased from 0 rpm to 500 rpm in two minutes. The RVA was stopped 1 min or 2 min after an increase in viscosity was observed for the short and long manufacturing profiles respectively. In the BTS cooker each formulation was heated to 80°C in 3 min and held an additional 4 min. A screw speed of 120 rpm or 140 rpm was used for the PC and PCF respectively. Texture profile analysis (TPA) and the RVA melt test were performed on all PC and PCF produced. The formulation used had a significant ($P<.05$) effect on the TPA hardness, hot viscosity, and melt time of the PC and PCF produced in the RVA and in the BTS cooker. However, the PC and PCF produced in the RVA had a significantly ($P<.05$) higher TPA hardness and melt time as compared to PC and PCF produced in the BTS cooker. The RVA manufacturing time (short vs long) did not have a significant ($P>.05$) effect on any parameter for the PCF. However with the PC, the long manufacturing time significantly ($P<.05$) increased hot viscosity and melt time. Future research will focus on identifying RVA manufacturing profiles that produced PC and PCF that matches the functionality of process cheese produced on a pilot scale.

Key Words: Process Cheese

159 Salt whey ingredient. V. V. Mistry* and M. R. Acharya, *South Dakota State University.*

A method for manufacturing a salt whey ingredient (SWI) was developed (patent pending). Approximately 110 of kg salt whey was obtained for each of three replicates from salted curd that had been placed in barrels for draining and separated by centrifugal separation at 35°C. The skimmed salt whey was pasteurized at 63°C for 30 min, cooled to 20°C and condensed in a rising-film single-stage evaporator. The concentrate was spray dried in a single-stage spray drier to 3.3% moisture, 1.97% fat, 10.1% protein, 40.1% salt and 39.8% lactose and used in the manufacture of pasteurized process cheese and cheese spreads. The pasteurized process cheese formulations consisted of a blend of young (1- to 2-mo old) and aged (4- to 6-mo old) Cheddar cheese in equal proportions as follows: control pasteurized process cheese; control with no emulsifier; cheese with 2% SWI; cheese with 1.7% SWI but no emulsifier. For the cheese spread there were two formulations: control Provolone cheese

spread; and Provolone cheese spread with SWI. For cheeses with emulsifier 3% disodium phosphate duohydrate was used. The targeted salt (NaCl) content was 2%. All cheeses were manufactured using a single-auger lay-down cooker with direct steam injection and a batch size of up to 15 kg, packaged in 2-kg containers, sealed and stored upside down at 4°C. Pasteurization was at 74°C for 2 min. All pasteurized process cheeses contained approximately 42% moisture. Cheeses with the SWI were smoother than those without. Cheeses with the SWI but without emulsifier exhibited excellent stretch properties. The pH of cheeses without emulsifier was lower (5.8) than those with emulsifier (6.1) and the SWI had no impact on pH. Cheeses with the SWI and without emulsifier melted more (70 mm) than the corresponding control (64 mm) but the former released more free oil. There were no differences in hardness among cheeses with emulsifier but in the absence of emulsifier, the cheeses with added SWI were softer (10.5 kg) than the controls (15.5 kg). The spreads averaged 57% moisture and the composition of the control and SWI cheeses was similar. The flowing and melting characteristics of cheese with SWI were excellent.

Key Words: Salt whey, Drying, Cheese

160 Comparison of the melting properties of process cheese using a Rapid Visco Analyzer (RVA) and the Schreiber melt test. L. A. Rosenberg* and L. E. Metzger, *MN-SD Dairy Food Research Center, University of Minnesota, St. Paul, MN.*

The melt characteristics of process cheese are an important functional attribute. Currently, there remains a need for a fast, accurate and low cost test to evaluate cheese meltability. The objective of this study was to determine if the RVA melt test could distinguish differences between commercial process cheese samples and to compare this test to the Schreiber melt test. The melt properties of fifty-five commercial process cheese samples from four different manufacturers were analyzed with the RVA and Schreiber melt test. Three replicates using the RVA and five replicates using the Schreiber melt test were performed. In the RVA melt test 15 g of ground cheese and 1 g of propylene glycol were used. The sample was subjected to a heat, holding, cooling profile during continuous mixing, and an apparent viscosity vs. time graph was obtained. The melt time, hot viscosity and solidification time were determined from each apparent viscosity vs. time curve. In the Schreiber melt test, samples with a 34 mm dia. and 7 mm height were placed into a forced draft oven at 100°C for 7 minutes. After removal from the oven the diameter was measured. The RVA melt test had a lower coefficient of variation and of the 55 samples analyzed six had a CV greater than 5 whereas with the Schreiber melt test 50 of the 55 samples had a CV greater than 5. There was low correlation (<.50) between the Schreiber melt test and the individual RVA parameters. Additionally the correlation varied substantially depending on the manufacturer. The lack of correlation between the Schreiber melt test and individual RVA parameters maybe a result of the high CV observed with the Schreiber melt test. Also eight of the samples analyzed had a low Schreiber melt value (< 38 mm) and could not be distinguished, whereas these samples had significantly (P<.05) different RVA melt parameters. These results indicate that the RVA may be a more sensitive technique for measuring meltability as compared to the Schreiber melt test.

161 Effect of rice bran oil as a natural antioxidant on the storage stability of whole milk powder. L. F. Osorio*[1], J. U. McGregor[2], J. S. Godber[3], and N. Y. Farkye[4], [1]*Escuela Agrcola Panamericana, Zamorano, Tegucigalpa, Honduras,* [2]*Food Science and Human Nutrition Dept., Clemson University, Clemson, SC,* [3]*Food Science Dept., LSU Ag Center, Baton Rouge,* [4]*Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.*

As the world economic conditions continue to improve, the demand for whole milk powder (WMP) will continue to increase. There is a need to increase production of WMP to satisfy the U.S. market and enhance potential for export. Autoxidation drastically reduces the shelf life of WMP due to the production of off flavors and odors. The objective of this study was to evaluate the use of rice bran oil (RBO) containing 5 percent oryzanol as an antioxidant in WMP produced using commercial and pilot scale spray drying systems. WMP was obtained by three different drying technologies; commercial spray, pilot spray and pilot pulse. RBO at 0.1 percent w/w of the original milk was added before and after drying in pilot pulse and pilot spray drying and after drying in commercial spray drying. Samples were stored at 45°C for 50 days in an incubator to accelerate oxidation. Samples were tested every 10 days for oxidation progress. RBO proved to be an effective antioxidant regardless of drying method and regardless if RBO was added before or after drying. RBO significantly slowed oxidation as shown by TBARS, peroxide value, and hexanal production. Significantly lower concentrations of malonaldehyde (mg/kg) were obtained when RBO was added before drying, compared to RBO added after drying. Trained sensory panelists were not able to detect the presence of RBO added before or after drying. Small levels of RBO addition have the potential to extend the shelf-life and functional properties of high fat containing milk powders by acting as an antioxidant.

Key Words: Whole milk powder, Oxidation, Rice bran oil

162 Flavor stability of skim and whole milk powder. M. E. Carunchia Whetstine*, M. A. Drake, Y. Karagul-Yuceer, and Y. K. Avsar, [1]*North Carolina State University.*

Skim and whole milk powder (SMP, WMP) are widely used as food ingredients and for direct consumption. Since milk powders may be stored, flavor stability and changes in flavor profiles during storage can impact quality and saleability. Hexanal concentrations have been used to follow quality degradation in milk powders. However, specific sensory changes and other volatile compound changes during storage are not well-characterized. The objectives of this study were to characterize flavor changes in SMP and WMP throughout 1 year storage at 21C using sensory and instrumental methods. Composite 25 kg commercially packaged samples of SMP or WMP (2 bags each) were collected from four different production locations. Powders were shipped overnight and received within 48 h of production. Flavor of rehydrated milk powders was characterized every three months by sensory and instrumental methods. Descriptive sensory analysis (n=7) was used to determine flavor profiles of the milk powders. Solid phase microextraction (SPME) and solvent extraction with high vacuum distillation in conjunction with gas chromatography-olfactometry and gas chromatography-mass spectrometry were used to characterize volatile compounds. Fresh SMP were characterized by cooked and sweet aromatic flavors while WMP exhibited cooked, caramelized, and milkfat flavors. These flavors were linked to specific volatile compounds. A wide variety of aroma-active volatiles were isolated from powders. WMP, in general, exhibited higher intensities of lactones and sugar degradation products (maltol, fureanol). WMP developed grassy, painty, and fatty flavors with storage time; SMP developed cardboard/fatty flavors. Aldehydes increased in SMP and WMP with storage time. Flavor of SMP was more stable than WMP, but flavor and flavor stability differed between the two SMP and the two WMP.

Key Words: Milk powder flavor, Aroma extract dilution analysis, Sensory analysis

163 The effects of composition and processing on milk foaming characteristics as measured by steam frothing. M. Levy[1], J. U. McGregor*[2], and W. Prinyawiwatkul[3], [1]*Chef John Folse and Company, Gonzales, LA,* [2]*Clemson University, Dept. of Food Science and Human Nutrition, Clemson, SC,* [3]*Food Science Dept., LSU Ag Center, Baton Rouge.*

Steam frothing of milk is required to produce an acceptable foam for many espresso coffee drinks (i.e. cappuccinos). Specific aspects of composition and processing may affect the foaming properties of milk. The aim of this study was to determine the effect of fat content, heat treatment, free fatty acid addition and storage time on the frothing properties of milk. The four treatments included: fat content (0.08 percent and 3.25 percent), HTST and Ultra pasteurization temperatures, pre and post-pasteurization addition of lauric acid solution (0.0 percent and 2.0 percent of 0.5 M concentration) and storage time (1 and 10 days). For each treatment, 250 ml of milk was frothed with a Feama Espresso machine (model c85/1) using a 7.5-cm diameter graduated beaker for 25 seconds. Froth characteristics were observed and the steam froth value (SFV), amount of dissipation and foam volume were determined after 5 minutes. The free fatty acid level for all treatments was also determined prior to frothing. There was no significant difference found between day 1 and day 10 for SFV, foam volume, or dissipation when comparing each treatment over time. There was also no significant difference over time based on fat level, pasteurization temperature, or pre pasteurization free fatty acid addition. When total interactions for all treatments over time were observed, there was a significant difference in SFV and FFA level.

There was also a significant difference for all testing procedures between all free fatty acid levels between treatments.

Key Words: Cappuccino, Coffee, Milk

164 Distribution of milk protein at air interfaces in ice cream examined by transmission electron microscopy and immunogold labeling.

H. D. Goff* and Z. Zhang, *University of Guelph, Guelph, ON Canada.*

This study investigated the distribution of β-casein and β-lactoglobulin at air interfaces in ice cream by the combined use of freeze substitution transmission electron microscopy and immunogold labeling. When there was no added emulsifier, the fat globules appeared as discrete with clear dark protein edges and did not directly attach to air interfaces. Air interfaces mainly contained casein micelles, β-casein and a minor part of whey proteins, among which β-lactoglobulin was detected. Dissociation of casein micelles was evident by the presence of free β-casein and deformed casein micelles, especially for those adsorbed to fat and air interfaces. Addition of EDTA to ice cream led to thicker protein lines surrounding fat globules and air bubbles. The fact that less casein micelles but considerable free β-caseins were found adsorbed to either air or fat interfaces indicated more dissociation of casein micelles induced by EDTA. When mono and di-glycerides (MDG) were introduced to ice cream, the protein border between fat globules became discontinuous and partial coalescence of fat took place. Partially coalesced fat, individual fat globules, casein micelles, β-caseins and β-lactoglobulins were found attached directly to air interfaces.

Key Words: Ice cream, Protein, Foam

165 Effect of pH and ionic strength on competitive protein adsorption to air bubbles in aqueous foams made with mixed milk proteins.

Z. Zhang* and H. D. Goff, *University of Guelph, Guelph, ON, Canada.*

Quantitative analysis of competitive milk protein adsorption to aqueous foam was performed by capillary zone electrophoresis (CZE). Foams were made by whipping protein solutions, in which skim milk powder (SMP) and whey protein isolate (WPI) were dissolved in various proportions and with various pH and concentration of NaCl. Adsorption of β-casein into foam phases was most preferential under all solution conditions. Enrichment of caseins into the foam phase was more apparent than that of whey proteins and more so when samples contained less proportion of SMP and more WPI. The foamability of WPI increased when the concentration of NaCl rose from 0 to 0.1 M, and deceased when NaCl concentration increased further. The foamability of SMP demonstrated a continuous improvement when ionic strength increased from 0 to 0.8. NaCl at low concentration (< 0.4 M) did not show significant effect on competitive adsorption among milk proteins, indicating electrostatic interactions do not play a key role in competitive adsorption. NaCl at higher concentration, e.g. at 0.6 M, retarded whey proteins from adsorption to the foam made from 50:50 mixtures of SMP and WPI. The whippability of WPI was highest at pH 4.5 and lowest at pH 3, and that of SMP was exactly the opposite. More α-lactalbumin was adsorbed to foam when the protein solutions were acidified from pH 6.6 to pH 3. The proportions of β-lactoglobulin and α-lactalbumin in the foam phase were obviously higher at basic pH and lower at acidic pH, compared with that at natural pH of WPI. The whippability of SMP was slightly improved when pH of SMP increased to 7 and 8.

Key Words: Protein, Foam, Capillary electrophoresis

166 Elucidation of the mechanisms of casein micelle stabilization by carrageenans extracted from *Gigartina lanceata* red seaweed.

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The stabilization mechanisms of carrageenans on casein micelles were examined using diffusing wave spectroscopy (DWS). Carrageenans were extracted from the male, female, and tetrasphorophyte life-cycles of a red seaweed, *Gigartina lanceata*, native to southern New Zealand. The seaweed was boiled in 0.5M NaCl for 15 minutes, filtered through a coarse cloth and Whatman #113 filter paper (2×), and cooled to 4°C. The carrageenan was precipitated by addition of two volumes of 2-propanol at #18°C to the filtrate, then freeze-dried. Solutions (1%) of isolated carrageenans were prepared and heated at 85°C for 30 minutes to hydrate the polysaccharides before use. Low-heat skim milk powder was hydrated for 12 hours at 4°C and adjusted to pH 5.5 and 6.5. Carrageenans were mixed at concentrations of 0.01% to 0.5% in the 10% skim milk powder solution and the size of casein micelle aggregates measured by DWS. A 1% solution of λ-carrageenan was also prepared and used for comparison. The viscosity of the continuous phase was measured over a shear rate range 10 s^{-1} to 50 s^{-1} after ultracentrifugation of the mixture at 100,000×g for 30 minutes to calculate aggregate size from DWS data. Casein micelle size at both pH values without carrageenan was 200±10 nm. DWS correlation curves suitable for analysis of the casein-carrageenan mixtures at pH 5.5 were obtainable up to 0.5% polysaccharide concentration for male and female extractions, and up to 0.2% for λ-carrageenan. Correlation curves for the mixtures at pH 6.5 were only obtainable up to 0.05% carrageenan. The size of the aggregates increased as the carrageenan concentration increased. Carrageenans are known to adsorb onto the surface of casein micelles, even though both are negatively charged, by interaction with the positively charged section of κ-casein. As the carrageenan concentration increases, bridging of micelles occurs followed by steric repulsion of micelles at higher carrageenan concentration, and finally depletion flocculation at the highest concentration once the micelle surface is saturated with adsorbed carrageenan. The DWS technique is suitable for determining the onset of depletion flocculation from the rapid increase in aggregate size.

Key Words: Carrageenan, Casein micelle, DWS

167 The lactose permease of *Streptococcus thermophilus* is phosphorylated by the doubly phosphorylated form of HPr, a phosphoprotein of the phosphoenolpyruvate:sugar phosphotransferase system.

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Streptococcus thermophilus (*St*) is used to make fermented milk products such as yogurts and cheeses. Lactose, the main sugar in milk, is taken up by *St* via a permease called LacS. The sugar is then hydrolyzed inside the cell into glucose and galactose by the enzyme beta-galactosidase. The glucose moiety is metabolized via the glycolytic pathway, while galactose is released into the extracellular medium. LacS catalyses two modes of transport: proton-motive-dependent symport and lactose/galactose exchange. LacS possesses a hydrophilic carboxyl-terminal domain called IIA^{LacS} that can be phosphorylated on His-552 by HPr(His_{15} P), a phosphocarrier protein of the phosphoenolpyruvate:sugar phosphotransferase system (PTS). Phosphorylation of IIA^{LacS} increases the rate of lactose/galactose exchange and, until now, has been reported to occur only at the expense of HPr(His P). However, streptococcal cells possess significant amounts of a doubly phosphorylated form of HPr, HPr(Ser_{46}-P)(His_{15} P), whose functions remain unclear. The goal of this study was to determine whether IIA^{LacS} of *St* could be reversibly phosphorylated by HPr(Ser-P)(His P). IIA^{LacS} phosphorylation was carried out using [^{32}P]PEP and the following purified proteins: His_6-HPr, His_6-HPr(Ser-P), His_6-EI, and the carboxyl-terminal IIA^{LacS} domain comprising 173 amino acids. Results showed that *St* IIA^{LacS} could be phosphorylated by HPr(His P) and HPr(Ser-P)(His P) at virtually the same rate. Experiments conducted with *Streptococcus salivarius* (*Ss*), a species phylogenetically closely related to *St* that does not expel galactose during growth on lactose, indicate that the rate of *Ss* IIA^{LacS} phosphorylation by *Ss* HPr(Ser-P)(His P), but not by HPr(His P), was higher than the rate of *St* IIA^{LacS} phosphorylation by *St* proteins. Experiments performed with heterologous systems showed that this difference did not result from differences in the amino acid sequences of the HPr proteins. Lastly, we demonstrated that *St* and *Ss* IIA^{LacS} P could transfer their phosphate group to HPr(Ser-P). In conclusion, our results unequivocally demonstrate that both HPr(His P) and HPr(Ser-P)(His P) play a key role in the phosphorylation state of *St* and *Ss* lactose permease.

Key Words: Lactic acid bacteria, Lactose transport, Protein phosphorylation

168 Does brine temperature influence salt uptake by Ragusano cheese? C. Melilli*[1], D. M. Barbano[2], G. Licitra[1], G. Portelli[1], G. Di Rosa[1], and S. Carpino[1], [1]*CoRFiLaC, Regione Siciliana, 97100 Ragusa, Italy,* [2]*Northeast Dairy Food Research Center, Department of Food Science, Cornell University, Ithaca, NY.*

Twenty six 3.8 kg blocks were made on each of 3 different days. A block was analyzed prior to brine salting. Blocks (5) were placed into each of 5 different saturated brines at 12, 15, 18, 21, and 24°C. One block was removed from each brine tank after 1, 4, 8, 16, and 24 d, weighed, sampled, and analyzed for salt and moisture. Weight loss (net of moisture loss and salt uptake), salt uptake, and moisture loss after 24 d increased with increasing brine temperature. Cheese porosity and viscosity of the water phase within the pores influence the rate and extent of salt uptake during 24 d of brining. Previously, lower brine concentration (18 vs 24%) achieved higher surface porosity and faster salt uptake. In the present study, moisture loss occurred from all cheeses at all temperatures, mostly during the first 4 d. Moisture loss decreases surface porosity of the block and forms a barrier to salt penetration. Moisture loss increased with increasing temperature and this decreased surface porosity. If decreased porosity was the only factor influencing salt uptake at various brine temperatures, then the cheeses at higher temperature should have had lower salt content. However, the opposite was true (2.91, 3.05, and 3.36% salt after 24 d of brining at 12, 18, and 24°C, respectively). Brine temperature also influences the viscosity of the aqueous phase of the cheese. The water phase of cheese in lower temperature brine would have higher viscosity and slower salt uptake, even though the cheese at lower brine temperature would have a more porous structure (favoring faster salt uptake) than cheese at higher brine temperature. Therefore, reducing brine concentration at 18°C increased salt uptake by increasing cheese porosity, while decreasing brine temperature decreased salt uptake due to increased viscosity of the water phase of the cheese. Faster salt uptake and lower temperature will help control early gas development.

Key Words: Brine temperature, Salt uptake, Ragusano cheese

169 The influence of native pasture plants on aroma compounds in Ragusano cheese. S. Carpino*[1], S. Mallia[1], S. La Terra[1], G. Licitra[1], P. J. Van Soest[2], and D. M. Barbano[3], [1]*CoRFiLaC, Regione Siciliana, 97100 Ragusa, Italy,* [2]*Department of Animal Science,* [3]*Department of Food Science, Cornell University, Ithaca, NY.*

Raw milk from 13 cows fed TMR supplemented with native pasture and from 13 cows fed only TMR on one farm was collected separately 4 times with an interval of 15 d between collections and 2 blocks (14 kg each) of cheese were made from each milk. Our objective was to determine the influence of consumption of native plants in Sicilian pastures on the aroma compounds present in Ragusano cheese. Qualitative differences in the types of odor active compounds in the cheese were detected using GCO. Out of 31 odor active compounds found in the cheeses, 18 were detected only in cheeses produced from milk of cows consuming pasture. Of the 18 compounds 10 were also found in at least one of 14 plant species selected out of 40 in the pasture. Selected plant species from the genera: Anthemis, Beta, Calendula, Cerinthe, Diplotaxis, Erodium, Euphorbia, Fumaria, Geranium, Malva, Medicago, Rumex, Scorpiurus, and Sinapis were known to be selected by the cows and represented pasture diversity. For example *Calendula arvensis*, a Compositae, was one of the most abundant plants, while *Euphorbia helioscopia*, (well known for secondary compounds) was consumed in small amounts. The following compounds were found in all cheeses produced from milk of cows consuming pasture and not in cheeses from TMR milk (numbers in parenthesis indicate plant species containing the compound out of 14): delta decalactone (14), (E)-2-nonenal (13), (Z)-2-nonenal and citronellol (11), vanillin (9), phenylacetaldehyde (6), 1-carvone (4), ethyl 2-methyl butyrate and (E, E) 2,4 octadienal (2), geranyl acetate (1), while 2,4′decadienal, 3-hydroxy-2-butanone, 2-nonanone, methionol, 2,6-dimethyl pyrazine, dimethyl disulfide, (E)-methyl jasmonate and dodecanal were not found in the 14 plants species. Compounds found uniquely in pasture cheeses, but not found in the 14 plant species may have been present in other pasture plants not analyzed.

Key Words: Aroma, Pasture, Ragusano cheese

170 WITHDRAWN , .

171 Lipolysis and proteolysis within blocks of Ragusano cheese at different brine temperatures. C. Melilli[1], D. M. Barbano*[2], M. Manenti[1], J. M. Lynch[2], S. Carpino[1], and G. Licitra[1], [1]*CoRFiLaC, Regione Siciliana, 97100 Ragusa, Italy,* [2]*Northeast Dairy Foods Reseach Center, Department of Food Science, Cornell University, Ithaca, NY.*

The influence of brine temperature and salt gradients within blocks on lipolysis and proteolysis in Ragusano cheese was determined. Twenty six 3.8 kg blocks (15x15x15 cm) were made on each of 3 d. One block was analyzed prior to brine salting. Five blocks were placed into each of 5 different saturated brines at 12, 15, 18, 21, and 24°C. One block was removed from each brine after 1, 4, 8, 16, and 24 d of brining. Each block was divided into four portions of approximately equal weight representing, sequentially, the exterior surface to the center. Total (copper soap method) and individual (GLC) free fatty acids (FFA) and pH 4.6 and 12% TCA soluble nitrogen (SN) were measured. The pH 4.6 SN (5.12 to 7.37%, 12 vs 24°C) and 12% TCA SN (1.79 vs 4.27%, 12 vs 24°C) as a percent of TN at 24 d increased with brine temperature and they were higher in the block center and lower at the surface at all temperatures. Total FFA content increased with increasing brine temperature (ca. 76 to 221 mg/100 g; 12 vs 24°C) for all portions and the total FFA content across all temperatures was higher at the exterior 25% of the block than the interior 75% (ca. 180 to 115 mg/100 g, respectively) at 24 d. Higher total FFA content at the surface of the block was not expected and was the opposite of the behavior of SN. The average C4 as a percentage of total FFA increased (13.0, 27.9, and 38.2% at 12, 18, and 24°C, respectively) with increasing brine temperature at 24 d. The opposite behavior of total FFA content from the surface (i.e., high salt/low moisture) to the center of the block (low salt/high moisture) vs SN content may be due to a different direct effect of salt on enzyme and substrate interaction during lipolysis or a combination of this effect and movement of low molecular weight water-soluble FFA from the interior to the surface of the block with moisture movement during brine salting.

Key Words: Brine temperature, Lipolysis, Proteolysis

172 Impact of pH during aging on proteolysis, texture and melting characteristics of Mozzarella cheese. M.A.S Cortez[1], M. M. Furtado[1], M. L. Gigante[2], and P. S. Kindstedt*[3], [1]*Federal University of Vicosa/CAPES, MG/Brazil,* [2]*State University of Campinas, Campinas, SP/Brazil,* [3]*University of Vermont, Burlington, VT/USA.*

Previous studies demonstrated that the calcium distribution and apparent viscosity of newly made and aged Mozzarella cheeses were altered when the pH was altered using a novel post-manufacture approach. This study evaluated the effect of pH modulation on the proteolysis, unmelted texture and melting characteristics of Mozzarella cheese during aging. On four separate occasions, cultured LMPS Mozzarella cheeses were obtained from a commercial producer on the day after manufacture. Cheeses were sectioned into samples that were randomly assigned to two groups. Samples in Group 1 were shredded, subdivided, and exposed to either ammonia vapor to increase the pH by ca. 0.3 pH units or HCL vapor to decrease the pH by ca. 0.2 pH units. The samples were then vacuum packaged, stored at 4°C, and analyzed for pH 4.6 and 12% TCA soluble N, apparent viscosity, free oil and water soluble calcium on d 5, 12, 22 and 40. Group 2 samples were exposed to either ammonia vapor to increase the pH by ca. 0.6 pH units or HCL vapor to decrease the pH by ca. 0.25 pH units. The samples were then vacuum packaged, stored at 4°C for 15 d to allow the pH within samples to equilibrate, and then analyzed for TPA hardness and springiness, meltability, and pH 4.6 and 12% TCA soluble N on d 17, 29 and 41. Data were analyzed by ANOVA according to a spilt-plot design. Increasing the pH resulted in significantly higher TPA hardness and apparent viscosity and lower meltability and water soluble calcium values throughout aging. Decreasing the pH had the opposite effects. The rate of increase in pH 4.6 and 12% TCA soluble N during aging was not significantly affected by pH treatment. Thus, differences in cheese pH did not affect proteolysis rates over the ranges studied during 40 d of storage at 4°C. The significant

effects of pH on hardness, meltability and apparent viscosity were presumably caused in part by the observed pH-dependent changes calcium distribution.

Key Words: Mozzarella cheese, Functionality, pH

173 Purchasing and consumption behaviors, attitudes and expectations of Taiwanese urbanites toward cheese. I. M. Tsai* and M. R. McDaniel, *Oregon State University*.

Purchasing and consumption behaviors, attitudes and expectations of Taiwanese urbanites toward cheese were investigated. Four focus groups involving a total of 25 international Taiwanese students were conducted first, followed by a consumer survey in which 793 native Taiwanese urbanites participated. The focus group results provided good predictions and explanations of survey findings. Both studies found that in Taiwan cheese was treated as an ingredient in foods and that subjects lacked knowledge about cheese. Taiwanese consumed cheese at restaurants more frequently than at home. Chinese culture played an important role in subjects?attitudes and behaviors relating to cheese. Sensory, health and usage concerns, packaging, and marketing factors influenced purchasing decisions. A moderate cheese price, low fat, low cholesterol, high calcium, and individually wrapped slices were expected by subjects. Important sensory expectations were the presence of stringiness (appearance and texture) and creaminess (aroma) and the absence of oiliness (appearance and flavor), stickiness (appearance) and bitter and sour aftertaste. Finally, suggestions were offered to assist successful cheese export to the integrated Chinese marketplace, a high potential import market in Pacific Rim Asia.

Key Words: Taiwanese, Cheese consumption, Expectation

174 Gas chromatographic profile of volatiles in cheese induced by different fat globule surface coatings. D. W. Everett*[1], J. Crownshaw[1], A. Ginestet[2], M. Leus[1], and J.-P. Dufour[1], [1]*University of Otago, Dunedin, New Zealand,* [2]*Ecole nationale superieur de biologie applique a la nutrition et l'alimentation, Dijon, France*.

The effect of fat globule coating material on the production of volatile compounds in cheese slurries was examined by solid phase microextraction (SPME) coupled with gas chromatography (GC)-flame ionization detection and mass spectrometry. To prepare the slurries, skim milk was concentrated 2.5× by ultrafiltration. Anhydrous milk fat (40°C) or soy oil (room temperature) was homogenized at 75 MPa with casein, two types of spray-dried commercial buttermilk powder, or freeze-dried milk fat globule membrane (MFGM) isolated by ultracentrifugation of fresh buttermilk. The emulsions or the control cream sample were added to concentrated skim milk to form slurries with a fat to casein ratio of 4:3. *Mucor miehei* rennet protease was added to a second series of otherwise identical slurries. The slurries were cultured with *Lactobacillus bulgaricus* and *Streptococcus thermophilus* at 31°C until pH 5.5 was reached, then stored at 12°C until GC analyses at 30 and 120 d. Duplicate samples were heated at 50°C for 60 min to extract low boiling point compounds in the headspace by adsorption onto carboxen/polydimethylsiloxane SPME fibers.
Standard plate count of the four milk powders used for emulsifying the fat in the slurries was less than 10^3cfu/g at 32°C. Sensory analysis showed that the cream control slurry had a yogurt and cheese aroma with slight lipolytic overtones. The MFGM slurry had a low acid cheese aroma. The two buttermilk and the casein slurries had no detectable cheese aroma. GC analysis showed that 3-hydroxy-2-butanone and octanol were only detectable in the cream control. Compounds not detectable in the cream control, but present in the other slurries, included butanal, 2-heptanol, 2-octenol, 2,4-heptadienal, and 1-octen-3-ol. Compared to the others, the MFGM slurries contained a higher concentration of 2,3-pentadione and 2-heptanol whereas hexenal was not detectable. Benzaldehyde was only detectable in the cream and MFGM slurries. Nonanol was not detectable in the cream or MFGM slurries. The rennet protease had no significant effect on GC peak profiles of homogenized slurries. One factor in the development of cheese volatiles is evidently the nature of the fat globule membrane.

Key Words: Gas Chromatography, Cheese, Flavor

175 Impact of milk preacidification with carbon dioxide on the proteolysis of Cheddar cheese. B. K. Nelson* and D. M. Barbano, *Northeast Dairy Foods Research Center, Cornell University*.

In previous work, milk preacidification with citric and acetic acids increased proteolysis in Mozzarella cheese during storage. Our objective was to preacidify cheese milk, but not have residual acetic or citric acid in the cheese. Half of the pasteurized whole milk was injected with CO_2 in-line after the cooling section of the pasteurizer. The amount of added CO_2 was about 1600 ppm. Cheddar cheese was produced three times with a milled curd process. Make procedure, starter and coagulant addition, and rate of salt application were the same for both treatments. No effect of treatment on cheese moisture (grand mean = 37.25%) was detected, but salt content was higher and calcium lower ($p \leq 0.05$) for the CO_2 treatment. Both pH 4.6 and 12% trichloroacetic acid (TCA) soluble nitrogen (SN) increased with age for both treatments. Cheese made from CO_2 treated milk had a higher ($p \leq 0.05$) amount of pH 4.6 SN as a percentage of TN (e.g., 18.57 vs. 16.41% at 3 mo) indicating a greater extent of primary proteolysis. An increase ($p \leq 0.05$) in TCA SN was also observed (e.g., 8.33 vs. 7.68% at 3 mo). More proteolysis was observed for the CO_2 cheese, in spite of its higher ($p \leq 0.05$) salt-in-the-moisture (5.96 vs. 3.92%). The protein content of the expressible serum (ES) removed from the control and CO_2 curd prior to salting was not different, but the protein content of the ES was higher (3.05 vs 5.67%) for CO_2 cheeses immediately after pressing. No difference in intact casein content (by SDS-PAGE) of the ES from curd prior to salting was detected, but immediately after pressing the amount of intact casein in the ES (removed at 25°C) was higher for the CO_2 cheeses. Several factors may have increased primary proteolysis in the CO_2 cheeses:1) higher chymosin retention due to lower whey draining pH, 2) the lower calcium content in the cheese (2.08 vs. 2.82%), and 3), the higher casein content in the water phase of the cheese providing a greater accessibility of casein to chymosin.

Key Words: Proteolysis, Carbon Dioxide, Cheddar

176 Impact of preacidification of milk with carbon dioxide on composition and yield of Cheddar cheese. B. K. Nelson* and D. M. Barbano, *Notheast Dairy Foods Research Center, Cornell University*.

Work done previously in our laboratory with preacidification of milk for Mozzarella cheese with acetic and citric acids demonstrated that preacidification altered the serum phase of the cheese. The intent of this investigation was to achieve a similar change in the serum phase of the cheese without residual citric or acetic acid in the cheese. Two vats of milled curd Cheddar were made in the same day with and without CO_2 added to the milk. CO_2 was injected in-line after the cooling section of the pasteurizer. The mean level of added CO_2 in the cheese milk was about 1600 ppm. All cheese making conditions were kept the same for the two treatments to determine the effect of added CO_2 on milk component recoveries and yield. Weights of the pasteurized milk, whey, salt whey, and cheese were recorded and the compositions determined for three days of cheese making. The pH of whey at draining was lower for the CO_2 treatment (5.96 vs. 6.35). Total make time (rennet addition to milling at pH 5.3) was shorter for the treatment compared to the control (161 vs.176 min). No differences in cheese moisture and protein content were detected, but cheeses made with CO_2 treatment had lower ($p \leq 0.05$) fat and calcium content and higher salt (2.24 vs. 1.44%) and pH (5.08 vs. 5.00). The amount of salt added per weight of curd was the same for both treatments but the retention of salt was much higher in the CO_2 treatment. No significant difference due to CO_2 was detected in total accountability for fat, protein, calcium and total solids or protein recovery in cheese. There was a lower ($p \leq 0.05$) recovery of fat and calcium in the cheese made from milk with added CO_2 (87.57 vs. 93.08% and 43.56 vs. 59.75%, respectively). The lower recovery of calcium was expected due to the difference in pH of the whey at draining. The decrease in cheese yield efficiency due to higher fat and mineral loss in whey caused by the use of CO_2 was estimated to be 4.4 and 0.3%, respectively.

Key Words: Cheese Yield, Cheddar, Carbon Dioxide

177 Effect of supplemental dietary fish oil and soy oil on production and composition of milk and properties of butter from cows with low and high atherogenic index . G. Bobe*[1], S. Zimmerman[1], E. G. Hammond[1], A. E. Freeman[1], D. H. Kelley[1], J. Dedrick[1], P. A. Porter[2], C. M. Luhman[2], and D. C. Beitz[1], [1]*Iowa State University,* [2]*Land O'Lakes.*

The atherogenic index (AI), defined as AI = [%C12:0 + 4 × %C14:0 + %C16:0] ÷ [Σ%unsaturated fatty acids], characterizes the atherogenicity of dietary fats. Fats with higher AI-values are assumed to be more detrimental to the human health. Previously, we demonstrated that properties of butter differ between cows on the same diet that produce milk fat with high and low AI. Butter from low AI milk fat was more spreadable. The objective of this experiment was to determine whether the difference in properties of butter as well as the production and composition of milk of cows with high and low AI can be affected differently by feeding additional dietary fish oil and soy oil. These diets have been shown previously to decrease the AI of milk fat. A 3×3 latin square design with one replication in summer and one in fall was used. Holstein cows (60-200 days in milk) that produced before the treatment period milk fat with low AI (n=6) and high AI (n=6) were fed for three 3-week feeding periods with either a control diet (3.66% fat) or diets that contained additionally 1% fish oil and 1% soy oil as roasted beans, respectively. Feed intake and milk production was recorded during the third week on each diet. Milk samples were collected twice during the third week and analyzed for milk fat, protein, lactose, total solids, somatic cell count, and fatty acid composition. Furthermore, butter was made and analyzed for penetration distance and creep. Cows preselected for a low AI of milk fat maintained a lower AI than did cows with a high AI ($P \leq 0.05$). Feeding additional soy oil decreased the AI and increased the penetration distance in comparison to the control diet ($P \leq 0.05$), whereas feeding additional fish oil had no significant effect ($P \geq 0.05$). Feeding additional soy oil and fish oil increased numerically the difference in the response of AI and penetration distance, but the interactions were not statistically significant ($P \geq 0.05$). Dry matter intake, milk production, and milk composition were not affected by AI or diet ($P \geq 0.05$). We conclude that feeding additional soy oil and selecting cows with low AI act additively to produce a lower saturated milkfat that can be used to produce a more spreadable butter.

Key Words: Atherogenicity, Butter, Soy oil

Forages & Pastures: Silages, forage composition

178 Evaluating chemical characteristics of mixed corn plant and tomato pomace silage using experimental silos. R. Tahmasbi[1], B. Saremi*[2], and A. Naserian[2], [1]*Dasht dairy farm, Neyshabour, khorasan, Iran.,* [2]*Ferdowsi university of Mashhad, khorasan, Iran.*.

The aim of this study was to compare chemical characteristics of mixed silages (corn plant with various amounts of wet tomato pomace) and to examine whether corn plant will ferment properly with various amount of wet tomato pomace or not. Whole corn plants were chopped from a single field and mixed with 0(T1), 7.5(T2), 15(T3) and 100(T4)% (DM basis) wet tomato pomace and ensiled in 5-gallon plastic containers. The silos were packed with a hydraulic press, which permitted all silages to be made at similar densities. All containers were opened 60 days later and dry matter (DM), pH, ammoniated nitrogen (N-NH3), crude protein (CP), ASH, calcium (Ca), phosphorus (P), Acid detergent fiber (ADF), Neutral detergent fiber (NDF) were measured. Tomato pomace used in this experiment had 40.1±6.13%(DM-basis) seed. Data were analyzed using General Linear Models procedures of SAS v6.12 for ANOVA to evaluate differences among experimental groups. The design was completely randomized (equal replicates). Means were compared with Duncan test. Data showed that there was no difference for DM, NDF, Ca and P among treatments (P = 0.36, 0.09, 0.15 and 0.38 respectively). However, CP, Ash, ADF (P < 0.0001) and pH (P < 0.02) showed significant differences among treatments. Based on the results of this experiment, it seems that tomato pomace could increase crude protein of silage significantly without any reduction in the quality of silage fermentation and could reduce pH of silage to some extent because of its high concentration of organic acids.

Items	T1	T2	T3	T4	SEM
DM%	28.62^a	27.80^a	27.87^a	24.9^a	0.88
CP%	8.47^c	9.73^b	10.5^b	19.4^a	0.18
Ash%	7.63^a	7.55^a	7.38^a	5^b	0.18
Ca%	1.14^a	1.16^a	1.04^a	0.92^a	0.04
P%	0.48^a	0.55^a	0.30^a	0.30^a	0.07
ADF%	33^b	34^b	32^b	49.5^a	0.45
NDF%	61^{ab}	61.25^{ab}	57.5^b	63^a	0.82
pH	3.86^b	3.89^b	3.87^b	3.99^a	0.02
N-NH3(mg/dl)	10.32^a	10.51^a	10.43^a	3.11^b	0.05

Key Words: Tomato pomace, Corn silage, Experimental Silos

179 Chemical characteristics of alfalfa silage treated with urea and sulfuric acid. E. Khafipour, M. D. Mesgaran*, and F. E. Shahroudi, *Ferdowsi University of Mashhad,Mashhad,IRAN.*

This study was conducted to determine whether the addition of urea and/or sulfuric acid to alfalfa before ensiling would alter fermentation patterns. Second cut alfalfa (about 27% DM) was harvested, left for 8 h untill got 33% DM, then ensiled with urea (0.0 and 1% of DM) and/or sulfuric acid (0.0,0.3,0.9,1.5 and 2.1% of DM) in a complete randomized design, using small laboratory silos (4 silos per each treatment). The Chemical composition of silages was determined by the standard procedures, 45 days after ensiling. pH and N-NH3 were determined in the each silage extraction, CP and NPN in dry samples. Alfalfa silages containing urea, compared with the others, had significantly higher pH (4.28 vs 4), CP (205.9 vs 177.9 g/kg, DM) and NPN (18.7 vs 15.8 g/kg, DM)for 0.0,p< 0.05. Using sulfuric acid caused to decrease pH(4.6 vs 3.56)and N-NH3 (13.56 vs 8.18 mg/dl), but increased CP (183.4 vs 197.5g/kg) for 0.0 and 2.1% sulfuric acid respectively(p< 0.05). It has been indicated that urea, as an additive, for alfalfa silage, increased pH,CP and NPN. The effects of urea are relevant to its chemical composition as a source of nitrogen; On the other hand urea reduced heating,discoloration and visible molds in silage. Simultaneously use of urea and sulfuric acid decreased pH to the optimal range. It seems that positive effect of acid on CP content is relevant to its prohibitive function on proteins degradability in silage. Reduction in N-NH3 content of the acid treated silages is another reason for prohibitory function of acid on proteins degradation to soluble nitrogen and increasing of protein efficiency in silage. So, it has concluded that sulfuric acid can be used as a good preservative in alfalfa silage.

Key Words: Alfalfa silage, Additives, Chemical composition

180 Effect of hybrid, stage of maturity and use of silage innoculants on dry matter yield, nutritional value and digestibility of corn silage. L. O. Burciaga-Robles*, O. Ruiz-Barrera, C. Arzola-Alvarez, A. Grado-Ahuir, and Y. Castillo, *Universidad Autónoma de Chihuahua, Facultad de Zootecnia. Secretaría de Posgrado e Investigación.*

Two corn hybrids (Golden Harvest EX313 and H216) selected for high grain and high DM yield were harvested at two different stages of maturity (1: one third milkline or 2: two third of the milkline from the top of the kernel). The objective of this experiment was to evaluate the corn hybrids to determine potential differences in nutritive value of whole plant corn silage. Hybrids were grown in 2 plots of 5 Ha each in Bachniva, Chihuahua, Mexico on April 2001, harvested, and translated to the University Animal Nutrition Research Laboraory for evaluation. Samples of the plots were ensiled with or without corn silage inoculants (Control, Sill All® , Bio Sile®, and Urea) on 2 kg lab scale silos. Whole plant samples of EX313 had a lower (P < 0.05) percentage of DM content on the early harvest date, but no differences (P > 0.05) were detected on the late harvest date. Silage made from EX313 had a lower (P < 0.05) pH and CP. Silage made from H216 had lower values (P < 0.05) of lignin , IVDMD , and lactic acid. No significant differences were found on NDF, ADF, hemicelulose , or cellulose. Inoculation drastically affected the pH and lactic acid content of corn silage. There was no difference (P > 0.05) between Control, Sill All, and Bio Sile on pH values for early and late harvest. The pH values for Urea-inoculated corn silage were higher (P < 0.05) for early and late harvest for EX313 and H216. Also, the lactic acid content was higher (P < 0.05) for silage inoculated with Sill All versus the other treatments for both hybrids and

maturities. No other measures of nutritional value were affected by the silage inoculants. The hybrids evaluated in this study affected DM, CP, IVDMD, and lignin of corn silage and the use of all silage inoculants except urea imrproved the pH and lactic acid content of corn silage.

Key Words: Corn silage, Hybrids, Silage innoculants

181 Practical methodology for applying edible coverings to bunker silos. L. L. Berger* and J. R. Sewell, *University of Illinois-Urbana.*

The goal of this research was to develop a commercially feasible application method to cover bunker silos with an edible covering. In addition to easy application, the edible covering must provide effective protection, be a source of essential nutrients, be palatable, and cost effective. In previous research a starch-salt matrix had been applied by hand using a cement trowel. The previous formulation had a bread dough consistency, and had to be reformulated so that it could be sprayed. Also wheat flour was replaced with wheat ground through a 0.48 cm screen. A commercial CEJCO concrete pump, model CSS 2489 with a vertical shaft mixer and screw pump was used in this experiment. This unit was chosen because it could be powered by the hydraulic system of a farm tractor. A commercial air compressor was used to atomize the matrix as it was sprayed on the bunkers. The starch-salt matrix was applied at 30.3% moisture with a targeted thickness of 1.5 cm. Six mini-bunker silos 2.14 X 7.32 m with a packed limestone base and plywood walls were used. Approximately 5727 kg of chopped alfalfa (48.4% DM) were packed into each of six silos. The chopped alfalfa was packed with a small tractor and lawn roller. The three treatments were, uncovered, 6-mil polyethylene plastic (weighted with 15 cm corn forage), or covered with the sprayed starch-salt matrix. After the starch-salt matrix was applied an edible wax emulsion was sprayed on the covering to seal it. The silos were sealed on August 3 and opened beginning November 17, 2002 after 106 days of ensiling. When the silos were opened the starch-salt matrix was removed from the surface of the silage. The covering was fed at 2.5% of a corn silage-haylage diet for growing heifers without refusal. Samples of ensiled forage were collected from depths of 0-12.7, 12.8-25.4 and 25.5 to 38.1 cm and analyzed for percent ash and sodium. The percent ash and sodium for the three depths under the starch-salt matrix were 14.48, 12.36 12.06, and 1.15, 0.145, and 0.145, respectively. The fresh forage averaged 10.5% ash and 0.034% sodium. These sodium levels help preserve the silage immediately under the covering. This formulation and concrete pump combined proved to be an effective application method.

Key Words: Bunker silo, Edible covering, Concrete pump

182 Production response of lactating dairy cows to corn silage harvested from different varieties at different cutting heights. J. K. Bernard*[1], J. W. West[1], D. S. Trammell[1], and G. H. Cross[1], [1]*The University of Georgia, Dept. of Animal and Dairy Science.*

The objective of this trial was to determine the effect of variety and cutting height on the production response of lactating cows fed diets based on the resulting silage. Treatments were arranged as a 2 x 2 factorial to provide two corn varieties and two cutting heights. Two corn varieties (Pioneer 31G20 and 32K61) that had similar ratings for yield and nutrient content but differed in digestibility ratings were planted at a seeding rate of approximately 69,000 plants per ha on March 22, 1999. Corn within each variety was harvested on July 8 and 9, 1999 using a conventional pull type chopper at either 10.2 (LOW) or 30.5 (HI) cm cutting height. Corn was packed in a 2.4 m plastic bag and allowed to ensile. Minor differences were observed in the chemical composition (DM basis) of corn silage due to cutting height which averaged 26.4 and 25.07% acid detergent fiber (ADF), 46.0 and 44.9% neutral detergent fiber (NDF), and 67.9 and 68.5% in vitro true dry matter (DM) digestibility (IVTDMD) for LOW and HI, respectively. The DM yield at harvest was reduced by approximately 10.4% for HI compared with LOW. Four experimental diets were fed to 32 lactating Holstein cows in a 6 wk randomized design trial. Corn silage provided 40.6% of the DM in each of the experimental diets. There was an interaction ($P < 0.01$) between variety and cutting height due to higher intakes with 31G20 LOW and 31K61 HI. Milk yield and composition was not different among treatments and averaged 37.2 kg/d milk, 3.94% milk fat, and 3.17% milk protein. Apparent total tract digestibility was determined during the last week of the trial. Digestibility of ADF was higher ($P < 0.03$) for 31G20 than 32K61. An interaction was observed for DM ($P < 0.01$), CP ($P < 0.04$), ADF ($P < 0.07$) and NDF ($P < 0.07$) due to higher digestibility coefficients for diets containing 31G20 LOW and 31K61 HI compared to the other treatments. Although differences have been observed in the in vitro and in situ digestibility of corn varieties, no advantage was observed in milk production and composition among varieties reported to differ in nutrient digestibility in the current study. Although cutting height reduced the fiber content and increased IVTDMD of the resulting silage, no clear advantage was observed for increasing cutting height.

Key Words: Corn silage, Milk yield, Nutrient digestibility

183 Effect of crop maturity and processing of whole plant corn forage at harvest on nutrient composition and particle size distribution. K. W. Cotanch*[1], T. R. Pouliot[1], E. D. Thomas[1], C. S. Ballard[1], J. W. Darrah[1], P. Mandebvu[1], H. M. Wolford[1], C. J. Sniffen[1], and T. Sato[2], [1]*W.H. Miner Agricultural Research Institute, Chazy, NY 12921,* [2]*Zennoh National Federation of Agricultural Co-operative Associations, Tokyo, Japan.*

A Pioneer hybrid, (38K06; RM 93 d) was planted on May 4, 2001 on four plots, harvested at three stages of maturity (30%, 35%, and 40% theoretical whole plant DM content), and processed using three chopping methods: (1) chopped at 0.95-cm theoretical length of cut (TLC) and unprocessed; (2) chopped at 1.91-cm TLC and processed with 3 mm roll clearance; and (3) chopped at 1.91 cm TLC and processed with 1-mm roll clearance. Chopped forages were analyzed for particle size distribution using the Penn State Separation method. Fractions from each sieve were weighed, dried at 60C to determine percent particle distribution on DM basis. Physically effective NDF (peNDF) was determined as percentage of dry forage retained on a 1.18-mm screen. Forage samples (200 g) were weighed, dried, and separated into three categories: (1) whole kernels, with no visible damage or fragmentation; (2) fragmented kernels $\geq$ 2 mm; and (3) fragmented kernels $<$ 2 mm. Fractions were expressed on DM basis. In summary, processing increased proportion of fine particles and broken kernels, decreased medium particles and peNDF, but had no effect on coarse particles. Increase in maturity increased proportion of fine particles and peNDF and decreased medium particles but had no effect on coarse particles. Maturity by processing interaction showed that kernel breakage was increased without reducing whole forage peNDF when DM of forage was 40% and 1 mm processor roll clearance was used.

Fresh Whole Plant Composition (% of DM)	30% DM	35% DM	40% DM	SE	*P*-value
Actual DM	31.1c	34.2b	43.6a	0.41	<0.001
CP	6.96b	7.45a	6.70b	0.09	0.001
ADF	25.8a	23.4b	26.0a	0.61	0.017
NDF	43.9	41.2	43.7	0.70	0.052
Acid detergent lignin	3.25a	2.71b	3.10ab	0.16	0.045
Nonfiber carbohydrates	40.7	42.9	41.1	0.66	0.106
Particle Size Distribution (% of DM)					
> 19 mm	8.9	10.0	10.0	0.53	0.767
8 - 19 mm	61.8a	59.8a	55.1b	1.19	0.003
< 8 mm	29.3b	30.2b	34.9a	1.13	0.002
peNDF	88.1b	90.9a	91.0a	0.40	0.004

Particle Size Distribution (DM basis)	Unprocessed	3 mm	1 mm	SE	*P*-value
> 19 mm, %	9.3	10.8	8.8	0.53	0.368
8 - 19 mm, %	64.5a	56.3b	55.7b	1.19	<0.001
< 8 mm, %	26.2b	32.9a	35.5a	1.13	<0.001
peNDF, %	93.7a	88.3b	88.1b	0.40	<0.001
Total grain fractions, %	37.9a	30.7b	30.2b	1.70	0.006
Whole kernels, % of grain	17.0a	3.5b	1.2b	1.00	<0.001
Fragmented kernels ≥ 2 mm, % of grain	77.8b	84.3a	85.1a	0.70	0.006
Fragmented kernels < 2 mm, % of grain	5.2b	12.2a	13.6a	0.70	<0.001

Key Words: Crop maturity, Processing, Particle size distribution

184 Chloride fertilization of corn grown for silage affects mycotoxin concentrations. D. P. Casper*[1], D. Spangler[1], D. Schauff[1], G. Clark[2], and D. T. Wicklow[3], [1]*Agri-King, Inc., Fulton, IL,* [2]*University of Illinois Extension,* [3]*USDA-ARS, Peoria, IL.*

Dairy cattle fed mycotoxin contaminated forages can experience many different performance problems. *Fusarium* (FUS) molds can invade forages in the field up to feeding by producing the mycotoxins zearalenone and vomitoxin. Chloride (Cl) fertilization is reported to increase plant disease resistance. To evaluate if Cl fertilization of corn could reduce mycotoxin concentrations in silage, 4 application rates of Cl (0, 56, 112, and 224 kg/ha) and 2 FUS challenge rates (non-inoculated versus inoculated) were arranged in a 4 by 2 factorial design. Three blocks of 8 treatments were randomly assigned to plot sizes of 4.6 m^2 with buffer zones of 1.5 m. The corn variety was Syngenta® N48V8 planted at the rate of 12,141 kernels/ha. Potassium chloride was applied within 3 d of planting, while FUS challenge was accomplished by inserting non-cultured and cultured (Fusarium *graminearum*) toothpicks into ears at mid-silk and the corn plants were harvested for silage 30 d later. Corn plants were harvested by hand, chopped, and silage packed into sealed mini silos. Silos were stored for 60 d and then subjected to nutrient and mycotoxin analyses. Chloride fertilization resulted in a significant (P<.01) linear increase in Cl concentrations of corn silage (.20, .30, .38, and .52% DM, respectively for 0, 56, 112, 224 kg Cl/ha). An interaction of Cl x FUS was detected (P < .02) for zearalenone, but the interaction was nonsignificant (P>.10) for vomitoxin. When corn was inoculated with FUS, zearalenone concentrations (303, 237, 75, and 106 ppb) were greatest for 0 kg/ha Cl and lowest for 112 kg/ha Cl (P<.05). The main effect of Cl demonstrated greater (P<.05) vomitoxin concentrations (3.66, 5.11, 1.78, and 3.41 ppm) for 56 than 112 kg/ha with other Cl rates being intermediate. *Fusarium* molds have high protease, amylase, and cellulose activities which resulted in greater (P<.05) digestibility of NDF (52.6 and 55.0%) and DM (65.9 and 66.9%) compared to no inoculation. Application of Cl to corn can increase corn silage Cl concentrations. Higher Cl concentrations improved disease resistance of corn, which resulted in lower zearalenone and vomitoxin concentrations in the silage. The influence of mycotoxins on dairy cattle performance could be reduced by greater application rates of Cl to crops grown for forage.

Key Words: Chloride, Fusarium, Mycotoxin

185 Effect of endophyte type on adipose tissue fatty acid composition from beef cattle grazing tall fescue. C. E. Realini*, S. K. Duckett, N. S. Hill, J. R. Sackmann, M. H. Gillis, and K. R. Smith, *The University of Georgia, Athens.*

Adipose tissue fatty acid composition was evaluated from 14 Hereford steers grazing tall fescue infected with either wild-type (TOXIC, n=6) or novel, non-toxic (MAXQ, n=8) endophyte for 135 d. Steers were harvested at a commercial meat plant, the ribeye roll and the clod removed and transported to the UGA. The fatty acid profile of the subcutaneous (SQ), intramuscular (IM), and ground beef (GB) fat was determined by GLC. Data were analyzed as a 2 x 3 factorial with endophyte type treatment, adipose tissue site, and two-way interaction in the model. Interactions between adipose tissue and endophyte type were not significant (P > 0.05) with the exception of myristoleic (P < 0.05, C14:1). TOXIC and MAXQ had similar (P > 0.05) content of C14:1 in GB and SQ, whereas C14:1 was higher (P < 0.05) in the IM from MAXQ than TOXIC. Total lipid content was unaffected (P > 0.05) by endophyte type. Adipose tissues from TOXIC cattle had higher (P < 0.05) proportions of stearic, and lower (P < 0.05) proportions of palmitoleic and oleic acids than MAXQ. The percent of saturated fatty acids (SFA) was higher (P < 0.05) and monounsaturated fatty acids (MUFA) lower (P < 0.05) for TOXIC than MAXQ. Endophyte type did not alter (P > 0.05) the percent of polyunsaturated fatty acids (PUFA) and total conjugated linoleic acid (CLA), or the polyunsaturated:saturated (P:S) and omega-6:omega3 (n-6:n-3) fatty acid ratios. However, MAXQ tended (P < 0.10) to have a higher proportion of CLA isomer c9t11 than TOXIC (9.8 vs. 8.4 mg CLA/g lipid). GB and IM had higher (P < 0.05) concentrations of SFA, MUFA, and CLA c9t11; and lower (P < 0.05) concentrations of PUFA and P:S ratio than SQ fat. Presence of alkaloids in SQ fat from TOXIC cattle was detected by ELISA. Adipose tissues from TOXIC cattle showed greater degree of saturation and accumulation of alkaloids than MAXQ. Fescue toxicosis appears to influence fatty acid metabolism, which may be involved in the occurrence of fat necrosis. Finishing cattle on tall fescue pastures showed potential to enhance the fatty acid profile of beef including CLA and omega-3 fatty acids from a human health perspective.

Key Words: Tall fescue, Endophyte, Fatty acids

186 Stage of maturity, time of sampling, and method of drying effects on forage quality of Haybet barley. L.M.M. Surber*, S. D. Cash, J.G.P. Bowman, and K. M. Rolfe, *Montana State University, Bozeman, MT 59717.*

Forage barley varieties are an increasingly important crop in Montana accounting for 15.2 % of the barley varieties grown. Approximately half of Montana grain hay production comes from barley. The objective of this research was to evaluate method of sample drying, stage of maturity and time of sampling effects on forage quality of Haybet barley. Haybet barley was grown under irrigated conditions in 2002 near Bozeman, MT. Forage clip samples (5 cm) were collected at the boot (B) and water early-milk stage (W) of maturity. At each stage of maturity samples were collected in the morning (AM) and evening (PM) of two consecutive days. Clip samples were divided into two aliquots that were either freeze-dried (FD) with liquid nitrogen or oven dried (OD) at 60C in a forced air oven. At each stage, time, and drying method three replicates were taken. Each sample (n = 48) was ground through a 5-mm screen and evaluated for in situ DM disappearance (ISDMD) at 48 h. A sub-sample was ground through a 1-mm screen and evaluated for DM, NDF, ADF, CP, and NO_3-N. Stage of maturity affected ($P < 0.01$) all forage quality parameters. Neutral detergent fiber was 4.8% greater ($P < 0.01$) at W stage of maturity when compared to B stage of maturity (54.43 vs. 51.95%, respectively). Nitrate concentration was 45% lower ($P < 0.01$) at the W stage of maturity when compared to B stage of maturity (0.140 vs. 0.253%, respectively), however it was unaffected ($P > 0.10$) by time of sampling or method of drying. Crude protein content was 53% lower ($P < 0.01$) at W when compared to B stage of maturity (11.86 vs. 18.14%, respectively). Acid detergent fiber was 3.2% lower ($P = 0.08$) at PM than at AM (30.43 vs. 31.44%, respectively). In situ DMD tended to increase ($P = 0.11$) at PM compared to AM (76.45 vs. 75.21%, respectively). Freeze drying decreased ($P = 0.05$) ADF content by 3.6% when compared to OD (30.36 vs. 31.51%, respectively). Freeze drying increased ($P < 0.01$) ISDMD at 48 h, in contrast to OD (77.18 vs. 74.49%, respectively). Stage of maturity greatly affected forage quality of Haybet forage barley. Haybet cut in the evening tended to yield hay that was lower in ADF and higher in digestibility. Freeze or oven drying were equally effective methods of sample preparation for nitrate concentration determination.

Key Words: Haybet barley, Stage of maturity, Method of drying

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188 Effects of n-6/n-3 fatty acid ratios in young pig diets on performance and immune function. T. A. Meyer*, M. D. Lindemann, S. T. Franklin, M. L. Vickers, H. J. Monegue, and G. L. Cromwell, *University of Kentucky, Lexington, KY.*

Weanling pigs (n=36, 24 d of age, and 6.6 kg BW) were used in a 7-wk experiment to evaluate the effects of three dietary n-6/n-3 fatty acid ratios (n6/n3) on performance and immune function. Three diets contained either 5% menhaden oil, corn oil, or a combination resulting in n6/n3 ratios of 0.8, 6.7, and 39.8, and 1.0, 7.4, and 43.5 for the 4-wk nursery and 3-wk grower phases, respectively. Diets contained 1.22 and 0.95% lysine for the nursery and grower, respectively, and other nutrients met or exceeded NRC (1998) requirement estimates. Pigs were allotted two per pen minimizing weight and age differences across pens within a block. Pig weights and feed intake were recorded weekly. Colorimetric lymphocyte proliferation assays were performed prior to and 4 wk after treatment allotment. Plate conditions were 1 x 10^6 cells/ml, with 6.8% autologous serum, 16, 32, and 64 μg/ml for concanavalin A and 1, 5, and 25 μg/ml for pokeweed mitogen (PWM). Additionally, a primary and secondary killed H1N1 influenza A vaccination was administered after 2 and 5 wk with serum specific antibody analyzed at Wk 2, 5, and 7. ADG and ADFI (0.58 and 1.04 kg, respectively) did not differ ($P > 0.10$) among dietary treatments. However, a linear tendency ($P < 0.07$) in F/G occurred with increasing n6/n3 (1.79, 1.76, and 1.83, respectively). No lymphocyte proliferation differences among treatments occurred ($P > 0.10$) in response to either mitogen. However, lymphocyte proliferation decreased ($P < 0.01$) from Wk 0 to Wk 4 in cultures stimulated with 1 (1.30 and 1.17, respectively) and 5 (1.34 and 1.17, respectively) μg/ml PWM. Only the secondary vaccination produced detectable antibody to the influenza vaccine with no differences ($P > 0.10$) among dietary treatments. The dietary n6/n3 did not influence ADG, ADFI, lymphocyte proliferation, or humoral immune response but tended to improve F/G with declining n6/n3 in the diet.

Key Words: Pigs, Fatty acids, Immunity

189 Inclusion of oat hulls in diets for piglets based on native or cooked cereals. E. Lopez[1], M. A. Latorre[1], D. G. Valencia[1], R. Lazaro[1], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid. Spain.*

A trial was conducted to study the influence of main cereal (50% rice vs 50% corn), heat-processing of the cereal portion of the diet (native vs cooked at 97 ± 2 °C for 45 min), and inclusion of cooked oat hulls (0 vs 2%) on nutrient digestibility and productive performance of young pigs weaned at 21 d of age. Each treatment was replicated six times (five piglets penned together) and the trial lasted 35 d. The experimental diets were formulated to have similar nutritive value and were supplied in meal form. They contained 12% full-fat soybeans, 5 to 8% fish meal, and 20% milk products but no antibiotics were included. Apparent faecal nutrient digestibility was determined at 33, 43, and 49 d of age using 0.5% celite as additional indigestible marker. From 21 to 49 d of age piglets fed rice ate 20.5% more feed ($P < 0.001$), grew 19.1% faster ($P < 0.001$), tended to have less incidence of diarrhoea ($P = 0.12$), and had similar feed conversion than piglets fed corn. The improvements in feed intake and daily gains observed were maintained at 56 d of age. Cooking the cereal portion of the diet did not affect piglet performance at any age. From 35 to 49 d of age, the inclusion of 2% oat hulls in the diet reduced feed intake ($P < 0.05$) and tended to improve feed conversion ($P < 0.10$) but no significant effects were detected at 56 d of age. Digestibility of organic matter and gross energy did not differ markedly with age but was higher for rice than for corn diets. Nitrogen retention, however, was not affected by main cereal of the diet. Also, oat hull inclusion tended to reduce nutrient digestibility ($P < 0.10$) but heat processing of the cereal did not have any effect. It is concluded that the use of rice in substitution of corn improves nutrient digestibility and piglet performance and that the inclusion of moderate amount of oat hulls does not impair productivity and in fact might improve feed conversion in early stages of piglet life.

Key Words: Oat hulls, Piglet performance, Cooked cereals

190 Oat hulls in diets for young pigs based on cooked rice or corn without antibiotics. F. Martin[1], M. A. Latorre[1], J. M. Gonzalez-Alvarado[1], R. Lazaro*[1], and G. G. Mateos[1], [1]*Universidad Politcnica de Madrid. Spain.*

A trial was conducted to investigate the influence of cereal source (53% of cooked and rolled corn vs cooked rice) and inclusion of cooked oat hulls (0, 2, and 4%) on productive performance, apparent faecal nutrient digestibility of nutrients, and incidence of diarrhoea in piglets weaned at 20 d of age. Each treatment was replicated eight times (five piglets penned together) and the trial lasted 34 d. From 20 to 41 d of age, piglets were fed their respective experimental diets that included 13% full-fat soybeans, 8% fish meal, and 15% milk products without terrestrial animal proteins or antibiotics. The corn and rice used were cooked at 97 ± 2 C for 45 min (Amandus Kahl). From 41 to 54 d of age, all piglets received a common starter diet based on corn, barley, and soybean meal. Digestibility of nutrients was determined at 27 and 37 d of age using 0.5% celite as additional indigestible marker. From 21 to 41 d of age, piglets fed rice ate 15.0% more feed ($P < 0.01$) and grew 12.3% faster ($P < 0.05$) but had similar feed conversion than piglets fed corn. Most of the improvement in productive performance observed with rice feeding at 41 d were maintained at the end of the trial (659 and 623 g/d for feed intake; $P < 0.01$, and 447 and 418 g/d for daily gains; $P < 0.01$, for rice and corn diets, respectively). In general, digestibility of nutrients (organic matter, gross energy, NDF, and ether extract) increased with age and was higher for rice than for corn diets but nitrogen retention was not affected by main cereal used. Increasing the level of oat hulls in the diet did not affect performance or nutrient digestibility but reduced the incidence of diarrhoea from 21 to 41 d of age ($P < 0.05$). We conclude that cooked rice is an ingredient of choice in feeds for young pigs. Also, the use of moderate amounts of oat hulls might help to reduce the incidence of diarrhoea without impairing nutrient digestibility or piglet performance.

Key Words: Cooked cereals, Oat hulls, Piglet performance

191 Rice vs wheat feeding and protein level of the diet on performance of piglets from 10 to 16 kg BW. J. Bonet[1], J. Coma[1], M. Cortés[2], P. Medel[2], and G.G. Mateos*[3], [1]*Vall Companys Group, Spain,* [2]*Imasde Agropecuaria, S.L., Spain,* [3]*Universidad Politécnica de Madrid, Spain.*

The use of feeds without antibiotics has resulted in an increase in the incidence of diarrhoea in piglets. Two possibilities to improve productivity are the inclusion of more digestible cereals and the reduction in the protein content of the diet. Two trials were conducted to evaluate the influence of cereal (cooked wheat *vs* cooked rice) and protein level of the diet (LP, 15,5 %; HP, 21%) on performance of piglets from 46 to 63 d of age. The origin of the piglets was a farm with high (trial 1) or low (trial 2) health status. In each trial 416 piglets weaned at 21 d and distributed in the replicates at 25 d were used. Each treatment (2 x 2 factorial) had four replicates of 25 piglets. All diets contained 2.5 Mcal NE/kg and 1.38 % total lysine and were based on soybean meal, soy oil, and 60 to 74 % cooked cereal. Data were analyzed by GLM procedure of SAS using body weight at 25 d post weaning as a covariate. In trial 1 piglets fed rice diets ate more (588 *vs* 513 g/d; $P < 0.01$), grew faster (400 *vs* 339 g/d; $P < 0.01$), and had better feed conversion (1.47 *vs* 1.55 g/g; $P < 0.05$) than piglets fed wheat diets. Piglets fed HP diets ate more (569 *vs* 532 g/d; $P < 0.01$), grew faster (413 *vs* 326 g/d; $P < 0.01$), and had better feed conversion (1.37 *vs* 1.65 g/g; $P < 0.01$) than piglets fed LP diets. In trial 2, piglets fed rice grew faster (349 *vs* 317 g/d; $P < 0.01$) than piglets fed wheat, but no differences were observed for feed conversion. Also, piglets fed HP diets grew faster (379 *vs* 286 g/d; $P < 0.01$) and had better feed conversion (1.37 *vs* 1.60 g/g; $P < 0.01$) than piglets fed LP diets. An interaction cereal x protein level of the diet was observed for productive traits in both trials: the beneficial effects of HP diets were more evident in piglets fed wheat than in piglets fed rice ($P < 0.01$). We concluded that rice could be used advantageously in diets for piglets. Also, the use of 21% CP instead of 15.5% CP is recommended in diets for piglets of this age.

Key Words: Piglet performance, Cooked cereals, Protein level

192 Impact of spray-dried bovine serum on mortality and performance of turkeys challenged with *Pasteurella multocida*. J. M. Campbell*[1], J. D. Quigley[1], L. E. Russell[1], and L. A. Koehnk[2], [1]*APC, Inc., Ames, IA*, [2]*ARKO Laboratories, Ltd., Jewell, IA*.

Nicholas turkey poults (n = 80; 1 d of age) were allotted to a 2 x 2 factorial design. Treatments consisted of 1) challenge or no challenge and 2) Innavax® (INX; spray-dried bovine serum) treated water or untreated water. Tap water was mixed with 0 or 1.30, 0.65, 0.325, and 1.30% (wt/wt) INX on d 0-7, 8-14, 15-21, and 22-49, respectively. Water was mixed daily and provided ad libitum. Poults were fed commercial turkey starter and grower feed ad libitum. Poults were challenged on d 35 by swabbing the tonsils with 3.0 x 10^8 cfu of *Pasteurella multocida* Type III. Intake (feed and water), BW gain, feed efficiency and mortality were determined. Consumption of INX (d 0 to 7) increased ADG ($P < 0.03$), water intake ($P < 0.10$), and feed efficiency ($P < 0.10$); while total BW gain and feed intake were unaffected ($P > 0.10$) by treatment. No treatment differences ($P > 0.10$) were noted in ADG, total BW gain, feed or water intake, and feed efficiency from d 0 to 35. After the challenge (d 35), INX did not impact ($P > 0.10$) ADG, water or feed intake; while INX increased total BW gain ($P < 0.10$) and gain/feed ($P < 0.003$). Innavax improved ($P < 0.03$) survival (d 35 to 49) of challenged poults (94.1% survival) compared to challenged poults consuming untreated water (63.2% survival). These data suggest that the addition of INX to drinking water systems will increase ADG, water intake, and feed efficiency of poults the first week post placement. Furthermore, addition of INX to drinking water reduces mortality in turkeys exposed to *Pasteurella multocida*.

Key Words: Turkeys, Serum, Pasteurella multocida

193 Effects of different levels of spray dried egg and lactose on the performance of weaned pigs. C. M. Shao*[1], B. G. Harmon[2], and M. A. Latour[2], [1]*Wellhope Agri-Tech Co., Beijing China*, [2]*Purdue University, West Lafayette, IN*.

Spray Dried Egg (SDE) is an alternative source of immuno-globulin in phase 1 diets for weaned pigs. Three trials were conducted to study the effects of feeding SDE to pigs weaned at less than 18 days of age. In the first two trials, SDE was fed at 0 or 5% in diets containing a constant level of ME, lysine, methionine/cystine, threonine and tryptophan. Diets contained a constant amount of dried whey, poultry by-product meal (trial 1), meat and bone meal (trial 2) and fish meal. In the first trial, 168 pigs and in trial 2, 140 pigs were weaned at 14 to 18 days of age, blocked by weight, and randomly allotted to treatment in 10 day trials. Daily gain (ADG) was significantly greater in pigs receiving 5% SDE (243 g/day vs. 204 g/day in trial 1 and 204 g/day vs. 181 g/day in trial 2, $P<.05$). Feed intake (FI) was significantly greater in pigs receiving 5% SDE (236 g/day vs. 204 g/day in trial 1 and 263 g/day vs. 253 g/day in trial 2). Feed efficiency (FE) was not different between treatments. In trial three, SDE and lactose were added at 1:3 ratios to provide 0, 5, and 10% of the mixture to a basal diet containing 5% whey in treatments 1, 2 and 3. Whey was omitted in fourth diet containing 15% of the combination, SDE/lactose. The trial was conducted for 14 days each in phase 1 and phase 2 with 160 pigs used in the study. In phase 2, diets contained either 5% dried whey or 5% SDE/lactose. During phase 1, ADG improved from diet 1 to 4 (60.4, 64.9, 79.9, and 79.0 g, respectively $P<.05$), when lactose and SDE levels were increased. FE was not different across treatments. There were no differences in gain or efficiency when the SDE/lactose combination was fed at 10% of the diet compared to 15% SDE/lactose and removal of dried whey from the diet. The 5 heavy weight replications had much greater ADG compared to the 3 light weight replications (70.8 vs. 40.9, 76.3 vs. 45.4, 94.0 vs. 84.4, 88.1 vs. 63.6 g, respectively). Performance was greatest in pigs receiving 10% of the SDE/lactose combination. The addition SDE alone or in combination with lactose improved the performance of weaned pigs.

Key Words: Spray-dried egg, Lactose, Pigs

194 Effect of the substitution of feed growth promoter by plant extracts on the performances of broilers. D. Eclache*[1] and M. Besson[2], [1]*GENUOL*, [2]*PHODE, France*.

The protection of the consumers imposes the reduction if not the suppression of numerous growth promoters in broiler feeds. The effect of incorporating a product based on natural plant extracts (Oléobiotique®; OLEO, Phodé, France) on growth performance, was evaluated on yellow Ross broilers during the rearing period up to slaughter (39 days). The trial took place on a french research farm with high health status. Dietary treatments were: a positive control using the growth promoter avilamycine at 10 ppm (CON+); an OLEO group at 0.1% and a negative control without additives (CON-). Chicks (n=1500) were alloted to 5 pens per treatment with 100 chicks per pen (50 males, 50 females). During the fattening period, the growth rate was improved with OLEO compared to CON- ($P<0.10$, Table 1). There was no significant difference among the 3 diets for feed conversion rates during the 39-day period. In this trial, the supplementation of the feed with a plant extract allowed to obtain a significant increase in growth rate compared to the unsupplemented group and similar perfomance compared to the growth promoter group.

Table 1: Effect of a herbal extract product on the performance of broilers.

Period	Measure	CON+	CON-	OLEO	P-value
1-7 day	ADG, g/d	13.3^a	14.3^b	14.9^b	0.01
1-7 day	FCR	0.97^b	0.86^a	0.89^a	0.01
1-14 day	ADG	21.3^a	21.2^a	22.9^b	0.01
1-14 day	FCR	1.29	1.29	1.27	ns
1-27 day	ADG	40.0^a	40.0^a	42.1^b	0.01
1-27 day	FCR	1.58^b	1.56^{ab}	1.53^a	0.05
1-34 day	ADG	50.7^{ab}	49.5^a	51.4^b	0.10
1-34 day	FCR	1.60	1.62	1.62	ns
1-39 day	ADG	51.7^{ab}	50.3^a	51.9^b	0.10
1-39 day	FCR	1.78	1.79	1.80	ns

ns: non significant (P>.10). a,b: value with the same superscript did not differ (P>0.10).

Key Words: Broiler, Plant extract, Growth promoter

195 Bioefficacy of *B. coagulans* in broiler and piglet diets: a comparative study. E. Esteve[1], A. E. Espinel[2], C. Piñeiro[3], J. Gasa[4], M. Cortes[5], and P. Medel*[5], [1]*IRTA, Spain*, [2]*Norel, Spain*, [3]*PigCHAMP, Spain*, [4]*UAB, Spain*, [5]*Imasde Agropecuaria, Spain*.

Two trials were performed to determine the efficacy of dietary supplementation with the probiotic *B. coagulans* CECT 5940 containing 10^9 UFC/g on performance of both broilers and piglets. In Trial one (T1), 576 male chickens were used and there were four treatments, a control diet based on barley, corn and soya, and three levels of inclusion of the probiotic: 10, 100 and 1000 g/t. The experimental unit was a flat deck battery cage containing 12 chicks, and there were 12 reps per treatment. The experimental design was applied to a grower (0 to 21 d) and a finisher diet (21-42 d), both in mash form. In Trial two (T2), 300 piglets were used and there were three treatments, a control diet, and two levels of inclusion of the probiotic: 100 and 1000 g/t. The experimental unit was a pen containing 10 pigs, and there were 10 reps per treatment. The feeding program consisted of a Prestarter diet from weaning at 21 to 40 d, based on cooked corn, barley, soya and milk products and a Starter diet from 40 to 74 d, based on corn, barley, wheat and soya, being the experimental design applied to both pelleted diets. Both experiments were analyzed as a completely randomized block design by using the GLM procedure of SAS. In T1, feed efficiency was significantly improved by the probiotic inclusion from 21 to 42 d, and for the overall period (1.803, 1.786, 1.783 and 1.782 g/g for 0, 10, 100 and 1000 g/t of probiotic, respectively, $P<.05$). In T2, piglets fed the diet supplemented at the dose of 1000 g/t showed better feed conversion than remaining treatments, both in the Starter and in the overall period (1.51, 1.52 and 1.47 for 0, 100 and 1000 g/t of probiotic, respectively, $P<.05$). In conclusion i) the probiotic *B. coagulans* CECT 5940 improved feed conversion in both broilers and piglets, ii) the feed conversion improvement was found for the second and for the overall period in both trials.

Key Words: Probiotic *B. coagulans*, Piglets, Broilers

196 Effects of antibiotics and a heat-stable yeast product in diets for weanling pigs. N. Llanes*, J. D. Hancock, C. L. Jones, and C. W. Starkey, *Kansas State University, Manhattan*.

A total of 192 pigs (average initial BW of 6.8 kg and 21 d of age) were used in a 35-d experiment to determine the effects of a heat-stable yeast product on growth performance of nursery pigs fed diets without and with antibiotics. There were six pigs per pen and eight pens per treatment. Treatment diets were formulated to: 1.7% lysine, 0.9% Ca, and 0.8% P for d 0 to 7; 1.5% lysine, 0.8% Ca, and 0.7% P for d 7 to 21; and 1.3% lysine, 0.75% Ca, and 0.65% P for d 21 to 35. Treatments were arranged as a 2 x 2 factorial with main effects of antibiotic (without and with carbadox at 55 g/metric ton) and yeast (without and with 0.2% of the heat-stable yeast product). All diets had 3,000 mg/kg total Zn for d 0 to 7 and 250 mg/kg total Cu for d 7 to 35. For d 0 to 7 and 7 to 21, the diets were pelleted and for d 21 to 35, the diets were fed in meal form. Feed and water were consumed on an ad libitum basis throughout the experiment. Rate of gain was greater ($P < 0.01$) in pigs fed the antibiotic for d 0 to 21 and overall (d 0 to 35). Also, the antibiotic improved efficiency of gain for d 0 to 7 and 0 to 21 ($P < 0.04$). However, there were no effects of the yeast product on growth performance ($P > 0.15$) and there were no interactions among antibiotic and yeast additions in any phase of the experiment ($P > 0.08$). In conclusion, the antibiotic was effective as a non-specific growth promoter but the yeast product had minimal effect on growth performance of nursery-age pigs.

						P<		
Item	No AB/ No Yst	No AB/ Yst	AB/ No Yst	AB/ Yst	SE	AB	Yst	AB x Yst
d 0 to 7								
ADG, g	324	330	339	347	15	ns	ns	ns
ADFI, g	284	318	294	295	11	ns	0.15	0.18
G/F, g/kg	1,141	1,038	1,153	1,176	35	0.04	ns	0.11
d 0 to 21								
ADG, g	420	419	453	462	10	0.002	ns	ns
ADFI, g	470	489	498	492	12	ns	ns	ns
G/F, g/kg	894	857	910	939	18	0.02	ns	0.08
d 0 to 35								
ADG, g	517	516	531	544	7	0.01	ns	ns
ADFI, g	679	696	702	714	10	0.06	ns	ns
G/F, g/kg	761	741	756	762	12	ns	ns	ns

Key Words: Pigs, Antibiotics, Yeast

197 Efficacy of Bio-Mos® in the nursery pig diet: A meta-analysis of the performance response. J. C. Miguel*, S. L. Rodriguez-Zas, and J. E. Pettigrew, *University of Illinois at Urbana-Champaign, Urbana, IL/USA*.

A meta-analysis of all available data was conducted to evaluate the efficacy of Bio-Mos® on immediate post-wean, nursery pig performance. Fifty five comparisons from 29 separate experiments and 21 research teams were utilized in the analysis. When Bio-Mos®, a mannan oligosaccharide product (Alltech Inc.), was supplemented in the nursery diet there was an overall improved response ($P<0.01$) in growth rate (4.15%), feed intake (2.08%) and feed efficiency (-2.34%) compared to the performance of pigs fed a control diet. Several production factors were incorporated as independent variables into a statistical model with dependent variables of percentage response of growth measures to Bio-Mos®, to identify factors that affect the response to Bio-Mos®. The ADG response to Bio-Mos® was similar in publicly available data (5.44%) to that in the data from Alltech's files (3.34%), so all further analyses were done with the full data set. Growth rate of control pigs during the first 7 to 15 days after weaning was taken as an imperfect indicator of health. Pigs that grew more slowly during this period (less healthy pigs) responded more sharply ($P<0.01$) to Bio-Mos® (data shown as early ADG, g/% response in overall ADG: <180/7.18%; 180-280/2.67%; >280/1.50%). The ADG response also suggests that Bio-Mos® is most effective during the first four weeks post weaning (6.68%) compared to dietary inclusion longer than four weeks (2.98%). In addition, the ADG response to Bio-Mos® is larger in pigs weaned at an early age of 17-18 d (6.25%) compared to those weaned at 20-21 d (4.72%) and 24-28 d (3.51%). The optimal concentration of Bio-Mos® in the nursery diet could not be determined. The ADG response to Bio-Mos® was similar in the presence (4.80%) or in the absence (4.87%) of antibiotics in the diet, with the response being additive when Bio-Mos® was supplemented in combination with antibiotics. These data indicate that Bio-Mos® supplemented to the diet of nursery pigs can improve their growth performance.

Key Words: Mannan oligosaccharide, Nursery pigs, Performance

198 Use of fermented soybean meal in nursery diets. S. W. Kim, R. L. McPherson*, and F. Ji, *Texas Tech University*.

One hundred ninety two nursery pigs were weaned on d 19.2±0.2 and allotted into one of three dietary treatments: CON (control), FS3 (soybean meal fermented by Aspergillus Orizae, replacing 3% of normal soybean meal), and FS6 (replacing 6%). Fermented soybean meal contained live Aspergillus Orizae from the fermentation process. The CON contained 21% soybean meal and the FS3 and FS6 replaced soybean meal with fermented soybean meal by 3 and 6%, respectively. All diets contained 15% dried whey, 3% plasma protein, and 51% corn providing 1.43% lysine and 3.28 Mcal/kg ME. Each treatment had 8 replicates with 8 pigs per pen-replicate. Pigs were fed the experimental diets for 4 wk. Weight and feed intake of pigs were measured weekly. Diarrhea score was measured daily during the first 14 d. Pigs fed the FS3 tended to grow faster ($P = 0.062$) than pigs fed the CON during the wk-1. There was no difference in feed intake of pigs among the treatments during the wk-1. Gain/feed of pigs fed the FS3 and FS6 was greater ($P < 0.05$) than that of pigs fed the CON during the wk-1. During the wk-2 and -3, pigs fed the FS3 and FS6 had a greater ($P < 0.05$) gain/feed than pigs fed the CON whereas there was no difference in ADG of pigs among the treatments. Pigs fed the CON had a greater ($P < 0.05$) feed intake than pigs fed the FS3 and FS6 during the wk-2. During the wk-1 to -3, pigs fed the CON had a greater ($P < 0.05$) feed intake than pigs fed the FS6 whereas ADG of pigs was the same among the treatments. Pigs fed the FS3 and FS6 had a greater ($P < 0.01$) gain/feed than pigs fed the CON during the same period. During the wk-4, there was no difference in gain/feed, ADG and feed intake among the treatments. During the entire experimental period (wk-1 to -4), pigs fed the FS3 and FS6 had a greater ($P < 0.01$) gain/feed than pigs fed the CON. However, there was no difference in ADG and feed intake of pigs among the treatments during the entire experimental period. Pigs fed the CON had a higher ($P < 0.05$) incidence of diarrhea than pigs fed the FS3 during the wk-1 whereas there was no difference during wk-2. In conclusion, the use of fermented soybean meal with Aspergillus Orizae replacing conventional soybean meal up to 6% in nursery diets can improve growth performance and reduce the incidence of diarrhea.

Key Words: Nursery pigs, Growth, Fermented soybean meal

199 Use of probiotics and fermented soybean meal in lactation diets. J. Fei* and S. W. Kim, *Texas Tech University*.

Forty primiparous lactating sows and the litters were used to determine the effect of dietary supplementation of probiotics and fermented soybean meal on lactation performance. Primiparous sows were moved to individual farrowing crate on d 105 of gestation and allotted to one of four dietary treatments: CON (control), PA (probiotics-A containing Aspergillus Orizae, supplemented 0.2%), PB (probiotics-B containing Aspergillus Orizae and Bacillus Sp, supplemented 0.2%), and FS (fermented soybean meal by Aspergillus Orizae, replacing 2% of normal soybean meal) based on their body weight on d 105 of gestation. Fermented soybean meal contained live Aspergillus Orizae from the fermentation process. Sows received the experimental diets from d 105 of gestation until the weaning on d 21 of lactation. All lactation diets contained 17.5% CP (0.94% lysine) and 3.28 ME Mcal/kg. Sows were fed 2 kg/day until farrowing and fed ad libitum during lactation. Litter size was set to 10 pigs within 48 h postpartum (10.3±0.4). Weight and backfat of sows and weight of litters were measured weekly until weaning. Feed intake of sows was measured daily. All the litters were weaned on d 21 of lactation and sows were returned to gestation stalls. Numbers of days return to estrus were measured. Voluntary feed intake of sows did not differ among the treatments (5.64±0.19 kg/d). Weight gain of nursing pigs from the FS sows tended to be higher than that from the PA sows ($P = 0.061$). However, there was no difference in weight gain of nursing pigs between the CON and other treatment groups. Weight loss of the FS sows (6.7 kg) during the 21-d lactation was lower ($P < 0.05$) than that of the CON sows (16.6 kg). Weight loss of the PA and PB sows did not differ from that of the CON sows. Greatest difference ($P < 0.05$) in weight loss between the FS sows and the CON sows happened during the third week of lactation. Changes in backfat thickness of sows among the

treatments were not different during the lactation. The numbers of days return to estrus of sows among the treatments were not different. This study indicates that the use of fermented soybean meal with Aspergillus Orizae in lactation diet improved the performance of primiparous sows by decreasing body weight loss during lactation whereas the use of probiotics was not beneficial.

Key Words: Lactating sows, Probiotics, Fermented soybean meal

Physiology: Estrous synchronization

200 A comparison of the MGA® Select and 7-11 Synch protocols to synchronize estrus in postpartum beef cows. J. E. Stegner*, F. N. Kojima, M. R. Ellersieck, M. F. Smith, and D. J. Patterson, *University of Missouri*.

This experiment compared progestin-GnRH-PGF$_{2\alpha}$(PG) based protocols for estrus synchronization in postpartum beef cows. Cows were assigned by age, body condition score (BCS), and days postpartum (dpp) to one of two treatments. The MGA® Select treated cows (T1; n=109) were fed melengestrol acetate (MGA; 0.5mg·hd^{-1}·d^{-1}) for 14 d, injected with GnRH (100 μg i.m. Cystorelin) 12 d after MGA withdrawal, and PG (25 mg i.m. Lutalyse) 7 d after GnRH. The 7-11 Synch treated cows (T2; n=111) received MGA for 7 d, PG on day 7 of MGA, GnRH 4 d after PG, and PG 7 d after GnRH. Mean BCS (4.7 $\pm$ 0.1, T1; 4.7 $\pm$ 0.1, T2) and dpp (41 $\pm$ 1, T1; 41 $\pm$ 1, T2) did not differ (P $>$ 0.1) between treatments. Blood samples were collected 8 d and 1 d prior to MGA to determine pretreatment cyclicity [progesterone, P_4 $>$ 1ng/mL; 10/109 (9%), T1; 12/111 (11%), T2; P $>$ 0.1] and again on the day of PG to predict treatment response [81/109 (74%), T1; 84/111 (76%), T2; P $>$ 0.1]. Serum concentrations of P_4 at PG differed (P $<$ 0.01) between treatments [3.3 (T1) vs. 1.7 (T2) ng/mL]. Heat Watch® was utilized for 7 d after PG to detect estrus and AI was performed 12 h after the onset of estrus. Estrous response was similar (P $>$ 0.1) between treatments [100/109 (92%), T1; 101/111 (91%), T2]. The mean interval to estrus (65 $\pm$ 2 h, T1; 52 $\pm$ 2 h, T2) and synchrony of estrus (analyzed by ratio of variance, F-test) differed (P $<$ 0.01) between treatments. Synchronized conception and pregnancy rates [61/100 (61%), 61/109 (56%), T1; 71/101 (70%), 71/111 (64%), T2] and final pregnancy rate [97/109 (89%), T1; 98/111 (88%), T2] did not differ (P $>$ 0.2) between treatments. This study demonstrates that estrous response and fertility are similar among cows assigned to the MGA® Select or 7-11 Synch protocols. Synchrony of estrus, however, may be improved following treatment with the 7-11 Synch protocol. These data will be used to facilitate methods of fixed-time AI in beef cattle. (Supported by grants from Select Sires, Inc., and USDA-NRI 2000-02163.)

Key Words: Estrus synchronization, Progestin, GnRH

201 A comparison of two fixed-time AI programs for postpartum beef cows. F. N. Kojima*, J. E. Stegner, J. F. Bader, D.J. Schafer, R. L. Eakins, M. F. Smith, and D. J. Patterson, *University of Missouri*.

The objective of this study was to compare two fixed-time AI protocols for postpartum beef cows. Cows at two locations (location 1, n = 113; location 2, n = 95) were stratified by age, days postpartum (dpp), and body condition score (BCS), and randomly assigned to one of two fixed-time AI protocols. The two treatments included: 1) 7-11 Synch (n = 103: cows were fed melengestrol acetate [MGA; 0.5mg·hd^{-1}·d^{-1}] for 7 d followed by prostaglandin F$_{2\alpha}$ [PG: 25 mg i.m. Lutalyse] on d 7 of MGA, GnRH [100 μg i.m. Cystorelin] on d 11, and PG on d 18, with fixed-time AI 60 h after the last PG and GnRH at AI); and 2) CO-Synch plus EAZI-BREED^{TM} CIDR (CIDR: n = 105: GnRH was administered at the time of CIDR insertion [CIDR was in place for 7 d], PG was administered at the time of CIDR removal, with fixed-time AI 48 h after PG and GnRH at AI). One AI sire was used for all inseminations. Pregnancy rate to fixed-time AI was determined by ultrasonography between 50 and 60 d after AI. Quantitative data were analyzed by ANOVA and qualitative data were compared by Chi-square and logistic regression analyses. There were no differences attributed to location for any of the variables considered in the analyses. Results were, therefore, pooled for the respective treatments. Mean age (5.8 $\pm$ 0.2 vs. 5.8 $\pm$ 0.2), dpp (50.3 $\pm$ 1.7 vs. 51.5 $\pm$ 1.7), and BCS (5.6 $\pm$ 0.1 vs. 5.6 $\pm$ 0.1) were not different (P $>$ 0.10) between the 7-11 Synch and CO-Synch plus CIDR groups. Pregnancy rate to fixed-time AI did not differ (P $>$ 0.10) between the 7-11 Synch (65/103, 63 %) and CO-Synch plus CIDR (58/105, 55 %) groups. These data indicate that the 7-11 Synch and CO-Synch plus CIDR protocols provide significant opportunity to AI cows at a fixed time with resulting high fertility, eliminating the need to detect estrus. Duration of treatment and cost of these protocols provide flexibility for beef producers in choosing the protocol that matches a specific management scenario. (Supported by USDA-NRI 2000-02163)

Key Words: Beef Cows, Estrus Synchronization, Fixed-time AI

202 Effects of CIDR in the Ovsynch protocol on AI pregnancy rate in crossbred beef cows. H. K. Baitis*[1], A. Garcia[1], W. D. Whittier[1], and J. M. DeJarnette[2], [1]*Virginia Polytechnic Institute and State University, Blacksburg, VA/United States,* [2]*Select Sires, Inc., Plain City, OH/United States*.

Failure of the follicle to respond to the first GnRH injection in a synchronization protocol results in premature estrus (PE) in 8-10% of treated animals. The objective of this experiment was to determine if the addition of an intravaginal progesterone-releasing insert (CIDR) to the Ovsynch protocol would alter AI reproductive performance in postpartum beef cattle. Crossbred beef cows were subjected to synchronization of estrus and ovulation. Cows were managed in a typical commercial cow/calf operation at three locations in Virginia. A total of 379 mature beef cows were randomly allotted to receive either 50μg GnRH (Cystorelin, Abbott Laboratories) on d 0, PGF2α on d 7 (25 mg dinoprost), 100μg GnRH on d 9 (OV; n=188) or 50μg GnRH and CIDR on d 0, PGF2α on d 7 with CIDR removal, 100μg GnRH on d 9 (CIDR; n=190). Estrous activity was monitored with both Kamar (Kamar, Inc., Steamboat Springs, CO) and visual detection methods. Cows that exhibited PE were bred 12-16 h after estrus. All cows not detected in estrus were bred AI at 12-16 h after PGF2α. Pregnancy was diagnosed via trans-rectal ultrasonography 35-40 d post insemination. Data were analyzed using the Proc GLM (SAS) procedures. A higher pregnancy rate (P$<$0.05) was obtained in cows receiving a CIDR device (66%) compared with OV treatment alone (52%). Pregnancy rate to AI was not affected (P$>$0.05) by location, inseminator, or sire. In conclusion, addition of a CIDR to the Ovsynch protocol results in increased AI pregnancy rates in crossbred, mature beef cattle.

Key Words: Estrous synchronization, CIDR, Postpartum

203 Single versus a split dose of PGF$_{2\alpha}$ administered 18 or 19 d after a 14 d melengestrol acetate (MGA) treatment to synchronize estrus in *Bos taurus* x *Bos indicus* heifers. G. A. Bridges*, G. P. Portillo, M. K. Shaw, J. W. de Araujo, and J. V. Yelich, *University of Florida, Gainesville*.

Melengestrol acetate (MGA® Premix) and PGF$_{2\alpha}$ (LUTALYSE® Sterile Solution) were used to synchronize estrus in *Bos taurus* x *Bos indicus* heifers in 3 replications. Replications 1 (n = 139) and 2 (n = 146) were conducted at the same location in consecutive years, while replication 3 (n = 410) was conducted at a separate location. All heifers were administered MGA for 14 d at a rate of 0.5 mg head^{-1}d^{-1}. In replications 1 and 2 heifers were randomly distributed to receive either 25 mg PGF$_{2\alpha}$ i.m. 19 d following MGA or 12.5 mg PGF$_{2\alpha}$ i.m. on d 19 and 20 following MGA. In replication 3, heifers received the same PGF$_{2\alpha}$ treatments and were randomly divided into two groups with PGF$_{2\alpha}$ treatments initiated either 18 or 19 d following MGA. Visual detection of estrus was conducted in the AM and PM for 72 h after PGF$_{2\alpha}$ and heifers were AI 8 to 12 h after exhibiting estrus. Heifers not observed in estrus by 72 h following PGF$_{2\alpha}$ were timed-AI and received GnRH (100 μg i.m.; FERTAGYL®) at such time. Pregnancy was diagnosed by ultrasonagraphy 50 to 60 d following the synchronized breeding within each replication. Within replication 3, duration from MGA withdraw to PGF$_{2\alpha}$ administration did not effect any treatment variables analyzed, so data were combined. There were no significant treatment x replication effects for any variable analyzed so data were pooled. Heifers receiving a split dose of PGF$_{2\alpha}$ (50.1%; n = 341) had a greater (P $<$ 0.05) three-day estrous response compared to the single dose (43.2%; n = 354) heifers. Modifying the dosage of PGF$_{2\alpha}$ from a single to a split dose also increased (P $<$ 0.05) timed-AI pregnancy rates (23.9 vs 33.5%), and overall AI pregnancy rates (34.5 vs 42.5%), respectively. In

conclusion modifying the dosage of $PGF_{2\alpha}$ from a single to two consecutive half-doses 18 or 19 days following MGA increased three-day estrous response, timed-AI, and overall AI pregnancy rates in *Bos taurus* x *Bos indicus* heifers.

Key Words: *Bos indicus*, Progestin, Synchronization

204 Fixed-time artificial insemination of postpartum beef cows at 72 or 80 hours after treatment with the MGA® Select protocol. J. E. Stegner*, J. F. Bader, F. N. Kojima, M. R. Ellersieck, M. F. Smith, and D. J. Patterson, *University of Missouri*.

This study was conducted to determine the appropriate timing of fixed-time AI following administration of the MGA® Select protocol. Cows at two locations (location 1, n= 114; location 2, n = 97) were assigned to fixed-time AI at 72 or 80 h by age, body condition score (BCS), days postpartum (dpp), AI technician, and sire. All cows were estrus synchronized with the MGA® Select protocol [melengestrol acetate, MGA ($0.5mg{\cdot}hd^{-1}{\cdot}d^{-1}$) for 14 d, GnRH (100 μg i.m. Cystorelin; day 26) 12 d after MGA withdrawal, followed in 7 d with $PGF_{2\alpha}$ (PG; 25 mg i.m. Lutalyse; day 33)]. Cows were inseminated at 72 h (n = 108) or 80 h (n = 103) after PG with a second injection of GnRH at AI. There were no differences attributed to location for any of the variables considered in the analyses. The results are, therefore, pooled for the respective treatments. Mean BCS (5.2 ± 0.1,72 h; 5.3 ± 0.1, 80 h) and dpp (34 ± 2, 72 h; 35 ± 2, 80 h) did not differ (P > 0.1) between treatments. Blood samples were collected 7 d and 1 d prior to MGA to determine pretreatment cyclicity, and again on the day of PG to determine treatment response [progesterone > 1 ng/mL; (33/108, 31%, 72 h vs. 32/103, 31%, 80 h; P > 0.8, pretreatment); (74/108, 69%, 72 h vs. 69/103, 67 %, 80 h; P > 0.9, at PG)]. Pregnancy rates were higher (P < 0.05) among cows inseminated at 72 h (69/108, 64%) versus 80 h (52/103, 50%) following administration of the MGA® Select protocol. Pregnancy rates at the end of the breeding season did not differ (P > 0.2) between treatments [98/108 (91%), 72 h; 88/103 (85%), 80 h]. These data indicate that pregnancy rates resulting from fixed-time AI are improved when postpartum beef cows are inseminated at 72 versus 80 h following administration of the MGA® Select protocol. (Supported by grants from Select Sires, Inc., and USDA-NRI 2000-02163.)

Key Words: Fixed-time AI, Beef Cows, Progestin

205 A fixed-time AI program for postpartum beef cows with 7-11 Synch. F. N. Kojima*, J. E. Stegner, J. F. Bader, M. F. Smith, and D. J. Patterson, *University of Missouri*.

The 7-11 Synch protocol for synchronization of estrus in beef cows results in a tightly synchronized estrous response that generally peaks at 54 h following treatment. The objective of this study was to determine the optimum timing of fixed-time AI using the 7-11 Synch protocol. Cows were stratified by age, days postpartum (dpp), and body condition score (BCS), and randomly assigned to fixed-time AI at 48 or 60 h following the 7-11 Synch protocol. All cows were synchronized with the 7-11 Synch protocol and fed melengestrol acetate (MGA; $0.5mg{\cdot}hd^{-1}{\cdot}d^{-1}$) for 7 d followed by prostaglandin $F_{2\alpha}$ (PG: 25 mg i.m. Lutalyse) on d 7 of MGA, GnRH (100 μg i.m. Cystorelin) on d 11, and PG on d 18. Fixed-time AI was performed either at 48 (n = 123) or 60 h (n = 122) after the last PG injection, and GnRH was administered at AI. One AI sire was used for all inseminations. Pregnancy rate to fixed-time AI was determined by ultrasonography 50 d after AI. Quantitative data were analyzed by ANOVA and qualitative data were compared by Chi-square and logistic regression analyses. Mean age (5.5 ± 0.3 vs. 5.4 ± 0.3), dpp (46.8 ± 1.5 vs. 47.5 ± 1.5), and BCS (5.3 ± 0.1 vs. 5.3 ± 0.1) were not different (P > 0.10) between 48 and 60 h fixed-time AI groups. Pregnancy rate to fixed-time AI did not differ (P > 0.10) between cows that were inseminated at 48 (64/123, 52 %) or 60 h (72/122, 59 %) following the 7-11 Synch protocol. These data indicate that the 7-11 Synch protocol provides flexibility to AI cows at fixed times between 48 and 60 h following administration, resulting in high fertility and eliminating the need to detect estrus. Further research is needed to confirm results from this study and more precisely determine the most effective timing of AI following administration of the 7-11 Synch protocol. (Supported by grants from Select Sires Inc., and USDA-NRI 2000-02163)

Key Words: Beef Cows, Estrus Synchronization, Fixed-time AI

206 Timing of insemination and GnRH on pregnancy rates in beef cows in a modified CO-Synch estrous synchronization system. J. B. Hall*[1], J. M. DeJarnette[2], J. C. Whittier[3], and T. W. Geary[4], [1]*Virginia Tech, Blacksburg, VA,* [2]*Select Sires Inc., Plain City, OH,* [3]*Colorado State University, Fort Collins, CO,* [4]*USDA-ARS Miles City, MT*.

The objective of this study was to examine the effect of timing of fixed time AI (TAI) in the CO-Synch protocol on pregnancy rates in cows not displaying estrus by 48 h after prostaglandin. Postpartum beef cows (n = 825) from four herds were synchronized with an injection of GnRH (100 μg, Cystorelin®) on d 0 followed by PGF (25 mg, Lutalyse®) on d 7. Estrus detection was performed twice daily from d 6 to d 9. Cows detected in estrus (HD) were bred by AI 12 h after estrus. At 48 h after PGF, all cows not detected in estrus were randomly assigned by parity and days postpartum (74.5 0.5 d) to TAI at 48 h (TAI48) or 64 h (TAI64). All TAI48 and TAI64 cows received an injection of GnRH (100 μg) at AI. Body condition score (BCS; 5.2 0.02) was recorded at initiation of synchronization. Pregnancy was determined by ultrasonography between d 45 and d 60 post AI. Pregnancy rates to TAI were different across herds (herd x TAI, P < 0.05). In three herds, pregnancy rates were similar (P > 0.3) between TAI48 and TAI64 cows; whereas, in one herd pregnancy rate was greater (P < 0.002) in TAI64 than TAI48 cows. Across all herds, pregnancy rates were greater (P < 0.001) in cows bred after HD (66.8 %; 129/193) compared to cows bred TAI48 (40.7 %;129/317) or TAI64 (41.3 %; 130/315). Overall pregnancy rate for all AI times was 47.0 % (388/825). The percentage of cows bred after HD was influenced by herd (P < 0.01) with a range of 5.3 to 26.6 %. Pregnancy rate to timing of AI was not affected (P > 0.10) by BCS or days postpartum. We conclude that, in the CO-Synch protocol, TAI with GnRH at 48 h or 64 h after PGF results in acceptable AI pregnancy rates for cows not detected in estrus. Because TAI at 64 h would allow more cows to be inseminated following a detected estrus, heat detection + TAI64 may improve overall AI pregnancy rates.

Key Words: Estrous synchronization, Timed insemination, Beef cows

207 A timed insemination program for first service based on the use of estradiol cypionate (ECP) in lactating dairy cows. S. M. Pancarci, A. Arteche, F. Silvestre, S. Kamimura, and W. W. Thatcher*, *University of Florida, Gainesville, FL, USA*.

Objective was to determine if ECP may replace the first GnRH injection of a HeatSynch protocol based upon a measurement of pregnancy rate in lactating dairy cows. Primiparous (n=182) and multiparous (n=237) Holstein cows were assigned randomly to either a Heatsynch protocol or a Double-ECPsynch protocol following a pre-synchronization program in which $PGF_{2\alpha}$ (25 mg, i.m.) was given at 35 ± 3 and 49 ± 3 dpp. Cows assigned to the Heatsynch protocol (n=212) received an injection of GnRH (100 μg, i.m.) at 14 d after the second $PGF_{2\alpha}$ injection of the pre-synchronization sequence (63 ± 3 dpp). Seven days later (70 ± 3 dpp) $PGF_{2\alpha}$ was administered followed 24 h later (71 ± 3 dpp) with an injection of ECP (1 mg, i.m.) and a timed AI at 48 h after ECP (73 ± 3 dpp). Cows in the Double-ECPsynch protocol (n= 207) received an injection of ECP (2 mg, i.m.) at 7 d after the second $PGF_{2\alpha}$ injection of the pre-synchronization sequence (i.e., 56 ± 3 dpp). Ten days later (66 ± 3 dpp) $PGF_{2\alpha}$ was injected followed 24 h later (67 ± 3 dpp) with an injection of ECP (1 mg, i.m.) and a timed AI at 48 h after ECP (69 ± 3 dpp). In both treatment groups, cows that were detected in heat at 24 h after ECP (1 mg, i.m) injection were inseminated at that time. Pregnancy rates at 28 ± 1 and 63 ± 3 days following insemination did not differ between Heatsynch (44.8%, 37.3%) and Double-ECPsynch (39.1%, 28.0%) protocols. Risk of losing pregnancy between days 28 ± 1 and 63 ± 3 after the first service tended (P< 0.06) to be lower for the Heatsynch protocol (16.8%) than the DoubleECPsynch protocol (28.4%). Among cows that were not pregnant to the first service (n=230), 139 (60.4%) were re-inseminated following visual signs of estrus prior to pregnancy examination at day 28 ± 1. In conclusion, comparable pregnancy rates were achieved between DoubleECPsynch and Heatsynch programs in

lactating dairy cows. However, further studies are needed to reduce pregnancy losses.

Key Words: Estradiol cypionate, Timed insemination, Pregnancy rate

208 Increased dose of GnRH in a synchronized ovulation program for lactating dairy cattle.

K. E. Leslie, S. J. LeBlanc*, and C. H. Leslie, *University of Guelph, Ontario, Canada*.

Synchronization of ovulation and timed insemination with the Ovsynch protocol is a widely adopted reproductive management program in lactating dairy cattle. The probability of pregnancy is increased if a follicle is ovulated following the first injection of GnRH. In other contexts, there are some data to suggest possible positive dose response effects of GnRH. Our objective was to measure the effect of higher than usual doses of GnRH in the Ovsynch program on first insemination pregnancy risk in dairy cows. In 6 commercial herds over 1 yr, 537 Holstein and Jersey cattle received timed first insemination between 54 and 114 DIM (median 74 DIM) following the Ovsynch protocol. All cows received GnRH, PGF2α (500 μg cloprostenol) 7 d later, followed by GnRH 48 h later and AI the next day. At each injection of GnRH, cows were randomly and blindly assigned to receive either 100 or 200 μg gonadorelin acetate i.m., resulting in 4 treatment groups denoted by dose of GnRH: 100/100, 100/200, 200/100, and 200/200. Pregnancy was diagnosed by rectal palpation $>$ 35 d after AI. The probability of pregnancy following treatment was modelled with multivariable logistic regression, accounting for the correlation of cows within herd. Overall, there was no difference in pregnancy risk among groups (overall mean 32%). However, there was a treatment by DIM interaction. Parity and calving season covariates were not significant. Among cows bred before 75 DIM, pregnancy risks were: 100/100, 16%; 100/200, 28%; 200/100, 40%; 200/200, 24%, P = 0.01). Cows that received 200 μg GnRH at the first injection were more than 3 times more likely to be diagnosed pregnant than control cows (odds ratio = 3.4; 95% confidence interval, 1.5 - 7.5; P = 0.03); other groups did not differ from the 100/100 group. Among cows bred $\geq$ 75 DIM, there were no significant differences in pregnancy risk between treatment groups. We speculate that among cows bred earlier, the higher first dose of GnRH may have resulted in more cows ovulating in response to the injection, favouring the success of the Ovsynch program.

Key Words: Ovsynch, Gonadotropin releasing hormone, Postpartum

209 Resynchronization of ovulation using Ovsynch to induce second timed artificial insemination service in lactating dairy cows. .

P. M. Fricke*[1] and M. L. Welle[2], [1] *University of Wisconsin-Madison,* [2] *Miltrim Dairy, Athens, Wisconsin*.

Lactating Holstein cows (n=711) received a modified Presynch protocol to initiate first postpartum (pp) timed artificial insemination (TAI) service as follows: 25 mg $PGF_{2\alpha}$ (d 183; d 323; d 463 pp); 50 μg GnRH (d 603 pp); 25 mg $PGF_{2\alpha}$ (d 673 pp) and 50 μg GnRH+TAI (d 693 pp). At first TAI service, cows were randomly assigned to initiate the first GnRH injection of Ovsynch (50 μg GnRH, d 0; 25 mg $PGF_{2\alpha}$, d 7; 50 μg GnRH+TAI, d 9) at 19 d (D19), 26 d (D26), or 33 d (D33) post-TAI to induce second TAI service (Resynch) for cows failing to conceive to Presynch. All D19 cows received a GnRH injection at 19 d post TAI and continued the Ovsynch protocol only if diagnosed nonpregnant using ultrasound at 26 d post TAI. Cows in the D26 and D33 groups initiated Ovsynch only if diagnosed nonpregnant using ultrasound at 26 d or 33 d post-TAI, respectively. Overall conception rate to Presynch was 40.2% (286/711) and was greater (p<0.01) for D19 (46.0%, 108/235) and D26 (42.1%, 101/240) cows than for D33 cows (32.6%, 77/236). Overall conception rate to Resynch was 32.0% (123/384) and was greater (p<0.01) for D26 (33.9%, 41/121) and D33 (37.8%, 54/143) cows than for D19 cows (23.3%, 28/120). Resynch conception rate was greater (p<0.05) for D19 cows with (27.5%, 25/91) than for cows without (10.3%, 3/29) a CL at the $PGF_{2\alpha}$ injection of Ovsynch, whereas Resynch conception rate tended to be greater (p=0.09) for D26 + D33 cows with (38.7%, 75/194) than for cows without (28.6%, 20/70) a CL at the first GnRH injection of Ovsynch. For cows diagnosed pregnant to Presynch, overall pregnancy loss to d 68 of gestation was 23.4% (67/286) and was greater (p>0.01) for D19 (27.8%, 30/108) and D26 (27.7%, 28/101) cows than for D33 cows (11.7%, 9/77). Although administration of GnRH to pregnant cows 19 d after first TAI service did not appear to induce iatrogenic embryonic loss, initiation of Ovsynch 19 d after first TAI service resulted in a lower conception rate compared with initiation of Ovsynch 26 or 33 d after first TAI service.

Key Words: Resynch, Ovsynch, Presynch

210 Reproductive responses following postpartum suppression of follicular development with a Deslorelin implant during summer heat stress.

F. T. Silvestre*, S. Kamimura, J. A. Bartolome, A.C.M. Arteche, S. M. Pancarci, and W. W. Thatcher, *University of Florida, Gainesville, FL, USA*.

Holstein cows received a non-degradable GnRH-agonist implant (Deslorelin, 5mg) within 1 to 4d postpartum (n=120), between June 25 to Aug. 8, for comparison to control cows (n=127). Enrollment consisted of normal cows with a BCS $\geq$ 2.75. Cows were assigned weekly and injected with $PGF_{2\alpha}$ 7 d later. Implants were removed on Aug. 28 and Sept. 4 with implant exposure ranging from 28 to 67d. Ultrasonography (US) monitored numbers of ovarian follicles and CL at 7, 28, 35, 45, 56 and 66d of treatment or days postpartum in sub-samples of cows. At 31d after implant removal, cows enter a Pre-synch/Ovsynch protocol: GnRH on d0, $PGF_{2\alpha}$ on d7, GnRH on d17, $PGF_{2\alpha}$ on d24, GnRH on d26 and TAI 16h later. Cows were re-inseminated at estrus within 26d after TAI. Pregnancy rate (PR) was evaluated at 28d (US) after TAI. Blood samples were collected at: $PGF_{2\alpha}$ of pre-synch, subsequent GnRH, at TAI and 8d after TAI. The implant increased number of Class 1 (3-5 mm) follicles (21.03 $\pm$ 0.66 $>$ 11.27 $\pm$ 0.58; P$<$ 0.01) and decreased numbers of Class 2 (6-9 mm; 0.08 $\pm$ 0.17 $<$ 1.93 $\pm$ 0.15 P$<$0.01), Class 3 ($>$ 10 mm) follicles (0.01 $\pm$ 0.10 $<$ 1.81 $\pm$ 0.09; P$<$0.01), and CL (0.09 $\pm$ 0.06 $<$ 0.7 $\pm$ 0.05; P $<$0.01). Follicular development was arrested at $<$ 4 mm in the implant group during the postpartum-heat stress period. Percent cows cycling was less for the implant group at the beginning of the Ovsynch protocol (49%, n=114 $<$ 94%, n=117; P$<$0.01). The implant lowered PR: overall TAI PR (27 %, n=120 $<$ 53.5 %, n=127 %; P$<$ 0.09), TAI PR in cycling cows (33.9 %, n=56 $<$ 55.4%, n=110; P$<$ 0.06), and TAI PR in cycling cows that ovulated after TAI (39.5%, n=48 $<$ 60.9%, n=87; P$<$0.06). Accumulated PR (TAI + 26d AI) did not differ (40.8%, n=120 implant vs 59.8%, n=127 control; P$<$0.16). The implant induced delay in turnover of postpartum-heat stress damaged follicles compared to control may have contributed to lower PR. Rate of depletion of heat stressed damaged follicles may affect PR.

Key Words: Deslorelin implant, Heat stress, Fertility

211 Effect of ovulatory follicle size at time of GnRH injection or standing estrus on pregnancy rates and embryonic/fetal mortality in beef cattle.

G. A. Perry*[1,2], M. F. Smith[1], M. C. Lucy[1], A. J. Roberts[2], M. D. MacNeil[2], and T. W. Geary[2], [1] *University of Missouri, Columbia, MO,* [2] *USDA-ARS, Fort Keogh LARRL, Miles City, MT*.

Use of GnRH in AI protocols results in ovulation of a wide range of follicle sizes. Our objective was to determine the effect of ovulatory follicle size at GnRH-induced ovulation or standing estrus on pregnancy rates and embryonic/fetal mortality. Lactating beef cows (n = 273) received the CO-Synch protocol (100 μg GnRH, i.m. on d -9; 25 mg PG, i.m. on d -2; and 100 μg GnRH, i.m. on d 0 with timed AI) or were inseminated following detection of estrus using Heatwatch (electronic mount detectors). Ovulatory follicle size was determined by transrectal ultrasonography on d 0 (timed AI) or 12 h after detection in estrus. Pregnancy rates and fetal viability were determined by transrectal ultrasonography on d 27, 41, 55, and 68 after timed-insemination. On d 27 following GnRH-induced ovulation, there was a tendency ($P = 0.07$) for follicle size to effect pregnancy rates [13/45 (29%), 13/22 (59%), 18/39 (46%), 11/28 (39%), 13/20 (65%), and 7/19 (37%) for $\leq$ 11, 11.5 to 12, 12.5 to 13, 13.5 to 14, 14.5 to 15, and $\geq$ 15.5 mm follicles; respectively]; however, by d 68 embryonic loss in cows that were induced to ovulate $\leq$ 11 mm follicles resulted in lower ($P < 0.01$) pregnancy rates (8/45; 18%) than cows in each of the other groups, which were unchanged from d 27. When ovulation occurred following standing estrus (37 d AI breeding season) there was no effect of follicle size ($P = 0.18$) on pregnancy rates at d 25 to 39 after insemination [11/14 (79%), 14/20 (70%), 28/35 (80%), 26/41 (63%), 21/25 (84%), and 25/38 (66%) for $\leq$ 11, 11.5 to 12, 12.5 to 13, 13.5 to 14, 14.5 to 15, and $\geq$ 15.5 mm; respectively], nor were embryonic/fetal mortalities affected by ovulatory follicle diameter

($P = 0.66$). In summary, embryonic/fetal survival was decreased following GnRH-induced but not spontaneous ovulation of small ($\leq$ 11 mm) ovulatory follicles in beef cows.

Key Words: Fixed-time AI, Follicle Size, Embryonic Mortality

212 Effect of hCG administration approximately 5 d after artificial insemination on progesterone concentrations and AI conception rates in beef heifers. R. N. Funston*[1], J. L. Olson[2], R. J. Lipsey[3], T. W. Geary[4], and A. J. Roberts[4], [1]*University of Nebraska, Lincoln,* [2]*Montana State University, Bozeman,* [3]*American Simmental Association, Bozeman, MT,* [4]*USDA-ARS, Miles City, MT.*

Objectives of this study were to determine if administration of hCG approximately 5 d after AI would increase plasma progesterone (P4) concentrations and conception rates in beef heifers. Heifers from two locations (Location 1, n = 347; BW = 367 ± 1.72 kg; Location 2, n = 246; BW = 408 ± 2.35 kg) received MGA (0.5mghd^{-1}d^{-1}) for 14 d and an injection of PGF (Lutalyse®; 25 mg; i.m.) 19 d later. Heifers were observed for estrus continuously during daylight from 0 to 4.5 d after PGF and inseminated by AI approximately 12 h after onset of estrus. Pregnancy status was determined by ultrasound approximately 50 d after AI. One-half of the heifers inseminated at Location 1 were randomly assigned to receive an injection of hCG (Chorulon®, 3333 IU i.m.) 8 d after PGF and a blood sample was collected from all heifers 14 d after PGF for P4 analysis. One-half of the heifers inseminated at Location 2 were administered hCG on d 9 after PGF and a blood sample was collected from all heifers 17 d after PGF. Heifers at Location 1 had a 93% synchronization rate, exhibited estrus 2.46 ± .03 d after PGF and received hCG 5.05 ± .03 d after AI. Heifers at Location 2 had an 85% synchronization rate, exhibited estrus 2.69 ± .03 d after PGF and received hCG 5.8 ± .03 d after AI. Progesterone concentrations were greater ($P < 0.01$) for hCG treated heifers at both locations, 8.6 vs 4.6 ng/ml for treatment and control at Location 1 and 11.2 vs 5.6 ng/ml for treatment and control at Location 2. Conception rates (65 vs 70% for treatment and control, respectively) were not different ($P = 0.36$) at Location 1. Conception rates tended ($P = 0.11$) to be increased with hCG treatment at Location 2, 61 and 50% for treatment and control, respectively. In summary, hCG administration approximately 5 d after AI increased progesterone concentrations in beef heifers and tended to improve AI conception rates at one location.

Key Words: Heifers, Progesterone, hCG

213 Inclusion of a CIDR after initial artificial insemination concentrations of progesterone and corpus luteum volume in suckled beef cows. R. C. Wasson*, J. E Larson, D. R. Brown, and G. C. Lamb, *North Central Research and Outreach Center, University of Minnesota, Grand Rapids, MN 55744.*

The objectives of this study were to evaluate progesterone (P4), corpus luteum (CL) and follicular response in cows after insertion of a CIDR between d 5 and 21 of the estrous cycle. Seventeen Angus cows (75 to 110 days postpartum) were estrous synchronized with the Select-Synch (a 100 μg injection of GnRH followed by a 25 mg injection $PGF_{2\alpha}$ 7 d later). At artificial insemination (AI) all cows were body condition scored and randomly assigned to one of four treatments: 1) untreated controls (n = 5); 2) administration of a CIDR on days 5 to 14 after AI (n = 4); 3) administration of a CIDR on days 14 to 21 after AI (n = 4); and 4) administration of a CIDR on days 5 to 21 after AI (on d 14 after AI the first CIDR was removed and replaced with a new CIDR; n = 4). On d ?9, and -2 to 26 relative to AI, blood was collected and serum harvested daily for determination of P4 concentration, plus transrectal ultrasound of the ovaries was performed to determine follicle and CL diameters. Cows were examined for pregnancy via transrectal ultrasound on d 28 and 56. One cow in each treatment was pregnant after initial AI. Six cows were observed in estrus and inseminated by AI between d 21 and 26 (3, 1, 2, 0 for treatments 1, 2, 3, and 4, respectively). On d 56, the number of pregnancies per treatment were 3, 2, 3, 1 for treatments 1, 2, 3, and 4, respectively. Between d 5 and 21 average CL volume was greater ($P < 0.01$) for treatments 2 (3.8 0.2 cm^3), 3 (3.5 0.3 cm^3), and 4 (3.6 0.3 cm^3) than 1 (2.6 0.2 cm^3) and average concentrations of P4 were greater ($P < 0.01$) for treatment 2 (3.2 0.2 ng/mL) and 4 (3.4 0.2 ng/mL) than 1 (2.6 0.2 ng/mL),whereas 3 (2.9 0.2 ng/mL) was intermediate. Regardless of treatment CL volume and concentrations of P4 correlated ($r = 0.504$; $P < 0.001$). During d 5 to 21 the average concentration of P4 was greater ($P < 0.01$) in cows with a CIDR (3.8 0.2 ng/mL) than those without a CIDR (3.0 0.2 ng/mL). In addition, daily concentrations of P4 tended ($P = 0.11$) to be greater in cows with a CIDR than those without. We conclude that inclusion of a CIDR during after AI increased concentrations of P4 and enhanced CL volume during diestrus. Inclusion of a CIDR did not appear inhibit embryonic survival.

Key Words: Beef Cows, Progesterone, Estrous synchronization

Production, Management, & the Environment

214 Application of the Cornell Nutrient Management Planning System. T. P. Tylutki*[1], D. G. Fox[1], and M. McMahon[2], [1]*Cornell University, Ithaca NY USA,* [2]*McMahons EZ Acres, Homer NY USA.*

The Cornell Nutrient Management Planning System (CuNMPS) is a collection of software tools that have been developed to implement integrated nutrient management planning on dairy farms. The CuNMPS consists of the Cornell Net Carbohydrate and Protein System (for evaluating rations), and Cornell CropWare (a crop nutrient management tool). A five-year project was conducted with a case-study dairy farm to determine if applying these tools have the desired impact on nutrient management. The case-study farm (625 mature Holsteins) is located over a sole-source aquifer that supplies the drinking water for approximately 55,000 people. The farm has a tillable land base of 450 ha with a mix of well drained valley land (corn:alfalfa rotation) with a high leaching potential and shallow, acidic clay hill land (continuous grass) with a high run-off potential. In 1997 (year 1), lactating cows were averaging 30.9 kg milk per day, 44% cull rate, and 42.9% of the whole herd diet being home-raised (forages only). Numerous changes occurred during the next four years driven by the adoption of quality management principles. Changes included: animal grouping strategies, feed storage, crop rotation, crop harvesting, crop type, personnel training, herd management, feeding management, and overall business management. The integration of these changes has resulted in a 38% increase in the proportion of the diet that is home grown (currently 59%), 37% reduction in the feed nitrogen purchased, 40% reduction in feed phosphorus purchases, 47% reduction in cull rate (currently below 30%), 26% increase in herd size (due primarily to reduced cull rate), 9% higher milk per cow, and 45% more milk sold per day. Additionally, purchased feed costs for the entire herd (assuming 2002 feed prices in 1997) have been reduced 48% per 45.4 kg milk. This level of impact exceeded expectations; however, it highlights the need for precision feeding, improved integration of herd, soils and crops management and intensive model training for CNCPS and CropWare, a higher farm management level, and the adoption of continuous improvement and quality management by the farm and their advisors.

Key Words: Nutrient management, Quality control, Models

215 Nutrient management practices on U.S. dairy operations: Results from the NAHMS Dairy 2002 Study. B. J. McCluskey[2], J. E. Lombard*[1], and S. Ott[2], [1]*Integrated Livestock Management, Colorado State University, Fort Collins, CO,* [2]*USDA:APHIS:VS, CEAH, Center for Animal Health Monitoring, Fort Collins, CO.*

Sound nutrient management practices are essential to maximize the economic benefits of manure while simultaneously reducing the risk of adverse environmental consequences. New and existing regulations have been promulgated to find the balance between normal dairy operation practices and environmental protection. The National Animal Health Monitoring Systems Dairy 2002 study surveyed dairy operations in 21 states representing 82.8% of U.S. dairy operations and 85.5% of U.S. dairy cows. One specific objective of this study was to assess nutrient management practices used on U.S. dairy operations. Approximately 55% (S.E. 2.9) of operations reported using either a gutter scraper or

mechanical alley scraper (e.g. tractor) to handle a majority of the manure on the operation. Alley flush with fresh or recycled water was used on 1.9 % (S.E. 0.4) of operations. Most operations stored manure in a manure spreader (40.8% S.E. 2.1) or in an earth basin without treatment (22.5% S.E. 1.7). Just over 20% (S.E. 1.6) of operations analyzed manure for nitrogen, phosphorus or potassium. Thirty-nine percent (S.E. 2.1) of operations reported that they applied manure less than 200 feet from a body of water (lake, pond, stream or river), while 37.3/% (S.E. 2.1) only applied manure 1,000 feet or more from a body of water. Individual operation nutrient management plans have become required under many state and federal regulations. However, only 30.6% (S.E. 1.8) of operations reported that a written nutrient management plan was in place on their operation. When asked how they would classify their operation under the concentrated animal feeding operation (CAFO) guidelines, 38.1% (S.E. 2.1) of respondents had never heard of CAFO, 20.5% (S.E. 1.8) were not sure how their operation would be classified, 33.3% (S.E. 2.0) believed their operation would most likely not be classified as a CAFO and 8.1% (S.E. 0.9) believed their operation would be classified as a CAFO. //

Key Words: Nutrient management, Manure management

216 Culling rate and death loss associations with DHI production values. A. J. Young[1], S. C. Smith[2], and S. P. Tripp*[2], [1]*Utah State University, Logan,* [2]*DHI Computing Service, Provo, UT.*

The objective of this study was to examine the relationships between culling and death losses in herds in the Western United States. The DHI Computing Service database was queried on January 30, 2003 for herds that had more than 100 total cows, had been on test for more than a year and were located in the western U.S. (Texas to the west coast). A total of 1,005 Holsteins herds were identified, and then split into groups that milked either two or three times per day (2X or 3X). There were 734, 2X-Holstein (2X-H) herds for a total of 365,823 animals with average RHA of 9818 kg, 7.00% death loss, and a 32% cull rate. There were 269, 3X-Holstein (3X-H) herds for a total of 237,976 animals with average RHA of 11,133 kg, 7.75% death loss and a 34% cull rate. There were 121 Jerseys herds with a total of 40,182 animals that had a RHA of 7110 kg, 6% death loss and a 30% cull rate (herds were not divided into 2X or 3X). Correlations between herd summary production values and culling and death loss percentage were run for each group. For 2X-H herds, the correlation of % death loss with relative value of animal culled (RV) and RHA milk was r = -0.234 and r= -0.155, respectively. For the 2X-H herds, the correlation of percent culled with RHA milk and SCS was r= 0.065 and r = 0.054, respectively. The 3X-H herds had similar correlations of % death loss with RV (r = -0.153) and RHA milk (r = -0.218). For 3X-H herds, the correlations of percent culled with RV and SCS were r = 0.220 and r = 0.140, respectively. For Jersey herds the correlation of % death loss with RV was r = -0.325 and with SCS was r = 0.226. In addition, the correlation of percent culled with RHA milk protein% was r = 0.280 and with the milk protein to fat ratio was r = 0.310. For all groups, correlations between herd size and % death loss ranged from r = 0.005 to 0.043. We conclude that the percent culling and death loss are not associated with herd size, and are marginally or not at all associated with RHA, SCS or milk fat and protein percentage. The possible reasons for increased % death loss are not based on these variables.

Key Words: Culling, Death loss, DHI

217 The simulated economic cost of extended calving intervals in dairy herds and comparison of reproductive management programs. P. D. French*[1] and R. L. Nebel[2], [1]*Oregon State University, Corvallis,* [2]*Virginia Tech, Blacksburg.*

A computer simulation was developed to estimate the economic loss associated with extended calving intervals and to evaluate the relative cost of estrus detection and ovulation synchronization programs. Weekly production, conception, and cull events were generated for individual cows in a typical herd. Data for 10 herds of 125 cows in milk were generated over 7 years for one of 189 scenarios in a 7 by 3 by 3 by 3 factorial arrangement of treatments. Main effects were days open (85, 100, 115, 130, 145, 160, or 175), peak milk yield (36, 42 or 49 kg), break-even milk yield (14, 18, or 23 kg/d), and days in milk when open cows were designated do not breed (301, 350, or 399). Days open was increased from 85 to 175 by decreasing heat detection rate. Data were averaged annually and analyzed by the MIXED procedure of SAS. Annual income was calculated as the difference between revenue (milk, calf, and cull) and expenses (feed, replacement heifers, interest, and other). Income increased as days open decreased, cull milk yield increased, milk yield increased, and do not breed increased. For a typical herd, the loss in income per day open for each additional day open beyond 85 days in milk was $0.42, 0.42, 1.14, 1.98, 3.12, and 4.95 for 100, 115, 130, 145, 160, and 175 days open, respectively. Reduced income as days open increased was due primarily to reduced milk revenue and increased replacement expense. The cost of two estrus detection systems (HeatWatch® and pedometer) and two ovulation synchronization programs (ovsynch and presynch) were compared to visual estrus detection. Components included in the cost analysis were start-up and maintenance of the system. Cost was expressed as $/pregnancy and included adjustments for additional days open beyond 85 days in milk. HeatWatch® resulted in the lowest cost per pregnancy followed by pedometer, presynch, ovsynch, and visual detection. These results indicate that losses from extended calving intervals have been previously underestimated.

Key Words: Days open, Economic efficiency, Estrus detection

218 Herd management and cow productivity information from an autoregressive test-day model applied in southeastern Sicily. G. Azzaro[1], S. Ventura[1], J. Carvalheira[2], M. Caccamo[1], G. Licitra[1,3], E. Raffrenato*[1,4], and R. W. Blake[4], [1]*CoRFiLaC, Regione Siciliana, 97100 Ragusa, Italy,* [2]*Universidade do Porto, Vairao, Portugal,* [3]*D.A.C.P.A., Universit di Catania , Italy,* [4]*Department of Animal Science, Cornell University, Ithaca, 14853 NY, USA.*

Test-day (TD) models can account for environmental effects associated with each record, describe the trajectory of lactation for groups of animals, and provide reliable estimates of management factors affecting herd performance. An autoregressive multiple-lactation TD animal model with DFREML methodology was used to obtain estimates of genetic parameters for TD records, cow productivity and management information of Holstein, Brown Swiss and Modicana cows (a local breed) in southeastern Sicily. Records from the first three lactations (1994-2000) were used to estimate the genetic (co)variance components and parameters. The edited data were 214,650 (15,161), 44,768 (3,049) and 8,669 (660) records (cows) of milk, fat and protein for Friesian, Brown Swiss and Modicana breeds. Parameter solutions were applied using the model to routinely obtain monthly estimates of management factors for the 12 months preceding the current TD for all farms, including prediction of missing and future TD yields, cumulative 305-d lactations, management and lactation curves for each trait and breeds. These results are being used to develop management schemes. Management curves for milk and components reveal within-year variation in average daily yields and seasonal effects on quality, availability and cost of feed, thus facilitating evaluation of the feeding and management programs on a monthly basis. Comparison of lactation curves may also help identify limitations in nutrition and management. This monthly information, which is available online, is now a key extension tool in assisting farmer decision making.

Key Words: Test-day model, Management

219 Seasonality of productive life of dairy cows in Florida and Georgia. B. L. Butler* and A. de Vries, *Department of Animal Sciences, University of Florida.*

Seasonality of cow performance is a concern to dairy producers in the Southeast. In the hot summer months cows produce less milk, are more difficult to get pregnant, and may be more at risk of being culled. This seasonality may have major implications for optimal management decisions concerning reproduction, milk production, or the time of purchase of new animals. Our objectives were to quantify the effects of season of first calving on productive life, lifetime milk production, and first lactation cull rate of dairy cows in Florida and Georgia. Productive life is defined as the time between first calving and culling. Lifetime milk is defined as the total amount of milk produced between first calving and culling. First lactation cull rate is the fraction of cows that do not calve for a second time. DHIA lactation records were obtained and limited to cows culled primarily in 2000 (n=52,620). Monthly average productive life of cows calved for the first time in January through December were respectively 971, 971, 972, 936, 960, 845, 808, 862, 880, 928, 950, and 970 days. Corresponding lifetime milk productions were respectively 21688, 21558, 21641, 20339, 21249, 18549, 17802, 19168, 19621, 20773, 21312,

and 21646 kg. First lactation cull rates were respectively 27.1%, 28.7%, 28.2%, 29.1%, 27.8%, 37.4%, 39.7%, 33.3%, 33.4%, 29.1%, 27.8%, and 27.7%. The effect of month of first calving was not significant for the monthly cull rate of older lactations. We concluded that the month of first calving has significant effects on productive life, lifetime milk production, and first lactation cull rate. Cows calving for the first time in July had the shortest productive life, lowest lifetime milk production, and highest first lactation cull rate. The range between July and the most favorable month were 164 days of productive life, 3886 kg milk, and 12.4% first lactation cull rate. These results will likely have implications for optimal scheduling of reproduction, milk production, and cow replacement in Florida and Georgia.

Key Words: Productife Life, Dairy, Seasonality

220 Association between production, feed and weather on a commercial dairy - a case study. A. J. Young*[1] and S. P. Tripp[2], [1]*Utah State University, Logan,* [2]*DHI Computing Service, Provo, Utah.*

The objective of this study was to determine the associations of production, DMI, weather and ration composition with daily income on a commercial dairy. Bulk tank milk yield and components, number of milk cows at DHI test, total DM intakes from the EZ-Feed® feeding program, ration composition as formulated by the nutritionist and income based either on component prices from Federal Milk Marketing Order 135 or weekly 40#-block cheese prices from the Chicago Mercantile Exchange were used to compute daily milk and DMI per cow, value of product and income over feed costs (IOFC) for a commercial dairy. Daily temperature and humidity were collected and used to compute a temperature heat index (THI). The study period was from 8/20/01 to 1/13/03, and the mean milk/cow per day for the period was 32.9 kg on an average of 1751 milking cows. Mean milk fat and protein are 3.53% and 3.03%, respectively. The correlation between daily milk/DMI per cow and IOFC based on the price for cheese (Ch$) or price of fat and protein (FP$) was r = 0.448 and 0.371, respectively. The correlation between Ch$ and FP$ was r = 0.911. Value of daily product based on FP$/cow was correlated with ration rumen undegradable protein (RUP)(r = 0.578) and NDF (r = 0.501). Correlations between daily DMI/cow as predicted by the ration formulation and daily DMI/cow as fed was r = 0.033. Ration cost/day was correlated with ration RUP, soluble protein and ME (r = 0.474, r = -0.492 and 0.413, respectively). Milk/cow, ration ME, ration soluble protein, ration DM%, ration carbohydrate B1 fraction and ration cost/day were correlated with maximum and minimum THI at r = 0.487 and 0.454, r = -0.538 and #0.555, r = 0.552 and 0.551, r = -0.703 and #0.680, r = -0.488 and #0.481, r = -0.478 and #0.492, respectively. We conclude that evaluation of management changes on a dairy needs to consider not only production, but also product income, ration composition, DMI and weather in order to separate the effects of environment from management.

Key Words: Daily milk income, Feed costs, THI

221 Effects of prepartum exercise on metabolism, milk yield, and health disorders of dairy cows. J. A. Davidson* and D. K. Beede, *Michigan State University, East Lansing, MI.*

Objective was to determine effects of prepartum exercise of Holstein dairy cows on blood and liver metabolites, DMI, milk yield, and health disorders. Non-lactating, multiparous pregnant cows (n = 26) were blocked by parity and expected calving date and assigned randomly to treatments: no exercise or exercise (walking [3.25 km/h] every other day for 1.25 h from d 70 to 40 before expected calving date, and then 1.5 h to day of calving). Plasma lactate, non-esterified fatty acids, beta-hydroxybutyrate, and glucagon concentrations before parturition were not affected by exercise treatments. Prepartum venous plasma concentrations of glucose and insulin were greater as parturition neared for non-exercised compared with exercised cows ($P < 0.05$); concentrations after parturition were similar. Prepartum liver glycogen and triglyceride concentrations, BW, and DM and water intakes were not different among treatments. Postpartum liver glycogen concentrations tended to be lower for exercised compared with non-exercised cows (14.7 vs. 23.2 mg/g of wet tissue, $P = 0.09$), suggesting increased glycogenolysis. Postpartum liver triglyceride concentrations were similar. During the first 28 d of lactation, BW changes, DMI, milk yields, and milk component yields were not affected by prepartum exercise treatment. Three of 13 exercised cows had one or more peripartum health disorder, whereas 8 of the 13 non-exercised cows had one or more disorder (Type I error, $P = 0.05$; Type II error, $P = 0.48$). Prepartum exercise of dairy cows reduced the incidence of health disorders, but did not affect lactation performance during the first month.

Key Words: Dairy cows, Metabolism, Exercise

222 Using activity and milk yield as predictors of fresh cow disorders. J. L. Edwards and P. R. Tozer*, *The Pennsylvania State University, State College, PA.*

The objective of this study was to determine if daily walking activity along with daily milk yield could be used as predictors of metabolic and digestive disorders early in lactation. The data, collected from 1996 through 1999, were from 1445 dairy cows in three Florida herds. Activity and milk yield were collected from the Special Agricultural Equipment (S.A.E.) Afikim® computerized dairy management system. Mixed models analysis was undertaken on cows prior to their first detected heat identified by the difference in activity. A healthy cow was one that did not have an occurrence of a metabolic or digestive disorder during a full lactation. A sick cow had an occurrence of these disorders at any time during the current lactation. Metabolic disorders included Bovine Viral Diarrhea, ketosis, milk fever, and retained placenta. Digestive disorders included displaced abomasum, indigestion, reduced feed intake, traumatic gastritis, acidosis, and bloat. Individual diseases including ketosis, left displaced abomasum, retained placenta, and digestive disorders were analyzed to find when activity and milk yield decreased before these specific disorders were clinically diagnosed. The beginning day of decline, relative to the day the illness was diagnosed, for activity and milk yield is shown in the table below for cows clinically diagnosed with ketosis, left displaced abomasum, retained placenta, and digestive disorders. Daily milk yield of sick cows was approximately 15 kg/d less than the production of healthy cows. Considering these results, cows diagnosed with ketosis, left displaced abomasum, and general digestive disorders could be detected at least five to six days earlier based on changes in daily activity and milk yield.

Disease	Beginning day of decline Activity	Milk yield
Ketosis	-8	-6
Left displaced abomasum	-9	-7
Retained placenta	-1	-1
Digestive disorders	-8	-5

Key Words: Walking activity, Fresh cow disorder, Pedometer

223 Monitoring electrical power quality effects on milk production of dairy herds. D. Hillman*[1], D. Stetzer[2], M. Graham[3], C. L. Goeke[4], K. Mathson[2], H. H. VanHorn[5], and C. J. Wilcox[5], [1]*Michigan State University, East Lansing, MI,* [2]*Stetzer Electric, Inc., Blair, WI,* [3]*University of California, Berkeley, CA,* [4]*Goeke Enterprises, Mason, MI,* [5]*University of Florida, Gainesville, FL.*

Public Utility Commissions (PUC) in several states adopted 0.5 volt or 1.0 milliampere as the actionable limit for utilities to respond to complaints of uncontrolled voltage. Complaints that animal behavior and milk production were affected by electrical shocks below the adopted standards were investigated on 12 farms in Wisconsin, Michigan, and Minnesota. Milk production per cow was from daily tank-weight pickup and number of cows milked. Number of transient events, transients, voltage (peak to peak), waveform phase angle degree, sags and sag-Vrms were measured from event recorders plugged into milk house wall outlets. Data from 1705 cows and 939 data points were analyzed by multi-herd least-squares multiple regression and SAS-ANOVA statistical programs. In five herds for 517 days, milk/cow/day decreased -0.0287 kg/transient event ($P < 0.02$) as transient events increased from 0 to 99/day. Effects on milk/cow/day from event recorder measurements were significant for eight independent electrical variables. Step-potential voltage and frequency of earth currents were measured by oscilloscope from metal plates grouted into the floor of milking stalls. Milk decreased as number of 3rd, 5th, 7th, 21st, 28th, 42nd, and the sum of triplen harmonics (3rd, 9th, 15th, 21st, 27th, 33rd, and 39th) increased/day ($P < 0.003$). Event recorder transient events were positively correlated with oscilloscope average Vp event readings, with number of measures over 90 Hz, and number of 4th, 7th, 10th, and 42nd harmonics per day.

Steps/minute of a dancing cow, counted from videotape, were correlated with non-sinusoidal 8.1 to 14.6 mVp impulses recorded by oscilloscope from EKG patches on legs. PUC standards and use of shunt resistors in test circuits underestimate effects of non-sinusoidal, higher frequency voltage/current on rural power lines.

Key Words: Transients, Harmonics, Power quality

224 Adoption of human resource management practices in dairy businesses. R. E. Stup*, L. A. Holden, and J. Hyde, *Penn State University*.

As dairy farm organizations increasingly rely on non-family employees, the need for effective human resource management (HRM) practices becomes more pressing. The goal of this research project was to gather information about human resource management practices used in progressive Pennsylvania dairy businesses. We collected a detailed set of data from 62 dairy farm managers who were nominated by extension agents, business consultants, or other industry professionals based on their knowledge of the manager. Managers who were known by the professionals to be progressive and profitable were surveyed. The survey gathered information about the managers and the HRM practices they use. Information was gathered through personal visits by project researchers. Job descriptions are a fundamental HRM tool. They improve communication between the employee and employer about specific job qualifications and responsibilities. In this sample, 22% of managers indicated that all of their full-time employees had job descriptions, 25% indicated that some of their full time employees had job descriptions, and 52% indicated that none of their full-time employees had job descriptions. The percent of managers who used job descriptions for all part-time employees was 23%, for some was 20%, and for none of their part-time employees was 57%. Standard operating procedures (SOPs) are used to reduce variation in production processes that is introduced by employees carrying out tasks differently from one person to another and from one time to the next. In this study, 47% of managers indicated that they were using SOPs to manage at least one of their production processes. Providing performance feedback to employees is a basic responsibility for any human resource manager. Thirty-one percent of managers in this sample reported that they provided frequent feedback to their employees, 67% reported that they provided feedback only when an unusual situation (good or bad) arose, and 2% reported that they provided no feedback to employees about their performance. Educational opportunities in HRM should be expanded to increase adoption of important practices.

Key Words: Human resource management, Labor, Standard operating procedures

225 *Mycoplasma* in bulk tank milk on U.S. dairy operations. B. J. McCluskey[2], J. E. Lombard*[1], and H. L. Hirst[1], [1]*Integrated Livestock Management - Colorado State University,* [2]*USDA:APHIS:VS, CEAH, Center for Animal Health Monitoring*.

The National Animal Health Monitoring System's Dairy 2002 study surveyed dairy operations in 21 states representing 82.8% of U.S. dairy operations and 85.5% of U.S. dairy cows. Dairy 2002 data showed that 7.9% of participating dairies tested positive for *Mycoplasma spp.* when a single bulk tank sample was cultured. Western region states had a greater percentage of operations with positive cultures than operations in the Midwest, Northeast and Southeast regions. Large herds (500 head or more) were more likely to have positive cultures (21.7% S.E. 3.7) than medium herds (100 to 499 head) or small herds (less than 100 head) at 3.9% (S.E. 1.2) and 2.1% (S.E. 0.7), respectively. Variables potentially associated with positive bulk tank results were screened by chi square testing. Significant variables ($p < 0.2$) were entered into a logistic regression model. Types of variables tested in the model included; the number of new additions (dairy heifers, lactating cows, dry cows) to the herd as a percentage of the total herd; individual cow somatic cell count and bulk tank somatic cell count testing requirements prior to introducing new cattle to the operation; individual cow milk culture and bulk tank milk culture requirements prior to introducing new cattle to the operation; type of housing; milking procedures employed on the operation; herdsize and the region where the operation was located. The final model included herdsize, the number of lactating cows brought on to the operation as a percentage of the total herd, and the outside area that dry cows have access to in the summer. Region was forced into the model as a potential confounding variable. Small and medium sized operations were 25 and 10 times less likely to have a positive bulk tank sample than large herds, respectively. Operations that added a number of lactating cows in 2001 greater than or equal to 10% of the total herd were 2 times as likely to have a positive *Mycoplasma* bulk tank sample.

Key Words: Mycoplasma, Milk, Survey

226 Sample collection depth and physical separation by screening affect aflatoxin concentration in contaminated corn. A. F. Harper[1], J. B. Meldrum[2], J. Zhao*[1], and M. J. Estienne[1], [1]*Virginia Polytechnic Institute and State University, Blacksburg,* [2]*VA-MD Regional College of Veterinary Medicine, Blacksburg*.

We conducted a sampling study within a bin of corn grain (73,600 kg) previously determined to be contaminated with aflatoxin (57 ppb). The objective was to determine if depth within the bin and mechanical screening of the sample would have effects on aflatoxin concentration. Samples were collected with a probe at depths of 1, 3 and 5 m within the bin (n = 4/depth). The samples were mechanically shaken over a 6.75 mm screen to separate fine material (fines) from intact kernels. Fines made up 7.9 to 9.2 % of the weight of each sample. Dry matter, bulk density and aflatoxin concentration as detected by ELISA were determined for the separate fractions. Samples taken at 1 m depth had slightly lower dry matter than those taken at 3 and 5 m depths (87.7 % vs. 88.7 and 88.60 $\pm$ 0.2 %, $P < 0.01$). Whole kernels also had slightly less dry matter than fines (87.8 % vs. 88.8 $\pm$ 0.2 %, $P < 0.001$). Samples had greater bulk density with increasing sample depth (688.9, 702.3, and 717.5 $\pm$ 3.9 g/L for 1, 3 and 5 m depth, $P < 0.03$); and, whole kernels had greater bulk density than fines (755.8 vs. 649.9 $\pm$ 3.2 g/L, $P < 0.001$). The aflatoxin concentration in the whole kernel fractions was 86 to 89 % lower than aflatoxin concentration in the fines ($P < 0.001$). Samples taken at 1 m depth contained greater aflatoxin concentration than those taken at 3 and 5 m ($P < 0.001$). The sampling depth by sample fraction interaction was significant ($P < 0.001$). In the whole kernel fractions, mean aflatoxin concentrations were 31, 9 and 13 $\pm$ 13 ppb for depths of 1, 3 and 5 m, respectively and not different ($P > 0.25$). In the fines fraction, mean aflatoxin concentrations were 235, 82 and 96 $\pm$ 13 ppb for depths of 1, 3 and 5 m, respectively. Aflatoxin concentration in fines from the 1 m sampling depth was greater than in fines from 3 and 5 m depths ($P < 0.001$). These data illustrate the potential difference in aflatoxin concentration of corn at different locations within a bin. Under the conditions of this study, grain screening to remove fines would be effective in reducing aflatoxin to levels that pose little risk for swine and poultry feeding (aflatoxin < 20 ppb).

Key Words: Aflatoxin, Sampling, Screening

227 Investigating effects of ambient temperature and day length on milk production of first lactation Iranian Holstein heifers. A. Naserian[1], B. Saremi[1], and A. Alizadeh*[2], [1]*Ferdowsi University of Mashhad, Khorasan, Iran,* [2]*Tarbiat Modarres University, Tehran, Iran*.

Heat stress is well known to depress milk yield (MY) and appetite in dairy cows. Cows in early lactation are sensitive to heat stress, and respond to heat stress by reducing milk production. The aim of this study was to investigate effects of day length (DL) and ambient temperature (AT) on milk production of first lactation Holstein heifers. This experiment was conducted during 1997-2002 at the Ferdowsi University of Mashhad dairy farm. Nutrient requirements of different groups of animals were supplied according to NRC (1989). The size of herd is one hundred cows milked daily and produced around 2.5-ton milk. Milk production data were recorded monthly and Khorasan State Climatologic Station prepared temperature and day length data. Data were analyzed using General Linear Models procedures of SAS v6.12 to evaluate differences among experimental groups. The design was completely randomized (unequal replicates). Means were compared with Duncan test. Data in this experiment showed that DL and AT had significant effects on milk production in the second and ninth months ($P \leq 0.03$ and 0.01 respectively). To optimize MY, data indicate that the second month of milk production should be April, whereas November is the worst month for peak milk production. Based on these data we suggest that September is the best month for the ninth month of lactation and the worst

is March. To maximize MY under Iranian climatic and management conditions, calving should be synchronized to occur in February to have the second month of lactation at April.

Key Words: Ambient temperature, Day length, Milk production

Ruminant Nutrition: Grazing - rumen metabolism - protein

228 Effect of corn silage and grazing strategy on milk production and composition of grazing dairy cows. P. Chilibroste*, F. Elizondo, and D. A. Mattiauda, *Facultad de Agronomia. Est. Exp. M. A. Cassinoni.*

An experiment was completed to evaluate effects of corn silage allocation and within day grazing strategy on milk production (MP), milk composition, and body condition score (BCS) of early lactation grazing dairy cows (35±15 d in milk). A daily strip of pasture (1536±289 kg DM/ha), with an allowance of 15 kg DM/cow, was available to each treatment group between 9:00 and 15:00 h. Additionally, cows received 2.7 kg of concentrate at each milking (4:30 h and 15:30 h). Corn silage (16 kg/d/cow; fresh basis) was offered at 17:00 h (T1), at 8:00 h (T2) or in two equal meals at 17:00 and 8:00 h (T3). Thirty six cows were grouped by parity, MP and live weight, and randomly assigned to treatments. MP was recorded daily and milk composition was determined on four consecutive milkings each week (W). BCS was recorded at the beginning, middle and end of the study. Data was analyzed with repeated measures using the Proc Mixed procedure of SAS 8.1. Treatment, W and T*W effects were tested using a covariance structure. MP (25.4±0.94, 24.9±0.91 and 25.8±0.89 L/d for T1, T2 and T3, respectively), did not differ among treatments, but increased with time ($P<0.01$). There was no T*W interaction. Milk protein percent did not differ among treatments (2.98±0.05, 2.94±0.05 and 2.92±0.04 for T1, T2 and T3, respectively), although a T*W interaction ($P<0.01$) occurred. T2 cows lost BC at a higher rate than T1 (-0.389 vs. -0.167 units/wk) in the first half of the study but recovered BCS faster in the second half (0.057 vs 0.135 units/W, for T2 and T1 respectively). Corn silage allocation and grazing session strategy during the day did not effect MP and composition, although it modified BCS changes which could affect reproductive performance and energy partition during the lactation.

Key Words: Grazing, Feeding strategy

229 Effect of corn silage and grazing strategy on rumen fermentation patterns of dairy cows. P. Chilibroste*[1], C. Baccetta[1], S. Etchegaray[1], I. Ferreira[1], C. Lockhart[1], L. Posse[1], F. Elizondo[1], and D. A. Mattiauda[1], *Facultad de Agronomia. Est. Exp. M. A. Cassinoni.*

An experiment was completed to evaluate effects of within day corn silage feeding times and grazing strategy on rumen pH and ammonia concentrations of early lactation grazing dairy cows (3515 d). A daily strip of pasture (1536289 kg DM/ha; with an allowance of 15 kg DM/cow was provided to each treatment group between 9:00 and 15:00 h. Cows also received 2.7 kg of concentrate at each milking (4:30 and 15:30 h). Corn silage (16 kg/d/cow, fresh basis) was offered at 17:00 h (T1), at 8:00 h (T2) or equally distributed at 17:00 h and 8:00 h (T3). The 36 cows were grouped by parity, milk production and live weight, and randomly assigned to treatments. Two rumen fistulated dairy cows, within each treatment, were used for rumen fluid collection. Data was analyzed as repeated measures using the Proc Mixed procedure of SAS 8.1. Treatment, week, hour of the day and the interactions were tested using a covariance structure. Rumen samples were collected at the start, middle and end of the experiment at 0, 1.5, 3.5, 5, 8.5, 10, 14 and 22 h from the beginning of the grazing session. pH was determined immediately and ammonia N was determined in samples preserved with sulfuric acid and frozen at -15C. pH declined ($P<.05$) as the grazing session progressed, and T1 cows had the lowest ($P<.05$) value 8 h from t=0. Ammonia concentrations increased ($P<.05$) as the grazing session progessed with T1 cows having higher concentrations than T2 and T3 cows in earlier samplings. After termination of the grazing session (i.e, at t=6) ammonia N concentrations declined linearly in cows on all treatments. Differences among treatments are in the Table. Within day corn silage feeding times and grazing strategy both effected some aspect of rumen pH amd ammonia N values, which could supress pasture dry matter intake and rumen fiber digestion.

pH	Difference	Probability
T1 - T2	-0.282	≤0.01
T1 - T3	-0.382	≤0.05
T2 - T3	-0.100	NS
Ammonia N		
T1 - T2	63.78	≤0.1
T1 - T3	74.97	≤0.05
T2 - T3	11.19	NS

NS = non significant; Ammonia concentration = parts per million

Key Words: Grazing strategy, Grazing, Corn silage

230 Computer modeling of a dairy systems trial comparing Holstein-Friesians fed either pasture or TMR. P. C. Beukes, B. S. Thorrold, E. S. Kolver, M. E. Wastney, K. P. Bright, J.A.S. Lancaster, C.A.J. Palmer, and C. C. Palliser*, *Dexcel Ltd., Hamilton, New Zealand.*

A computer model of a whole farm system (known as the Whole Farm Model or WFM) was used to simulate a trial where Holstein-Friesian dairy cows were fed either grass or a Total Mixed Ration (TMR). The genetics were either New Zealand (NZ) or Overseas (OS) and the groups had comparable Breeding Worths. The aim was to determine the accuracy of the WFM in predicting cow production on a high protein versus high energy feed, i.e., pasture (the main feed used in New Zealand) or TMR. The TMR did not include grass and represented the diet upon which the OS genetics had been selected to produce overseas. The WFM is a dynamic model which consists of a framework to which are attached mechanistic submodels for cow metabolism (the Molly model) and pasture growth. Characteristics (initial and dry-off liveweight and milk potential) of a representative cow from each year of the trial were entered into the WFM together with the observed climate data and management so that the cows were fed ad lib pasture or TMR as in the trial. Predicted values for milk yield (kg/cow/year), milksolids production (kg/cow/year), milk fat %, milk protein %, liveweight change during lactation (kg) and dry-off liveweight (kg) were compared for the grass versus the TMR diet. The differences were significant ($P < 0.001$) for milk protein % (mean for grass = 3.66 %, standard error (SE) 0.02; mean for TMR = 3.39 %, SE 0.01), liveweight change during lactation (mean for grass = -12 kg, SE 28; mean for TMR = 139 kg, SE 12), and dry-off liveweight (mean for grass = 491 kg, SE 11; mean for TMR = 668 kg, SE 21). These model results agree with those from the trial. Although the trends were expected, given the higher energy content of TMR and the higher protein content of pasture, the values indicate the potential production of both NZ and OS genetics when fed well. It was concluded that the WFM model correctly predicts milk production, milk composition and body weight change in cows fed diets of different composition.

Key Words: Dairy cow, Model, Diet

231 Effect of grazing systems on chewing activity, ruminal pH fluctuations and pH of milk, blood and urine of dairy cows. C. Graf[1], M. Kreuzer[2], and F. Dohme*[1], [1]*Swiss Federal Research Station for Animal Production, Posieux, Switzerland,* [2]*Swiss Federal Institute of Technology, Zurich, Switzerland.*

Grass in its young vegetative stage is rich in rapidly-fermentable carbohydrates and poor in physical structure and therefore could cause low ruminal pH and reduced chewing activity in dairy cows on pasture. The effects of full-time grazing (G) versus part-time grazing with nightly supply of 5.5 kg DM either as hay (H) or corn silage (C) on chewing activity and pH in various body fluids and excretion products were studied in six rumen-fistulated Brown Swiss cows. A replicated 3 x 3 Latin square design was applied. Each experimental period lasted 28 d with sampling taking place from d 21 to 28. Grass intake was quantified by the double

alkane technique using controlled-release capsules. The pH of morning samples of milk, venous blood and urine was measured 2, 4 and 7 times per cow and period, respectively. Rumen pH was recorded continuously over 24 h except during milking with a pH electrode placed in the rumen through the fistula. These data were summarized separately for daytime and night for each cow as mean, maximum and minimum pH and time period when pH was below 5.8. The chewing activity, separated into eating and ruminating, was recorded continuously for 22 h using a behavior recorder. Grazing systems had no effect on the time spent ruminating and rumination time per kg DM intake. Cows in treatment G spent more time for eating per kg DMI (+15 min) compared to C and more time for eating per day (+121 min) compared to H and C ($P < 0.05$ for each). In rumen fluid, the maximum and minimum pH, the average night pH and the time period with pH < 5.8 did not differ among treatments. By contrast, throughout the day cows in treatment H had a lower mean ruminal pH (-0.24) compared to G, and the time period when pH was below 5.8 was longer with H (+66 min) compared to C ($P < 0.05$ for each). Milk and blood pH were not affected by treatments while urine pH tended to be lower (-0.07) in group G ($P = 0.06$). In conclusion, full-time grazing had no adverse effect on ruminal pH and rumination time whereas part-time grazing with nightly supply of hay caused less favourable ruminal pH conditions during the day.

Key Words: Grazing, Ruminal pH, Chewing activity

232 Effect of abomasal pectin infusion on digestion and nitrogen balance in dairy cows.

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We hypothesized that increasing postruminal fermentation would stimulate bacterial growth in the large intestine and shift some nitrogen (N) excretion from the urine to the feces. This should reduce N volatilization from manure and improve air quality. Four multiparous lactating cows were assigned to a Latin square with 14-day periods. All cows were fed a basal diet (27.4% NDF and 10.1% neutral detergent soluble fiber (NDSF)) to meet energy and nutrient requirements . Cows received 20 L/d saline infused into the abomasum via a rumen fistula. Treatments were: 0PEC=saline only (control); 0.5PEC=saline plus 0.5 kg/d pectin; 1PEC=saline plus 1.0 kg/d pectin; MOL=saline only with 1 kg/d dried molasses added to the basal diet. One cow was removed from the trial due to failure of the infusion device. Linear and quadratic effects of increasing pectin infusion were tested. Effect of site of fermentation was also tested (1PEC vs MOL). Average milk production was 36.3 kg/d and did not differ among treatments. NDSF provided by 0.5PEC was 0.39 kg/d and 0.78 kg/d for 1PEC. Based on fecal NDSF excretion, all of the infused pectin was apparently degraded for 0.5PEC and about 55% was degraded for 1PEC. Total tract apparent NDF digestibility was numerically reduced with pectin infusion and there was little difference in digestibility of neutral detergent solubles (NDS). As hypothesized, pectin infusion resulted in a numerical reduction in milk urea nitrogen, a reduction in fraction of N excreted in urine ($P<0.08$) and a numerical increase in fecal purines. It appears that increased postruminal fermentation from pectin occurred at the expense of postruminal fermentation of NDF, resulting in only a slight increase in total postruminal fermentation and a minor shift in N.

			Treatment				Contrast	
	0PEC	0.5PEC	1PEC	MOL	SEM	Lin	Quad	Site
DMI+pectin, kg/d	25.9	25.7	25.1	25.9	1.6	0.18	0.69	0.20
MUN, mg/dl	13.2	11.1	11.9	13.4	1.1	0.33	0.24	0.29
NDF digestibility, %	34.9	29.8	23.0	32.4	6.0	0.24	0.91	0.34
NDS digestibility, %	67.7	67.0	64.1	67.5	2.6	0.23	0.62	0.25
Fecal NDSF, kg/d	1.49	1.42	1.74	1.24	0.10	0.18	0.21	0.04
UrineN/ (urineN+fecalN)	0.49	0.46	0.43	0.48	0.03	0.08	0.74	0.10
Fecal purines, g/d	15.4	17.2	18.2	16.2	1.64	0.23	0.83	0.35

Key Words: Pectin, Postruminal fermentation, Nitrogen excretion

233 Effect of dietary cation-anion difference on the milk production of early lactation dairy cows.

J. R. Roche*, S. Petch, and J. K. Kay, *Dexcel (formerly Dairying Research Corporation), Hamilton, New Zealand*.

In pasture-based systems, the dietary cation-anion difference (DCAD) offered can vary from 0 to +100 meq/100g DM, but the effect of such a range on milk production is not known. Thirty-two multiparous Holstein-Friesian cows offered generous quantities of pasture (51±6 kg/cow.d^{-1}) were randomly allocated to one of four DCAD treatments. Treatment groups were grazed together and cows were supplemented twice daily with a mixture of $NaHCO_3$, $MgCl_2$ and $CaCl_2$. Final DCAD treatments were +48, +72, +99 and +116 meq/100g DM. Blood and urine pH increased ($P < 0.001$) linearly with increasing DCAD, as did blood base excess and blood HCO_3^- concentration. The ratio of calcium to creatinine in urine (CUCa) increased ($P < 0.001$) linearly with decreasing DCAD, suggesting an increased intestinal absorption of Ca in cows at lower DCADs. The DCAD range tested did not affect the yield of milk or the yield or concentration of protein or lactose. Milk fat yield and concentration increased ($P < 0.05$) linearly with increasing DCAD, but pasture intake, BW change and BCS change were not significantly affected. It is apparent from this study that pasture diets with a large range in DCAD do not greatly affect milk production.

DCAD, meq/100g DM	+48	+72	+99	+116	SED	DCAD	Linear
						P	*P*
Blood pH	7.43	7.45	7.48	7.49	0.007	<0.001	<0.001
Blood HCO_3^-, meq/L	31.3	32.5	34.7	38.0	1.15	<0.001	<0.001
Base excess, meq/L	6.99	8.31	10.59	13.66	0.789	<0.001	<0.001
Urine pH	7.93	8.25	8.3	8.36	0.251	<0.001	<0.001
CUCa	2.6	1.4	0.9	0.6	0.40	<0.001	<0.001
Milk yield, kg/c.d^{-1}	24.8	26.1	26.6	26.3	1.26	0.50	0.19
Fat yield, kg/c.d^{-1}	1.00	1.03	1.09	1.10	0.056	0.23	0.04
Protein yield, kg/c.d^{-1}	0.87	0.89	0.89	0.89	0.044	0.95	0.63
Lactose yield, kg/c.d^{-1}	1.25	1.27	1.28	1.29	0.070	0.94	0.52
Fat, %	3.96	4.06	4.22	4.17	0.123	0.19	0.04
Protein, %	3.43	3.44	3.40	3.39	0.048	0.69	0.29
Lactose, %	4.90	4.89	4.92	4.92	0.037	0.78	0.52
DMI, kg/c.d^{-1}	15.9	16.7	18.0	17.4	1.43	0.50	0.21
BW change, kg	10.9	7.4	8.9	18.0	7.88	0.55	0.37
BCS change	-0.11	-0.19	0.00	-0.06	0.094	0.26	0.29

CUCa - ratio of Ca to creatinine in urine

Key Words: DCAD, Lactating cow, Pasture

234 Influence of a polyclonal antibody preparation against rumen proteolytic bacteria on rumen fermentation and yield of milk and milk components.

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Twenty-eight multiparous dairy cows were used to study the effects of a polyclonal antibody preparation (PA) against rumen proteolytic bacteria (C. stricklandi, C. aminophilum, and P. anaerobius) on rumen fermentation and yield of milk and milk components. Cows were paired by days in milk (DIM; > 50 d) and allocated to one of two treatments (fed as a top-dressing daily): 1) a dose of PA carried in 120 g of soy-hull pellets (n = 14), or 2) 120 g of soy hull pellets (n = 14). Treatments were delivered during two 14-d feeding periods in a switch-back design; each period was preceded by a 14-d measurement period (baseline; no carrier or PA fed). Diets were formulated to contain 1.70 Mcal NE_l/kg DM, 17.5% CP, 0.65% Ca and 0.35 % P. Diets were delivered once daily and fed ad libitum. Dry matter intake (DMI) and milk yield were measured daily throughout each period. Daily milk samples were composited from d 8 to d 14 and analyzed for solids, fat, protein, somatic cell count (SCC), and milk urea nitrogen (MUN). Rumen fluid was collected on d 14 of each period. Data were analyzed as a paired switchback design with cow as the experimental unit. Data for DMI and milk yield and components were separated into early lactation (EL; < 140 DIM) and late lactation (LL; ≥ 140 DIM) groups. When appropriate, milk yield and/or DMI measured during the baseline period were used as covariates in this analysis. Milk yield and 4% fat corrected milk (FCM) tended ($P < 0.15$) to be greater when EL cows were fed PA. Neither milk fat nor protein concentration was affected ($P > 0.05$) by feeding PA to EL cows. Concentration of milk solids was reduced ($P < 0.05$) when PA was fed to EL cows. Neither SCC nor MUN were affected ($P > 0.05$) by feeding PA to EL cows. Feeding PA to LL cows had no effect (P >

0.05) on milk yield, FCM, fat, protein, or SCC. However, concentration of milk solids and MUN were reduced (P < 0.05). Feeding PA had no effect (P > 0.05) on pH, or VFA and ammonia concentrations. Results of this short term feeding of a polyclonal antibody preparation against rumen protoelytic bacteria indicate that this preparation may enhance milk yield in early lactation cows without affecting rumen fermentation.

Key Words: Rumen fermentation, Milk production, Passive immunization

235 Urea synthesis by ruminal epithelial and duodenal mucosal cells isolated from growing sheep.

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To determine the capability of ruminant gut tissues to synthesize urea, ruminal epithelial (REC) and duodenal mucosal cells (DMC) were isolated from growing Polypay ram lambs (n=4) fed a mixed forage-concentrate diet. Isolated cells were incubated for 90 min with either acetate (5mM) or propionate (5mM) plus four combinations of substrate to support urea synthesis (arginine, Arg; aspartate + citrulline, AspC; aspartate + ornithine + ammonia, AspON; aspartate + ornithine + ammonia + N-carbamoylglutamate, AspONG; 5 mM each) in a 2 x 4 factorial arrangement of treatments. Background urea present in 0 time (Control) and total urea release was determined by stable-isotope dilution with gas chromatography-mass spectrometry. For both cell types, effects of VFA and interactions between VFA and substrate combinations were not observed. For REC, total urea release was 56.6, 6.7, 3.7, 5.8, and 2.2 nmol per 10^6 cells respectively for Arg, AspC, AspON, AspONG, and Control. Arg addition resulted in 10-fold greater ($P < 0.001$) urea release than other treatments that did not differ from control. For DMC, total urea release was 4.2, 2.4, 1.5, 4.0, and 2.1 nmol per 10^6 cells respectively for Arg, AspC, AspON, AspONG, and Control. Arg and AspONG treatments resulted in greater ($P < 0.001$) urea release than other treatments and control, indicating that ammonia N can be utilized for urea synthesis by DMC if carbamoyl phosphate synthetase is activated. These results demonstrate that ruminant gut tissues are capable of synthesizing urea, particularly by REC when degrading Arg. Further research is needed to determine the extent to which arginine degradation by the REC contributes to N recycling in vivo in order to assess the impact on arginine requirement in ruminants.

Key Words: Ruminal epithelial cells, Duodenal mucosal cells, Urea synthesis

236 Assessment of metabolizable protein recommendations for milking Jersey cows by NRC (2001).

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Metabolizable protein (MP) recommendations by NRC (2001) were derived almost exclusively from Holstein data. The objective of this study was to assess whether the calculated recommendations are accurate for Jersey cows considering the greater protein concentration of Jersey milk. Ten multiparous and ten primiparous Jersey cows were used in a three period, five treatment crossover experimental design. Experimental periods were 4 wk in length, with d 1 to 7 used for standardization, d 8 to 14 as time for adjustment, and d 15 to 28 for data collection. Levels of supplied MP were changed solely by varying the level of RUP (RDP was constant at 10.4% of DM). The treatment diets were 80, 90, 100, 110, and 120% of the RUP recommendations according to NRC (2001) for each individual cow based on DMI, milk production and composition during wk 1 of each period when a control (RUP=100%) diet was fed. All diets contained 30% corn silage, 20% hay, 26.5% ground shelled corn, and 10% whole linted cottonseed on a DM basis. A high post-ruminal digestibility bloodmeal and nonenzymatically browned soybean meal supplemented with rumen protected methionine were the sources used to modify RUP of diets by substitution with soybean hulls and urea. The level of RUP had a significant (P<0.01) positive linear effect on milk production (27.2, 26.8, 27.8, 27.8, and 29.3 kg/d), milk true protein concentration (3.69, 3.75, 3.76, 3.81, and 3.80 %), milk true protein production (1.000, 1.001, 1.046, 1.056, and 1.109 kg/d) and milk urea N (11.2, 12.0, 15.5, 13.3, and 18.7 mg/dL) for 80 to 120 % of NRC RUP respectively. Quadratic, cubic and quartic effects of RUP were not significant (P>0.10) for all variables except for a significant quadratic effect of RUP on MUN. Milk fat concentration (5.09 %), fat production (1.402 kg/d), log SCC (5.41), body weight (417.5 kg), body condition score (2.85), and DMI (17.9 kg/d) were not affected (P>0.10) by RUP levels. These results suggest that NRC (2001) either overestimate MP supply from microbial or feed origin, or underestimate MP requirements of Jersey cows.

Key Words: Metabolizable protein, Rumen undegradable protein, Jersey cows

237 Effect of dietary crude protein level and degradability on ruminal fermentation and nitrogen utilization in lactating dairy cows.

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The objective of this study was to evaluate the effect of dietary CP level and degradability on N utilization in lactating dairy cows. Four ruminally and duodenally cannulated Holstein cows were allocated to two dietary treatments in a crossover design. The diets were based on alfalfa hay, triticale silage, cottonseed, corn grain, soybean meal, and molasses and were formulated to provide similar metabolizable protein but different levels of ruminally degradable protein; CP content of the diets was 18.5 (HP) and 17.2% (LP). Ruminal ammonia was labeled with ^{15}N and excretion of tracer in milk protein was determined for a period of 120 h. Ammonia concentration in the rumen tended to be higher ($P < 0.1$) on HP than LP. Microbial N flow to the duodenum, ruminal digestibility of dietary nutrients, DMI, milk yield, fat content, and protein content and yield were not different ($P > 0.05$) between the diets. Total tract apparent digestibility of N was higher ($P < 0.05$) on the HP diet than on the LP diet (73.0 *vs* 69.0 %, respectively). Urinary N excretion tended to be higher ($P < 0.1$) on HP than on LP (0.348 *vs* 0.274 kg/d, respectively). The cumulative excretion of ammonia ^{15}N into milk protein, as proportion of ^{15}N dosed intraruminally, was not different between the two diets (11.8 *vs* 14.3%, respectively). The area under the milk protein ^{15}N excretion curve was greater ($P < 0.05$) for LP compared to HP (1.049 *vs* 0.957 at % exc. × h, respectively). The proportions of bacterial protein originating from ammonia N and milk protein originating from bacterial N were not different ($P > 0.05$) between the two diets. Milk urea N concentration was higher ($P < 0.05$) for HP than for LP (15.8 *vs* 13.1 mg/dl, respectively). In conclusion, excess RDP in the diet resulted in higher ruminal ammonia and milk urea N concentrations but had no significant effect on the efficiency of utilization of ruminal ammonia for milk protein, urinary N losses, or milk yield and fat and protein content.

Key Words: Dietary protein, Rumen ammonia, Milk protein

238 Use of milk urea nitrogen to evaluate dietary protein on commercial dairy farms.

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The first objective was to evaluate the potential for using milk urea N **(MUN)** to identify overfeeding or underfeeding of protein on commercial dairy farms. The second objective was to use MUN and ration analysis to determine if dairy producers were feeding protein as recommended by the National Research Council **(NRC)**. A previously developed model was used to predict MUN concentrations using milk yield and ration CP% and NE_L. A target MUN was calculated using NRC's dietary recommendations. If cows were receiving more protein than recommended by NRC then their observed MUN values would be higher than expected and visa versa. Bulk tank and TMR samples, as well as milk production and cow information, were collected from twenty-one Holstein dairy farms across Maryland repeatedly in March, June, September and December (n=73). Predicted MUN explained 40% of the variation in observed MUN and 8% was explained by collection month ($P < 0.05$). This model predicted MUN to be 2.2 mg/dl greater than was observed (residual error = 2.8 mg/dl). Observed MUN was influenced by collection month, farm, average days in milk, and dietary CP% ($P < 0.05$). There is a correlation between MUN and dietary CP% where high MUN indicates high dietary CP% ($P < 0.0001$). Both TMR and MUN analyses suggested that cows were overfed protein 69% of the time. Additionally, 9.9% of the time, both analyses suggested that cows were underfed protein which resulted in an overall agreement of both methods at 78.9%. However, nearly 20% of the time, the TMR analysis (used in calculating predicted MUN value) indicated that cows were being overfed protein while observed MUN values suggested that cows were not receiving adequate protein. Using observed MUN values

resulted in an under-prediction of protein feeding status compared to using TMR analyses, but most dairy producers were feeding over NRC recommendations for protein.

Key Words: Milk urea ditrogen, Dietary protein

239 Effect of increased rumen-undegradable protein fed prepartum on milk production and milk protein yield in early lactation for high producing Holstein cows. K. M. Kouri*, S. M. Andrew, and T. A. Hoagland, *University of Connecticut, Storrs, CT, USA.*

Thirty-six, twenty-four multiparous and twelve primiparous, Holstein cows were assigned to one of three treatments to evaluate the impact of feeding higher rumen-undegradable protein (RUP) for four weeks prepartum on milk production, milk protein content and yield of milk protein during early lactation in corn silage-based rations. The prepartum basal diet consisted of 37% corn silage, 11.3% alfalfa silage, 35.8% mixed hay and 10.3% concentrate mix (DM basis) fed as a TMR. The control treatment (CT) was formulated to provide RUP at 31% of CP using soybean meal (SBM). Diet RUP was increased for the other two treatments to 36% of CP, by substituting either heat-treated soybean meal (HTSBM) or animal-marine byproduct (AMP) for SBM. Cows were blocked by parity, expected calving date, body condition score (BCS) and randomly assigned to one of the three treatments. Prepartum treatment rations were fed to maintain BCS for at least 28 d prepartum. Following parturition cows were fed a common lactating cow ration for 56 d postpartum. Daily dry matter intake (DMI), weekly body weight (BW), and bimonthly BCS were measured throughout the entire experiment. Upon parturition, daily milk weights were recorded and weekly milk samples were collected for determination of milk true protein, milk fat, milk urea nitrogen (MUN), somatic cell count (SCC), and total solids (TS). There were no treatment differences for DMI, BW, BCS, milk protein, SCC or TS. There was a trend for increased milk production (P=0.07) and milk protein yield (P=0.17) for multiparous cows fed HTSBM compared with multiparous cows fed CT. No treatment difference in these variables was observed for primiparous cows. MUN tended to be higher for multiparous cows fed HTSBM, compared to multiparous cows fed the CT. Increasing the RUP in the prepartum ration by feeding HTSBM tended to increase milk production and milk protein yield in the subsequent lactation for multiparous cows fed higher levels of RUP.

Key Words: Rumen undegradable protein, Prepartum, Milk protein

240 Strategic ration balancing by supplementing lysine, methionine, and Prolak® on efficiency of milk protein production and potential environmental impact. J. H. Harrison[1], R. L. Kincaid[1], W. Schager[1], L. Johnson*[1], D. Davidson[1], L. D. Bunting[2], and W. Chalupa[3], [1]*Washington State University,* [2]*Archer Daniels Midland Co.,* [3]*University of Pennsylvania.*

The primary objective of this study was to reduce dietary CP of lactating cows without reducing milk yield. A second objective was to reduce farm N import. Three diets were formulated using the CPM Dairy model to vary in content of CP, metabolism protein balance, and predicted balance of Met and Lys. According to estimated % Lys and Met sufficiency, treatments were defined as Lys/Met = 89/91 (control), Lys/Met = 99/116, and Lys/Met = 116/109. Ration CP was effectively reduced by 14% (18.6 % CP vs 16.0 % CP) with inclusion of a commercial source of free lysine (Archer Daniels Midland, Decatur, IL),Met (Alimet®, Novus International, St Louis, MO), and a commercially available RUP source (Prolak® H J Baker, Atlanta, GA). Respective diets were fed in a 14-week continuous trial design. Cows (n = 36) were paired for parity and PTA prior to initiation of the study, then fed individually via Calan® headgates. Cows were milked 2x/day and were provided Posilac®. Diet reformulation was successful in reducing (P < .05) N imported by 8.6 %, increasing FCM, reducing MUN, and improving efficiency of milk protein yield. A proper balance of Lys/Met was necessary to maintain milk production when CP% was reduced in the diet. The apparent imbalance of Lys/Met in the second treatment decreased milk fat% and production of FCM. This study illustrates the benefits of reducing dietary CP and improving efficiency of milk protein production. Detailed data are summarized below.

Item	Control 18.6% CP	16% CP Lys/Met (99/116)	16% CP Lys/Met (116/109)	SE	P<
DMI, kg	20.4	20.5	20.5	1.35	NS
CP Intake, kg	3.79	3.28	3.28	—	—
Milk, kg	35.8	35.4	37.5	2.32	NS
3.5% FCM, kg	37.2^a	33.4^b	38.6^a	2.29	.04
Milk Fat, kg	1.34^a	1.11^b	1.38^a	0.83	.02
Milk Protein, kg	1.10	1.08	1.13	.071	NS
MUN, mg/dl	18.8^a	13.0^b	14.4^b	.92	.01
Ratio of Milk True Protein to Intake Protein	.29	.33	.34	—	—

Key Words: Protein, Environment, Nutrient management

241 Effect of HMB and HMBi on milk production, composition, and N efficiency of Holstein cows in early and mid-lactation. J. T. Sylvester*[1], N. R. St-Pierre[1], B. K. Sloan[2], J. L. Beckman[1], and S. M. Noftsger[1], [1]*The Ohio State University, Columbus, OH, USA,* [2]*Adisseo, Alpharetta, GA, USA.*

Dietary supplementation of 2-hydroxy-4-(methylthio)-butanoic acid (HMB) results in inconsistent increases in milk yield, fat content and fat production. Chemical modification of HMB to an isopropyl ester (HMBi) increases its methionine (Met) bioavailability to approximately 50%. The objectives of this study were (1) to determine the lactation response (volume and components) to ruminally available Met (HMB), (2) to determine the lactation response to partially protected Met provided as HMBi, and (3) to evaluate whether HMBi supplied at 0.15% of the diet provides enough ruminally available HMB to achieve maximal production response. Sixty-one Holstein cows (24 primiparous, 37 multiparous) were assigned to one of four dietary treatments 21 to 28 days after calving. A base diet consisting of (DM basis) 32.5 % corn silage, 17.5 % alfalfa hay, 10 % whole cottonseed and 40 % of a pelleted concentrate made primarily of ground corn, soybean hulls, Megalac, dehulled-solvent extracted soybean meal, blood meal, urea, vitamins and minerals was fed for 16 weeks as a control diet (treatment 1), or was supplemented with 0.1% of diet DM with HMB (treatment 2), with 0.15% with HMBi (treatment 3), or with 0.045% HMB and 0.15% HMBi (treatment 4). The control diet contained an estimated 31.3 % NDF, 10.6 % RDP, 6.2 % RUP, 10.9% metabolizable protein (MP), 6.78% lysine (% of MP), and 1.79 % methionine (% of MP). Results were analysed as a randomized block design with repeated measurements using a mixed model with a first order autoregressive covariance of errors. Results showed a significant (P<0.05) increase in milk yield (2.9 kg/d), true protein composition (0.15%), true protein production (115 g/d), fat production (165 g/d), and lactose production (182 g/d) from the feeding of HMBi. Supplementation of HMB had non-significant effects on milk yield and composition with only lactose production showing a significant improvement. Dietary supplementation of HMBi reduced the amount of N excreted in the urine by increasing the amount of N secreted in milk.

Key Words: Methionine hydroxy analog, Dairy cattle, Milk yield and composition

Ruminant Nutrition: Dairy feedstuffs

242 Effect of *bmr*-6 and *bmr*-18 brown midrib genes on forage sorghum silage in lactating dairy rations. A. L. Oliver*[1], R. J. Grant[1], and J. F. Pedersen[2], [1]*University of Nebraska, Lincoln, NE,* [2]*USDA/ARS, Lincoln, NE.*

Diets of normal sorghum, brown midrib *bmr*-6 sorghum, *bmr*-18 sorghum, and corn silage were fed to determine the effect of these two sorghum brown midrib genes on lactational performance, ruminal metabolism, and digestion. Sixteen multiparous Holstein dairy cows (including four ruminally fistulated) averaging 124 ± 68 DIM were assigned to one of four diets in a replicated Latin square design with 3-week periods. Diets comprised of 40 % test silage, 10 % alfalfa silage, 3.7 % whole cottonseed, and 23.6 % concentrate mix. Cows were housed in a tie-stall barn and fed in individual feed boxes. Lignin was decreased

in the *bmr*-6 and *bmr*-18 sorghum silage when compared to the normal sorghum silage. In addition, the normal sorghum silage had greater NDF and ADF than *bmr*-6, *bmr*-18, and corn silage. There was greater DMI for *bmr*-6 (25.2 kg/d) sorghum silage than *bmr*-18 (23.4 kg/d) sorghum silage while no difference was seen between sorghum silages and corn silage. Milk production (kg/d) and 4 % FCM were significantly greater ($P < 0.10$) for those consuming the *bmr*-6 sorghum and corn silage than normal sorghum silage. Silage source had no effect on overall chewing time. Eating time was increased ($P < 0.10$) with the normal and *bmr*-18 sorghum silages. Rumination time was greatest with *bmr*-6 sorghum silage. Corn, *bmr*-6, and *bmr*-18 sorghum silage had greater ($P < 0.10$) DM digestibility when compared to normal sorghum silage. Corn silage and *bmr*-6 sorghum had higher NDF digestibility ($P < 0.10$) when compared to *bmr*-18 and normal sorghum silage.

Key Words: Brown midrib, Sorghum, Milk production

243 Comparison of a corn silage hybrid with high cell wall content and digestibility with a lower cell wall hybrid on lactational performance of Holstein cows.

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We hypothesized that substituting a corn silage hybrid with high cell wall content and digestibility for a lower cell wall hybrid with lower digestibility would improve feed intake and milk production in lactating Holstein cows. In trial 1, 40 cows (12 primiparous) ranging in milk production from 24.1 to 44.0 kg/d, after a 2-wk preliminary period, were used in a crossover design with 2-wk periods. Diets consisted of either 45% high cell wall and digestibility corn silage (HCW) or 45% lower cell wall corn silage (LCW) plus 10% alfalfa hay, and 45% concentrate. There was a 5.1 percentage-unit range in NDF content and a 5.3 percentage-unit range in 30-h in vitro NDF digestion between the two corn hybrids. The DMI (25.4 vs 24.2 kg/d) and 4% FCM yield (34.3 vs 31.7 kg/d) were higher ($P<0.05$) for cows fed the HCW diet compared with the LCW diet. Milk composition was unaffected by diet ($P>0.20$). When HCW was substituted for LCW on a DM basis, there was no relationship ($P>0.30$) between pretrial milk yield during the preliminary period and response to HCW silage. In trial 2, 40 cows (8 primiparous) ranging in milk production from 20.6 to 49.0 kg/d, after a 2-wk preliminary period, were used in a crossover design with 2-wk periods. Diets consisted of the same LCW diet as trial 1 and a diet containing HCW at a concentration (40% of DM) that resulted in equal NDF content (29.4%) between the two diets (HCWN). The DMI (26.8 kg/d) was unaffected by diet ($P>0.30$), although there was a trend ($P<0.13$) for greater DMI (% of BW) for cows fed the HCWN diet compared with LCW silage (4.24 vs 4.12). Milk fat % (3.91 vs 3.79) and 4% FCM yield (34.9 vs 33.4 kg/d) were greater for cows fed HCWN versus LCW diet ($P<0.07$). When HCW was substituted for LCW silage on a NDF basis, there was a linear and quadratic ($P<0.02$) relationship between pretrial milk yield and response to HCW: cows with greater milk production during the preliminary period had a greater milk response to HCW than lower producing cows. Results of these trials support our hypothesis that HCW corn silage results in greater DMI and milk yield than LCW silage, whether substitution occurs on a DM or NDF basis.

Key Words: Corn silage, Fiber digestibility, Milk yield

244 Effect of endosperm type of corn grain on starch degradability by ruminal microbes in vitro.

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Six corn hybrids were grown in plots in 3 states (MI, NE, PA) in 1999. Hybrids differed in endosperm type: floury, opaque-2, waxy, dent, and flint (2). Corn grain was harvested at 40%, 30%, and 20% moisture, rolled and ensiled in duplicate 10- x 30-cm PVC silos. Whole kernels and rolled samples were frozen until analysis. Within each location, duplicate silos from each plot and maturity were opened after 35 d and 120 d and frozen until analysis. Samples were ground with dry ice (Wiley mill, 1-mm screen) before analysis. In vitro starch degradation was determined after incubation for 7 h in buffered media with 20% rumen fluid. Vitreousness of endosperm for hybrids ranged from 4 to 62%. Starch degradation was affected by hybrid (49.8 to 60.3%, $P < 0.001$) and increased with moisture content (46.0 to 65.8%, $P < 0.001$), ensiling (0 d vs. 35 d and 120 d, 46.3 vs. 59.3%, $P = 0.001$), and time of ensiling (35 d vs. 120 d, 57.4 vs. 61.2%, $P < 0.001$). However, several interactions were detected. Sample fragility, measured as DM of ground samples passing a 106-μm aperture screen, explained additional variation when included as a covariate ($P < 0.001$) and ranged by hybrid from 26.7 to 40.8% ($P < 0.001$). No interactions were detected when particle size was included as a covariate; starch degradation was increased by ensiling (52.6 vs. 56.2%, $P = 0.01$) and affected by hybrid (52.3 to 58.8%, $P = 0.001$), but not by moisture content or time of ensiling. Starch degradation of hybrids was highly related to vitreousness both with ($R^2 = 0.96$, $P < 0.001$), and without ($R^2 = 0.66$, $P < 0.05$) particle size as a covariate. Increased starch degradation with increased time of ensiling and moisture content was associated with increased kernel fragility. Corn hybrids vary in starch degradation by ruminal microbes because of fragility and vitreousness of endosperm.

Key Words: Corn grain, Starch degradation, Endosperm type

245 Effects of corn grain endosperm type and brown midrib corn silage on milk production and feeding behavior of lactating dairy cows.

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Effects of endosperm type of corn grain and the brown midrib 3 mutation in corn silage on milk yield, DMI, and feeding behavior of cows were evaluated. Eight ruminally and duodenally cannulated Holstein cows (72 ± 8 DIM; mean ± SD) were used in a duplicated 4 x 4 Latin square design with a 2 x 2 factorial arrangement of treatments. Grain treatments were dry corn grain from hybrids with floury or vitreous endosperm and silage treatments were corn silage from a hybrid with the *bm3* mutation or an isogenic control hybrid without the *bm3* mutation. Diets were formulated to 27% neutral detergent fiber and 18% crude protein. Corn grain and silage supplied ∼23% and ∼38% of the diet DM, respectively. An interaction of treatments was detected for 3.5% FCM ($P = 0.10$). Floury endosperm decreased 3.5% FCM 1.2 kg/d compared to vitreous endosperm when fed with control corn silage (39.7 vs. 40.9 kg/d), but had the opposite effect, increasing 3.5% FCM 2.1 kg/d, when fed with *bm3* corn silage (42.2 vs. 40.1 kg/d). Corn grain with floury endosperm decreased DMI 1.8 kg/d compared to vitreous when fed with the control silage diets (23.6 vs. 25.4 kg/d) but increased DMI 0.5 kg/d when fed with *bm3* corn silage (25.2 vs. 24.7 kg/d; interaction: $P = 0.07$). The interaction of grain and silage treatments for DMI can be attributed to a decrease in meal size for floury vs. vitreous corn with control corn silage (2.18 vs. 2.47 kg DM) but an increase in meal size for floury vs. vitreous corn with the *bm3* corn silage (2.25 vs. 2.05 kg DM; interaction: $P = 0.03$). Diets containing *bm3* corn silage tended to increase number of meals compared to control corn silage (11.7 vs. 10.6; $P < 0.10$). Intermeal interval was not affected by treatment. It is unlikely that ruminal distension limited DMI because effects of treatment on meal size and ruminal pool sizes of DM and NDF (interactions $P < 0.05$) reflected effects of treatment on DMI. Treatment effects on meal size and DMI were likely from differences in temporal patterns of fuel production and absorption.

Key Words: Endosperm, Brown midrib, Feeding behavior

246 Dairy cattle performance, health, and milk composition when fed silage and grain from Bt (Cry1F) and near-isogenic control hybrids.

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Objectives for this study were to evaluate the health and performance of dairy cows fed non-Bt maize and a new generation variety of Bt maize containing the Cry1F gene (Herculex^{TM} I). Twenty lactating Holstein cows were assigned to treatment groups and fed diets containing whole plant maize silage and maize grain from Bt and near-isogenic control hybrids. The study used a cross-over design with two 28-day treatment periods each preceded by 7-day adjustment periods. To minimize variability due to stage of lactation, two blocks of ten cows with 90-130 DIM at the start of the trial were used. Equal numbers of cows from each of two genetic selection lines (high and average fat + protein predicted transmitting ability) were assigned to treatments within blocks. Diets were formulated to be isocaloric and isonitrogenous. Daily production of milk, fat, protein, lactose, non-fat solids, and total solids did not differ for cows fed the Bt and non-Bt control diets ($P > 0.05$). Further,

groups did not differ for milk urea nitrogen and somatic cell count. For milk fat percentage, there was a significant treatment × genetic group interaction, however overall yields for milk and solids corrected milk did not differ and were 38.9 and 36.4 kg for Bt and 38.6 and 36.8 kg daily for non-Bt fed groups, respectively. Dry matter intakes were 27.1 and 27.9 kg per day and did not differ for the treatment and control diet groups ($P > 0.05$). Physical measures of cow health were collected weekly and included body weight, body condition score, temperature, and pulse and respiration rate; treatment group means for these parameters were not different. Blood chemistry and hematological analyses were conducted using blood samples collected from cows at two-week intervals. Overall, the Bt and non-Bt fed groups did not differ for these 21 indices of health. Further, hematological profiles for cows in the treatment groups were not different ($P > 0.05$). In summary, there were no differences in milk production, milk composition, or cow health as indicated by physical parameters, blood chemistry, and hematological analyses when dairy cows were fed diets containing maize grain and whole plant maize silage from Bt (Cry1F) or its near-isogenic counterpart hybrid.

Key Words: Genetically modified corn, Dairy cattle, Milk yield

247 Effects of feeding corn silage produced from corn containing MON810 and GA21 genes on feed intake, milk production and composition in lactating dairy cows. S. Calsamiglia*[1], B. Hernandez[1], G. F. Hartnell[2], and R. H. Phipps[3], [1]*Universidad Autonoma de Barcelona, Spain,* [2]*Monsanto Company, St. Louis, MO,* [3]*University of Reading, UK.*

Eight multiparous (126 DIM) Holstein cows (mean live-weight 647 kg) were used in a single reversal study to assess effects of feeding genetically modified corn silage on feed intake and milk production. The potential for transgenic DNA and proteins to occur in milk was also evaluated. The trial consisted of two periods of 28 d (23 d adaptation and 5 d sampling). Cows were housed in a tie-stall barn, fed a TMR ration ad libitum and milked twice daily. Diets contained (DM basis) 45% corn silage, 10% alfalfa hay and 45% concentrate (1.66 Mcal NEl/kg DM, 15.8% CP, 35% NDF and 4.1% fat). Treatments were corn silage containing Roundup Ready event GA21 and MaisGard event MON 810 (RRMG) and a non-modified control line (CTR). Milk was analyzed for fat, protein, solids-non-fat, lactose and somatic cell counts, and transgenic DNA and CRY1A(b)-protein. Chemical composition (37.6% DM, 1.51 Mcal NEl/kg, 8.6% CP, 40% NDF, 19.6 ADF, and pH 3.76) and in vitro DM digestibility (62%) of corn silages were within normal ranges and similar between treatments. Silage type did not affect DM intake (22.1 kg/cow/d). Cows fed the RRMG produced milk with slightly higher ($P < 0.05$) milk protein (3.09 vs 3.00%), lactose (4.83 vs 4.72%) and solids-non-fat (8.60 vs 8.40%) compared with CTR. However, the total yield of milk (36.5 kg/d), 3.5% fat corrected milk (34.4 kg/d), fat (1151 g/d), protein (1106 g/d), lactose (1738 g/d) and solids-non-fat (3094 g/d), and somatic cell count (128000 cells/ml) were not affected by type of silage indicating no overall production difference. All milk samples were negative for the presence of transgenic DNA from either trait or fragments thereof and the CRY1A(b)-protein encoded in the RRMG (limit of detection of 0.1 ng/ml). Results from the chemical composition and production responses indicate that the use of the RRMG silage did not adversely affect animal performance.

Key Words: Corn silage, Genetically modified organism, Dairy cattle

248 Effects of replacing chopped alfalfa hay with alfalfa silage in total mixed rations fed to lactating dairy cows at two levels of concentrate inclusion. M. S. Einarson*[1], J. M. Calberry[2], B. W. McBride[2], K. M. Wittenberg[1], and J. C. Plaizier[1], [1]*Department of Animal Science, University of Manitoba,* [2]*Department of Animal and Poultry Science, University of Guelph.*

Twenty four lactating dairy cows received one of three total mixed rations (TMR) in a higher concentrate range (Exp.1) or a lower concentrate range (Exp.2). Diets in the higher concentrate range (A, B and C) contained (DM basis) 38.5% barley grain based energy supplement, 30.5% corn silage, 17.0% protein supplement and 4.2% sunflower seeds. Diets in the lower concentrate range (D, E, and F) contained (DM basis) 31.7% barley grain based energy supplement, 40.5% corn silage, 13.9% protein supplement and 4.2% sunflower seeds. Diets also contained (DM basis) 0%, 4.9%, and 9.8% alfalfa silage and 9.8%, 4.9%, and 0% chopped hay for both diets A, B and C, respectively, and for diets D, E and F, respectively. Replacing chopped hay with alfalfa silage significantly decreased the proportion of dietary DM passing through the 8 mm bottom screen of the Penn State Particle Separator (PSPS) and dietary DM content, significantly increased the physical effective NDF (peNDF, NDF retained by the PSPS screens), but did not effect dietary CP, NDF and starch contents in both experiments. In the higher concentrate range, this replacement significantly increased rumen pH and significantly decreased total VFA, but did not affect DMI, milk yield and milk composition. This replacement did not significantly affect rumen pH, VFA concentrations, DMI, milk yield and milk composition in the lower concentrate range.

	Higher concentrate range					Lower concentrate range				
Diet	A	B	C	SE	P	D	E	F	SE	P
DMI (kg/d)	21.9	23.5	23.9	1.4	NS	22.2	22.3	22.0	1.4	NS
Rumen pH	6.27^{b}	6.35^{ab}	6.47^{a}	0.04	<0.05	6.28	6.27	6.31	0.04	NS
Total VFA (mM L^{-1})	95.3^{a}	88.3^{ab}	79.8^{b}	2.2	<0.05	91.9	92.1	89.8	1.8	NS
Milk Yield (kg d^{-1})	39.2	38.9	39.1	0.4	NS	37.0	36.8	36.2	1.4	NS
Fat (%)	2.39	2.53	2.63	0.1	NS	2.90	2.9	2.75	0.1	NS
Protein (%)	3.18	3.21	3.26	0.1	NS	3.03	3.03	3.14	0.1	NS
PSPS										
Top screen (% DM)	8.7	9.4	12.6	1.8	NS	12.1	12.4	11.3	0.8	NS
Bottom screen (% DM)	29.5	31.3	32.2	1.2	NS	35.4^{b}	37.5^{ab}	40.7^{a}	1.3	<0.05
Bottom pan (% DM)	61.9^{a}	59.3^{ab}	55.2^{b}	1.8	<0.05	52.4^{a}	50.1^{ab}	47.9^{b}	1.2	<0.05
NDF in retained fraction (%DM)										
Top screen	64.1	60.9	61.8	0.8	NS	63.7	64.5	61.5	1.3	NS
Bottom screen	48.3	46.0	47.4	1.4	NS	52.1	50.5	48.7	1.4	NS
Bottom pan	32.4	32.4	32.9	0.5	NS	35.2	34.1	33.8	1.0	NS
peNDF (% DM)	20.1^{b}	21.0^{ab}	23.3^{a}	1.2	<0.05	25.4^{c}	26.9^{b}	28.2^{a}	0.4	<0.05
DM (%)	54.0^{a}	52.4^{ab}	50.1^{b}	1.5	<0.05	48.9^{a}	46.7^{ab}	45.0^{b}	1.5	<0.05
CP (%DM)	16.8	16.4	16.8	0.1	NS	14.7	14.5	14.7	0.6	NS
NDF (%DM)	41.1	41.2	41.7	1.3	NS	43.8	44.0	45.3	0.8	NS
Starch (% DM)	24.7	25.0	24.2	1.6	NS	20.4	20.4	19.2	1.6	NS

Key Words: Physical effective NDF, Dairy cows, Rumen

249 Effects of different dietary ratios of alfalfa and corn silages on milk production and rumen metabolism in lactating dairy cows. A. F. Brito*[1] and G. A. Broderick[2], [1]*University of Wisconsin-Madison,* [2]*US Dairy Forage Research Center.*

Diluting alfalfa silage with corn silage may be useful for improving N efficiency in dairy cattle. Twenty-eight lactating Holstein cows (8 ruminally fistulated) were randomly assigned to 7, 4 x 4 replicated Latin squares with 28-d periods to assess the effects of different ratios of alfalfa to corn silage on milk production, rumen metabolism, and N utilization. Diets contained (% of DM) the following proportions of alfalfa:corn silages, 50:0 (diet A), 37:13 (diet B), 23:27 (diet C), or 10:40 (diet D). All diets contained 26% NDF and contents of CP were 17.8% (diet A), 17.0% (diet B), 16.5% (diet C), and 15.7% (diet D). DMI decreased linearly (P<0.001) across diets with the lowest intake observed on diet D. Milk yield had both linear (P=0.02) and quadratic (P=0.04) effects and again diet D was lowest. Fat yield decreased linearly (P=0.001) with diet A differing from diets C and D. Protein yield was similar across diets but a quadratic effect (P=0.03) was observed. Total urinary N excretion, ruminal NH_3, and total AA decreased linearly (P=0.002, P<0.001, and P=0.004, respectively) and in all cases diet D was the lowest. Ruminal pH and propionate were not different. However, ruminal acetate and acetate:propionate decreased linearly from diet A to D (P<0.001). Overall, diet D was associated with the poorest production although it yielded better N utilization.

Item Alfalfa:corn silages	A 50:0	B 37:13	C 23:27	D 40:0	SE[1]
DMI, kg/d	26.5^{a}	25.9^{a}	25.0^{b}	23.2^{c}	0.44
BW gain, kg/d	0.92	0.90	1.07	1.03	0.18
Milk yield, kg/d	41.5^{a}	42.0^{a}	41.5^{a}	39.5^{b}	0.87
Milk fat, kg/d	1.57^{a}	1.52^{ab}	1.41^{bc}	1.35^{c}	0.07
Milk protein, kg/d	1.26	1.32	1.30	1.26	0.03
Urinary N excretion, g/d	418^{a}	429^{a}	401^{a}	367^{b}	17
Ruminal pH	6.29	6.31	6.30	6.31	0.06
Ruminal NH_3, mM	7.52^{a}	7.14^{a}	6.23^{a}	4.42^{b}	0.66
Ruminal total AA, mM	4.20^{a}	3.87^{a}	4.07^{a}	2.57^{b}	0.51
Ruminal Acetate, mM	88.6^{a}	84.8^{ab}	79.6^{bc}	74.0^{c}	3.5
Ruminal Propionate, mM	29.2	29.7	30.3	31.5	2.1
Ruminal Ac:Pr	3.22^{a}	2.95^{ab}	2.84^{b}	2.53^{c}	0.14

[1]Standard error of least square mean difference; ^{a,b,c}Means in rows without common superscripts are different (P<0.05)

Key Words: Milk production, Alfalfa:corn silages, N utilization

250 Comparison of sample preparation methods for in situ digestion of processed and unprocessed corn silage. K. W. Cotanch*[1], C. S. Ballard[1], E. D. Thomas[1], S. M. Leach[1], M. P. Carter[1], P. Mandebvu[1], C. J. Sniffen[1], and T. Sato[2], [1]*W.H. Miner Agricultural Research Institute, Chazy, NY 12921,,* [2]*ZENNOH National Federation of Agricultural Co-operative Associations, Tokyo, Japan.*

Whole plant corn (Pioneer hybrid 38K06; RM 93 d) planted on May 4, 2001 on four plots, was harvested at 35% DM content and processed using one of three methods prior to ensiling: (1) chopped at 0.95-cm theoretical length of cut (TLC) and unprocessed; (2) chopped at 1.91-cm TLC and processed with 3 mm roll clearance; and (3) chopped at 1.91 cm TLC and processed with 1-mm roll clearance. Forage samples were ensiled in laboratory minisilos that were sealed for 130 days and stored at 20C. After opening, the minisilo contents were analyzed for chemical composition and remaining sample processed using one of four sample preparation methods prior to in situ digestion: (1) samples used "as is" without further processing; (2) samples separated into stover and kernels, with stover dried at 60C and ground to pass through 2 mm screen in a Wiley mill and then remixed with kernels; (3) samples pseudo-masticated with a traditional hand-cranked meat grinder; and (4) samples dried at 60C and ground to pass through a 2 mm screen. Forage samples (approx. 6 g on DM basis) were weighed into Dacron bags (10 x 20 cm) in triplicate and incubated into the rumen of a lactating dairy cow for 24 h to determine apparent DM (DMDa), NDF (NDFd), and apparent starch (Starch-d) disappearances. Repeatability of each method used to prepare the samples prior to in situ digestion was determined by measuring the coefficient of variation among the replicates. In summary, pseudo-mastication and grinding increased NDFd of corn silage from forage processed with 3-mm roll clearance at harvest.

Main Effects DM basis)	Un-processed	3 mm	1 mm		SE	*P*-value
DMDa[1], %	58.3	57.8	57.0		0.71	0.845
NDFd[2], %	32.1a	28.8b	22.0c		1.13	0.001
Starch-d[3], %	93.4b	96.9a	96.8a		0.63	0.001
Main Effects DM basis)	As Is	Sepa-rated	Masti-cated	Ground	SE	*P*-value
DMDa, %	56.9b	55.9b	57.5b	60.4a	0.82	0.008
NDFd, %	26.8	29.0	27.7	27.1	1.31	0.654
Starch-d, %	93.1b	91.7b	99.4a	98.6a	0.73	0.001
Starch CV, %	1.0a	2.2a	0.4b	0.6b	0.4	0.020
Interactions DM basis)	As Is	Sepa-rated	Masti-cated	Ground	SE	*P*-value
NDFd, %						
Unprocessed	38.4	37.0	28.3	24.9	2.26	0.001
3 mm	24.3	29.5	31.3	30.1		
1 mm	17.7	20.4	23.3	26.5		
Starch-d, %						
Unprocessed	87.9	88.8	99.5	97.6	1.26	0.042
3 mm	95.3	94.1	99.3	99.0		
1 mm	96.0	92.4	99.4	99.2		

[1]Apparent DM disappearance at 24 h of incubation in the rumen of a lactating cow; [2]Neutral detergent fiber disappearance at 24 h of incubation in the rumen of a lactating cow; [3]Apparent starch disappearance at 24 h of incubation in the rumen of a lactating cow.

Key Words: Sample preparation method, In situ digestion, Processed and unprocessed corn silage

251 Effect of carbohydrate source on ruminal fermentation and nitrogen utilization in lactating dairy cows. A. N. Hristov*, J. K. Ropp, K. L. Grandeen, S. Abedi, R. P. Etter, A. Melgar, and A. E. Foley, *Department of Animal and Veterinary Science, University of Idaho, Moscow, ID.*

The objective of this study was to investigate the effect of sugar, starch, NDF, and a carbohydrate (CHO) mix on utilization of ruminal ammonia in dairy cows. Four ruminally and duodenally cannulated Holstein cows were allocated to four dietary treatments in a 4 × 4 Latin square design trial. Cows were fed, at 12-h intervals, an all alfalfa hay diet. CHO [corn dextrose, GLU; corn starch, STA; fiber, NDF (white oat fiber); and a CHO mix (25% of each): apple pectin, GLU, STA, and NDF, PEC] were introduced intraruminally during feeding at 20% of dietary DMI. Ruminal ammonia was labeled with ^{15}N. GLU resulted in reduced ($P < 0.05$) DMI compared to NDF (21.7 *vs* 22.6 kg/d, respectively). NDF had the highest (6.41, $P < 0.05$) average ruminal pH (13 samples in 30 h) followed by STA, PEC, and GLU (6.19, 6.05, and 5.96). Ruminal ammonia concentration was higher ($P < 0.05$) in NDF and PEC than in GLU and STA (16.4, 12.4, 8.5, and 9.6 mmol/L). Compared to the other CHO, GLU reduced ($P < 0.05$) acetate and total VFA concentrations in the rumen. Milk yield and milk fat content were not different ($P > 0.05$) between treatments but NDF had lower ($P < 0.05$) milk protein concentration compared to the other CHO. STA resulted in lower ($P < 0.05$) MUN concentration than NDF (16.9 *vs* 22.4 mg/dl). The area under the milk protein ^{15}N excretion curve (22 samples in 120 h) tended to be larger ($P = 0.052$) for STA than for NDF and PEC. As percent of the dose given, cumulative excretion of ^{15}N in milk protein was greater for STA (6.64%) than for GLU (5.87%, trend at $P < 0.1$) or NDF (5.58%, $P < 0.05$). Estimated time to reach 50% of maximum ^{15}N excretion tended to be shorter ($P = 0.101$) for STA than for GLU (36 *vs* 48 h, respectively). Overall, excretion of ^{15}N in milk protein was greater ($P < 0.05$) for STA than for GLU and NDF. Compared to glucose and fiber, starch enhanced utilization of ruminal ammonia for milk protein synthesis in dairy cows.

Key Words: Dietary carbohydrates, Rumen ammonia, Milk protein

252 Linted and delinted cottonseed as feeds for lactating dairy cows. V. R. Moreira*[2], L. D. Satter[1,2], and B. Harding[3], [1]*U.S. Dairy Forage Research Center, Madison, USDA - Agricultural Research Service,* [2]*Department of Dairy Science, University of Wisconsin - Madison,* [3]*Buckeye Technologies, Memphis, TN.*

Performance of lactating dairy cows fed diets containing either mechanically delinted whole cottonseed (**DWCS**; 3.7% lint) or linted whole cottonseed (**LWCS**; 11.7% lint) was measured. Forty one primiparous (86±39 DIM) and 39 multiparous (88±30 DIM) cows were fed TMR containing 13% (DM basis) **DWCS** or **LWCS** in two blocks of 112d (n=53, and n=27). Other TMR ingredients were corn silage (28.1%DM), alfalfa silage (23%), high moisture shelled corn (27.8%), soybean meal (1.8%), Soy-plus® (1.8%), blood meal (2%), and mineral-vitamin supplements (2.5%). Dry matter intake and milk yield were measured daily, and milk composition bi-weekly. Fecal grab samples were taken on weeks 3 and 13 of each block to estimate excretion of intact whole seeds. Body condition score tended ($P \leq .11$) to increase with **DWCS** (.22 vs. .11) for primiparous cows, although this was not reflected in body weight change. Assuming a DM digestibility of 67% for all TMR, only 3.37 and 1.91% of ingested seeds (lint excluded) were excreted undigested with **DWCS** and **LWCS**, respectively. Although significant, treatment differences in excreted seeds would have little nutritional consequence. **DWCS** performed as well as **LWCS** for all of the key cow performance and milk composition variables measured.

MULTIPAROUS				$P\leq$	
	DWCS[1]	LWCS[1]	SEM	Lint	Lint*week
Milk Yield, kg/d	37.4	37.5	0.83	0.91	0.68
DMI, kg/d	23.8	23.1	1.60	0.14	0.001
Fat, %	3.16	3.16	0.23	0.95	0.51
True protein, %	2.90	2.88	0.03	0.64	0.59
3.5%FCM, kg/d	35.0	34.8	2.01	0.92	0.82
BW change, kg/d	30.2	26.0	9.87	0.76	-
BCS change	0.27	0.31	0.05	0.54	-
Intact WCS, % fecal DM	1.53	0.72	0.15	0.001	0.01

PRIMIPAROUS				$P\leq$	
	DWCS[1]	LWCS[1]	SEM	Lint	Lint*week
Milk Yield, kg/d	32.7	32.8	0.78	0.88	0.96
DMI, kg/d	20.5	20.4	0.59	0.83	0.001
Fat, %	3.23	3.19	0.11	0.77	0.37
True protein, %	2.99	2.95	0.03	0.35	0.32
3.5%FCM, kg/d	31.3	30.9	1.12	0.70	0.11
BW change, kg/d	2.0	-9.6	133.0	0.60	-
BCS change	0.22	0.11	0.45	0.11	-
Intact WCS, % fecal DM	1.02	0.61	0.10	0.01	0.65

[1] **DWCS** or **LWCS**: TMR containing Delinted or Linted WCS

Key Words: Cottonseed, Dairy cows

253 Physical effectiveness of whole cottonseed as affected by lint and particle size. M.L.M. Lima*, J. L. Firkins, J. T. Sylvester, S.K.R. Karnati, and W. Mattos, [1]*Escola de Veterinaria - UFG, Goiania, GO - Brazil,* [2]*The Ohio State University, Columbus - OH,* [3]*Universidade de Sao Paulo, ESALQ, Piracicaba - SP - Brazil.*

The objectives of this study were to evaluate fermentation and physical effectiveness of whole cottonseed as influenced by particle size and availability of linters. Six ruminally cannulated Holstein cows averaging 155 DIM and 33.0 kg/d of milk were used in a 6 x 6 Latin square design with 15 d periods Whole cottonseeds (WCS), starch-coated WCS (Easiflo, EAS), mechanically delinted cottonseed (DEL) and pelleted WCS (PEL) were included in four diets with 16% forage NDF (FNDF). There were a low forage diet (LFD) with 16% FDNF and a high forage diet with 21% FDNF. The DMI did not differ among cottonseed diets (P>0.05), but it was higher (P <0.01) for cows fed the cottonseed diets than HFD. Milk yield was higher for cows fed LFD (P<0.01) and did not differ among cottonseed diets and HFD. Milk fat percentage (3.76%) was not affected (P>0.05) by treatments. Ruminating and chewing activity (min/kg of DMI) were unaffected by cottonseed diets (P>0.05), but they were lower (P <0.05)for cows fed the cottonseed diets than HFD. Rumen pool sizes of DM and NDF and DM turnover rate were unaffected by cottonseed diets, but they were higher (P=0.01) and lower (P=0.03), respectively, for cows fed the cottonseed diets than HFD, apparently explaining the similar ruminal mat consistency among treatments. Rumen mean pH, and the passage rates of ruminal fluid and indigestible NDF were unaffected (P>0.05) by treatments. The presence of linters had minimal effect on chewing effectiveness under our conditions.

Key Words: Whole cottonseed, Linters, Particle size

254 Effect of changes in peNDF and starch source on intake, milk production and milk composition of dairy cows. P. Berzaghi*[1,2] and D. R. Mertens[2], [1]*University of Padova, Italy,* [2]*US Dairy Forage Research Center, Madison, WI.*

The study evaluated the effects of changes in ration physically effective NDF (peNDF) and starch source on dairy cow performance. The negative control (NC) diet was formulated to induce milk fat depression and contained 19% peNDF using finely chopped (TLC = 6.4 mm) corn silage as the main forage source. Three diets were formulated to increase peNDF to 22% by adding corn silage (CS) or chopped alfalfa hay (AH) or chopped grass hay (GH) to NC. Each of the four diets was formulated with dry ground corn (DGC) or finely ground high moisture corn (HMC) to obtain eight diets that varied in starch source and peNDF source and concentration. Twenty-four cows were blocked for milk production and half were assigned to either DGC or HMC diets in replicated 4x4 Latin squares with 21d periods. Intake, milk production, milk composition were recorded during the last week of each period. A mixed model was used for ANOVA. Increasing dietary peNDF raised milk fat percentage by 0.38% (P<0.01) and milk fat yield by about 60g/d (P<0.04), regardless of starch source. On average, HMC depressed (P<0.03) milk fat percentage by 0.47% compared to DGC and milk fat was lowest (2.87%) for the HMC-NC. Among peNDF sources, AH was most effective (P<0.07) in increasing 3.5%FCM production. Milk production tended (P<0.11) to be greater for NC diets and was lower (P<0.02) for CS than AH and GH diets regardless of starch source. Although daily DMI was about 1.6 kg less (P<0.03) for HMC diets compared to DGC, milk production was not different. Regardless of starch source, AH increased (P<0.05) DMI compared to NC, whereas CS did not. Additional peNDF from GH increased DMI for DGC, but not for HMC diets resulting in a significant (P<0.01) peNDF source x starch interaction. Larger particles in feed refusals suggest that GH may not have increased the particle size of consumed diets. In conclusion, changes in dietary peNDF and starch source were most effective alleviating milk fat test depression when used together.

Key Words: Physically effective fiber, Starch, Milk fat

255 Effect of dietary calcium concentration on solubility of phosphorus in feces. M. J. Aguerre*[2] and L. D. Satter[1,2], [1]*U.S. Dairy Forage Research Center, USDA-Agricultural Research Service,* [2]*University of Wisconsin, Madison.*

Excess dietary P is excreted in the feces, largely in water-soluble form, thus increasing the risk of P loss to the environment. The effect of dietary Ca concentration on the solubility of feed P in feces of lactating cows was determined by feeding diets containing either 0.6 (LCa) or 1.10 % (HCa) of Ca and 0.5 % of P. Diets contained (% DM) 35 % corn silage, 20 % alfalfa silage, 25.35 % high moisture shelled corn (HMSC), 8 % soybean meal, 10 % roasted soybeans, 0.6 % monosodium phosphate, 0.55 % $CaCO_3$ and 0.5 % of a salt and vitamin mix.To achieve the higher dietary Ca concentration a small amount of HMSC was replaced by limestone ($CaCO_3$). The diets were fed to 11 mid-lactation cows in a crossover design using 2-wk periods. Fecal grab samples were collected from the rectum at four different times during the last two days of each period (two samples per day) and refrigerated for later analysis. Feed intake and lactation performance were also measured during the trial. The increase in Ca concentration in the diet from 0.6 to 1.10 % had a significant effect (P<0.01) on the amount of soluble P in feces (LCa= 0.36 and HCa=0.31 %), but had no effect (P=0.26) when it was expressed as a percentage of total P (soluble P/ total P) excreted in the feces. Milk yield (32.7 vs. 32.6 kg/d), DMI (22.0 vs. 22.1 kg/d), total P in the feces (0.87 vs. 0.81 %) and fecal Ca (2.4 vs. 2.6 %) for the LCa and HCa trts were not affected by treatment (P>0.10). Animal performance measurements were consistent with those from other studies, although a lower fecal Ca excretion was expected with cows on the LCa diet. High levels of Ca in the diet do not appear to affect the proportion of soluble P: total P in the feces.

Key Words: Calcium, Soluble phosphorus, Milk production

256 Somatotropic function: the somatomedin theory revisited. T. D. Etherton*, *Penn State University*.

Impressive progress has been made during the past 20 years in our understanding of the biology of somatotropin (ST) in domestic animals. Collectively, studies have established that administration of porcine ST (pST) to growing pigs markedly stimulates muscle growth and decreases fat deposition. In addition to these "efficacy" studies, a substantial number of investigations examined the mechanisms by which ST regulates growth of domestic animals. A central concept proposed initially to explain the effects of ST was the "somatomedin hypothesis", i.e., that the effects of ST, secreted by the pituitary, are mediated by circulating IGF-I (initially characterized as sulfation factor and then somatomedin) produced exclusively in the liver. Much subsequent research has established that the somatomedin theory needs to be revised (and has been). Work conducted in our lab has shown that the effects of ST on lipid metabolism and insulin sensitivity in adipose tissue are not mediated by IGF-I and are direct effects of ST. While circulating IGF-I is important for postnatal growth, studies have demonstrated that mice lacking the liver IGF-I gene have an 80% reduction in total IGF-I (and IGF binding proteins), however, postnatal growth is normal. In these mice, free IGF-I levels (not bound to IGF binding proteins) are normal. Thus, the original somatomedin hypothesis has undergone considerable remodeling to a contemporary version that better explains the complexities of GH effects on adipose tissue metabolism and growth. The latter appear to reflect a situation where liver-derived IGF-I, at least in mice, is not essential for growth. Further studies will be necessary to unravel the importance of endocrine versus autocrine/paracrine IGF-I.

257 A new plasmid-mediated approach to enhance somatotropin function in pigs. R. Draghia*, *ADViSYS Inc*.

Tremendous progress is being made in identifying and understanding the stimulatory molecules that regulate growth and the potential application of these molecules in animals. A parallel and significant effort is focused on the discovery and development of economically feasible gene delivery technologies. Plasmid-mediated growth hormone releasing hormone (GHRH) therapy has emerged as an excellent candidate. GHRH, a hypothalamic hormone, stimulates normal growth hormone (GH) production and release. We have shown that pigs directly injected with 0.1mg myogenic plasmid expressing porcine GHRH had significantly greater weight gain than controls. With plasmid treatment, body composition studies have shown a 22% decrease in fat deposition and a 10% increase in bone mineral density. In a different study, gilts were injected intramuscularly at day 85 of gestation with 0, 0.1, 0.5, 1, or 5 mg of a synthetic GHRH-expressing plasmid (HV-GHRH). Piglets from gilts treated with 1 or 5 mg of HV-GHRH were larger at birth and weaning compared to controls. These two groups reached 100 kg 9 days earlier than the other groups. GHRH levels were higher at birth, and IGF-I levels were significantly increased in the 5 mg group beginning at 21 days of age when compared with controls. Pituitaries from the 5 mg group contained a significantly increased number of somatotrophs and lactotrophs from birth to 100 kg. Because of the central role of the GHRH-GH-IGF-I axis in the regulation and coordination of the anabolic processes of growth and reproduction, the benefits of plasmid-mediated GHRH supplementation to pregnant animals are far-reaching. During pregnancy, maternal changes impact intrauterine and postnatal development. Direct GHRH action induces changes in pituitary cell lineage of the offspring which can then directly enhance growth and welfare once the postnatal growth comes under the control of GH and IGF-I. Administration of GHRH to the gilt has an additional advantage over the direct administration of growth-promoting agents to the adult individual animal. By improving fetal growth, GHRH treatment of the gilts diminishes the incidence of neonatal deaths, which has always represented a major economic loss for the swine industry.

Key Words: GHRH, GH, Plasmid

258 Somatotropin regulation of skeletal muscle protein deposition in pigs. T. A. Davis, J. A. Bush, R. C. Vann, A. Suryawan, and D. G. Burrin, *USDA-ARS Children's Nutrition Research Center*.

A primary goal of exogenous somatotropin (ST) treatment is to increase lean body mass. This is accomplished, in part, by increasing the efficiency with which dietary amino acids are used for protein deposition. ST administration also improves protein balance by minimizing the loss of protein during fasting and maximizing the protein gained during meal absorption. Amino acid catabolism is reduced by ST treatment as indicated by reductions in blood urea nitrogen concentrations, urea synthesis, liver urea cycle enzyme activity, and amino acid oxidation. Stable isotope tracer/mass transorgan balance studies have recently demonstrated that ST treatment increases protein anabolism in young, growing swine by increasing protein synthesis in the hindlimb and portal-drained viscera in the fully-fed state, with no effect of ST on protein degradation. More detailed study to examine the tissue-specific response to ST treatment indicates that GH treatment increases protein synthesis in skeletal muscle by increasing the efficiency of the translational process, but only in the fed state. The ST-induced stimulation of skeletal muscle protein synthesis in the postprandial state involves mechanisms that enhance the binding of both mRNA and initiator methionyl-tRNA to the 40S ribosomal subunit. ST increases protein synthesis in the intestine and liver in both the fasted and fed state by increasing ribosome number, with no change in translation initiation. Thus, the protein synthetic response to ST treatment is tissue specific and dependent upon nutritional state.

259 Alteration of somatotropic function by proinflammatory cytokines. R. A. Frost* and C. H. Lang, *Penn State University College of Medicine*.

Unsanitary living and rearing conditions contribute to infection and weight loss in animals and humans. Infectious insults direct amino acids away from growth and skeletal muscle accretion towards the synthesis of acute phase proteins. The loss of skeletal muscle protein stores results in both a decrease in muscle function and increased mortality. In general, muscle protein synthesis is decreased in rat models of sepsis including after the injection of components of the bacterial cell wall such as lipopolysaccharide (LPS). Although the over-expression of proinflammatory cytokines is known to hasten the loss of skeletal muscle protein it is not known whether this is a direct effect of cytokines or if it is secondary to changes in the IGF-system. The drop in muscle protein synthesis is preceded by changes in the expression of IGF-system components. Plasma levels of IGF-I are dramatically lowered by infection in rats, mice, pigs and steers. The drop in IGF-I occurs despite an increase in the plasma concentration of somatropin (GH). Animals are therefore GH resistant. IGF bioactivity is determined not only by its plasma concentration but also by IGF binding proteins (IGFBPs). IGFBP-3 the most abundant IGFBP is degraded during some catabolic states. Administration of IGF-I as a complex with IGFBP-3 restores both plasma IGF-I levels and muscle protein synthesis in septic rats. In contrast to IGFBP-3, the plasma concentration of inhibitory IGFBPs such as IGFBP-1 are increased during infection. IGFBP-1 accumulates in skeletal muscle where it can inhibit IGF dependent protein synthesis. IGF-I and IGFBP-1 are regulated at the level of gene transcription by proinflammatory cytokines. Prophylactic administration of an IL-1 receptor antagonist or a TNF binding protein can prevent the changes in IGF-I, IGFBP-1, and muscle protein synthesis. Recent studies demonstrate that bacterial components that activate immune cells also activate the innate immune response in skeletal muscle. LPS increases proinflammatory cytokine mRNA expression in muscle from control mice but not mice with a mutation in the LPS receptor (TLR4). LPS also increases cytokine expression in human and mouse myoblasts. Local expression of cytokines in skeletal muscle may negatively regulate the autocrine synthesis of IGF-I. Current work is focused on deciphering the mechanism by which muscle becomes GH resistant and the development of therapies to maintain muscle protein stores during infection.

260 Relationship between conception rate and in vitro sperm viability. J. J. Parrish*, *University of Wisconsin, Madison, WI.*

It has been the goal of many scientists to develop in vitro methods of predicting a bull's fertility. One approach has been to evaluate the viability of sperm. While it is obvious that a sperm must be viable to fertilize an oocyte, it is not clear what are the criteria that define a viable sperm. For example, viability stains that use histological stains such as eosin or fluorescent DNA binding molecules such as propidium iodide rely on a permeable plasma membrane to define a non-viable sperm. Evaluation of the percentage of non-viable sperm might be done using microscopy or flow cytometry for better accuracy but in either case only a single aspect of viability is addressed. Only modest correlations have been reported between this type of a viability measurement and bull fertility. Additional aspects of sperm viability or functionality need to be measured in order to improve the correlations. In the development of computer-aided methodology that evaluates sperm morphology and its relationship to bull fertility we found that only viable sperm morphology was related to bull fertility. The method used to assess the relationship of bull fertility to measures of semen quality is important as well. It is likely that identifying bulls with fertility below a desired threshold, diagnostic test approach, will be more productive than evaluating the relationship of a semen quality traits to fertility of all bulls. Approaches using multiple comparisons on viable sperm and diagnostic statistics need to be developed if bull fertility is to be predicted better. Supported by the College of Agriculture and Life Sciences and USDA-NRI.

Key Words: Sperm viability, Flow cytometry, Bull fertility

261 Accessory sperm and embryo quality: insights to male fertility. R. G. Saacke*, *Department of Dairy Science, Virginia Tech.*

Six-day-old non-surgically recovered bovine ova/embryos from single ovulating cows have been used as biomonitors to evaluate seminal deficiencies that are compensable (where fertility responds positively to elevated sperm dosage) and uncompensable (where fertility is depressed and does not respond to elevated sperm dosage). They have also been used to evaluate reproductive strategies and in some cases, the interaction of individual males with different strategies. The fertilization status and embryo quality of the six-day-old presumptive morula permits the independent evaluation of two major components contributing to pregnancy or its failure, i.e., fertilization status and embryonic development. In addition, quantitative and qualitative evaluation of accessory sperm provides some insight to the sperm available for fertilization either as a function of the male/inseminate or a specific reproductive strategy. Factors influencing sperm access to the ovum in vivo (based upon accessory sperm number per ovum/embryo) were differences due to: the male, the female, time of insemination relative to ovulation, the interaction of males with time of insemination, site of insemination, dosage of sperm per inseminate, interaction of male and dosage and superovulation. Major identifiable male factors depressing quality of embryos were associated with perturbations in spermatogenesis as reflected by altered sperm head morphology and/or incidence of sperm nuclear vacuoles in semen. Impacts of these factors on fertility appear to be exacerbated by superovulation. In agreement with field data, male/seminal factors influencing sperm access to the ovum (compensable) appear to be quite independent from those influencing embryo quality (uncompensable). Futuristically, meaningful laboratory testing of semen for fertility should ultimately consider compensable and uncompensable seminal deficiencies, sperm dosage, and the reproductive strategy to which the semen will be applied.

Key Words: Bull, Semen quality, AI fertility

262 Genetic selection for improved reproduction. K. Weigel*, *University of Wisconsin.*

Achieving pregnancy in high-producing dairy cows in a timely and cost-effective manner may be today's greatest management challenge. Fertility is highly influenced by management and environmental factors, but significant genetic differences exist in both male (service sire) and female (daughter) fertility. The first challenge in improving fertility through genetic selection is data collection, because an inverse relationship exists between quantity and quality. Rough measures, such as calving interval, are available for all multiparous milk-recorded cows. Insemination data (and non-return rates) are available for about half of the cows, while pregnancy exam outcomes are available for perhaps a quarter of the animals. Detailed data, such as technician ID and type of estrus (standing or synchronized) are available in selected herds, and milk progesterone data are typically limited to experimental herds. The second challenge is statistical modeling. Linear models are inappropriate for binary conception rates, and data of continuous traits, such as days open, are badly skewed. Threshold models are technically appealing, but extreme category problems can occur when contemporary groups are small (especially in animal models). Survival analysis can be used to evaluate days open or time from first insemination until pregnancy, and this allows inclusion of censored data (e.g., cows with no pregnancy exam). Models for longitudinal binary analysis may have the greatest potential, because direct genetic evaluation of 21-day pregnancy rate for individual animals is possible (e.g., did pregnancy occur in each successive 21-day interval after the voluntary waiting period). The third challenge is education of users. Results can be published in various ways, but each has limitations. The concept of a trailing 21-day pregnancy rate is understood by many producers, but some confuse it with non-return rate or conception rate. Differentiation between male and female fertility is an ongoing problem, so published information must be labeled concisely. Lastly, the negative relationship between milk production and female fertility creates challenges, because many sires with high genetic merit for production will have undesirable daughter fertility values.

Key Words: Fertility, Dairy cattle, Genetic selection

263 Sustaining the fertility of artificially inseminated dairy cattle: The role of the artificial insemination industry. J. M. DeJarnette, C. E. Marshall, R. W. Lenz, D. R. Monke, W. H. Ayars, and C. G. Sattler, *Select Sires, Inc., Plain City, OH, USA.*

As the dairy industry strives to thwart an apparent decline in reproductive efficiency, the fertility of the male must not be overlooked. The fertility potential of an artificial insemination (AI) dose is a function of the quantity, quality and health status of the semen contained therein. Management of sire health and associated disease testing protocols are paramount. Post-thaw semen quality evaluations combined with adjustments to cell numbers per dose and culling of ejaculates and (or) bulls, minimizes the variation in fertility potential of individual samples and (or) sires released for sale. Identification of additional semen quality attributes associated with fertility could provide more accurate methods to predict, manage and select for AI sire fertility. However, because the values of most "known" semen quality traits (motility, acrosome integrity, normal morphology) are highly correlated with each other, any "new" technology must not be evaluated in a vacuum but in light of existing methodology to consider the additive benefit in fertility prediction and (or) economic utility of implementation. Unfortunately, the association between semen quality and fertility is often limited by the accuracy of the fertility estimate. Cryopreservation techniques that extend post-thaw sperm survival and (or) reduce rates of capacitation may reduce sensitivity to insemination timing and are promising opportunities to improve fertility from the male perspective. The AI industry must increase research efforts to enhance, predict and measure fertility in both male and female bovine. The role of the AI industry representative has and will continue to evolve from that of salesperson and genetic advisor to that of reproductive and herd-management consultant. More emphasis must be placed on these characteristics in hiring practices and in advanced training in reproductive-management skills. The magnitude of the decline in reproductive efficiency that can be attributed to genetics is the subject of considerable debate. Through semen purchasing decisions, dairymen dictate the relative importance of various genetic selection criteria to the dairy industry and thereby the emphasis to be placed on these traits in AI sire-sampling programs.

Key Words: Artificial insemination, Fertility, Dairy cow

264 Relative importance among sow productivity traits in the selection criterion for purebred dam lines, based on a modified profit function with causal relationships between traits. V. M. Quinton*[1], J. W. Wilton[1], J. A. B. Robinson[1], and P. K. Mathur[2], [1]*University of Guelph, Guelph, Canada,* [2]*Canadian Centre for Swine Improvement, Ottawa, Canada.*

Economic weights for sow productivity traits in pure-line pig populations were derived from a single profit equation in order to provide flexibility to alternative market requirements or production systems. The profit function method was modified to account for differences in piglet perinatal survival environment imposed by litter size at birth. Both the 100kg finished pig and the feeder pig market were considered. As an example, the economic weights were calculated from average trait values in Ontario purebred Yorkshire herds and provincial average prices and costs. Based on the unmodified profit function, when the mean litter size was increased from 6 to 16 pigs, and all other traits remained constant, the economic weight for total litter size was constant, and those for survival traits increased from \$0.16/% to \$0.43/% for the finished pig market. When the profit function was modified, the weight for litter size decreased as mean litter size increased, from \$2.51/pig for 6 pigs/litter to \$1.76/pig for 16 pigs/litter. Economic weights for all other traits were the same as before the modification. The effect was similar for the feeder pig market. Short-term profit in the finished pig market from index selection with economic weights for a mean litter size of 8 pigs was 97% of that based on the correct weights when the mean litter size was 12 pigs, and 87% when the mean litter size was 16 pigs. Profit from selection for litter size alone was 85% of the maximum attainable from selection on the correct index in the finished pig market, and 51% of the maximum in the feeder pig market for an average litter size of 12 pigs. Relative predicted gains from selection on either reduced or incorrect indices decreased with the length of the selection program, and in some cases the decrease became substantial in the long-term.

Key Words: Sow productivity, Profit function, Economic weight

265 Comparison of two models to estimate breeding values for intramuscular fat percentage in Duroc pigs. D. W. Newcom* and T. J. Baas, *Iowa State University, Ames, IA.*

Data from a selection experiment designed to increase intramuscular fat percentage in Duroc swine were used to compare how animals rank based on breeding values estimated from either a one- or two-trait animal model. Predicted intramuscular fat percentage (PIMF) was estimated using linear regression analysis of five image parameters averaged across four longitudinal ultrasound images and 10th rib off-midline backfat from a cross-sectional image. Carcass intramuscular fat percentage (CIMF) was determined by chemical analysis of a slice from the 10th rib of the loin. All pigs in the selection experiment (boars, barrows, and gilts) were scanned, and one to three barrows and selected gilts from each litter were harvested. Breeding values were estimated using MATVEC and fitting a one- or two-trait animal model. The one-trait model estimated breeding values for PIMF (P1) from only PIMF for all pigs (n=1630) with gender and scan group as fixed effects, animal (genetic) and litter as random effects, and scan weight as a covariate. The two-trait model estimated breeding values for PIMF (P2) and CIMF (C2) from PIMF for all pigs and CIMF from those pigs (n=392) harvested. In addition to the effects in the one-trait model, harvest group and harvest weight were added as a fixed effect and covariate, respectively, in the two-trait model. Spearman rank correlation coefficients were calculated between P2 and C2, P2 and P1, and C2 and P1. Correlations were calculated for all pigs with scan data, within year for all pigs scanned (n=379, 637, and 614, for Gen 0, 1, and 2, respectively), and by gender within year. The rank correlations between P2 and C2, P2 and P1, and C2 and P1 for all pigs with scan data were 0.95, 0.95, and 0.84, respectively. Rank correlations by year for all three EBV combinations increased over the three generations of the project. After sorting by sex, rank correlations in Generation 2 between C2 and P1 for boars and gilts were 0.91 and 0.91, respectively, showing similar animals would be selected when ranking was based on C2 or P1.

Key Words: Swine, Breeding values, Intramuscular fat

266 Evaluation of Dorset, Finnsheep, Romanov, Texel, and Montadale breeds of sheep: Productivity of F_1 ewes in fall breeding seasons. E. Casas*, B. A. Freking, and K. A. Leymaster, *USDA-ARS, U.S. Meat Animal Research Center.*

Objectives were to estimate effects of sire breed (Dorset, Finnsheep, Romanov, Texel, and Montadale), dam breed (Composite III and northwestern whiteface), mating season (August, October, and December), ewe age (1, 2, and 3 yr), and their interactions on productivity of F_1 ewes. A total of 1,799 F_1 ewes produced 3,849 litters from 4,804 exposures to Suffolk rams during 35-d mating seasons. Conception rate and ewe longevity were determined. Litter size and weight at birth were recorded and litter size and weight at weaning and 20 wk of age were analyzed separately for dam- and nursery-reared litter mates. Total productivity through 3 yr of age for each ewe entering the breeding flock was calculated as the sum of 20-wk weights for dam- or nursery-reared lambs. Interactions of sire breed x mating season, sire breed x ewe age, and mating season x ewe age were generally significant. Interactions of sire breed x mating season were often due to changes in rank as well as magnitude, indicating the importance of matching sire breeds to specific mating seasons. Litter size at birth of Dorset-, Texel-, and Montadale-sired ewes was not affected by dam breed; however, Finnsheep-sired ewes out of northwestern whiteface dams were more prolific than Finnsheep-sired ewes out of Composite III dams and the opposite situation existed for Romanov-sired ewes. Least-squares means of sire breeds ($P < 0.001$) for total productivity of dam-reared lambs were 98.5, 103.5, 106.9, 124.6, and 154.9 kg for Texel, Dorset, Montadale, Finnsheep, and Romanov, respectively. Superior productivity of Romanov-sired ewes was due to greater conception rates and litter sizes for each mating season and ewe age, as well as greater ewe longevity. Total productivity of F_1 ewes by Composite III dams (125.6 kg) was greater ($P < 0.001$) than ewes born to northwestern whiteface dams (109.7 kg). Experimental results provide comprehensive information about the appropriate use of these breeds in crossbreeding systems.

Key Words: Reproductive traits, Sheep, Breeds

267 Pedigree analysis of a closed population of crossbred sheep. K. M. MacKinnon*, L. A. Kuehn, and D. R. Notter, *Virginia Polytechnic Institute and State University, Blacksburg, Virginia.*

Inbreeding and genetic diversity were compared in selected and control lines of 50% Dorset, 25% Rambouillet and 25% Finnsheep breeding established in 1983 and maintained as closed populations for 13 yr. Fall-lambing selection (S) and spring-lambing genetic control (G) lines were created in spring, 1987. Selection for fall lambing began in spring, 1988. Flock S consisted of 125 ewes and 10 rams; G was composed of 45 ewes and 5 rams. Fourteen sire lines were identified in G in 1987; a ram from each line was retained whenever possible. Founder numbers were 126 in S and 96 in G. Inbreeding was evaluated for three sets of animals from each line: all lambs (L), all rams and ewes present (P) and an offspring from each mating (M, including hypothetical offspring for open ewes). Inbreeding rates were similar for L, P and M in S (1.41 ± 0.04, 1.46 ± 0.06 and 1.56 ± 0.04 %/yr), but variable in G due to small population size and sampling of five rams per year (1.91 ± 0.98, 1.42 ± 0.15 and 1.82 ± 0.13 %/yr). Average inbreeding rates yielded effective population sizes for L, P and M of 35.5, 34.3 and 32.1 in S and 26.2, 35.2 and 27.3 in G. Effective founder numbers for L, P and M were similar in S (32.0, 31.5 and 31.6), but varied in G (25.2, 30.8 and 28.8), possibly due to inbreeding effects, small population size and sampling of rams. Numbers of founder genome equivalents (the number of equally represented founders needed to produce the observed heterozygosity) reveal impacts of small population size, bottlenecks, inbreeding and overlapping generations, which were more evident for L, P and M in G (5.2, 10.0 and 3.7) than in S (6.6, 6.7 and 5.3). Effects of inbreeding on lamb BW, fall fertility of ewes and ewe litter size were calculated using REML and found to be -0.027 ± 0.023 kg/%, -0.70 ± 0.25 %/% and -0.0018 ± 0.0053 %/%. Results suggest that genetic variation in a flock is best determined by analysis of animals available to be bred. G animals were similar in heterozygosity to S, as is desired in a genetic control line.

Key Words: Pedigree, Inbreeding depression, Sheep

268 Competing risks analysis of lamb mortality. B. R. Southey*[1], S. L. Rodriguez-Zas[1], and K. A. Leymaster[2], [1]*University of Illinois Champaign-Urbana, Urbana, IL,* [2]*USDA, ARS, USMARC, Clay Center, NE.*

Survival is often represented as the time elapsed between two events (e.g. birth to mortality) or until the end of period considered. The typical survival models assume one type of terminal event thereby ignoring that there could be multiple causes of mortality. A competing risks model that accounts for different causes of mortality was evaluated. Discrete survival methods using a complementary log-log link function were applied to lamb mortality records from a composite population at the US Meat Animal Research Center. Causes of mortality were grouped into disease, maternal (e.g. dystocia), pneumonia and other causes. A total 8301 lamb survival records from birth to weaning were analyzed using sire, animal and maternal effect mixed models including sex, contemporary group, type of birth and age of dam as fixed effects. The results showed substantial differences on the effect of lamb sex among mortality categories. The influence of birth type and age of dam on survival showed little variation with mortality category. Estimates of variance components from the sire and animal models compared to the maternal model indicated maternal components were present. Estimates of heritability from a maternal effects model ranged between 10 and 20% and varied with the mortality category. Results from the maternal category were consistent with literature studies on parturition, lamb behavior and selection for rearing ability. These results indicate that failure to account for the cause of the terminal event on mortality and longevity studies may hide important genetic differences. Therefore, breeding programs are likely to be ineffective when the multiple causes involved in time to event traits such as mortality and longevity are ignored.

Key Words: Analysis, Sheep, Survival

269 Genetic correlations for litter weight weaned with reproduction and wool characteristics in Rambouillet, Columbia, Targhee and Polypay sheep. . K. J. Hanford*[1], L. D. Van Vleck[1], and G. D. Snowder[1,2], [1,2]*USDA, ARS, U.S. Meat Animal Research Center,* [1]*Lincoln, NE,* [2]*Clay Center, NE.*

Genetic correlations between litter weight weaned (LW) and litter size born (NB), litter size weaned (NW), fleece weight (FW), fleece grade (FG), and staple length (SL) were estimated from Rambouillet (RAM), Columbia (COL), Targhee (TAR), and Polypay (POL) data collected from 1950 to 1998 at the U.S. Sheep Experiment Station, Dubois, ID. Numbers of breed records ranged from 8,313 to 39,816 for LW; 9,081 to 44,211 for NB and NW; 8,872 to 39,820 for FW and FG; and 1805 to 3574 for SL. Estimates of direct heritability with single-trait animal models using REML ranged from 0.07 to 0.09 for LW, 0.08 to 0.10 for NB, 0.03 to 0.07 for NW, 0.50 to 0.66 for FW, 0.16 to 0.41 for FG, and 0.56 to 0.76 for SL. Estimates of the genetic correlation between LW and NB were similar for RAM, COL and TAR breeds (0.59, 0.68, and 0.62, respectively), but was close to zero for POL (0.05). The low correlation for POL may be due to generally restricting ewes to rearing only 2-3 lambs, which would impact a highly prolific breed such as POL more than less prolific breeds. The estimate of genetic correlation between LW and NW was close to one for all breeds, as expected, because NW is a component of LW. Estimates of the genetic correlations between LW and both FW and FG were near zero for all breeds, except RAM (0.12 for FW and -0.19 for FG). Estimates of the genetic correlations between LW and SL varied among the breeds (0.07, -0.19, 0.10, and -0.17 for RAM, COL, TAR, and POL, respectively). Litter weight weaned is often used as an overall measure of range ewe productivity. These results suggest that selection for LW would result in neutral or favorable correlated responses except for a decrease in FG for RAM and decreases in SL for COL and POL. Decreases in FG and SL would have a minimal economic impact because of the small genetic correlations and because increased LW should offset decreases in FG and SL under today's market prices.

Key Words: Fiber, Genetic Correlation, Prolificacy

270 Influence of birth weight and birth rank on lamb survivability. C. S. Welsh*[1], B. L. Golden[1], R. M. Enns[1], D. J. Garrick[1], and G. B. Nicoll[2], [1]*Colorado State University, Fort Collins, CO, USA,* [2]*Landcorp Farming Ltd, Rotorua, New Zealand.*

The objective of the sheep breeder is to increase the number of lambs weaned, either by increasing prolificacy or increasing lamb survival. Increasing prolificacy reduces lamb survival because, relative to singles, multiple lambs have competition for milk and reduced birth weight (BW). Breeding values (BV) for prolificacy are readily available. The heritability of number born is 0.10 to 0.15, implying birth rank (BR; single, twin, triplet, or quadruplet) has a genetic component. Lamb survivability BV have yet to be implemented. The objective of this study was to determine if BR should be fit as a fixed effect in the evaluation of lamb survivability (LS). If birth rank (BR) is fit, the BV predicts LS adjusted for BR. By omitting BR as a fixed effect, the BV predicts LS including the effect BR has on LS. Possible genetic influences on LS include BW and BR. Data were from two Romney flocks (n=31,127) with lambs born 1997-2000 at Landcorp, New Zealand. LS was scored 0 for death prior to weaning and 1 for survival. Pearson (partial) correlation matrices were derived. The phenotypic correlation between LS and BR was -0.17, indicating lamb survival decreases as number of lambs born increases. Adjusted for BW, this correlation decreased to -0.14, suggesting birth weight does not fully account for the decline in lamb survival observed as BR increases. The phenotypic correlation between BW and LS was 0.2, suggesting higher birth weight is associated with higher survival. Once this correlation was adjusted for BR, it decreased to 0.13, indicating some of the effect birth weight has on lamb survival is independent of number of lambs born. These results show phenotypic variation in lamb survival cannot be explained entirely by birth weight differences nor by birth rank differences. Further research to compare the relative accuracy of lamb survivability BV for alternative models is planned.

Key Words: Sheep, Survival, Genetic analysis

271 Caprine genetic resource conservation program. J. M. Dzakuma*[1], S. A. Ericsson[2], B. L. Sayre[3], T. A. Gipson[4], and H. D. Blackburn[5], [1]*Prairie View A&M University, Prairie View, TX,* [2]*Sul Ross State University, Alpine, TX,* [3]*Virginia State University, Petersburg, VA,* [4]*Langston University, Langston, OK,* [5]*USDA-ARS-National Animal Gerplasm Program, Fort Collins, CO.*

A genetic resource conservation center for goats has been established at Prairie View A&M University (PVAMU). The objectives of the project are based upon: 1). Genetic resources are the building blocks for all production systems. 2). Conservation, maintenance, enhancement and access to these genetic resources will enable small goat producers to increase their profitability. 3). Angora doe numbers have declined two-thirds from about 750,000 in 1995 to 260,000 in 2000. Spanish and Tennessee Stiff-legged doe numbers have also declined because they have been crossed to the dominant meat type breeds. Sixty four F and 8 M per breed of Tennessee Stiff-legged, Spanish and Boer goats, were bred in fall 2002 in order to establish live populations (*in situ*) conservation program at PVAMU. The *in situ* population was divided into 2 lines/breed: Line 1, would be selected for growth and Line 2, selected for resistance to common gastro-intestinal parasites. *Inter se* matings will be made in subsequent years within each line, within breed. Simultaneously, collection of semen that would be preserved cryogenically (*ex situ*) as part of the National Animal Germplasm Program (NAGP), has commenced in West TX with Sul Ross State University and in East TX with PVAMU. Genotyping efforts at Virginia State University have linked the myotonic phenotype to a single nucleotide polymorphism (SNP) in the chloride channel-1 (C1C-1) gene expressed in skeletal muscle. Continued efforts are underway to characterize the genotype in relationship to carcass traits in the Tennessee Stiff-legged breed. Phenotypic and genetic characterization of goat breeds will be carried out at all the institutions. Although this project has been initiated in TX the preservation effort will be extended nationally. This *in situ* project will enable the breeds to be properly characterized and evaluated in East TX environment and allow us to perform comparative trials, undertake crossing experiments and conduct research into other areas. Presently, 12.9 and 22.9 % of the germplasm needs for Spanish and Angora breed regeneration and security have been acquired.

Key Words: Goats, *ex situ*, Genetic resources

272 Population genetic structure of a colony of German Shepherd and Labrador Retriever dog guides. J. B. Cole*[1], D. E. Franke[1], and E. A. Leighton[2], [1]*Louisiana State University, Baton Rouge, LA,* [2]*The Seeing Eye, Inc., Morristown, NJ.*

Pedigree analysis was used to describe changes in genetic diversity in a colony of dog guides. German Shepherds (GS) and Labrador Retrievers (LR) were evaluated. Parameters estimated included average coefficients of relationship to the breed, average coefficients of inbreeding, effective founder number, effective ancestor number, founder genome equivalents, and effective population size. There were rapid increases in average pairwise relationship in both breeds, although the average was approximately one-third higher in the GS population than in the LR population. A similar trend was observed for average inbreeding. Both measures showed a steady increase for several generations and levelled off thereafter. In the current generation, relationship and inbreeding for all animals averaged 25.3% and 26.2% in GS and 15.5% and 22.0% in LR, respectively. Effective founder number initially decreased in GS until generation 3, and then increased steadily. There was a constant increase in effective founder number in LR after founding. Final values were 35.5 and 20.2 in GS and LR, respectively. A similar pattern, with current values of 23.6 and 16.9, was seen for effective ancestor number as well. This is probably due to the fact that this is a small population which received new genetic material by migration distinctly different populations. Founder genome equivalents were initially higher in the GS but decreased over time in both breeds to 5.6 and 5.3 in GS and LR, respectively. Changes have been effected in the genetic management of the breeding colony to slow, and eventually reverse, the trends towards increased relationships and inbreeding. Effective population sizes are not expected to change significantly in the near- to medium-term. Use of a more diverse portfolio of sires and dams, as well as the introduction of germplasm from outside of the current breeding colony, will help insure the continued health of this population.

Key Words: Population structure, Dog guides, Genetic diversity

Companion Animals

273 Human-animal-relationship as a risk factor for overweight pets. E. Kienzle*[1] and R. Bergler[2], [1]*Chair of Animal Nutrition, Ludwig-Maximilians-University, Munich, Germany,* [2]*Psychological Institute, University of Bonn, Bonn, Germany.*

Hundred and twenty cat owners and 120 dog owners (60 with overweight and 60 with normal pets, respectively) were interviewed by standardized questionnaires. Questions to dog and cat owners were made similar where applicable. Overweight dogs more often slept in their owner's bed. Their owners talked more and on a greater variety of subjects to their dogs and they were less afraid of taking diseases from their dogs. Exercise, work or protection by the dog were rated as less important. These characteristics of the human-animal-relationship were interpreted as signs of over-humanisation of overweight dogs. In overweight cats the human-animal-relationship also showed indicators of over-humanization, such as talking to the cat on topics which are not related to the cat. Owners of overweight cats and dogs watched their pets more often when they were eating. Several items indicate that feeding the pet was an important stimulant for communication with the overweight pet. The human-animal-relationship of owners of overweight cats was characterized by a higher intensity of the bond between owner and cat. By contrast there were hardly any indications that the bond between overweight dogs and their owners was stronger than the bond between normal dogs and their owners. Owners of overweight dogs appeared to be more aware of the overweight problem than owners of overweight cats. In overweight dogs the number of meals and snacks was significantly increased compared to normal dogs. In normal and overweight cats there was no difference in the frequency of meals and snacks, however, overweight cats often had free choice of food intake. Overweight cats and dogs were given kitchen scraps more often on top of their usual diet. Preventive health care for the pet (such as health checks, observation of feces quality, vaccinations) was more important to the owners of normal pets than to those of overweight pets. Owners of overweight dogs had less interest in preventive health care for themselves than owners of normal dogs, whereas in owners of overweight cats there was a tendency to the contrary.

Key Words: Human-animal-relationship, Overweight, Pets

274 Effect of temperament on stress response of stray adult dogs in a shelter environment. C. L. Coppola*, T. Grandin, and R. M. Enns, *Colorado State University, Fort Collins, CO USA.*

Due to a dog's inherent social nature and a keen sense of its surroundings they are vulnerable to changes in the environment. The main stressors a domestic dog encounters in a shelter are isolation, exposure to constant noise and novel, irritating stimuli. The objective of this study was to examine the relationship between seven temperament traits of stray adult dogs and their stress response to the shelter environment as measured by salivary cortisol after 9 days in the shelter. Dogs (n = 26) included in the study were healthy, non-pregnant, potential adoption candidates not claimed by their owner. Animals that were deemed dangerous and/or not suitable for adoption were excluded from the study. The primary temperament traits evaluated were: sociability (interaction with people and other dogs) and reactivity (response to sudden novel stimuli). The secondary temperament traits evaluated were: independence, confidence, calmness, playfulness and lack of fear. All traits were ascertained through the results and interpretation of an adoptability assessment conducted on the 2nd day of housing in the shelter. A Mixed Model was used to evaluate the effect of temperament on cortisol level on day 9. The model included the fixed effects of each temperament level and type (as classified by AKC breed types), as well as the random effect of individual. Sociability, reactivity, confidence, calmness and lack of fear affected cortisol levels on day 9 ($P < 0.05$). As sociability and reactivity levels increased in an individual animal, cortisol level increased by 0.2342 ± 0.083 and $0.2313 \pm 0.075 \mu g/dl$, respectively. Isolation or lack of socialization and reaction to the shelter environment are important key factors in predicting the stress response of an animal while housed in a shelter environment. Identification of animals that may have an elevated stress response may prove to be beneficial from both a welfare and financial standpoint by decreasing overall stress response and ultimately improving the physical and mental health of the animal.

Key Words: Dog, Temperament, Stress Response

275 Use of expert system software in teaching problem solving in a companion animal nutrition class. J. P. McNamara*, *Washington State University.*

The objective was to demonstrate effectiveness of teaching nutrition and problem solving skills using problem solving techniques and expert system software in an advanced class. The course is AS 406, Nonruminant Nutrition. The only prerequisite is one basic Animal Feeds and Feeding class, for which students have had one year of college chemistry, biology, one semester of organic chemistry. The objective is to teach advanced nutritional principles and practical feeding of nonruminants, primarily companion animals. Students first demonstrate that they can balance a ration using the algebraic method, then move on to problem scenarios. Students do not answer questions, rather they design a list of questions they need to have answered to solve the problem. After that, students begin designing an expert system to help someone else (a client, for example) to solve a different problem or to learn some aspect of nutrition. They develop an objective, a flowchart of questions and potential answers, and then write an expert system using commercially available software containing an inference engine for backward or forward chaining. This process forces students to define a problem or a learning objective and devise the question set which will provide answers leading to a specific recommendation or finding. They must also provide the potential answers to the questions they ask, and then make their findings. The process helps the students to learn nutritional facts and concepts, and to use specific logic, as the system will not run otherwise. Students (with teacher guidance and input at each step) decide which pieces of information are critical to the situation then explain the reasoning for the solution to the user. The software is easy to learn, based on normal English, and logical IF, AND, OR, THEN, and ELSE, statements. No previous computer programming experience is necessary. Potential effectiveness may be demonstrated by the fact that all students (8 years, more than 180 students) have been able to design a working system, with

the majority including sufficient depth of knowledge expected at senior level. Student evaluations provide high rankings (9 of 10 or better) on fostering independent thinking ability, problem-solving skills, ability to apply knowledge.

Key Words: Critical thinking, Nutrition, Companion animals

276 Investigations on the energy requirements of adult cats . G. Edtstadtler-Pietsch[1], R. Rudnick[2], and E. Kienzle*[1], [1]*Chair for Animal Nutrition, Ludwig-Maximilians-University, Munich, Germany,* [2]*Nestle Purina PetCare Research.*

Energy requirements of 138 adult colony cats were determined by recording the energy intake during periods of weight constancy (> 4 weeks). Females had a mean body weight of 3.88 kg, while the body weight of male cats averaged 5.09 kg. Neutered females were significantly heavier than intact queens (mean body weight of 4.09 kg and 3.64 kg, respectively, $p<0.05$). Middle-aged cats had higher body weights than young (< 5 yrs)and very old cats (> 10 yrs.). The mean energy requirement of adult cats was 251 kJ ME/kg BW. Maintenance energy requirements per body mass unit decreased with increasing body weight. Mean energy requirements of cats with a body weight of up to 3 kg were 319 kJ ME/kg BW, while heavy cats with a body weight of over 5 kg needed only 209 kJ ME/kg BW for weight maintenance. This suggests that most of the heavier cats were not larger cats, but rather more overweight cats with a reduced percentage of fat-free body mass. Energy requirements of a cat population with a considerable percentage of overweight individuals can therefore be best described using a function with an exponent for metabolic body mass, which is considerably lower than 0.75 (maintenance energy requirements= 544 kJ ME/kg $BW^{0.40}$). Neutered cats had significantly lower energy requirements than intact cats (286 kJ ME/kg BW vs. 231 kJ ME/kg BW;$p< 0.05$).When the cats were grouped according to body weight there were no significant differences between intact and neutered cats of the same weight group. The young adult cats had higher energy requirements per body mass unit than middle-aged animals. While cats of 1 to 5 years of age needed an average of 313 kJ ME/kg BW, mean maintenance energy requirements of cats between 6 and 10 years of age only came up to 231 kJ ME/kg BW. Very old cats had slightly higher energy requirements than middle aged cats. Age effect interacted with the effect of overweight. When only data of lean cats were evaluated there was a gradual decrease of energy requirements with age.

Key Words: Maintenance energy requirements, Cats

277 Prediction of energy digestibility based on total dietary fiber (AOAC-method) in complete dry food for dogs and cats. E. Kienzle*[1], V. Biourge[2], and A. Schönmeier[1], [1]*Chair of Animal Nutrition, Ludwig-Maximilians-University, Munich, Germany,* [2]*Royal Canin, Research Center, Aimargues, France.*

It has been repeatedly demonstrated that there is a negative relationship between fiber in dry matter and energy digestibility in pet foods. This is true for any method of fiber determination that measures the major percentage of cellulose. So far, however, there are only few observations on total dietary fiber (TDF; by AOAC-method) and energy digestibility. In the present study therefore 610 digestion trials with dog foods and 261 digestion trials with cat foods were evaluated. Digestion trials were carried out according to AAFCO-protocols, and energy in food and feces was determined by bomb calorimetry. In addition to TDF the crude fiber (CF) content was determined in 495 dog foods. The following regression equation between energy digestibility (%) and TDF in % dry matter (DM) was obtained for dog food: energy digestibility = 96.6-0.96×TDF (% DM); r=0.94**. A similar equation was obtained for cat food: energy digestibility = 95.6-0.89×TDF (% DM); r=0.88**. For crude fiber in dog foods the regression equation was: energy digestibility = 92.9-1.6×CF (% DM); r=0.87**. This confirms earlier results. The correlation was even closer for TDF than for CF, and for TDF there were no outliers. Prediction of energy digestibility in dry food by TDF as a basis for prediction of ME may be even more accurate then prediction of energy digestibility by CF.

Key Words: Total dietary fiber, Energy digestibility, Cats and dogs

278 Comparison of in vitro nutrient disappearance to in vivo nutrient digestibility and fermentablility using the ileal-cannulated dog model. E. A. Flickinger*, A. M. Gajda, C. M. Grieshop, L. L. Bauer, N. R. Merchen, and G. C. Fahey, Jr., *University of Illinois Department of Animal Sciences.*

A model for estimating in vitro nutrient digestibility previously has been developed and validated using ileal-cannulated pigs. Our objective was to determine the accuracy of this model at predicting dry matter (DM), organic matter (OM), and crude protein (CP) digestibility in ileal-cannulated dogs. Two diets were used: a moderate diet (25% protein, 11% fat) and a super-premium diet (28% protein, 23% fat). Diets were fed to 8 ileal-cannulated dogs in a crossover design with chromic oxide used as a digestibility marker. The same diets were used as substrates in an in vitro system. Briefly, samples were ground and incubated with pepsin-HCl followed by pancreatin enzyme to simulate hydrolytic digestion before incubating with anaerobic media and canine fecal inoculum to simulate colonic fermentation. The in vitro model accurately ranked DM, OM, and CP hydrolytic digestibility of these diets, but predicted differences ($P<0.05$) due to diet in digestibility of all three nutrients, while the in vivo model resulted in differences ($P<0.05$) for CP alone. For digestive values including fermentation, the in vitro model correctly ranked and predicted differences ($P<0.01$) in disappearance of DM and CP as compared to the in vivo model. However, the in vitro model predicted no difference between the OM total tract digestibility of the two diets, while the in vivo model resulted in greater ($P<0.01$) OM digestibility of the super-premium diet. Generally, the in vitro model predicted digestibility coefficients that were lower than in vivo results, with the most variability occurring in CP digestibility values and the least variability occurring in DM digestibility values. These results indicate that although this in vitro model may aid in predicting relative diet digestibility, it is not a substitute for in vivo research on canine nutrient digestibility.

Key Words: Dog, In vitro, Nutrient digestibility

279 Influence of diet on fecal *Lactobacillus* population. C. J. Fu*[1], J. N. Carter[2], J. H. Porter[1], and M. S. Kerley[1], [1]*University of Missouri-Columbia,* [2]*Nestle Purina PetCare Company.*

Forty Labrador Retriever puppies were used in a completely randomized block design to compare the effect of two meat-based (treatments 1 and 2) and two grain-based (treatments 3 and 4) extruded dry commercial diets on the *Lactobacillus* population in the feces. The crude protein content of treatments 1 - 4 were 28.0, 28.0, 25.5, and 27.0 % on DM basis, respectively. The fecal samples were collected individually from each dog on day 0, 3, and 14. Total anaerobe (TOTA) and *Lactobacillus* (LACT) bacteria were enumerated by an agar plating method. The media for TOTA enumeration was anaerobe basal agar (Oxoid, CM972, Basingstoke, Hampshire, England) with 10 % sterile defribinated horse blood. The media for LACT was MRS broth (Difco, #288130, Sparks, MD, USA) and agar (20 g/L) with 20 mg/L vancomycin supplement. Incubation time was 48 h in an anaerobic chamber at 37 ^{o}C. Lactobacillus as a percentage of TOTA was greater ($P< 0.05$) for treatment compared to the others (24 vs 16, 7, and 14 %). There was no main effect ($P> 0.05$) due to day of sampling (11, 15, and 20 % LACT for day 0, 3, and 14, respectively). However, the ratio increased ($P< 0.05$) from day 0 to day 14(11 and 38 % LACT, respectively) for the puppies fed the diet that resulted in the greater percentage LACT population. Diet can influence gut bacterial population in the puppy. Differences appear to exist in the ability of commercial diets to elicit bacterial population responses. There were no obvious correlations between type of diet and fecal LACT.

Key Words: Diet, *Lactobacillus*, Puppy

280 Effects of refrigeration and extended frozen-storage on organic acid profiles of commercial soft goat milk cheeses. Y. W. Park*, J. H. Lee, and S. J. Lee, *Fort Valley State University, Fort Valley, GA.*

Acceptability of a cheese depends largely on flavors formed during its aging process. Organic acids are important flavor compounds in cheeses, and formed as a result of the hydrolysis of fatty acids, bacterial growth, or addition of acidulants during cheesemaking. Although organic acid compositions of goat cheeses are important flavor parameters for consumer acceptability, little information is available on this premise. Three lots of a commercial soft goat milk cheeses were purchased from a licensed goat dairy to study organic acid profiles and their changes in goat cheeses during extended refrigeration and frozen storage. The cheeses were subdivided into three equal portions. One subsample was stored as unfrozen control (UFC) at 4^{o}C for 4 weeks (0, 14, 28 days), and the other two portions were frozen at -20^{o}C and stored for 0 and 3 months (FZC and 3FZ), then immediately thawed at 4^{o}C, followed by aging at 4^{o}C for 4 wks. Concentrations of various organic acids were quantified using a HPLC (Hewlett Packard; LC-1100 Series) equipped with auto sampler, quaternary pump, vacuum degasser, diode array detector, and fluorescence detector. The column was reverse phase Hewlett Packard ODS Hypersil 5mm (125 X 4 mm), and solvent was 0.5% (wt/vol) $(NH_4)_2HPO_4$. The soft goat cheese contained all tested standard organic acids except pyruvic acid in various amounts including formic, malic, lactic, acetic, orotic, citric, uric, tartaric, and propionic acids. Many unidentified isomeric peaks appeared between the known standard peaks. Lactate was highest organic acid, followed by acetate in the soft cheeses. Storage treatments (UFC, FZC and 3FZ) significantly (P<0.05) affected most of the identified organic acid contents such as acetate, butyrate, citrate, formate, lactate, malate, orotate isomers, propionate, propionate isomers, a tartarate isomer and uric acid, while aging periods did not influence them. Acetic, orotic and propionic acids were most significantly (P<0.05) affected by frozen-storage, which could be important predictors for the soft goat cheese.

Key Words: Goat cheese, Organic acids, Frozen-storage

281 Effects of 3 month frozen-storage and refrigeration on proteolysis of soft goat milk cheeses determined by SDS-PAGE and gel image analysis. S. J. Lee[1], J. H. Lee[1], J. Rhodes[2], and Y. W. Park*[1], [1]*Fort Valley State University, Fort Valley, GA,* [2]*The University of Georgia, Athens, GA.*

Freezing cheeses is not a common industrial practice. However, the seasonality of goat milk production necessitates a food technological approach to alternative methods of year-round marketing such as frozen-storage of the goat products. Three batches of commercial plain soft caprine cheeses were purchased. Each lot of the cheese was divided into three equal portions. One portion was immediately stored at 4^{o}C for 0, 14 and 28 days, and the 2nd and 3rd subsamples were immediately frozen (-20^{o}C) for 0 and 3 months, thawed, and placed at 4^{o}C in the same way as the unfrozen control samples. Proteins of the cheeses were extracted with SDS- and Tris-buffers, and specific degradative protein bands were analyzed by SDS-PAGE and Kodak 1D Image Analysis Software System. Electrophoretic patterns of all unfrozen and frozen soft goat cheeses showed at least 8 distinct protein bands, including s_2-, - -, a_1-caseins, -lactoglobulin and some degraded polypeptides from caseins (CN). Other -CN degradative products (i.e., -I peptide) bands were faint but detectable. The s_2- and -CN were two major proteins in the goat cheeses, where the ranges of the two CNs of total proteins were 12-14% and 56-59%, respectively. All protein bands except band No. 6 showed significant (P<0.01) differences in the intensities of corresponding protein bands between batches. Effects of storage treatments (unfrozen, 0 and 3 month frozen) were significant (P<0.05) for bands 1, 3 and 8, while non-significant for bands 2, 4, 5, 6 and 7, indicating that s_2-CN was affected by storage group, while -CN was not. Cheeses with the longer storage groups and greater aging periods tended to show higher density of degradative proteins and peptides than those with the shorter storage and aging treatment groups.

Key Words: Goat cheese, Proteolysis, SDS-PAGE

282 Tocopherol concentrations and their changes in caprine milk cheeses during extended refrigeration and frozen storage. J. H. Lee*, S. J. Lee, B. L Gadiyaram, and Y. W. Park, *Fort Valley State University, Fort Valley, GA.*

Vitamin E has antioxidant activity capable of protecting polyunsaturated lipids in biological systems from oxidative degradation. Vitamin E activity in foods is derived from a series of compounds of plant origin, the tocopherols and tocotrienols. The study was conducted to determine tocopherol contents of caprine milk cheeses and evaluate effects of refrigerated and frozen storage on tocopherol levels in the products. Three lots of commercial plain soft caprine cheeses were purchased and 3 lots of Monterey Jack goat cheeses were manufactured at the university dairy pilot plant. Each lot of both cheese varieties was divided into three equal portions. One portion was immediately stored at 4^{o}C for 0, 14 and 28 days, and the 2nd and 3rd portions were immediately frozen (-20^{o}C) for 0 and 3 months, then thawed, and stored as the same way as the unfrozen samples. Concentrations of tocopherol were quantified using a HPLC (Hewlett Packard; LC-1100 Series) equipped with auto sampler, quaternary pump, vacuum degasser, diode array detector, and fluorescence detector. The column used was reverse phase column Bio-Sil ODS-5S (250 X 4 mm, i.d.), and solvent was mobile phase (Hexane:Isopropanol; v/v-98.5:1.5). Flow rate was 1.5 mL/min, and detector was Hewlett Packard 1046A programmable fluorescence detector, fluorescent set at excitation wavelength of 295 nm and emission wavelength of 330 nm. The pooled data of the mean -tocopherol (g/g cheese) for the unfrozen, 0 and 3 months frozen soft goat cheeses at 4^{o}C for 4 wks were: 7.47, 7.98 and 7.28, indicating no difference between storage treatments. The corresponding mean -tocopherol contents of Monterey Jack hard cheese were: 18.2, 12.2, and 6.66, showing that significant (P<0.05) differences in vitamin E between storage treatments. There was a significant (P<0.01) and negative correlation between -tocopherol level and storage period, while no relations were found between vitamin E levels and acid degree value or pH of the experimental cheeses.

Key Words: Caprine cheese, Tocopherol, Refrigerated storage

283 Capacity of milk processing industry in Hungary. G. Virag[1], J. S. Zsarnoczai*[2], and H. F. Salem[2], [1]*Agricultural Intervention Centre, Budapest, Hungary,* [2]*Szent Istvan University, Godollo, Hungary.*

By the end of 1990s in Hungary 80 % of purchased milk was milk of extra quality. After joining to EU only this part of milk can be used for human consumption concerning qualitative demands of EU. In spite of decreasing the milk production, the consumption and production were balanced, and the seasonal overproduction was dicontinued by export. The self-sufficiency of milk products was changing between 110 and 123% between 1994-1998. Capacity of pasteurized milk processing was only 32%, also the ultra pasteurized milk processing was 33%. Capacity of the tasted milk product processing 27% in average, but capacity of the sour milk product processing was higher, 48%, curd production capacity was 26%, tasted curd product capacity was 37%. The capacity of natural cheese production was very high, namely 68%, and capacity of processed cheese in bulk was less, namely 42%, and butter production one was 20%, but the butter-cream production capacity was at the highest level, because it was 72%. The capacity utilization was at low level in Hungary, but differences were considerable between the regions. In general the capacity of those milk product processing was higher, which were much more demanded by consumers, like butter-cream and natural cheese. In general the Hungarian milk processing is charachterized by a large number of factories, which is much more, than in EU. The concentration is considerable in EU, but concentration process of milk industry is going on in Hungary. Also in Hungary the efficiency of human resources should be increased in ordet that the milk industry will be more competitiveness.

Key Words: Concentration of milk industry, Human consumption, Qualitative demands of EU

284 Subsidy for private storing butter and cream in Hungary. I. Feher[1], G. Virag[2], S. J. Zsarnoczai*[1], H. F. Salem[1], and L. Villanyi[1], [1]*Szent Istvan University, Godollo, Hungary,* [2]*Agricultural Intervention Centre, Budapest, Hungary.*

The aim of the subsidy for private storing at ensuring the adequate butter supply in European Union. After joining to EU also this kind of subsidies will be used in Hungary The subsidy for private storing could be provided based on the following conditions: 1. for pasteurized cream, which has fat content between 35-80%, 2. for non salted butter made of pasteurized cream or milk in factory permitted by EU and its fat content is 82% at minimum level and its water content is 16% at maximum level, 3. for salted butter made of pasteurized cream or milk in factory permitted by EU and its fat content is 82% at minimum level and its water content is 16% at maximum level. The subsidy is determined by storing cost and possible changing prices of fresh butter and butter-stock. The condition of subsidy for private storing is to make an contract for storing based on decided demands with Agency of Payment belonging to state member, in areas of which butter and cream are stored. The subsidy can be claimed in writing form from Agency of Payment for butter and cream having been stored between 15th of March and 15th of August in given year. The application for subsidy should be sent to Agency of Payment, when products have arrived to store within 28 days. The contract for storing is signed, when the application has received at Agency within 30 days. The contracting party or person responsible for storing should keep a record of products stored relevant to contract. In case of contract for private storing the storing period extents between 90 and 210 days. If the contracting party does not keep the deadline, the subsidy will be decreased by 15% and be payed only for that period, when butter and cream were really stored.

Key Words: Subsidy for private storing, Pasteurized cream, Contract for private storing

Horse: Equine production & management

285 Effect of n-3 polyunsaturated fatty acid source on plasma fatty acid profiles of horses. P. D. Siciliano*[1], S. K. Webel[2], L. S. Brown[2], L. K. Warren[1], T. E. Engle[1], and P. D. Burns[1], [1]*Colorado State University, Fort Collins, CO/USA ,* [2]*United Feeds, Inc., Sheridan, IN/USA.*

Eighteen mature geldings of American Quarter Horse, Arabian, and Thoroughbred breeding, with an average body weight of 569 $\pm$ 8 kg were randomly assigned to one of three dietary treatments, control (CTRL, n = 6), ground whole flaxseed (FS, n = 6) or protected n-3 polyunsaturated fatty acid source (PFA, n = 6; United Feeds, Inc., Sheridan, IN, USA) to determine the effect of n-3 fatty acid source on plasma fatty acid profiles. All horses were group-fed brome grass hay ad libitum. All horses were individually fed 0.8 kg as-fed of a vitamin mineral supplement top-dressed with 0.57 kg as-fed of their respective dietary treatment, daily. The total n-3 fatty acid concentration of the top-dressed supplements, calculated as the sum of C18:3n-3, C20:5n-3, and C22:6n-3, was 0.47, 5.56 and 5.02 g/100g diet as-fed for CTRL, FS and PFA, respectively. Experimental diets were fed for a period of 28 d. Blood samples were collected on d 0, 14, and 28 by jugular venipuncture, and plasma was harvested and analyzed for fatty acid composition. The individual plasma fatty acids C16:0, C16:1n-7, C18:0, C18:1n-9, the sum of C18:2n-6 and n-9, C18:3n-3, C20:0, C20:4n-6, C20:5n-3, C22:5n-3, and C22:6n-3 were expressed as a percent of the total plasma fatty acids. The percent total n-3 fatty acid composition of plasma was calculated as the sum of the percentages of total plasma fatty acids for C18:3n-3, C20:5n-3, C22:5n-3, C22:6n-3. Data were analyzed as a repeated measures design using the PROC MIXED ANOVA procedure of SAS. Mean plasma C20:4n-6, C20:5n-3, C22:6n-3, and total n-3 fatty acids in horses fed PFA increased from d 0 to 14 ($P < 0.01$), and then remained unchanged from d 14 to 28 resulting in greater ($P < 0.01$) proportions of these fatty acids on d 14 and 28 in PFA as compared to FS and CTRL (treatment x time; $P < 0.015$). These results suggest that supplemental PFA increased the proportion of n-3 fatty acids in plasma of horses, whereas a similar amount of n-3 fatty acids provided by ground whole flax seed did not.

Key Words: Horse, Polyunsaturated fatty acids, Flax seed

286 Development of a Model for Treating Insulin Resistance in Mares. M. M. Vick*, D. R. Sessions, S. E. Reedy, B. A. Murphy, E. L. Kennedy, and B. P. Fitzgerald, *University of Kentucky, Lexington KY.*

Obesity in mares is associated with insulin resistance (IR), which in turn may predispose them to laminitis and other inflammatory disease states. In obese humans, biguanides are a family of drugs that have been successfully used to treat IR. The goal of this study was to test the hypothesis that in the horse, dietary-induced insulin resistance can be alleviated by treatment with the biguanide, metformin. Fourteen mares (body condition score 5-7) were maintained at pasture and supplemented with .75 kg mixed grain and corn oil per day (2.64Mcal/kg) for a period of two months to increase obesity and induce insulin resistance. IR was determined by hyperinsulinemic euglycemic clamp procedure. All mares were considered insulin resistant based on low glucose infusion rates during the clamp procedure. Subsequently, the mares were allocated to control (n=7) and treatment (n=7) groups that were balanced for body weight, body condition, and degree of IR. Metformin hydrochloride was tested at three dose levels (1.5, 3.0, and 4.5g PO, x2 daily). Each dose was tested for successive periods of 30 days, beginning June 1st. Peripheral insulin sensitivity was determined by the clamp procedure at the end of each 30-day interval. Additionally, blood samples were collected x3 per week and body weight and percent body fat were determined at 3-week intervals. Treatment with metformin (1.5g x2/day) was associated with increased insulin sensitivity compared to untreated mares ($P<0.05$). The highest dose (4.5g) was unaccompanied by increased insulin sensitivity. At a dose of 3.0g, insulin sensitivity was greater than pretreatment ($P<0.05$) and accompanied by reduced fasting insulin concentrations; however, the degree of sensitivity was not different from that observed in untreated mares. In conclusion, observations from this preliminary study suggest that treatment of obese, insulin resistant mares with metformin may lead to increased insulin sensitivity. This effect may be dose dependent since only lower doses appeared to be effective.

Key Words: Metformin, Insulin resistance

287 Factors associated with mare reproductive loss syndrome in central Kentucky and surrounding areas. S. L. Gray*[1], D. L. Cross[1], K. E. Panter[2], W. C. Bridges[1], and T. Gimenez[1], [1]*Clemson University, Clemson, SC,* [2]*USDA Poisonous Plants Research Lab, Logan, UT.*

On 10 May 2001, a study of the Mare Reproductive Loss Syndrome (MRLS) reported in Central Kentucky and surrounding areas was initiated. This syndrome caused several thousand mares in this area to abort many early-term and a few late-term foals. The mares showed few signs of toxicity. Thirty-eight pastures on 11 farms were studied. Pastures were divided into two groups; those with early fetal losses (Treatment), and those without losses (Control). Overall botanical composition of pastures was evaluated. Chi square analysis of the botanical data showed a relationship between the evidence of consumption ($p<0.0001$) of Poison Hemlock (Conium maculatum) in problem pastures and MRLS. Subsequent chemical analysis determined that the Poison Hemlock plants contained 0.8-1.0% piperidenic alkaloids that are known to be toxic to animals. To study the clinical response to Conium maculatum in gravid mares, 14 mares were bred for experimental study. At gestational age 45 days, mares were randomly assigned to one of three groups:(1)Control-received no Conium; (2)Low (L)-received Conium at an alkaloid titration of 2.8mg/kg body weight; (3)High (H)-received Conium at an alkaloid titration of 4.3mg/kg body weight. Conium maculatum slurry was administered once per day for 4 days. Foals were observed by transrectal ultrasound. Mares were physically examined and blood samples were collected at times 0h, 1h, 2h, 3h, 4h, 5h, 6h, 24h, 25h, 48h, 49h, 72h, and 73h. Blood samples were analyzed for piperidinic alkaloid concentrations, blood chemistry components, and progesterone levels. Compared to the control mares, the H mares expressed decreased body weight, higher pulse and respiration rates, more ataxia, colic, salivation, and sweating ($p<.05$). The H and L groups both showed increased frequencies of incoordination and tremors

(p<.05). One abortion in the H group was detected 19 days following the first dose. Assay results from piperidinic alkaloid tests are pending.

Key Words: MRLS, Conium maculatum

288 Effects of feeding endophyte-infected tall fescue diets on embryo survival in mares during early gestation. R. C. Youngblood*[1], B. J. Rude[1], D. L. Christiansen[1], N. M. Filipov[1], R. Hopper[1], N. S. Hill[2], B. P. Fitzgerald[3], and P. L. Ryan, [1]*Mississippi State University, Mississippi State, MS,* [2]*University of Georgia, Athens, GA,* [3]*University of Kentucky, Lexington, KY.*

A high incidence of early embryonic death and spontaneous late-term abortions occurred in Kentucky and neighboring states in spring 2001 and 2002. The objective of this study was to evaluate the embryotoxic potential of feeding endophyte-infected tall fescue seed and hay to mares during early gestation. Mares (n = 12) were matched by stage of gestation (d 60-100) and assigned to diets (6/diet) that were fed for 10 days. Diets consisted of endophyte-free (E-) or endophyte-infected (E+; 271 ppb ergot alkaloid content equivalent to 1.36 μg/kg BW/day) tall fescue seed (0.5% BW) mixed with sweet feed (10% CP) as well as ad libitum access to E+ tall fescue or ryegrass hay, for E+ and E- treatments, respectively. Rectal temperatures (RT), blood samples and urine was collected daily. Blood and serum was analyzed for clinical chemistry, progesterone (P4), prolactin (PRL), and 3-4-dihydroxyphenylacetic acid (DOPAC, a catecholamine metabolite) analyses, whereas urine was analyzed for ergot alkaloids. Also, fetal heartbeat and presence of echogenic material in fetal fluids was monitored daily by ultrasonography (US). RT (E+ 37.76 0.03; E- 37.84 0.03 C) and PRL (E+ 14.06 0.76; E- 12.11 0.76 ng/ml) serum concentrations were not different between groups. Measuring the change in concentration from d 0 over time, P4 concentrations were not different (E+ -0.64 1.49; E- -0.55 1.47 ng/ml). There was no negative pregnancy outcome and US showed no increase in echogenic material in fetal fluids. There was a rapid and persistent (p<0.05) decline in DOPAC concentrations in E+ compared with E- mares (2.1 0.14 and 4.4 0.43 ng/ml, respectively). Urinary ergot alkaloid concentration was greater (p < 0.01) in E+ compared with E- mares (532.12 52.51 and 13.36 2.67 ng/mg creatinine, respectively). Although no embryo loss was observed during the current study, the elevated concentrations of urinary ergot alkaloids and the depressed endogenous catecholamine activity indicate that prolonged exposure to E+ tall fescue could be detrimental to embryonic development and survival in horses.

Key Words: Equine, Ergot alkaloids, Catecholamine

Meat Science & Muscle Biology: Muscle proteinases and meat quality

289 The Calpain system and animal agriculture. D. E. Goll*, *Muscle Biology Group,University of Arizona,Tucson, Arizona 85721.*

Even before purification of calpain was first described (Dayton et al., 1976), calpain activity had been linked to postmortem tenderization (Goll et al., 1974). Studies have since established that nearly all (up to 90 % or more) of the tenderization that occurs during postmortem storage at 2-4°C is the result of calpain activity. Most convincing are the studies showing that there is nearly no degradation of actin and myosin during storage at 2–4°C even for periods as long at 2–3 weeks postmortem. The major cathepsins in skeletal muscle, cathepsins B, D, and L, all rapidly degrade myosin and actin, whereas the calpains are unique among the known proteolytic enzymes in that they do not degrade either actin or myosin.

There presently are three well-characterized members of the calpain family: μ-calpain, a protease that requires 3-50 μM $Ca2^+$ for half-maximal activity; μ-calpain, a protease that requires 400–800 μM $Ca2^+$ for half-maximal activity; and calpastatin, a protein that inhibits proteolytic activity of the calpains but of no other protease with which it has been tested.

In addition to its role in postmortem tenderization, evidence indicates that the calpain system is responsible for initiating turnover of the myofibrillar proteins in skeletal muscle. Hence, the calpain system has an important role in muscle protein turnover and the rate and efficiency of skeletal muscle growth. Existing evidence indicates that changes in calpastatin activity are more closely related to postmortem tenderization and rate of muscle growth than changes in calpain activity are. Because skeletal muscle contains sufficient calpain activity to destroy all myofibrillar proteins in the muscle in less than 5 min, future studies should focus on how activity of the calpains is regulated (e.g., via calpastatin, phosphorylation, other?) in postmortem and growing muscle.

Dayton, W.R., Goll, D.E., Zeece, M.G., Robson, R.M., and Reville, W.J. (1976) A $Ca2^+$-activated protease possibly involved in myofibrillar protein turnover. Purification from porcine muscle. Biochemistry 15, 2150–2158.

Goll, D.E., Stromer, M.H., Olson, D.G., Dayton, W.R., Suzuki, A., and Robson, R.M. (1974) The role of myofibrillar proteins in meat tenderness. Proc. Meat Industry Res. Conf., American Meat Institute Foundation, Arlington, VA. pp. 75–98.

290 The influence of calcium metabolism on beef tenderness. T. A. Walsh*, R. H. Pritchard, D. M. Wulf, and K. W. Bruns, *South Dakota State University, Brookings, SD/USA.*

Calpain and calpastatin activity are thought to be the determining factors for meat tenderness, and Ca plays a role in calpain activity. The present theory is to manipulate beef cattle diets to change muscle Ca levels and consequently calpain activity and shear force. To test whether dietary Ca manipulations affect tenderness, Angus steers (n=20), from a single source, were assigned to pairs based on an allotment weight. One steer from each pair was assigned to the control treatment (CO) and the other to the low dietary Ca (LC) treatment. All cattle were fed a typical high grain finishing (0.65% Ca) diet starting at 343 kg BW; dietary restrictions were imposed 113 d later at 561 kg BW. The LC received a 0.24% Ca diet for 14, 21 or 28 d prior to harvest and was returned to the CO diet for one feeding 16 h prior to harvest. Individual performance and carcass data were collected. Post mortem muscle temperature and pH were determined for the *Longissimus dorsi*, *Triceps brachii*, and *Semimembranosus* muscles from each carcass at 1, 3, 6, 24, and 48 h post mortem. Warner-Bratzler shear force was determined on three steaks from each muscle from each carcass, on d 5, 10 and 15 post mortem. There appeared to be no adverse affect on DMI or ADG when fed a LC diet. Serum Ca levels at exsanguination were higher (P<0.01) for LC cattle than CO (11.9 v. 9.3 mg/dL). Muscle pH was higher (P<0.05) for LC at 1 h (6.47 v. 6.25), 3 h (6.16 v. 5.97), 48 h (5.61 v. 5.57) post mortem. Warner-Bratzler shear force values did not differ (P>0.2) between treatments on d 5, 10, and 15 for the *Longissimus dorsi* (3.0 kg ± 0.18) and *Triceps brachii* (3.1 kg ± 0.15). Shear force was lower (P<0.05) for LC on d 5 for the *Semimembranosus* (3.6 v. 4.2 kg). Muscle Ca concentration was numerically higher in the LC than CO (38.6 v. 37.3 μg/g). The depletion of Ca from finishing diets did not appear to have adverse affects on performance, but did increase serum Ca levels and altered muscle pH and shear force values of the *Semimembranosus*.

Key Words: Beef, Muscle, Calcium

291 Influence of early postmortem protein oxidation on beef quality. L. J. Rowe, K. R. Maddock, A. Asmus, S. M. Lonergan, and E. Huff-Lonergan, *Iowa State University.*

The objective of this study was to examine the impact of early postmortem protein oxidation on the color and tenderness of beef steaks. To obtain a range of oxidation levels, both longissimus dorsi et lumborum (LDL) muscles from each of ten beef steers fed a finishing diet with vitamin E (1000 IU per head per day, minimum of 126 d [VITE], n = 20 muscles) and from another ten beef steers fed the same finishing diet without vitamin E (CON diet, n = 20 muscles) were used. Within 24 h after harvest, LDL muscles from each animal were cut into 2.54 cm thick steaks and individually vacuum packaged. Steaks from each animal were assigned to a control group (not irradiated) and an irradiated group (average dose = 6.4 kGy). Steaks were irradiated within 26 h postmortem and were aged at 4°C for 0, 1, 3, 7, and 14 d after irradiation. Steaks from each diet/irradiation/aging time treatment were used to determine color, shear force, and degree of protein oxidation (carbonyl content and sulfhydryl content). Steaks from animals fed VITE diet had significantly higher α-tocopherol contents than steaks from animals fed the CON diet. At 0 d post-irradiation, within diet,

steaks that had been irradiated had lower L* values ($P < 0.05$). At all aging times irradiated steaks, regardless of diet, had significantly lower a* and b* values than non-irradiated steaks. Carbonyl concentrations were significantly higher in irradiated steaks compared to non-irradiated steaks at 0, 1, 3, and 7 d post-irradiation ($P < 0.05$). Protein carbonyl content was significantly and positively correlated to Warner-Bratzler shear force values. Immunoblot analysis for carbonyls showed that Vitamin E supplementation decreased the number and extent of oxidized sarcoplasmic proteins. At d 0 post-irradiation, sulfhydryl content of purified myofibrils from irradiated steaks was significantly lower compared to myofibrils from non-irradiated steaks ($P < 0.03$). These results indicate that increased oxidation of muscle proteins early postmortem could have negative impacts on fresh meat quality.

Key Words: Protein oxidation, Irradiation, Beef quality

292 Effects of oxidation on beef tenderness and mu-calpain activity. L. J. Rowe*, K. R. Maddock, A. Trenkle, S. M. Lonergan, and E. Huff-Lonergan, *Iowa State University*.

The objective of this study was to examine the role of early postmortem tissue oxidation in regulating postmortem mu-calpain activity and subsequent meat tenderness. It was hypothesized that oxidative conditions in postmortem (PM) tissue would decrease mu-calpain activity and minimize the extent of tenderization. To achieve different levels of oxidation two treatments were used, supplementing beef animals with vitamin E the last 126 days on feed and irradiating products early PM. Ten beef steers were fed a finishing diet that included vitamin E at 1000 IU per head per day. Another ten beef steers were fed the same finishing diet without vitamin E. At 24 h PM, both strip loins from each animal were cut into 2.54 cm thick steaks, and individually vacuum packaged. Steaks from each animal were irradiated within 26 h PM at 0 kGy (n = 20 loins) or 6.4 kGy (n = 20 loins). Steaks were aged at 4°C for 0, 1, 3, 7, and 14 d post-irradiation. Steaks from each diet/irradiation/aging group were used to determine Warner-Bratzler shear force (WBS), calpain activity, autolysis, and degradation of myofibrillar proteins. At 1, 3, 7, and 14 d post-irradiation, WBS values of irradiated steaks were significantly higher compared to non-irradiated steaks. Western blots of troponin-T and desmin showed decreased proteolysis in irradiated samples compared to non-irradiated samples. Casein zymography predicted that mu-calpain from irradiated meat had less activity in the tissue than did mu-calpain from non-irradiated meat. Western blotting showed mu-calpain from irradiated meat was less autolyzed compared to mu-calpain from non-irradiated meat. These observations suggest that oxidation in early postmortem meat may be an important inhibitor of mu-calpain activity and should be considered more closely in early PM studies. This study also suggests that irradiation of whole muscle meat products before tenderization is complete will arrest tenderization and potentially compromise the palatibility of the product.

Key Words: Calpain, Protein oxidation, Beef tenderness

293 Effects of oxidation on inactivation of calpastatin in beef . K. R. Maddock, L. J. Rowe, E. Huff-Lonergan, and S. M. Lonergan*, *Iowa State University*.

The objective of this study was to examine the role of early postmortem (PM) tissue oxidation in postmortem inactivation of calpastatin and subsequent protein degradation. It was hypothesized that conditions that influence protein oxidation have the potential to alter inactivation of calpastatin and degradation of troponin-T. To achieve different levels of oxidation two treatments were used, supplementing cattle with vitamin E the last 126 days on feed and irradiating products early PM. Ten beef steers were fed a diet that included vitamin E at 1000 IU per head/per day (VITE). Ten beef steers were fed the same diet without vitamin E (CON). At 24 h PM, both strip loins from each carcass were cut into 2.54 cm thick steaks, and individually vacuum packaged. Steaks from each carcass were irradiated within 26 h PM at 0 kGy (n = 20 loins) or 6.4 kGy (n = 20 loins). Steaks were aged at 4*C for 0, 1, 3, and 14 d post-irradiation. Calpastatin activity (units/g tissue) and specific activity (units/g extracted protein) were determined on steaks aged 0, 3 and 14 d post-irradiation. Western blots were used to determine the predominance of intact calpastatin in paired steaks and to detect proteolysis of troponin-T. VITE treatment resulted in steaks with lower calpastatin activity and specific activity at 0 d post-irradiation than steaks from the CON diet ($P < 0.05$). At d 1 post-irradiation, troponin-T was more degraded in non-irradiated steaks from VITE steers than non-irradiated steaks from the CON steers ($P < 0.05$). Diet did not affect calpastatin activity at 3 or 14 d. Irradiation did not result in consistent differences in calpastatin activity at 0 d post-irradiation. Calpastatin activity and specific activity in steaks receiving 6.4 kGy were higher at 3 and 14 d postmortem than companion (0 kGy) steaks ($P < 0.01$). Immunoblots for calpastatin demonstrate that intact calpastatin was detected more frequently in irradiated samples than non-irradiated samples at 0 and 1 d post irradiation. The results demonstrate increased oxidation of muscle in the early PM period has the potential to decrease the rate of inactivation of calpastatin and may influence proteolysis of other meat proteins.

Key Words: Calpastatin, Protein oxidation, Proteolysis

294 Effect of pH and ionic strength on calpastatin inhibition of μ- and m-calpain. K. R. Maddock*, E. Huff-Lonergan, L. J. Rowe, and S. M. Lonergan, *Iowa State University, Ames, IA*.

The objective of the study was to determine the extent to which pH and ionic strength influence the inhibition of μ- and m-calpain. Calpastatin, μ-calpain, and m-calpain were purified from porcine semimembranosus. μ- or m-Calpain (0.45 units) were incubated with fluorogenic peptide Suc-Leu-Leu-Val-Tyr-AMC (170 M) in the presence of calpastatin (0, 0.15, or 0.30 units) under the following pH and NaCl concentration conditions: pH 7.5, 165 mM NaCl; pH 6.5, 165 mM NaCl; pH 6.0, 165 mM NaCl; pH 7.5, 295 mM NaCl; pH 6.5, 295 mM NaCl; pH 6.0, 295 mM NaCl in a total volume of 1 ml. The reactions were initiated with addition of 100 μM $CaCl_2$ for μ-calpain and 1 mM $CaCl_2$ for m-calpain. Calpain activity was measured at 30 and 60 min in a fluorometer using an excitation wavelength of 380 nm and emission wavelength of 460 nm. Percent inhibition with 0.15 or 0.3 units calpastatin was standardized against activity of calpain alone at each each pH and ionic strength combination. Activity of μ-calpain was affected by pH ($P < 0.01$). Immunoblotting of μ-calpain demonstrated more autolysis of the 80 kDa subunit in pH 7.5 incubations compared to pH 6.5. This may explain the observation that within each ionic strength, μ-calpain exhibited the greatest activity at pH 6.5. High ionic strength reduced μ-calpain activity ($P < 0.01$). Inhibition of μ-calpain by calpastatin was not affected by pH, but was affected by ionic strength. Percent inhibition of μ-calpain was significantly higher in 295 mM than 165 mM NaCl at 30 min and 60 min when 0.3 units of calpastatin was included in the assay. Activity of m-calpain was greater at pH 7.5 than 6.5 ($P < 0.01$). m-Calpain activity was not detected at pH 6.0. Percent inhibition of m-calpain by calpastatin was greater at pH 6.5 than 7.5 at 165 mM NaCl ($P< 0.01$). Percent inhibition of m-calpain was greater at 295 mM than 165 mM NaCl ($P<0.01$). These observations indicate that activity of calpain and inhibition of μ- and m-calpain by calpastatin can be affected by pH and ionic strength and merits further investigation.

Key Words: Calpastatin, Calpain, Proteolysis

295 Degradation of calcium regulating and intermediate filament proteins is related to fresh pork quality. A. E. Asmus*[1], E. P. Berg[2], J. L. Melody[1], S. M. Lonergan[1], and E. Huff-Lonergan[1], [1]*Iowa State University Ames, IA,* [2]*University of Missouri Columbia, MO*.

Proteins that regulate calcium in muscle may influence pork tenderness and water-holding capacity. These proteins include the sarcoplasmic reticulum Ca2+-ATPase pump-1 (SERCA-1) and ryanodine receptor (RYR). Proteolysis of the intermediate filament protein desmin has also been related to increased tenderness in meat. We hypothesized that degradation of these proteins (SERCA-1, RYR, and desmin) may be related to tenderness. Commercial hybrid pigs (n=54) were harvested and pH measurements were taken in the longissimus dorsi (LD) and the semimembranosus (SM) at 1 h and 24 h postmortem. Warner-Bratzler (WBS) shear force measurements were made on LD samples at 1 d and 21 d postmortem. LD and SM samples were analyzed by immunoblotting with antibodies for SERCA-1, RYR and desmin. Immunoreactive bands were quantified using densitometry. WBS at 1 d was significantly correlated to intact SERCA-1 at 7 d in the LD (r=0.358), indicating products with lower WBS may have less intact SERCA-1. WBS at 1 d was significantly correlated to the amount of intact RYR in the LD at 24 h (r=0.423), indicating that samples with less intact RYR may have lower WBS. Significant correlations were observed between WBS at 21 d and desmin degradation in the LD at 96 h and 7 d (r=0.527 and

r=0.331 respectively) , indicating that samples with less intact desmin may have lower WBS values. The pH at 24 h and intact SERCA-1 at 96 h and 7 d in the LD were significantly correlated (r=0.276 and r=0.306 respectively) and in the SM at 96 h and 7 d (r=0.326 and r=0.382 respectively) indicating that samples with low 24 h pH had less intact SERCA-1 at later aging times. These results indicate increased proteolysis of SERCA-1, RYR, and desmin may be associated with increased tenderness. These results also indicate that SERCA-1 degradation may be associated with differences in pH decline.

Key Words: Tenderness, Pork, Proteolysis

Nonruminant Nutrition: Feed ingredients

296 Influence of variation in particle size on the flow characteristics of ground corn. C. N. Groesbeck*, R. D. Goodband, M. D. Tokach, J. L. Nelssen, S. S. Dritz, C. W. Hastad, and K. R. Lawrence, *Kansas State University, Manhattan*.

In previous research, we showed that roller mill (RM) ground corn flows better than corn ground with a hammer mill (HM), and decreasing particle size and increasing fat decreases flow ability. Therefore the objective of these experiments was to determine if the flow differences between HM and RM ground corn were due to the particle size standard deviation (PSSD). In both Exp., RM and HM corn samples were sifted through 13 screens and material from each screen was collected. Samples were dried 12 h to equalize moisture content. Soy oil was then added at 0, 4, and 8 % to samples. Flow ability was then determined by measuring angle of repose (the maximum angle measured in degrees at which a pile of grain retains its slope). A large angle of repose represents a steeper slope and poorer flow ability. In Exp. 1, we created 5 RM samples with mean particle size ranging from 1415 to 343 microns and 5 HM samples from 1382 to 333 microns. All samples were created to have similar PSSD, ranging from 1.1 to 1.3. There was an interaction (P<0.05) between particle size, added fat, and mill type. Increasing fat increased angle of repose; however, the difference was less in fine ground HM samples than in the RM samples. In RM samples, decreasing particle size had less of an impact on flow ability than in HM ground corn. In Exp. 2, we used 4 RM and 4 HM samples that were constructed from the previously collected grain. All samples were similar in mean particle size (641 to 679 microns) with varying PSSD (1.62 to 2.27). There was no (P>0.10) fat x PPSD x mill type interaction observed. Increasing fat (P<0.04) and PSSD (P<0.001) decreased flow ability. These data suggest that the greater flow ability of RM ground corn appears to be a result of less particle size variation. However, with fine particle sizes (<700 microns) other factors, such as particle shape, may also contribute to flow ability.

Key Words: Particle size, Hammer mill, Roller mill

297 Effects of soybean meal source and level on growth performance of weanling pigs. K. R. Lawrence*, R. D. Goodband, M. D. Tokach, S. S. Dritz, J. L. Nelssen, J. M. DeRouchey, C. W. Hastad, B. W. James, and M. G. Young, *Kansas State University, Manhattan*.

Three experiments were conducted to compare the effects of increasing solvent extracted soybean meal (SBM) and extruded-expelled soybean meal (EESOY) in diets for early-weaned pigs. All pigs (PIC; 5 pigs/pen) were fed a control diet containing no SBM or diets containing 20% or 40% of either SBM or EESOY. In Exp. 1 (n=175, 6.0 kg BW; 7 pens/treatment), diets were formulated using NRC (1998) nutrient values for SBM and previously determined values for EESOY. From d 0 to 14, no differences were observed in ADG or ADFI (P>0.05), but G:F became poorer (linear, P<0.06) with increasing soybean meal source. Soybean meal sources were analyzed for CP after the trial was completed. We speculated numeric differences in performance between sources could have been a result of lower than expected CP in the EESOY. In Exp. 2 (n=350, 5.9 kg BW; 14 pens/treatment), soybean meal sources were analyzed and actual nutrient values were used in diet formulation. From d 0 to 14, increasing SBM decreased ADFI (linear, P<0.02). Increasing EESOY decreased ADG, ADFI, and G:F (linear, P<0.01). Soybean meal sources used in Exp. 1 and 2 were then analyzed for trypsin inhibitor (TI). The EESOY from Exp. 1 and 2 had TI values greater than 6 mg TI/g, suggesting it was underprocessed, while SBM had values less than 2 mg TI/g. In Exp. 3 (n=350, 7.1 kg BW; 14 pens/treatment), different lots of EESOY and SBM were analyzed for TI (EESOY=1.8 mg TI/g; SBM=0.7 mg TI/g) to ensure quality and actual CP values were used in diet formulation. From d 0 to 14, increasing EESOY decreased ADG and ADFI, but improved G:F (linear, P<0.01). Increasing SBM decreased ADFI, but improved G:F (linear, P<0.02). No differences (P>0.05) were found between soybean meal sources. Feeding 40% EESOY or SBM in diets immediately after weaning resulted in poorer growth performance of weanling pigs compared to those fed lower levels (20%). Feeding properly processed EESOY resulted in similar growth performance compared to feeding SBM.

Key Words: Pigs, Soybean meal, Performance

298 Effect of Poultry by-product meal on pig performance. J. R. Orozco-Hernandez*, J. J. Uribe, S. G. Bravo, V. O. Fuentes-Hernandez, A. Aguilar, and O. H. Navarro, *Centro Universitario de los Altos, Universidad de Guadalajara, Tepatitlan, Jalisco, Mexico*.

Searching and assessing proteinaceous ingredients to be used in single stomach animals is a constant task. On the other hand, there is a continuous renewal of poultry population which generates a protein source of amino acids that can be used in pig feeding. The objective of the trial was to assess increasing levels of a poultry by-product meal in practical pig feeding, from weaning to market weight. Forty newly weaned hybrid pigs were separated into 5 animal groups to assess the addition of 0, 2.5, 5 y 7.5% (dry matter basis) of a poultry by-product meal (HSA) to a sorghum-soybean meal diet in pigs. The intake was measured daily and the weight gain was calculated using initial and final measurements. The initial weight was used as co-variable for the gain. Most of the production parameters were negatively affected with the addition of HSA (P < 0.05). Carcass yield and fat content were reduced (P < 0.05), however the yield of mexican style cuts varied differently. In conclusion, increasing the addition of HSA affects negatively some of the production parameters and carcass yield in pigs.

Key Words: Poultry by-product, Pig, Feeding

299 Effect of inulin and sugar beet pulp on the growth performance and carcass characteristics of wean to finish pigs. G. F. He*, S. K. Baidoo, Q. Yang, and R. D. Walker, *Southern Research and Outreach Center, University of Minnesota, Waseca, MN 56093*.

The objective of the present study was to determine the performance and carcass characteristics of wean-to-finish pigs fed diets with different carbohydrate sources (inulin and sugar beet pulp). Six hundred and forty early weaned (17-d old, 5.7 ± 0.11kg body weight) barrows and gilts were housed in an environmentally controlled facility from wean to finish. The duration of the study was divided into five phases: 5.7-10; 10-20; 20-50; 50-90; 90-115kg BW. Pigs were blocked by initial body weight and allotted to four dietary treatments: (1) corn soybean meal basal diet as control; (2) basal diet supplemented with inulin in water, 132g/L in phase 1-2, 66g/L in phase 3-5; (3) Ground sugar beet pulp (5% and 7% in phase 1 and 2, 9% in phase 3-5) replacing partial corn in control diet; (4) basal diet supplemented with 0.25% antibiotics (ASP250, Roche Vitamins Inc., Basel, Switzerland) only in phase 1-3. Pigs in treatment 4 grew faster (P<0.01, 601, 613, 594 and 666 g/day for treatment 1-4, respectively, s.e. =8.10) and had higher feed intake (P<0.01, 1244, 1276, 1273, 1368 g/day for treatment 1-4, respectively, s.e.=18.30) than others in phase 1-3. Gain to Feed was negatively influenced (P<0.01) by sugar beet pulp supplementation in treatment 3 compared to treatments 1, 2 and 4 (0.48, 0.48, 0.46, 0.49 for treatment 1, 2, 3 and 4, respectively, s.e.=0.004) in phase 1-3. In phase 4, increased growth rate was observed in pigs supplemented with inulin in water (P<0.01, 1021, 1054, 1026, 1002 g/day for treatment 1-4, respectively, s.e.=9.79). In phase 5, there was no difference in growth performance among treatment groups. Post-slaughter carcass characteristics, including average fat depth, average loin depth, lean percentage and carcass grade premium, were not influenced by the treatments except dressing percentage, which was lower for treatment 3 group (P=0.02, 74.4%, 74.4%, 73.4% and 74.6% for treatment 1, 2, 3 and 4, respectively, s.e.=0.29). In conclusion, continuous supplementation of inulin

in water improved pig performance in late but not early growth stage. Dressing percentage was reduced by sugar beet pulp supplementation in wean-to-finish diets.

Key Words: Wean -to - finish pigs, Inulin, Sugar beet pulp

300 Effect of ractopamine on the performance and carcass characteristics in finishing pigs. G. He*, S. K. Baidoo, Q. M. Yang, and R. D. Walker, *Southern Research and Outreach Center, University of Minnesota, Waseca*.

This study was designed to evaluate the effect of ractopamine on finishing pigs fed two levels of total lysine (0.81% vs. 1.11%) with and without ractopamine (0 vs. 10 ppm) in a two-way factorial arrangement. Three hundred and twenty crossbred barrows and gilts with body weight of 971.12 kg housed in an environmentally controlled facility were blocked and randomly allotted to the four dietary treatments. Pigs' weight and feed intake were recorded weekly until the average of the pen reached 115-kg body weight. Ractopamine significantly promoted growth rate (965 vs. 1110 g/day, S.E. =23.3, P<0.01) and improved Gain: Feed ratio (0.28 vs. 0.33, S.E. =0.0067, P<0.01). The improvement in growth rate by ractopamine was 133% higher at high lysine level than low lysine level. In addition, the improvement by ractopamine on growth rate decreased with time (1158 vs. 1441 g/day in week 1, 946 vs 1050 g/day in week 2 and 791 vs 839 g/day in week 3, S.E. =40.3, P=0.014). Average backfat depth was reduced by ractopamine supplementation only when high lysine diet was fed (0.76 vs 0.79 cm at 0.81% lysine and 0.80 vs 0.70 at 1.11% lysine, S.E. =0.025, P<0.01). Average loin depth was significantly increased by the addition of ractopamine (2.79 vs 2.90 cm, S.E. =0.021, P<0.01). Increased lean muscle percentage by ractopamine was only observed in high lysine group (55.2% vs 55.4% at 0.81% lysine and 55.1% vs 56.3% at 1.11% lysine, s.e. =0.22, P=0.026), whereas dressing percentage was significantly increased by ractopamine only in low lysine group (73.7% vs 75.6% at 0.81% lysine and 74.2% vs 74.6% at 1.11% lysine, s.e. =0.31, P=0.021). In conclusion, ractopamine improved growth performance and carcass characteristics in pigs fed the high lysine diet and increased dressing percentage in finishing pigs fed low lysine diet.

Key Words: Finishing pigs, Ractopamine, Carcass characteristics

301 Comparison of grain sources (barley, white corn, and yellow corn) for swine diets and their effect on fatty acid composition and fat quality. J. F. Lampe*, T. J. Baas, and J. W. Mabry, *Iowa State University*.

An experiment was conducted to evaluate the effect of energy source on fatty acid characteristics and fat quality of the longissimus muscle of pigs. Diet treatments (primary energy sources) were: 1) yellow corn, 2) white corn, 3) 1/3 yellow corn, 2/3 white corn, 4) 2/3 yellow corn, 1/3 white corn, and 5) barley. Pigs were from two genetic sire lines, Duroc and Hamp x Duroc sires (HD) on PIC 1055 females. A total of 999 pigs were included in the trial in a 2 x 2 x 5 factorial arrangement with two genetic types, two sexes (barrows and gilts) and five dietary treatments. Eight pigs were randomly selected from each pen of 26 (n= 319) for meat, eating quality, and fatty acid evaluation. Pigs were placed on test at 27.6 kg and fed to 130.2 kg. In a four-phase diet regimen, the final two phases of the finishing diets (67.2 to 130.2 kg) included 1% supplemented choice white grease. All animals were held overnight at a commercial abattoir before harvest. One whole skin-on, boneless loin was collected from each carcass and held at -1 degree Celsius in a vacuum-sealed bag at the Iowa State University Meat Lab. At 25 to 27 days post-harvest, loins were analyzed for meat and eating quality and samples were collected from the 10^{th} rib for fatty acid analysis. Fatty acid composition was determined by standard gas chromatographic procedures. Pigs were given an individual subjective fat color score. Pigs fed diet 5 had a lower (P < 0.05) iodine value than pigs fed all other diets. Dietary treatments had no effect on (P > 0.05) subjective fat color scores. Pigs fed diet 5 had higher (P < 0.05) saturated and monounsaturated fatty acids than pigs fed all other diets. Results suggest that different energy sources evaluated in this study do not have an effect on subjective fat color but do have an effect on fat firmness.

Key Words: Pigs, Fatty acid composition, Energy sources

Production, Management, and the Environment

302 Effect of scraping frequency in a free stall barn on volatile N loss from dairy manure during summer. V. R. Moreira*[2] and L. D. Satter[1,2], [1]*U.S. Dairy Forage Research Center, Madison, USDA - Agricultural Research Service,* [2]*Department of Dairy Science, University of Wisconsin - Madison*.

The difference between estimated nitrogen:phosphorus ratio (**N:P**) of fresh excreta and measured **N:P** in scraped manure was used to estimate N loss when manure was scraped 2× (0800 and 1900h) or 6× (0900, 1200, 1500, 1800, 2300, and 0400h) daily, during each of two 24h-periods in late August. Mid-lactation cows (n=137), milking 31.6 kg/cow/d, were distributed among 4 pens for an ongoing feeding trial with diets containing two levels of P (.38 and .55% of DM) and similar CP (19.3% of DM). Each pen had a back (stall) and a front (feedbunk) alley from which manure was scraped and sampled separately. The NRC (2001) model was used to estimate dry matter intake. Excretion of N and P was calculated as kg of ingested nutrients minus the amount of nutrients secreted in milk. Volatile N loss as a percent of excreted N was estimated as: **1 - (manure N:P ÷ excreta N:P)**. Average air temperature outside the barn throughout the sampling period was 18^{o}C (max=27^{o}C and min=11^{o}C). Statistical analysis was performed as Repeated Measures within alley using a first order autoregressive covariate structure (Mixed Procedures - SAS 8.0). It was expected that frequent manure removal from the barn floor would result in lower N volatilization by reducing the time of manure exposure. This was not observed. Frequent scraping could have an offsetting effect by enhancing volatile N loss through spreading urine over a larger floor area. Volatile N loss was estimated to range between 37.5 and 43.1% of excreted N.

	Scraping frequency (**Freq**)							
	2×	2×	6×	6×		Effects ($P\leq$)		
Manure analyses	Front alley	Back alley	Front alley	Back alley	SEM	**Freq**	Alley	Day ∗**Freq**
pH	7.73	8.15	7.84	8.04	0.14	1.00	0.01	0.43
Temp., ^{o}C	21.7	23.2	22.0	22.3	0.52	0.48	0.29	0.23
Dry i matter, %	10.7	11.6	11.4	11.9	0.48	0.26	0.01	0.71
N, %DM	4.09	4.04	3.86	3.86	0.10	0.03	0.75	0.32
Ash, %DM	16.5	17.9	16.1	16.7	0.51	0.11	0.01	0.05
P, %DM	0.95	0.93	0.96	0.95	0.04	0.67	0.54	0.05
N:P	4.44	4.62	4.16	4.19	0.17	0.03	0.36	0.04

Key Words: Dairy manure, Ammonia, Nitrogen

303 The effect of dietary calcium and phosphorus on water extractable phosphorus in feces of dairy cows. J. D. Ferguson[1], S. R. Michelone*[1], C. F. Ramberg, Jr.[1], and Z. Dou, [1]*University of Pennsylvania, School of Veterinary Medicine*.

Four TMR rations varying in Ca and P content were fed to two groups of mid-late lactation cows (15/ per group) to examine the effect on water extractable phosphorus in feed and feces. The study was a Latin Square design with three, four week periods with diet switches between groups every two weeks. The rations had the following Ca, P content (%DM basis): Con: Ca .69, P .38; HighCa: Ca 1.2, P .38; HighCa$_P$: Ca 1.2, P .60; HighP: Ca .69, P .60. On three consecutive days of the second week of each dietary block, daily samples of feed and feces were collected for analysis of DM, Ca and P. Fecal samples were collected from each cow, mixed thoroughly, and composited daily by group. Wet samples of feces (2 g, approximately .3 g of DM) and dried, ground samples of TMR

(.3 g DM) were analyzed in replicate for total P and water extractable P. Samples were mixed with ninety eight ml of water, shaken for one hour at room temperature and then filtered. The filtrate was analyzed for inorganic P (Pi) and total P (Pt) using the phosphomolybdate blue method of Murphy and Riley (1962) and ICP methodology, respectively. All variables were analyzed as a repeated measures with dietary treatment nested within group using PROC GLM in SAS statistical software.

	Period One			Period Two			Period Three		
Item (%DM)	Con	High-Ca	SE	Con	High CaP	SE	Con	High-P	SE
TMR-Ca	.78^a	1.25^b	.04	.74^a	.90^b	.06	.80^a	.83^a	.0 3
TMR-P	.37^a	.36^a	.01	.40^a	.52^b	.02	.42^a	.68^b	.03
Fec-Ca	1.72^a	2.78^b	.05	1.76^a	2.50^b	.07	1.68^a	1.73^a	.03
Fec-P	.64^a	.63^a	.02	.73^a	1.17^b	.01	.72^a	1.17^b	.0 3
Water	Extract-able P	TMR		(%total P)					
TMR	57.6^a	58.8^a	1.91	62.3^b	84.9^d	1.91	63.0^b	70.0^c	1.91
Feces	47.6^a	23.4^b	4.9	52.2^a	50.0^a	4.9	57.5^a	78.7^b	4.9

Key Words: Phosphorus, Calcium, Feces

304 Slow-release thyme oil granules for control of odor and pathogens in feedlot cattle waste.

V. Varel*, D. Miller, and E. Berry, *USDA, ARS, Roman L. Hruska U.S. Meat Animal Research Center.*

Confined animal feeding operations can be a source of odor emissions, global warming gases, water pollution, and food contamination. Laboratory studies have indicated plant oils with antimicrobial activity can be used to control pathogens and odor emissions from cattle and swine wastes. However, these oils are volatile and were ineffective when topically applied to a feedlot surface. Our objective was to evaluate the effectiveness of topically applying thyme oil incorporated into corncob granules, added once per week, to control odor emissions and fecal coliforms in feedlot manure. Manure samples from six locations in each pen were collected from three control and three treated pens (15 x 150 m; 50 400-kg cattle/pen), three times per week for eight weeks. Samples were analyzed for thyme oil concentration, VFA and branched-chain VFA (odor), and number of *Escherichia coli* and total coliform bacteria. Over the eight weeks, with the exception of wk 7, the desired concentration of 0.15 to 0.2% thyme oil was maintained in the manure. Concentrations of VFA and branched chain-VFA increased over time in control and treated pens. However, production of VFA in treated pens, 7.5 $\pm$ 1.3 μmol·g DM^{-1}·wk^{-1}, was less than the rate of production in control pens, 18.0 $\pm$ 2.1 μmol·g DM^{-1}·wk^{-1} ($P < 0.01$). Likewise, production of branched-chain VFA in treated pens, 0.31 $\pm$ 0.04 μmol·g DM^{-1}·wk^{-1}, was less than control pens, 0.55 $\pm$ 0.06 μmol·g DM^{-1}·wk^{-1} ($P < 0.01$). Treatments did not differ in time for concentrations of *E. coli* and coliforms; although the concentrations of *E. coli* in treated pens, 2.9 $\pm$ 1.2 cfu x 10^5·g DM^{-1}, were 91% less than control pens, 31.1 $\pm$ 4.0 cfu x 10^5·g DM^{-1} ($P < 0.04$). Similarly, concentrations of coliforms in treated pens, 3.7 $\pm$ 1.3 cfu x 10^5·g DM^{-1}, were 89% less than control pens, 35.3 $\pm$ 4.2 cfu x 10^5·g DM^{-1} ($P < 0.04$). These results indicate odor emissions and fecal coliforms can be reduced in feedlot manure with a once per week application of thyme oil in a granular form.

Key Words: Plant oils, Feedlot waste, Odor

305 Changes in concentrations of selected malodorous compounds from dairy manures associated with storage and composting.

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Emissions of malodorous compounds from livestock manures are offensive and can cause health hazards to humans and cattle. Changes of manure storage and handling methods may prevent the formation and/or enhance the degradation of odors. Volatile fatty acids (VFAs), phenol, cresols, indoles and NH_3 were quantified with fresh (n=12) and 12-day-aged (n=12) manures during pilot-scale composting in 205 L vessels either aerated continuously (AC) with high (2.3 kg/hr)/low (0.8 kg/hr) air flow controlled by thermostats or intermittently (AI) on a 5 min high air flow 55 min off cycle. Manures were mixed with sawdust (3:1, w/w) to yield C:N ratios between 21 and 32. GLC/FID was used to analyze VFAs in emissions and pH 2 water extracts of composting masses. Ether extracts of phenolics and indolics were quantified by GLC/MS. Aeration (P=0.012), and not manure age (P=0.883) influenced NH_3 emissions. Mean NH_3 emissions from fresh and aged manure AI were 50 and 60 g. Fresh and aged manure AC emitted 121 and 110 g NH_3. NH_3 peaked early and decreased to undetectable by day 17. Aged, compared to fresh manure, contained greater varieties and amounts of VFAs, phenols and indoles with the most offensive odors. Fresh manures contained acetate, propionate, isobutyrate, isovalerate, phenol, p-cresol, and indole (5000, 500, 40, 70, 35, 200 and 5 μg/g). Aged manures contained acetate, propionate, isobutyrate, butyrate, isovalerate, valerate, phenol, p-cresol, indole and skatole (9000, 2700, 200, 2500, 2800, 350, 50, 350, 10 and 30 μg/g). By day 8, trace quantities of acetate remained in fresh manure, while acetate, propionate and butyrate (900,120 and 130 μg/g) were in aged manure. Disappearance of VFAs, phenolics and indolics was similar in manure/sawdust windrows that were turned weekly or turned weekly with forced subsurface aeration (10 m^3/min). Avoiding anaerobic aging of dairy manures and composting with minimum air flow to maintain an aerobic environment was important in reducing concentrations of the chemicals studied and reducing NH_3 emissions.

Key Words: Manure, Odors, Ammonia

306 Adding potassium, clinoptilolite zeolite and yucca extract to feedlot diets to reduce nitrogen losses from manure .

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Rapid loss of nitrogen (N) from manure and resulting nitrogen emissions is a major environmental concern. It is possible that a potassium clinoptilolite zeolite (CZ) because of its cation exchange capacity may bind ammonia, thus reducing manure N loss. Furthermore, yucca extract (YP) is believed to have anti-urease activity, which could reduce urea breakdown to ammonia in manure. In this study, the CZ was added to feedlot diets at 1.2 and 2.5% (DMB) in place of steam flaked corn. YP was added in addition to the 1.2% CZ level in Treatment 3. Experimental cattle were heavy yearling Angus-Continental cross steers. The experimental control diet consisted of 86% steam flaked corn, 6.5% corn silage and 7.5% premix (DMB). There were 8 reps/treatment and 8 steers/rep. They were fed on concrete floor pens and at approximately 100 days, on feed, the pens were cleaned and no bedding added. After one week of manure accumulation, the manure was collected from each treatment, mixed and stacked and analyzed for N and DM initially and at 3,5,7,14,21 and 28 days. Previous studies had indicated that the majority of the N loss occurs within the first 28-days. Manure N losses for the four treatments are shown in Table 1. CZ 1.2%, CZ 1.2% + YP and the CZ 2.4% treatments each reduced N loss compared to the control. The CZ 2.4% treatment was not better than the CZ 1.2% treatment. The combination of CZ 1.2% + YP was extremely effective in reducing N loss at the 3, 7 and 14 day sampling periods, but not better than CZ alone at 21 and 28 days. It was concluded that the CZ or CZ + YP resulted in a substantial reduction in manure N losses compared to the control.

Percent N/d loss/d	Treatments			
d	Control (%)	CZ1.2% (%)	CZ1.2% +YP (%)	CZ2.4% (%)
3	21.6	4.6	1.4	3.8
7	22.0	6.7	1.9	9.4
14	25.3	6.4	2.4	10.3
21	28.2	9.1	8.5	12.7

Key Words: Clinoptilolite zeolite, Nitrogen loss, Manure

307 Demonstrations to show the economic value of dairy manure as fertilizer. J. A. Pennington*[1], K. W. VanDevender[1], J. A. Hawkins[2], and R. L. Duncan[3], [1]*University of Arkansas Cooperative Extension Service, Little Rock,* [2]*University of Arkansas Cooperative Extension Service, Conway,* [3]*University of Arkansas Cooperative Extension Service, Berryville*.

Demonstrations were conducted on a dairy farm (DF) with a dry manure management system and on a dairy farm (WF) with a wet or liquid manure system to determine the economic value as fertilizer of manure collected around the milking center. Nitrogen (N), phosphorus (P), and potassium (K) were valued at $0.64, $0.53, and $0.31/kg. DF had 80 cows which were in a holding pen and scraped feeding floor for 5.5 h/d; it produced 197,000 L/yr of manure with 6.1, 4.8, and 5.6 g/L of N, P, and K in manure from the stacking shed. Total value of manure as fertilizer was $1610.23/yr for N, P, and K. WF had 120 cows in a holding pen for 3 h/d; it produced 1,700,000 L/yr of manure with 0.57, 0.22, and 0.52 g/L of N, P, and K. Total value of manure as fertilizer from WF was $1091.70/yr for N, P, and K. Assuming that P is not needed with no value and 20% of nitrogen is lost in application, net values of the manure near the milking center as fertilizer were $959.11/yr for 5.5 h/d on DF and $772.02/yr for 3 h/d on WF. Assuming uniform distribution of manure throughout the 24 h, net values of manure were $3541.33/yr for 80 cows on DF and $6176.16/yr for 120 cows on WF or $44.27/cow/yr and $51.47/cow/yr, about 50% of the expected total values of manure that primarily resulted from the decreased values of N and P. These data did not consider the costs to apply the manure as fertilizer but showed to dairy producers that cow manure had economic value as fertilizer.

Key Words: Dairy, Manure, Fertilizer

308 Production of eight byproducts over a ten-year period for California and seven countries with estimates of phosphorus and potential ethanol production. J. N. Asmus and J. G. Fadel*, *Univeristy of California, Davis, CA*.

Byproduct production from ten countries; Argentina, China, Egypt, Kenya, Republic of Korea, Mexico and the USA, plus world totals and California were determined from 1990-1999 for almond hulls, bagasse, brans, beet pulp, molasses, brewers grain, grain straws and cakes. Total DM tonnes, phosphorus and theoretical ethanol yields were examined over time. Simple linear regressions were used to test if slopes were significantly different from zero. Crop production data were from FAO and California state databases. Byproduct conversions were from published articles. Compositions were from NRC. Ethanol yields were determined from published conversions from cellulose and hemi-cellulose fractions. Ethanol DM yields were converted to liters assuming 1.14 liters of ethanol per kg of ethanol DM. Total world DM and phosphorus production showed an increase over time for bagasse, brewers grains, and brans with increases of 22%, 12% and 17% respectively. Slopes were different from zero (P=0.0001) for bagasse, brans, and brewers grains. China's production of brewers grain contributed 66% of the world's increase. Byproduct trends showed little change over time for all countries studied. However, production of brewers grains, wheat straw, and bagasse in China increased by 190%, 16% and 23% with slopes different from zero (P=0.05). California's production showed changes in cottonseed of #35% with a slope different from zero (P=0.01). Theoretical ethanol yields follow the same trends as metric tonnes of DM for each byproduct. Byproducts used as a feed in California had a higher economic value when compared to byproducts used for ethanol production. This is in contrast to straw byproducts that showed a higher value when used for ethanol production compared to their feed value. Byproducts production over a ten-year period showed stable trends except for China. Total worldwide byproduct use for feed is not reflected in this study. Under current California market conditions only straw byproducts should be considered as potential substrates for ethanol production.

Key Words: Byproduct

309 Gravity belt thickener with polymer assisted separation out-performs static gravity screen-roll press combination for separating the solid and liquid fractions of swine slurry. P.M. Walker[1], T.R. Kelley[1], K.E. Earing*[1], and J.E. Ringler, [1]*Illinois State University, Normal, IL/USA*.

Two separation systems were evaluated for their ability to separate the solid and liquid fractions of co-mingled gestation, farrowing, nursery and grow-finish anaerobic swine slurry under field conditions. On each of eight occasions 26,496 L. of slurry were separated with each system. Samples of raw unprocessed slurry (RS), slurry separated with a gravity screen-roll press combination separator (SS), effluent collected after RS was separated with a polymer assisted gravity belt thickener (SE1) and effluent collected after SS was separated with a polymer assisted gravity belt thickener (SE2) were collected in duplicate with a 2.4 m probe from 2.44 m deep holding pits following agitation. Percol 755O flocculant was mixed with slurry at a concentration rate of .014% to coagulate slurry solids with the gravity belt thickener system. No polymer was used to assist the gravity screen-roll press system. For each collection 2-500 ml slurry or effluent samples were poured into settlelometers and diluted with 500 ml of de-ionized water. Following a 1 h settling time samples were analyzed for separable solids (SSS), total suspended solids (TSS), dissolved oxygen (DO), chemical oxygen demand (COD), nitrogen (N) and phosphorus (P). The mean solids concentration percents were 3.65 $\pm$ 0.06 RS, 2.65 $\pm$ 0.02 SS, 0.19 $\pm$ 0.01 SE 1 and 0.16 $\pm$ 0.01 SE2. Compared to RS, SSS (mL:L) were reduced 59.1% for SSand SE1 and SE2 reductions approached 100.0%. TSS were not different (P>0.05) between RS and SS but were reduced (P<0.05) in SE1 (94.7%) and SE2 93.9%. COD was not different (P>0.05) between RS and SS but was reduced (P<0.05) in SE1 (84.7%) and SE2 and 63.0%. No differences (P>0.05) were observed between slurry and effluents samples for NH_3 and DO. P concentrations were reduced (P<0.05) in SS, SE1 and SE2 but N concentrations were reduced (P<0.05) in only SE1 and SE2 compared to RS. N was reduced 79.5% and 70.8% in SE1 and SE2 while P was reduced 17.0%, 92.2% and 55.1% in SS, SE1 and SE2 compared to RS. Under field conditions a polymer assisted gravity belt thickener was more effective for removing nutrient concentrations and pollution indicators compared to a non-polymer assisted gravity screen-roll press combination separator.

Key Words: Separation, Swine, Slurry

310 Relationship between dystocia and calf morbidity and mortality. S. M. Tomlinson*[1], J. E. Lombard[1], F. B. Garry[1], V. Khunkhun[1], and L. P. Garber[2], [1]*Integrated Livestock Management, Colorado State University, Fort Collins, CO,* [2]*USDA:APHIS:VS, CEAH, Center for Animal Health Monitoring, Fort Collins, CO*.

The objectives of this year-long observational study were to obtain dystocia occurrence rates on three Colorado dairies and identify the relationship between dystocia and subsequent calf morbidity and mortality. Each delivery received a dystocia score (standard scale 1 to 5) based on calving ease. Calf viability and health data were collected for 6,690 calves from 6,528 dams. Odds ratios (OR) were calculated for calves born with any assistance (scores 2-5) compared to calves born without assistance (score 1). The odds of being stillborn were calculated for each calf sex. Subsequent OR's for calf morbidity, death greater than 1 day of age and overall calf death prior to weaning were calculated only for heifer calves since bull calves were sold soon after birth. Primiparous animals required significantly more assistance at calving (52.6%) compared to 28.7% of multiparous animals (P<0.0001). Overall, 7.2% of calves were stillborn. Calves that required birthing assistance were significantly more likely to be stillborn than those calves that did not require assistance (OR=5.3). The odds ratios for still births were 4.7 for bull calves and 6.8 for heifer calves that experienced dystocia, although this sex difference was not statistically significant. Calf morbidity was significantly increased for heifer calves that required assistance during birth (OR=1.3). Heifer calves that required assistance were more likely to experience a respiratory or digestive event compared to heifers that did not require assistance (OR=1.4). Overall, 13.4% of heifer calves were born dead or died prior to weaning. No significant increase in death rate was observed from 1 day of age until weaning. However, when still births plus mortality to weaning was evaluated, dystocia heifers were more likely to die (OR=2.3). Dystocia had a significant impact on calf morbidity and mortality.

Key Words: Dystocia, Calf morbidity, Calf mortality

678 Biological considerations pertaining to use of the retinal vascular pattern for permanent identification of livestock. J.C. Whittier*[1], J. Doubet[2], D. Henrickson[2], J. Cobb[2], J. Shadduck[2], and B. L. Golden[1,2], [1]*Colorado State University,* [2]*Optibrand, Ltd LLC.*

Our objective was to characterize the retinal vascular pattern (RVP) as a stable biomarker for use in identification of livestock. The central retinal artery and vein enter the eye along the optic nerve and divide to supply the retinal surface. The geometric configuration of this vascular bed develops and is completed during fetal growth as vasculogenesis and angiogenesis occur. Other authors have reported that retinal angiogenesis is a Laplacian process which is ubiquitous in nature and follows branching patterns seen in rivers, trees, roots, and erosion channels. RVP images from livestock can be converted into a quantifiable format using a digital camera. Indexes can be created from the patterns resulting from a hashing function to allow rapid one-to-many searching. The number and position of branches, along with the diameter of each vessel combine to offer an information rich biomarker for use in animal identification. To evaluate each RVP the dominate trunk vessel of bovine RVP images was positioned vertically and branches on the right and left of the trunk and other branching points were counted. RVP images from 52 different cattle were evaluated. Branches from the left (LB=6.4, 2.2; mean, variance) and right (RB=6.4, 1.5) of the vascular trunk; total branches from the vascular trunk (TBVT=12.8, 4.3), and total branching points (TBP=20.0, 13.2) showed differences across animals. A paired comparison of RVP from both eyes of 30 other animals confirmed that eyes from the same animal differ. RVP images of 4 cloned sheep from the same parent line were evaluated to confirm the unique RVP in genetically identical animals. The uniqueness of the RVP allows for the unalterable association of animal with owner and premises improving the reliability of processes such as contaminated product recall, disease epidemic containment, and subsidy payment schemes.

Key Words: Retinal vascular pattern, Animal identification, Biomarker

Ruminant Nutrition: Minerals and vitamins

311 Role of trace minerals and vitamins in optimizing immune function of cattle. E. B. Kegley*, *University of Arkansas, Fayetteville.*

The immune system is a complex, multi-faceted response to challenge. Dysfunctions of this system result in significant annual losses to livestock producers; problems may, in part, be addressed by nutritional intervention. Enhancing the immune response through optimizing nutrition is a goal receiving increasing emphasis. Specifically, trace mineral and vitamin status alter various components of the immune system and will be the subject of this review. Research results indicate that trace minerals; including: Zn, Cu, Se, Cr, and Co; and vitamins E and A; impact immunocompetence. Many of these micronutrients have antioxidant activities that benefit animal health. Zinc plays a major role in disease resistance and immune responsiveness of many species. In lab animals, Zn deficiency impairs thymus activity, natural killer cell and neutrophil function, and cytokine production. Yet, research in ruminants has been more variable. Severe Zn deficiency impacts lymphocyte function and wound healing. In dairy cattle, high levels of supplemental Zn are generally associated with reduced somatic cell counts, possibly reflecting the importance of Zn in maintaining effective epithelial barriers. Copper and Se status affect several aspects of the immune system. In vitro, neutrophils isolated from ruminants deficient in Cu or Se have reduced ability to kill ingested bacteria, part of nonspecific immunity. Studies with ruminants indicate little effect of Cu deficiency on specific immune function. In contrast, supplemental Se has enhanced ruminant antibody response. Selenium deficiency is correlated with increased incidence of metritis and clinical mastitis in dairy cows. Supplemental vitamin E decreases morbidity in stressed calves. Research continues to determine the optimal concentrations and sources of micronutrients in the diets of ruminants, considering that dietary requirements for optimizing immune function may be greater than those needed for maximal growth or reproductive performance, and may be greater during periods of physiological stress.

Key Words: Trace minerals, Vitamins, Cattle

312 Incidence of bovine respiratory disease in receiving heifers: effects on weight gain and carcass characteristics. S. P. Montgomery*, J. S. Drouillard, J. J. Sindt, M. A. Greenquist, W. F. Miller, J. N. Pike, E. J. Good, E. R. Loe, M. J. Sulpizio, and T. J. Kessen, *Kansas State University.*

Crossbred beef heifers (n = 665, BW = 225 ± 24 kg) were used in a completely randomized design to determine the effects of bovine respiratory disease (BRD) on ADG and carcass characteristics. Heifers were processed within 24 h of arrival and processing included vaccination against common viral and clostridial diseases, recording of rectal temperature, and measurement of plasma glucose and lactate concentrations. Heifers were subsequently monitored for clinical signs of BRD including depression, lethargy, anorexia, coughing, rapid breathing, and nasal or ocular discharge. Heifers exhibiting signs of BRD received antibiotic therapy and the number of times a heifer was treated for BRD was recorded and ranged between zero and three. Following the 36-d receiving period heifers were allowed to graze native range for 136 d and then transported to a commercial feedyard where they were fed a common series of diets throughout a 124-d finishing period. Plasma glucose and lactate concentrations measured at time of initial processing were greater ($P < 0.1$) for heifers not treated for BRD than the mean of heifers subsequently treated for BRD, and decreased (linear, $P < 0.01$) as treatment for BRD increased. Rectal temperature measured at time of initial processing increased (linear, $P < 0.03$) with increased treatment for BRD. Initial BW, ADG, and final BW during the receiving period decreased (linear, $P < 0.01$) as treatment for BRD increased, while grazing period ADG was increased (linear, $P < 0.01$). Finishing period ADG, final BW, hot carcass weight, fat thickness, and marbling score were decreased (linear, $P < 0.05$) with previous incidence of BRD. These data suggest that initial plasma glucose and lactate concentrations may be indicative of health status of newly arrived receiving cattle and that increased incidence of BRD in cattle decreases ADG and carcass quality.

Key Words: Health, Daily gain, Carcass quality

313 Effect of copper source and level on performance and copper status of cattle consuming molasses-based supplements. J. D. Arthington*[1], F. M. Pate[1], and J. W. Spears[2], [1]*University of Florida - IFAS, Ona,* [2]*North Carolina State University.*

Two studies were conducted to evaluate the availability of Cu offered to cattle consuming molasses-based supplements. In Exp. 1 (84 d), 24 Braford heifers were randomly assigned to 12 pastures (n = 2 heifers/pasture). Heifers were provided 1.5 kg of TDN and 0.3 kg of supplemental CP/heifer daily using a molasses-cottonseed meal slurry. Three treatments were randomly assigned to pastures (4 pastures/treatment), providing 100 mg of supplemental Cu daily in the form of 1) CuSO4 (inorganic Cu), or 2) organic-Cu (Availa-Cu; Zinpro Corporation, Eden Prairie, MN). A third treatment received no supplemental Cu. Heifer BW was collected at the start and conclusion of the study. Jugular blood and liver samples were collected on d 0, 29, 56, and 84. In Exp. 2 (72 d), 24 Brahman-crossbred steers were fed the same molasses-cottonseed meal supplement at the same rate used in Exp. 1. Steers were housed in individual pens (15 m2) with free-choice access to stargrass hay. Four Cu treatments were assigned to individual steers (6 pens/treatment) providing, 1) 10 ppm Cu from an organic source (Availa-Cu), 2) 10 ppm Cu from Tri-basic Cu chloride (TBCC; Micronutrients Inc., Indianapolis, IN), 3) 30 ppm Cu from TBCC, or 4) 30 ppm Cu, 50:50 ratio of TBCC and organic Cu. Body weights, blood, and liver samples were collected on d 0, 24, 48, and 72. In Exp. 1, liver Cu was similar between heifers supplemented with inorganic and organic Cu. Each source resulted in increased ($P < 0.05$) liver Cu concentrations compared with the unsupplemented control. Plasma ceruloplasmin concentrations were higher ($P < 0.05$) for Cu-supplemented heifers, independent of Cu source. Heifer ADG tended ($P = 0.11$) to increase with Cu supplementation compared with the non-supplemented control. In Exp. 2, liver Cu was greater ($P < 0.05$) on d 24, 48, and 72 for steers consuming 30 ppm compared with 10 ppm Cu. Steers supplemented with organic Cu had lower DMI compared with steers supplemented with 10 or 30 ppm of TBCC. The inorganic and organic Cu sources evaluated

in this study were of similar availability when offered in molasses supplements. A dietary Cu concentration greater than 10 ppm might be necessary to ensure absorption in beef cattle fed molasses-based supplements.

Key Words: Cattle, Copper, Molasses

314 Evaluation of Na requirements for finishing feedlot heifers. C. B. Wilson*, G. E. Erickson, C. N. Macken, and T. J. Klopfenstein[1], [1]*University of Nebraska, Lincoln, NE.*

A trial was conducted to evaluate the effects of increasing levels of salt (NaCl) inclusion on animal performance and feed intake. The objective of this trial was to establish a NaCl level and Na requirement that maximizes intake and performance while minimizing excretion of Na to the environment. Fifty-nine head of individually fed yearling heifers (365 kg) were assigned randomly to treatment and fed for 113d. Heifers were adapted to concentrate on treatment diets by increasing intake (0.23 kg/d) from 1.5 % of BW until ad libitum consumption was attained, approximately 21 d. The diet included 42.5% high moisture corn, 42.5% dry rolled corn, 7.5% grass hay, 3% tallow and 5% supplement. Five treatments (12 hd/trt) were formulated to include increasing levels of NaCl in the supplement at 0, 0.125, 0.25, 0.375 and 0.5 % of diet DM. Treatments bracketed 1996 National Research Council (NRC) minimum Na requirements (0.08% of DM). Water intake was measured using water meters on a group basis to evaluate additional Na intake. Ingredient and water analysis showed increasing levels of Na intake from 3.0, 7.0, 11.0, 14.7 and 19.3 ± 0.38 g/heifer/d with an average of 1.9 g/d from water. Analyzed Na levels in the diet were 0.03, 0.07, 0.11, 0.16 and 0.20 % of DM. Analysis of performance data showed no significant difference in ADG, DMI or gain:feed (G:F) with different levels of NaCl. Overall, NaCl supplementation was not effective in increasing ADG, G:F or DMI. Heifer performance averaged 1.46 ± 0.06 kg/d ADG with G:F averaging 0.150 ± 0.004. No significant effects were detected for fat, marbling or yield grade (P > 0.10) data across all treatments. These results suggest that NaCl inclusion in diets is not necessary, and the Na requirement is less than current NRC recommendations. Feedlot operations may reduce the excretion of Na to the environment and help to make feeding cattle more environmentally sustainable (i.e. minimizing Na buildup in acres receiving manure and runoff water).

Key Words: Salt, Sodium requirement, Feedlot cattle

315 Effect of feeds naturally high in selenium on performance and selenium concentration in various tissues of finishing beef steers. T. L. Lawler*[1], J. B. Taylor[2], J. W. Finley[3], and J. S. Caton[1], [1]*North Dakota State University, Fargo, ND,* [2]*USDA-ARS, Dubois, ID,* [3]*USDA-ARS, Grand Forks, ND.*

A majority of the human daily requirement of selenium (Se) can be obtained from beef. Although Se content of edible beef tissue is highly variable, previous research suggests that this content can be influenced by the concentration and form of Se in feedstuffs consumed. Data are limited describing effects of feeds high in Se on performance and tissue Se concentration of finishing beef steers. Therefore, 45 beef steers (BW = 351.1 24.1 kg) were assigned to one of four treatments: Se adequate (CON; n = 12), or high Se provided as high Se wheat (WHT; n = 11), high Se hay (HAY; n = 11), or sodium selenate (SEO; n = 11). Selenium content for WHT, HAY, and SEO diets was 65 g·kg^{-1} BW·d^{-1}, and for CON, 9.5 g·kg^{-1} BW·d^{-1}. Kidney, pelvic, and heart fat was higher ($P = 0.06$) among CON and WHT compared to SEO and HAY (2.9, 2.9, 2.4, 2.5 0.2%, respectively); other performance measures were not affected($P > 0.01$). Concentration of Se in kidney and spleen was different ($P < 0.01$) in response to treatment with WHT > HAY > SEO > CON (12.98, 10.86, 10.05, 8.40 0.26 ppm for kidney and 5.16, 3.82, 2.60, 2.00 0.09 ppm for spleen; respectively). Liver samples contained 10.79, 9.91, 6.56, 2.33 0.80 ppm Se where WHT = SEO > HAY > CON, respectively ($P < 0.01$). Selenium content of the muscle was much greater ($P < 0.01$) in treatments containing feeds naturally high in Se (WHT > HAY > SEO = CON; 4.41, 3.32, 1.55, 1.33 0.18 ppm, respectively). In conclusion, producers can effectively increase selenium concentration in muscle tissues by feeding feedstuffs naturally high in Se without compromising performance or carcass characteristics. These results reveal a potential market for feeds naturally high Se through the provision of a readily available Se source to cattle, and an effective method to create a beef product that is naturally high in Se.

Key Words: Beef, Wheat, Natural

316 Effect of total dissolved solids and sulfates in drinking water for growing steers. H. H. Patterson, P. S. Johnson, and W. B. Epperson, *South Dakota State University, Brookings, SD.*

Previous data from our laboratory showed that water with elevated total dissolved solids (TDS) and sulfates was detrimental to performance and health of growing steers. The objective of this study was to determine the level of TDS or sulfates where reductions in performance and health occur. Eighty-four crossbred steers (290 kg) were blocked by weight and randomly assigned to one of 12 pens (7 steers/pen). Pens were randomly assigned to one of four water treatments (3 pens/treatment) based on TDS and sulfate concentrations (mg/L): 1) 1150 TDS (385 sulfates); 2) 2800 TDS (1815 sulfates); 3) 4800 TDS (3000 sulfates); and 4) 7500 TDS (4800 sulfates). All water was obtained from natural sources and constituted the only available water source. Steers were fed a diet (0.97 Mcal/kg NEg) of ground grass hay and wheat middlings from May 23 to September 4 (104 days). Compared to 1150 TDS water, steers on 4800 TDS water had lower (P = 0.08) body weights at study end. Steers receiving 7500 TDS water had lower (P = 0.001) ending weights than all other treatments. Average daily gain and dry matter intake declined quadratically (each P = 0.02) with increasing TDS level (0.81, 0.75, 0.67, and 0.28 kg/d and 9.43, 9.35, 8.59, 5.98 kg/d for ADG and DMI on 1150, 2800, 4800, and 7500 water, respectively). Gain/feed declined quadratically (P = 0.04) with increasing TDS level. Incidence of polioencephalomalacia was 48% in the 7500 treatment with no cases in any other treatment (P = 0.0001), and 33% of steers on the 7500 treatment died of polioencephalomalacia (P = 0.0001). Water with 4800 mg/L TDS and 3000 mg/L sulfates tended to cause performance reductions in growing steers, whereas water with 7500 mg/L TDS and 4800 mg/L sulfates caused marked reductions in steer performance and health. These data, combined with field observations, suggest that water quality in a significant portion of South Dakota may be insufficient for optimal production.

Key Words: Water quality, Polioencephalomalacia, Performance

Dairy Foods Symposium: Hispanic-Style Cheeses

317 Overview of Hispanic cheese. N. Y. Farkye*, *Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.*

The growth of Hispanic population in the U.S.—31.3 million in 2000 (i.e., 11.9% of the U.S. population) and the increased interest in ethnic foods has resulted in an increased demand for Hispanic cheeses. Between 1997 and 2002, Hispanic cheese production in the U.S. grew over 70% from 68.8 million lb to 117.5 million lb. Queso Fresco (pronounced *K*eh-so Fres-co) is the most popular variety with a finely milled and crumbly texture. Panela (*P*ah-neh-la) has a basket-weave appearance. Average composition of Queso Fresco is 49% moisture, 22.5% fat, 21.5% protein, 2.0% salt and pH of 6.3; and Panela contains 50% moisture, 23% fat, 20% protein, 1.6% salt and pH of 6.3. Cotija (*K*o-tee-hah) is hard and crumbly, similar to young Parmesan and contains 37% moisture, 27% fat, 26% protein, 4% salt and pH 5.5. Oaxaca (*W*a-ha-ka) is a 'pasta filata' variety similar to Mozzarella with an average composition of 45% moisture, 24% fat, 23% protein, 1.7% salt and pH of 6.0. Asadero (*A*h-sah-deh-ro) contains 45% moisture, 21% fat, 24.5% protein, 1.7% salt and pH 5.6. Asadero may contain emulsifying salts, hence its high meltability. Other Hispanic cheeses are Queso Blanco (*K*eh-so Blan-co); Queso Para Freir, Queso Aejo (*K*eh-so An-ye-ho), meaning 'aged cheese'; Queso Enchilado (*K*eh-so En-chee-la-do) which is essentially Queso Fresco with a coating of paprika or chili powder; Queso Chihuahua (*K*eh-so Chee-wah-wah), also called Mennonita or Queso Quesadilla is a hard to semi-hard variety similar to Cheddar or Jack; Queso Creama which is similar to Panela but has a higher fat content; and Requeson which is similar to ricotta.

Key Words: Hispanic cheese

318 The growing Hispanic cheese market and distribution. R. Poe*, *Sequoia Valley*.

The Hispanic consumer is a significant market segment in the USA. Current Hispanic population in the U.S. is 34.8 million and it is expected to grow to 13.3% of the U.S. population by 2005. The demand for Hispanic cheeses is no longer regional but national. Cheese is an integral part of an average Hispanic meal—with queso being used as a staple or filler. Distribution of Hispanic cheeses is primarily in "bulk". Customers always want to taste the product prior to purchase, and then purchase by weight. Pre-packaged cheese is less than 10% of volume. In the U.S., about 90% of "bulk" Hispanic cheeses are delivered by Direct Store Delivery (DSD) to Carnicieras (mom and pop stores). However, the growth of pre-packaged cheeses is expanding rapidly due to retail chains recognizing the growth of Hispanic cheeses. Hence, the newest trend of distribution is through Retail Chain Distribution Centers and/or Master Distributors. Current distribution and marketing trends will be discussed.

Key Words: Hispanic cheese, Marketing, Distribution

319 Starter cultures for Hispanic-style cheeses: The case of Queso-Fresco. B. Vallejo-Cordoba*, M. J. Torres-Llanez, M. A. Mazorra-Manzano, and A. F. Gonzalez-Cordova, *Centro de Investigacion en Alimentacion y Desarrollo, A. C., Hermosillo, Sonora, Mexico, 83000*.

Queso Fresco is characterized by being high in moisture content, having a mild flavor and a short shelf-life. It is also the most popular Hispanic-style cheese consumed in Mexico and the United States. Traditionally, Queso Fresco is made from raw milk; however, its high moisture content, near neutral pH and absence of starter cultures makes this cheese an unsafe product. To solve this problem, an alternative would be to produce Fresco cheese from pasteurized milk using non-specific starters. However, the use of such starters means that the organoleptic quality of the product bear little relation to those of its traditional counterpart. There is thus increasing interest in the development of specific indigenous starters for use in the manufacture of traditional-type cheeses that would allow the making of a uniform safe product of constant quality. The objectives of this work are to present the design of specific starter cultures for the production of Queso Fresco. Additionally, the use of non-specific commercial starter cultures utilized in the manufacture of the most popular Hispanic-style cheeses consumed in Mexico will be discussed. Four cheese batches were prepared following traditional practices. Physiological and biochemical characteristics of native lactic acid bacteria isolated from the cheese were studied for their identification and inclusion in the specific starters. Cheeses were made by using pasteurized milk and six different starters and their flavor and texture were compared with the traditional cheese. Queso Fresco made with specific starter cultures were not significantly different ($p > 0.01$) from the traditional cheese made from raw milk. Queso Fresco made from pasteurized milk and specific starters, allowed the making of a uniform safe product of organoleptic qualities equivalent to its traditional counterpart.

Key Words: Starter cultures, Hispanic-style cheeses, Fresco cheese

320 Effect of fatty acid modification to lower saturates on quality of Queso Blanco. S. O'Keefe* and A. Aigster, *Virginia Tech Department of Food Science*.

Nutritional recommendations to lower consumption of saturated fat often lead to reduced consumption of dairy products, including cheese. Dairy products with fatty acid compositions with lower saturates and higher monoenes would have clear health benefits for consumers. Queso blanco is a Hispanic, acid-set cheese which is non-melting and has a very short production time. Experiments were conducted to investigate the effects of milk fatty acid modification, to increase monounsaturates and lower saturates, on texture, sensory properties and oxidative stability of queso blanco prepared using acetic acid. Milk with modified fatty acid composition was obtained by feeding calcium salts of high oleic sunflower oil. Oleic acid was increased from 26% to 40% and the oleic to palmitic acid ratio increased from 1.0 to 2.0 after modification. The was no measurable effect of modification on texture of cheese as determined using an Instron. Sensory panels indicated that acceptability was similar between normal and modified cheese and storage stability testing showed similar levels of oxidation after storage. Queso blanco prepared using milk modified to have high oleic and low saturated fatty acid compositions has similar texture, sensory and stability to traditional cheese.

Key Words: Queso blanco, Monoene, Cheese quality

321 Crumbliness of Queso Fresco. S. Gunasekaran*, *University of Wisconsin-Madison*.

The Queso Fresco is one of the most common Latin American white cheeses that has a unique crumbly texture. Queso Fresco is crushed and sprinkled on foods and then consumed. The cheese maintains its integrity under heat. Therefore, it is ideal for casseroles, Mexican specialties such as enchiladas, quesadillas, tacos and other dishes that are broiled or baked before serving. Since Latin American cheeses are new for mass manufacturing in the U.S., evaluation of major textural characteristics has not been widely performed. The crumbliness of Queso Fresco-type cheeses may be defined as a "measure of how readily the cheese can be fragmented into small particles suitable for even spreading." Currently, crumbliness is measured subjectively. We have developed an objective instrumental method to measure crumbliness in comparison to sensory evaluation. The instrumental tests we investigated include texture profile analysis, uniaxial compression, and shear. The samples crushed in the compression tests were subsequently subjected to particle analysis to estimate total number of crumbled particles. Statistical correlations were obtained using ANOVA with Tukey multiple comparison between the sensory parameters (firmness, moistness, crumbliness, particle size, particle size uniformity) and instrumental-test parameters (hardness, toughness, modulus, fracture stress, fracture strain, number of particles, etc.). The sensory perception of crumbliness, described as the ease of fragmenting the cheese, was used as the primary indicator defining the cheese crumbliness. Among the many properties measured, total number of particles determined from particle analysis correlated the best with sensory crumbliness.

Key Words: Queso fresco, Crumbliness, Particle size

322 Cheeses from different countries of Latino America. V. Alvarez*[1] and R. Jimenez-Flores[2], [1]*The Ohio State University,* [2]*DPTC-California Polytechnic State University*.

Latino American (LA) countries have a rich tradition in the production and consumption of cheese, which is called "Queso" and "Queijo" in Spanish and Portuguese, respectively. Cheesemaking in LA region started when the Spanish and Portuguese conquers brought the first herds to the American continent. Therefore, all cheeses made in LA were originally developed following European cheesemaking procedures. There is a wide variety of cheese products found from the north of Mexico to the south of Argentina due to vast differences in climate, agricultural practices and traditions. LA cheeses can be soft, semi-hard and hard. As in other countries of the world, cheeses are named for the town, region or community in which they are made, thus many cheeses with different names might have practically the same textural and flavor characteristics. Some well known cheeses from LA are queso Añejo, Panela, Cotija, Oaxaca, tipo Manchego from Mexico; fresh cheeses made with whole or partially skimmed milk and pressed are called Queso Prensa, in El Salvador and Venezuela, Queso de Puna in Puerto Rico, Queso Estera in Colombia and Queso Descremado in Costa Rica. Other recognized LA cheeses are Queso Colonia in Uruguay; Queijo Prato (Prato cheese), Requeijao and Minas Frescal in Brazil; Mar de Plata, Mantecoso and Parmesan in Argentina. The important characteristics and processing of these LA cheeses and their relationship with the Hispanic cheeses found in the U.S. market will be reviewed and discussed.

Key Words: Cheese, Queso, Latino America

323 Functional and rheological attributes of Hispanic-style cheeses. D. L. Van Hekken*[1], M. H. Tunick[1], D. W. Olson[1], F. J. Molina-Corral[2], A. A. Gardea[2], and P. M. Tomasula[1], [1]*USDA, ARS, Eastern Regional Research Center,* [2]*Centro de Investigacion en Alimentacion y Desarrollo, Cuauhtemoc, Mexico*.

The range of functional and rheological properties of the many styles of Hispanic cheeses arise from variations in their composition and methods used to process them. However, limited information is available on these cheeses. The objective of this joint ERRC-CIAD study was to characterize the compositional (moisture, fat, protein, salt), physical (pH, water activity), functional (color change upon heating, meltability), and

rheological (hardness, springiness, cohesiveness, chewiness, elastic and viscous modulus, torsion shear stress and shear strain) properties of soft (Panela, Queso Fresco), semi-hard (Mexican Mennonite, Oaxaca), and hard (Cotija) commercially manufactured Hispanic-style cheeses. The cheeses were obtained from Mexico (Mennonite-style) and the US. Soft cheeses typically contain over 50% moisture, 18 to 25% fat, 17 to 22% protein and 1-3% salt, have pH $\geq$ 6.0, and low meltability. The semi-hard cheeses contain 40 to 50% moisture, 18 to 25% fat, 20 to 30% protein, and 0.8 to 2% salt, pH from 5.0 to 5.5 and high meltability. Cotija, the most common hard cheese, contains less than 40% moisture, 23 to 30% fat, 23 to 30% protein, over 4% salt, pH 5.6, and has intermediate meltability. The semi-hard cheeses showed the greatest total color change upon heating which was related to their high meltability. All soft cheeses were similar in springiness and cohesiveness, but varied in hardness, chewiness, rigidity, and viscoelastic properties. All semi-hard cheeses were similar in springiness, cohesiveness, and viscoelastic properties, but varied in chewiness and rigidity. Cotija was similar to the semi-hard cheeses in springiness and viscoelastic properties. Compared to the soft cheeses, the semi-hard and hard cheeses had higher values of springiness, cohesiveness, chewiness, and viscoelastic properties. These results are discussed in terms of the processing steps that are used to manufacture these cheeses.

Key Words: Hispanic cheese, Functionality, Rheology

Dairy Foods Symposium: Listeria monocytogenes: a model pathogen for farm-to-table intervention

324 Transmission of Listeria monocytogenes in the dairy food system, overview.

M. Wiedmann*, *Cornell University, Ithaca, NY.*

Listeria monocytogenes not only causes a severe human foodborne disease, but also has been linked to infections in more than 20 different animal species. Animal listeriosis has particularly been reported in cattle, goats, and sheep; symptoms in these animals include meningitis, abortions, and septicemia as well as, less commonly, non-systemic infections such as uveitis and mastitis. Human listeriosis outbreaks involving a variety of dairy products (including butter, chocolate milk, Hispanic style cheeses) have been reported. According to the USDA/FDA Listeria risk assessment Hispanic style fresh cheeses represent a particular high risk food for acquiring listeriosis (on a per serving basis). L. monocytogenes strains also have a considerable ability to survive outside a mammalian host and under a variety of stress conditions, which represent a particular concern for the food industry. This organism has not only been shown to be present in most dairy processing plant environments, but specific strains of this organism have also been found to persist in processing plant environments for extended periods (up to months and years). While L. monocytogenes has been found in raw milk, current pasteurization time-temperature combinations effectively inactivate L. monocytogenes. Post-processing contamination from plant environments probably represents the most common source of L. monocytogenes contamination of pasteurized dairy products. Nevertheless, any point of the dairy food continuum may contribute to the presence of L. monocytogenes in dairy foods. Even for dairy products produced from pasteurized milk, L. monocytogenes present in raw materials or introduced from farm environments into processing plant on fomites (e.g., personnel) may indirectly contribute to finished product contamination. I will present a farm to table transmission model for L. monocytogenes, which will incorporate our current knowledge on the ecology and transmission of L. monocytogenes. Considerable gaps in this model will need to be filled before we can quantify the contributions of different potential sources in the dairy food continuum to finished product contamination at point of consumption.

Key Words: Listeria, Transmission, Food safety

325 Ecology and transmission of *Listeria monocytogenes* in ruminants and the farm environment.

K. K. Nightingale*, E. D. Fortes, C. R. Nightingale, Z. Her, Y. H. Schukken, Y. T. Grohn, and M. Wiedmann, *Cornell University.*

Listeria monocytogenes is an important human foodborne and animal pathogen. The interrelation of agent, host, and environmental factors such as strain virulence, host immuninty, and agricultural production practices, makes the epidemiology listeriosis difficult to elucidate. *L. monocytogenes* has been implicated as the causative agent in several large outbreaks of human foodborne illness. Thus, *L. monocytogenes* contamination of raw agricultural commodities used to produce foods that undergo minimal bactericidal processing (i.e. unpasturized dairy and ready-to-eat products) is a serious concern. The definitive source of *L. monocytogenes* in finished products is not clear. Because *L. monocytogenes* can infect food animals and survive in the environment for extended periods of time, *L. monocytogenes* may be carried through the food continuum by animals. Knowledge of *L. monocytogenes* transmission and ecology in pre-harvest food systems is needed to reduce contamination throughout the food chain. A case-control study was conducted to determine the prevalence and molecular epidemiology of *L. monocytogenes* in production ruminants, animal feed, and the farm environment (soil and water). Overall, *L. monocytogenes* was abundantly present in ruminant feces, animal feed, and the farm environment. While the prevalence of *L. monocytogenes* was not significantly different in bovine case and control farms, *L. monocytogenes* was significantly more common in small ruminant (caprine and ovine) case farms compared to controls. Therefore, the epidemiology of *L. monocytogenes* differs in small ruminant and bovine farms. Our data support an on-farm transmission model in which specific pathogenic *L. monocytogenes* subtypes in animals feeds are amplified in animals with or without clinical disease and dispersed into the farm environment. Cattle farms appear to maintain a large environmental *L. monocytogenes* load, including subtypes which have been linked to human listeriosis outbreaks. While we have established the presence of disease related *L. monocytogenes* subtypes on farms, the contamination source of animal-based foods which undergo listeriocidal heating steps is not known and requires further research.

Key Words: L. monocytogenes, Molecular epidemiology, Pre-harvest food safety

326 Human listeriosis outbreaks linked to dairy products: a European perspective.

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Dairy products have been implicated in approximately half of the reported listeriosis outbreaks in Europe. The listeriosis outbreaks have mostly been linked to consumption of raw milk or products produced from non-pasteurized milk. The outbreaks in Switzerland in 1983 to 1987 due to non-pasteurized soft cheese, the outbreak in Austria in 1986 related to non-pasteurized milk, and the outbreak in France in 1995 related to a brie-type cheese made of non-pasteurized milk demonstrate the risks involved with consumption of raw milk or soft cheeses made of non-pasteurized milk.

The pasteurization process of raw milk, which destroys *Listeria monocytogenes*, has not eliminated the risk of *L. monocytogenes* in dairy products. The outbreak in Finland from 1998 to 1999, with butter as the source, points out the fact that dairy products made of pasteurized milk may act as vehicles for *L. monocytogenes*. The post pasteurization equipment such as the packaging machine was contaminated with the outbreak strain elucidating the importance of post processing hygiene.

Extensive work has been done in several European countries during the last decade to the present day to prevent outbreaks and to decrease the incidence of listeriosis. This work has included preventive measures in the food processing plants, consumer advice, and early detection of outbreaks. The dairy processing plants have focused on improving the post processing hygiene and implementation of hazard analysis critical control programs, and the consumers belonging to the risk group have been informed about dietary risk factors. In fact, there has been a marked reduction in the incidence of listeriosis in some European countries during the last decade suggesting a relationship between the preventive measures and the reduction in listeriosis.

Several European countries have a national surveillance system with continuous genotyping of clinical strains which enables early detection of listeriosis outbreaks. The development of a common European surveillance program is in a planning stage. Such a program would give requisites for the recognition of multi-national outbreaks.

Key Words: Listeriosis, Dairy product, Outbreak

327 Control of *Listeria monocytogenes* in dairy processing plant environments. P. A. Hall*, *Kraft Foods - North America*.

Control of *Listeria monocytogenes*(LM) in processing plant environments is a multi-faceted approach requiring diligence and dedication throughout the entire organization. There are five elements that add up to effective LM control in a processing facility. The so-called Listeria equation consists of Traffic Patterns + GMPs + Dry, Uncracked, Clean Floors + Sanitary Design + Sanitation Procedures. A breakdown in any one of these elements can lead to an unacceptable risk of LM contamination in the plant environment and, ultimately, the finished product. Essential to effective LM control is a rigorous, aggressive environmental monitoring program. It is recommended that the genus Listeria be used as an indicator for LM and that a sufficient number of equipment and other sites be monitored (dependant on the size of the facility) on a weekly basis to ensure that the processing environment is under control. Incentive must be provided to plant personnel to aggressively find and eliminate LM in the environment. In order to ensure this, plant employees must must be provided with the proper tools and training, and the criticality of LM control must continuously be reinforced. This presentation will cover the key elements and specifics required to ensure effective LM control in dairy processing facilities.

Key Words: Listeria monocytogenes, Food safety, Environmental monitoring

328 The Listeria risk assessment: Dairy foods. S. Dennis*, J. Hicks, C. Carrington, and R. Whiting, *Food and Drug Administration, College Park, MD*.

The HHS/USDA *Listeria monocytogenes* risk assessment was issued in draft for public comment in January 2001. The purpose of the risk assessment was to systematically examine available scientific data and information to estimate the predicted relative risk of serious illness and death associated with consumption of ready-to-eat foods. The types of foods evaluated in the risk assessment include seafood, produce, dairy foods, meats, and deli salads. The dairy foods include five types of cheeses, milk, ice cream and other miscellaneous dairy products. This risk assessment is a tool that regulatory agencies can use to evaluate the effectiveness of current policies, programs, and regulatory practices. Using newly available data, information, and modeling techniques, the draft risk assessment will be revised in 2003. If the revised risk assessment is released before the meeting, the latest information on the predicted risks will be presented.

Key Words: Risk assessment, Listeria monocytogenes

Horse Symposium: Nutrient management

329 Knee deep in manure: what do horse owners do with it? L. K. Warren*, *Colorado State University, Fort Collins, CO USA*.

The average 455-kg horse produces 26 L of manure per day or 9.5 m^3/yr. When bedding material is added, the volume can easily exceed 20 m^3/yr per horse. How do horse owners manage all of this manure? The National Animal Health Monitoring System (NAHMS) Equine '98 Study found that approximately 11% of horse operations in the U.S. had manure removed from their property, 78% utilized or stored manure on-site, and the remaining 11% reported "other" means of disposal. Over half of the operations surveyed by NAHMS reported that the application of manure and stall waste on fields and pastures was the primary means of disposal. Those that allowed waste to accumulate or "left it to nature" made up 29% of the operations, and this practice was more likely to be employed when fewer horses were housed on the property. Hauling waste to a landfill or combining manure with household garbage for pickup was also more likely to be used as a disposal option with small, 1 or 2 horse operations. On-farm composting of horse manure was attempted by approximately 36% of those surveyed by NAHMS and was more prevalent in the northeast and western states. The increasing trend for horses to be housed on small, 1-35 acre "hobby" farms and in boarding stables means a larger number of horses are being housed on smaller parcels of land with less acreage available for spreading manure. Add to this greater restrictions on landfill dumping and the expense of hauling manure off-site and it becomes evident that horse owners are quickly losing waste disposal options. And simply "leaving it to nature" is not acceptable due to the risk of runoff and leachate from manure polluting watercourses and domestic water supplies. Educational programs are needed to inform horse owners about environmentally sound and neighbor-friendly waste management practices. In addition, markets must be found for horse waste or composted horse manure. And methods to reduce the waste stream (e.g., efforts to minimize bedding, feeding highly digestible feeds) should be investigated.

Key Words: Horse, Manure disposal, Waste management practices

330 Nutrient management regulations and the North Carolina equine industry. R. Mowrey*[1], [1]*North Carolina State University*.

In 1992, NC state regulations covering waste discharge required confined animal feeding operations above species based thresholds including equine operations with 75 or more head, to develop a waste management plan. Additional regulations developed by the Environmental Management Commission, govern surface water loading of nutrients in 3 of 17 NC river basins. The Tar-Pamlico River Basin (TPRB) nutrient management strategy requires agricultural operations to collectively achieve a 30% reduction in nitrogen from 1991,loading within a 7 year period. The N.C. Horse Council-Environmental Issues Committee (NCHC-EIC) monitors development of nutrient management regulations, recommends best management practices (BMP's) to control nutrient loading and serves as the horse industry liaison working with government agencies. Current recommended TPRB regulations require horse operations with 20 or more head to participate in a pasture point system based on pasture BMP's. The NCHC-EIC assists in development of BMP's with pre-assigned point values. Producers who implement BMP's will earn points. When BMP's are implemented and a required point total is reached, producers will be exempt from additional nutrient management efforts. Potential BMP's include exclusion from water sources, non-fertilizer zones, alternate water sources and dietary nutrient management. A lack of equine research data to support BMP's has hindered the approval process. The NCSU Animal Science and Biological Engineering Departments received FY 2003 to 2005 grant funding from the U.S. Environmental Protection Agency to conduct manure and pasture management educational programs. A series of producer educational conferences and field days will demonstrate BMP's on horse farms that improve water quality. The project will be implemented with the assistance of Regional Equine Information Network System volunteers in multi-county areas. Demonstrations will focus on developing and testing improved animal crop and waste management systems to provide maximum environmental protection. This information will be essential to support the development of future equine BMP's to enhance water quality.

Key Words: Equine, Pasture management, Water quality

331 Potential impact of new Concentrated Animal Feeding Operation regulations on the equine industry. D. R. Topliff*, *West Texas A&M University*.

The new regulations from EPA concerning the definition of Animal Feeding Operations (AFO) and regulation of certain AFOs as Concentrated Animal Feeding Operations (CAFO) have been finalized. These new regulations contain provisions that have potentially serious consequences for the horse industry. EPA has adopted a three-tiered plan for regulation of CAFOs that classify them as Large, Medium, or Small and places the number of confined horses necessary to qualify for a particular status at 500 and 150 for the first two categories and authority of regional directors to specify operations for the third. Any AFO that discharges pollutants directly into the waters of the U.S. or has animals in direct contact with waters of the U.S. may be designated as a CAFO regardless of the number of animals confined. Data was provided to EPA from the

American Horse Council requesting that horses be counted in the same manner as feedlot cattle, however EPA chose to continue counting each horse as two animal units. Thus, any operation that has 150 or more horses in confinement (including stalls or dry lots) for a total of 45 days or more in any 12-month period or is otherwise designated as a CAFO has a duty to seek coverage under an NPDES permit. Many stables, breeding farms, and exhibition facilities that have not previously been affected may now have to meet the requirements of the new regulations, including a provision to be able to contain all of the runoff from a 25-year, 24-hour storm event. The economic cost could be devastating to the industry.

Key Words: Equine industry, CAFO regulation, Environmental regulations

Southern Branch ADSA Symposium: How can we best work together to serve tomorrow's dairy industry?

332 How best can we work together to serve tomorrow's dairy industry: university extension faculty perspective. L. O. Ely*, *University of Georgia*.

The Cooperative Extension Service was created with the Smith-Lever Act of May 8, 1914. Extension work was to "consist of giving instruction and practical demonstrations in agriculture and home economics to persons not attending or resident in said colleges in the several communities, and imparting to such persons information on said subjects through field demonstrations, publications and otherwise". At this time the population of the US was rural and education for most was finished at the eighth grade level. Basic information in animal and human nutrition was being discovered. Today extension work has the same objective but the audience is much different. Only a small percent of the US population is rural and engaged in agriculture. The education level is post high school. The need is not for basic information but for fine tuning management decision-making. Producers are looking for ways to handle the overload of information and records that are available to them. Extension can provide resources that will aid in utilization of record keeping systems and decision-making programs that analyze these records. These programs may be web based for independent use by producers instead of one on one or group meetings between producers and extension specialists. Society has demanded impact and accountability statements that have left agriculture with low scores because of small clientele numbers. Evaluation of quality is not part of these scores, as it is not easily quantified. Other countries have privatized their extension services. In the US there has been an increase in private companies developing their sales force into an extension service that competes with the land grant system. The new objective may be that extension service and industry must cooperate to provide programs and resources to the dairy industry. How does the leadership in college administration evaluate this paradigm shift?

Key Words: Dairy industry, Extension service, Function

Animal Health: Diseases and mammary health

333 Changes in the mechanical properties and the lesion score of the sole horn in first lactation dairy heifers. B. Winkler and J. K. Margerison*, *University of Plymouth, Seale Hayne*.

This experiment compares mechanical tests of the sole horn toughness with the pattern of lesion formation, in the pre- and postpartum heifers. Mechanical tests were completed on samples of sole hoof horn taken from 20 heifers at 2 months before parturition (p1) and 100 days postpartum (p2). Simultaneously, all claws were assessed for the lesions score levels (LS) of sole horn. Heifers were kept at pasture prepartum and housed loose in a straw-bedded yard postpartum. Hoof samples were collected from all claws and analysed for elastic modulus (ELM) and puncture resistance (PR). Each measurement was replicated five times on the same area of each claw. PR force required fracture sole horn was significantly greater in front claws (FC) when compared to hind claws (HC) ($P<0.05$) (FC 9.7, HC 8.8N), but there was no significant difference between the inner and outer claws. PR force, ELM and LS significantly increased postpartum compared with prepartum ($P<0.01$) (p1- 7.8N, 86.9N/mm2 and 73.1; p2- 10.7N, 118.0N/mm2 and 186.5). LS was significantly greater in the HC compared with the FC during the postpartum period ($p<0.001$) (HC 223.7, FC149.3). In the HC the outer claws presented a significantly ($p<0.05$) greater LS when compared to the inner claws in both periods. In the FC the LS was significantly higher in the inner claws ($P<0.01$) postpartum. Prepartum ELM and PR force were not correlated with lesion score either pre or postpartum. However, postpartum ELM and PR force were significantly negatively correlated ($p<0.01$) to the increase in lesion score between periods ($R=0.65$). Differences of EML and PR between FC and HC may be related to the different pressure distribution in these claws. Mechanical tests reflected increases in sole lesions and LS following

Key Words: Lameness, Sole tissue, Mechanical testing

334 Muscle protein tyrosine nitration patterns during chronic subclinical intramuscular parasitism: Co-localization to fiber type and ubiquitin. T. H. Elsasser*[1], S. Kahl[1], J.L. Sartin[2], R. Fayer[1], A. Martinez[3], F. Cuttitta[3], and J. Hinson[4], [1]*USDA-ARS, Beltsville, MD,* [2]*Auburn University, Auburn, AL,* [3]*NIH-NCI, Bethesda, MD,* [4]*University of Arkansas, Little Rock, AR*.

The present study was conducted to determine whether the inflammatory oxidative response to chronic intramuscular parasitism, as modeled with the protozoan parasite *Sarcocystis cruzi*, results in protein nitration damage and whether a pattern to it localization can be characterized. Holstein steer calves (n=10; av.wt.= 124 kg) were assigned equally to control (C) and infected (I, 25,000 Sarco sporocysts) groups. Calves were slaughtered on d56 postinfection and samples of rectus femoris (RF) and psoas major (PM) harvested. Xanthine oxidase (XO) was measured in muscle homogenates by fluorescence (resorufin, 587 nm). Frozen sections (9 μ) were immunostained (IHC; horseradish peroxidase/DAB) for nitrotyrosine (NT) or ubiquitin (UBI) or co-localization of NT with fibertype (staining v nonstaining with mouse anti-myosin fast twitch), or NT with UBI via confocal immunofluorescence. Extracted muscle proteins were extracted, separated on 4-20% SDS PAGE gels, transferred to nitrocellulose, and probed for nitrated proteins using a anti-NT or antibovine-UBI. XO activity, a source of superoxide, was 2.3 times greater in I than C ($P<0.01$). Western blot demonstrated that >80% of the increase in NT was associated with an increased number of protein bands ($P<0.04$, I v C)with Mr >75 kD. IHC demonstrated very low levels of both NT and UBI staining in RF and PM of C but increased NT (42% more NT+ fibers, $P<0.05$) in both RF and PM of I. NT immunostaining could be categorized into three distinct forms: a) peripheral fiber (I and C), b) dispersed intrafiber (I), and c) cyst-specific (I). Both fast and slow fibers displayed the peripheral localization of NT and UBI. Only slow twitch oxidative fibers displayed extensive co-localized intrafiber NT staining regardless of muscle source. The sarcocyst itself was highly nitrated and muscle proteins in the immediate vicinity of the cyst displayed increased NT co-localized with UBI. The data suggest that the oxidative inflammatory response to chronic low-level muscle-resident parasitism generates nitrated muscle proteins. The nitration appears to be more pronounced in slow oxidative fibers and supports prior observations of more severe impact of this parasitism on muscles with higher percentages of slow twitch fibers.

Key Words: Stress, Health, Muscle

335 A relative comparison of diagnostic tests for Johne's disease. T. Duffield[1], D. Kelton[1], K. Leslie[1], K. Lissemore[1], and M. Archambault[2], [1]*Department of Population Medicine, University of Guelph,* [2]*Animal Health Laboratory, University of Guelph*.

Prevention and control of Johne's disease (JD) could be improved if diagnostic tests were reliable, rapid and economical. The objective of this study is to evaluate a commercial milk ELISA test relative to other diagnostic tests. 32 dairy herds in Ontario with a suspected high prevalence of JD had fecal and serum samples collected from all milking and dry

cows. Serum was tested for antibodies with an IDEXX ELISA (AHL). Preserved milk samples were collected at the following Dairy Herd Improvement (DHI) test day. These milk samples were sent to Antel Bio Corp. (Lansing, MI) for an in-house milk ELISA test. Cows positive on either the serum or milk ELISA test had their corresponding fecal sample tested with all three of the following: traditional fecal culture (FC) (Antel Bio), an IDEXX fecal PCR probe (AHL), and radiometric FC (BACTEC culturing system) (AHL). 286 of the 2148 serum samples were positive (13.4%). 124 of the 1699 cows milking on DHI test day were positive on milk ELISA (7.3%). The kappa between the milk and serum ELISA for the 1699 cows tested was 0.45 (0.38, 0.52). 326 cows were positive on one or both of the ELISA tests. 144 of the ELISA positive cows (either milk or serum) were positive on traditional FC (44.2%), while only 62 were identified positive on fecal PCR (24.1%). The BACTEC culture results are still pending. 686 fecal samples from ELISA negative cows are still being cultured. In total, complete FCs from nine herds (874 cows) will be analysed. Preliminary statistics were calculated for 257 cows having milk, serum, fecal PCR and FC results. Relative to FC, the positive predictive value for the milk and serum ELISA was 61.3% and 45.2%, respectively. The kappa between fecal PCR and FC was 0.57 (0.47, 0.68). The milk ELISA test reasonably predicts fecal shedding status and because of its convenience and cost, it has utility as a herd screening test.

Key Words: Johne's disease, Fecal culture, Milk ELISA

336 Detection of *Aspergillus fumigatus* in hemorrhagic bowel syndrome in dairy cattle. S. Puntenney*, Y.-Q. Wang, and N. Forsberg, *Oregon State University, Corvallis OR.*

The goal of the research was to investigate the association between *Aspergillus fumigatus*, *Clostridium perfringens* and hemorrhagic bowel syndrome (HBS) in lactating dairy cattle. Samples of gastrointestinal (GI) contents, GI wall, mesenteric lymph nodes and blood were obtained from HBS cows and from control cows in 4 states (IA, ID, OR and WA). Concentrations of *A. fumigatus* DNA in the samples were evaluated with a real-time quantitative Sybr Green PCR method using an ABI7700 thermocycler. A standard curve was constructed with purified *A. fumigatus* genomic DNA. Melt curve analysis was completed to ensure that only *A. fumigatus* DNA was detected in each assay. We also tested for the presence of *Clostridium perfringens* in the samples using a multiplex PCR which detected five of the major *C. perfringens* toxins. Seven HBS cows were obtained and each of them contained high concentrations of *A. fumigatus* in hemorrhaging GI contents, GI wall, mesenteric lymph nodes and blood. Two idiopathic cases of abomasal hemorrhage (one dairy cow and one gazelle)were also evaluated. Both cases were positive for *A. fumigatus*. *C. perfringens* alpha and epsilon toxin genes were detected in some HBS samples; however, their presence was not associated with HBS. Some HBS cows did not harbor *C. perfringens* toxin genes. In humans, *A. fumigatus* is pathogenic in immunocompromised patients. It is harmless in immunocompetent individuals. Dairy cattle may be immunosuppressed, particularly in early stages of lactation. Several studies have shown potential for *A. fumigatus* to infect the ruminant GI tract and to cause hemorrhage. Hence, we propose that *A. fumigatus* has similar potential in lactating dairy cattle. These observations do not preclude other pathogenic organisms from participating in HBS. Instead, we propose that *A. fumigatus* contributes to the etiology of a multi-factorial disease. Management of feed storage to minimize mold may reduce or eliminate incidence of HBS.

Key Words: Jejunal hemorrhage syndrome, Mold, Dairy herd health

337 The potential of infrared thermography as an early detection method for mastitis: Seasonal effects on predictability. R. J. Berry[1], A. D. Kennedy*[1], S. L. Scott[2], D. Fulawka[1], F. I. L. Hernandez[2], and A. L. Schaefer[3], [1]*University of Manitoba, Winnipeg, Manitoba, Canada,* [2]*Ag Canada Research Station, Brandon, Manitoba, Canada,* [3]*Ag Canada Research Station, Lacombe, Alberta, Canada.*

In order to determine the potential of using Infrared thermography (IRT) for early detection of mastitis, seasonal variation in udder temperature was determined and a prediction model based on the results was developed. Two groups of 10 dairy cows (lactation range 1-6) were monitored every other day starting 5 days before calving until 120 days into lactation. A "summer" group was studied over the time period 5/1/01-10/15/01 and a "winter" group was studied between 12/24/01-5/3/02. IRT images of the posterior surface of the udder were collected approximately 2 h before milking, and stored onto digital video cassettes. Rectal temperatures were taken concurrently. Barn temperatures were monitored remotely every 10 min. A lagged regression model was applied at the individual level. Model description is as follows: UStemp = Lag1UStemp + Lag2UStemp + EtempH2 + Max EtempH2 + EtempH24 + Max EtempH24 + EtempH48 + Max EtempH48. Where: UStemp=mean udder surface temp; Lag1 & Lag2Ustemp= lagged mean udder surface temp for the previous 1 or 2 measures, respectively; EtempH2, EtempH24, & Etemph48= mean environmental temperature for the previous 2, 24 and 48 h, respectively; MaxEtempH2, MaxEtempH24, & Max EtempH48= max environmental temperature for the previous 2, 24 and 48h, respectively. The model was significant for all animals in both groups ($p<0.05$), giving r^2 ranges of 0.41-0.88 and 0.27-0.63 for the Summer and Winter groups, respectively. Residuals for the model showed that the model more accurately predicted UStemp for the Summer group (mean residual =0.71, range 0.34-1.04; Winter group mean residual= 0.91, range 0.61-1.25). Residuals were below an endotoxin infusion-induced rise in UStemp of 2.3 C reported an earlier study by Scott et al (2000). Therefore, IRT shows potential as an early detection method for mastitis.

Key Words: Thermography, Dairy cattle, Mastitis

338 Protective efficiency of a mix DNA-protein vaccination strategy against *Staphylococcus aureus* mastitis in dairy cows. L. Shkreta*[1], B. G. Talbot[1], M. S. Diarra[2], and P. Lacasse[2], [1]*University of Sherbrooke, QC, Canada,* [2]*Dairy and Swine R&D Centre, Lennoxville, QC, Canada.*

The objective of this study was to test the protective efficiency of a vaccination strategy against *Staphylococcus aureus* mastitis. Four pregnant heifers were not vaccinated and used as control while four others were injected intramuscularly twice with a DNA vaccine (7 and 4 wks prior to calving) and once subcutaneously with a protein vaccine 17 days later. The DNA vaccine contained 2 mg of the bicistronic plasmid pCI-D1D3-ClfA that encodes epitopes of the *S. aureus* adhesins Clumping factor A (ClfA) and Fibronectin binding protein A (D1D3) and 2 mg of the plasmid pCI-GM-CSF that encodes the bovine Granulocyte macrophage-colony stimulation factor. The protein vaccine consisted of 200 μg of recombinant D1D3 and 300 μg of recombinant ClfA in incomplete Freund's adjuvant. Three weeks after calving, 3 quarters per cows were challenged through the teat canal with 900 CFU/quarter of *S. aureus* Newbould 305 while the fourth quarter was infused with saline. The DNA immunizations did not increase significantly the serum levels of anti-ClfA or anti-D1D3. However, the protein boost significantly increased the serum levels of anti-ClfA - IgG, IgG-2, IgG-1, IgM and IgA (respectively P<0,03; <0,01; < 0,01; < 0,05; and P<0,07), but only slightly those of anti-D1D3. Both antibodies were detected (P<0.05) in milk although levels of anti-D1D3 antibodies were low. The lymphoproliferative response induced by DNA vaccination was highly significant for both antigens (P< 0,001). All inoculated quarters developed mastitis. Over the following 3 weeks, the number of bacteria remained relatively constant in control cows but decreased gradually (time x treatment, P<0.05) in vaccinated cows. At the end of this period, the number of bacteria averaged 3.3 logCFU/ml in control and 1.4 (P<0.05) in vaccinated cows. Bacteria were still present in 11of 12 quarters for the controls and 5 of 12 quarters in vaccinated cows. In the period 24-72 hrs post challenge, vaccinated cows tended to have lower serum haptoglobin (P<0.09), cardiac rhythm (P<0.04) and body temperature (P<0.09) than control cows. In conclusion, this mixed DNA and protein vaccination strategy against *S. aureus* adhesins induced not only humoral and cellular immune responses but also partial protection in dairy cows.

339 Effectiveness of an internal teat sealant in the prevention of new intramammary infections during the dry and early lactation periods in dairy cows when used with an intramammary antibiotic. S. Godden*[1], P. Rapnicki[1], S. Stewart[1], A. Johnson[2], R. Bey[1], and R. Farnsworth[1], [1]*University of Minnesota, St. Paul, MN,* [2]*Total Herd Management Services, Clintonville, WI.*

The primary objective of this study was to describe whether quarters treated with an internal teat sealant in addition to an antibiotic at dry off (treated) would develop fewer new intramammary infections (IMI) during the dry period and early lactation, as compared to quarters

treated with antibiotic alone (control). Secondary objectives were to describe the effect of treatment on the prevalence of IMI and linear score (LS) after calving, and on the incidence of clinical mastitis between dry off and 60 DIM. The study enrolled 437 cows from two dairy farms in western WI. On the day of dry off all four quarters were sampled for bacteriological culture and SCC measures. After the final milking all four quarters were routinely infused with a commercially available long-acting antibiotic. Two contra-lateral quarters (LF/RH or RF/LH) were then randomly assigned the treatment of infusion with an inert internal teat sealant (Orbeseal, Pfizer Animal Health, Groton, CT). The teat sealant was stripped out at first milking after calving and the quarters re-sampled at both 1- 3 DIM and 6-8 DIM for bacteriological culture and SCC analysis. The incidence of new IMI occurring between dry off and 1-3 DIM was 25.9% and 20.6 % for control vs. treated quarters, respectively (odds ratio$_{treated}$ = 0.72, P < 0.05). The prevalence of IMI at 1-3 DIM was 29.5% and 23.3%, for control vs. treated quarters, respectively (odds ratio$_{treated}$ = 0.71, P < 0.05). Mean LS was significantly lower for control vs. treated quarters at 1-3 DIM (control = 5.5; treat = 5.2, P < 0.05) and at 6-8 DIM (control = 3.2; treat = 2.9, P < 0.05). Finally, there were significantly fewer clinical mastitis events between dry off and 60 DIM occurring in quarters treated with teat sealant and an antibiotic (5.9%) than in quarters treated with antibiotic alone (8.0%) (odds ratio$_{treated}$ = 0.72, P < 0.05).

Key Words: Internal teat sealant, Mastitis, Dry period

Breeding & Genetics: Beef cattle breeding

340 Factors to adjust birth and weaning weights of Red Angus calves for age of dam. J. M. Rumph*[1], L. S. Gould[2], R. L. Hough[2], and L. D. Van Vleck[3], [1]*University of Nebraska, Lincoln,* [2]*Red Angus Association of America, Denton, Texas,* [3]*USDA, ARS, USMARC, Lincoln, Nebraska.*

Age-of-dam adjustment factors now used by the Red Angus Association of America (RAAA) were evaluated to determine if they were still applicable for the current Red Angus population. After edits, 61,322 records were available for birth weight on bull calves, 64,056 for birth weight on heifer calves, 29,663 for weaning weight on bull calves, and 31,073 for weaning weight on heifer calves. Records of bulls and heifers were analyzed separately to estimate age-of-dam adjustment factors for bulls and heifers for each weight. Statistical models were similar to those used for national genetic evaluations by the Red Angus Association of America. Additive factors to adjust to a mature (5 – 10 yr old) dam basis for birth weight of bull calves were determined to be 3.13, 1.41, 0.41, and 1.13 kg for 2-, 3-, 4-, and 11-yr-old and older dams, respectively. For birth weight of heifer calves, adjustment factors were determined to be 3.08, 1.32, 0.45, and 1.04 kg for the same dam classifications. For weaning weight, adjustment factors for bull calves were 32.97, 17.19, 7.30, and 11.97 kg and for heifer calves were 25.80, 13.70, 4.90, and 10.48 kg. The adjustment factors currently used by the Red Angus Association of America under adjust birth weights at all ages for both sexes compared to these new estimates. For weaning weight, the adjustment factors currently used under adjust weaning weights for calves with 2-yr-old dams and with dams that are 11 yr of age or older. Weaning weights for calves out of 3- and 4-yr-old dams are slightly overadjusted with the adjustment factors now used for both sexes, but the magnitude of differences for bull calves is greater than for heifer calves. New adjustment factors for age-of-dam are recommended for use in RAAA genetic evaluations.

Key Words: Adjustment factors, Beef cattle, Genetic evaluations

341 Effects of genetic groups to account for selection on estimates of genetic parameters for a line of Hereford cattle. L. D. Van Vleck*[1], K. J. Hanford[1], and M. D. MacNeil[2], [1]*USDA, ARS, USMARC, Lincoln, NE,* [2]*USDA, ARS, LARRL, Miles City, MT.*

Robin Thompson originated the idea of an accumulated groups model to account for prior selection. Robin Westell's rules made the coefficient matrix for group models as easy to compute as the A-inverse rules of Henderson and Quaas made use of the numerator relationship matrix for calculation of predicted breeding values given components of the phenotypic variance. The effects of groups in the model on estimates of variance components, however, seem to be unpredictable. Groups were assigned arbitrarily instead of sire identification for some or all of 3,884 weaning weight records of Line 1 Herefords. With usual sire identification, estimates of parameters were 0.20, -0.38, 0.16, 0.19, 0.52 for direct heritability, direct-maternal genetic correlation, maternal heritability, and proportions of variance due to maternal permanent environmental and residual environmental effects. With 22 groups (to replace about one sire for each intake of sires), estimates were 0.13, -0.23, 0.11, 0.20, and 0.58. With 49 groups (all sires of an intake group assigned to that group), estimates were 0.05, 0.41, 0.11, 0.20, and 0.61. With each sire (160) assigned as a group, estimates were 0.06, 1.00, 0.01, 0.24, and 0.67. As another extreme, all sires were coded as missing and were not grouped. Estimates were 0.30, -0.72, 0.08, 0.28, and 0.45. For birth weight, usual estimates were 0.36, -0.06, 0.14, 0.03,and 0.49. With arbitrary groups, estimates were affected but less extremely than for weaning weight. With a dam effect replacing maternal genetic and permanent environmental effects in the model, substitution of group effects for sires had little effect on estimates of heritability for birth weight but did affect estimates of heritability for weaning weight (although less extremely than for the direct-maternal genetic models). More extensive analytical or simulation studies of effects of genetic groups on estimates of genetic parameters seem warranted.

Key Words: Beef cattle, Genetic correlation, Heritability

342 Maternal performance of Hereford, Angus, Red Angus, Simmental, Gelbvieh, Limousin, and Charolais sired two-year-old crossbred females. L. V. Cundiff*, *USDA, ARS, Roman L. Hruska U.S. Meat Animal Research Center.*

The objective of this experiment was to characterize reproduction and maternal traits of F1 cross females calving at 2 years of age in cycle VII of the Germplasm Evaluation Program at the U.S. Meat Animal Research Center. The females were produced in the spring of 1999 and 2000 as a result of artificial insemination matings of Hereford (H, 21 sires), Angus (A, 22), Red Angus (Ra, 21), Simmental (S, 20), Gelbvieh (G, 23), Limousin (L, 20), and Charolais (C, 22) bulls to Hereford, Angus, and composite MARC III (1/4 each Angus, Hereford, Red Poll, and Pinzgauer) cows. Data were obtained on 681 females exposed, 565 calves born, and 489 calves weaned in the fall of 2001 and 2002 as a result of natural service multi-sire matings to MARC III bulls. Data on calf crop born (CB, %) and weaned (CW, %), calving difficulty score (CDS, score), unassisted births (UB, %), birth weight (BW, kg), survival to weaning (SW), and 200-d weaning weight of progeny (WW, kg) were analyzed by least squares procedures using a model that included random effects for maternal grandsire in maternal grandsire breed, and fixed effects for maternal grandsire breed, maternal grandam breed, sex of calf (for BW, SW, WW only), birth year, and maternal grandsire breed x maternal grandam breed. Effects of maternal grandsire breed were significant (P<.05) for WW but not for any other trait. The means for WW of progeny with H, A, Ra, S, G, L, and C maternal grandsires were 187.4, 192,2, 188.1, 200.3, 195.2, 194.7 and 195.2 kg for WW, respectively. The mean least significant difference among maternal grandsire breed means for WW was 9.5 kg (P<.05). Breed of maternal grand sire means for S and G differed significantly from H and Ra, but not from any other breeds. Breed of maternal grandsire effects did not differ among H, A, Ra, L, and C breeds. Results for WW indicate that contrasts between British (H and A) and Continental European breeds (S, G, L, and C) are less than half as great for direct (3.5 vs 9.5 kg) and maternal (4.8 vs. 11.5 kg) breed effects in the current evaluation (Cycle VII of the GPE Program) as they were 25 to 30 years ago (Cycle I and II of the GPE Program).

Key Words: Beef cattle, Breeds, Germplasm

343 Genetic trends resulting from selection based on an index of birth weight and yearling weight. M. D. MacNeil*, *USDA-ARS, Fort Keogh LARRL, Miles City, MT.*

The CGC population is a stabilized composite of 1/2 Red Angus, 1/4 Charolais, and 1/4 Tarentaise germplasm. The objectives of this research were to estimate genetic parameters for weight traits of CGC and to evaluate genetic responses resulting from selection based on the

index: I = 365-d weight minus 3.2(birth weight). In 1989, a randomly selected control line and a line selected for greater values of the index were established. Average generation intervals were 3.16 ± 0.04 yr and 3.90 ± 0.08 yr in the index and control lines, respectively. Over three generations, the index selection line (n = 950) accumulated approximately 212 kg more selection differential than the control line (n = 912). Derivative-free multiple-trait REML methods were used to estimate (co)variance components and to predict breeding values upon convergence of estimates of (co)variance components. Heritability estimates for direct effects were: 0.32 ± 0.04, 0.49 ± 0.05, 0.49 ± 0.05, 0.30 ± 0.04, and 0.70 ± 0.04 for the index, birth weight, 365-d weight, 200-d weight, and cow weight, respectively. Heritability estimates for maternal effects were: 0.05 ± 0.02, 0.11 ± 0.03, 0.04 ± 0.02, and 0.19 ± 0.04 for the index, birth weight, 365-d weight, and 200-d weight, respectively. In the control line, direct genetic changes for the index and its components were small. For the index selection line, direct genetic changes for the index, birth weight, 365-d weight, 200-d weight, and cow weight were 6.0 ± 0.3, 0.45 ± 0.09, 7.74 ± 0.55, 3.42 ± 0.25, and 6.3 ± 0.9 kg/generation, respectively. Maternal genetic changes were generally small for both the control and index selection lines. Thus, selection for the index produced positive correlated responses for direct genetic effects on body weight traits at all ages with only minor effects on maternal genetic effects. Results demonstrate that despite a genetic antagonism that compromises selection response for reduced birth weight and increased postnatal growth, favorable genetic responses can be achieved.

Key Words: Beef Cattle, Genetic Gain, Selection Index

344 Bayesian estimation of breed-specific and segregation genetic variances applied to a Nelore-Hereford population. F. F. Cardoso*[1] and R. J. Tempelman[1], [1]*Michigan State University*.

The objectives of this study were to apply a hierarchical multiple-breed animal model (MBAM) to estimate breed-composition effects, breed-specific additive genetic variances and variance due to the segregation between breeds, and to compare the MBAM with a regular animal model (AM), by simulation and on a dataset on post-weaning gain (PWG) of crossbred beef calves. Phenotypic records were modeled as function of breed composition means and animal additive genetic effects using the variance-covariance specifications as proposed by Lo et al. Bayesian inference was based on MCMC. We validated the model on five simulated datasets derived from a population based on crosses of two breeds having a two-fold difference in genetic variance. In each of the five populations, true values of all variance components in the MBAM were always contained within the corresponding 95% posterior probability intervals (PPI). We also analyzed a dataset of 22,717 PWG records of a Nelore-Hereford population (40,082 animals in the pedigree). MBAM inference on Nelore and Hereford additive genetic variances (in kg^2) differed substantially. Herefords had a posterior median genetic variance of 90.9 with a 95% PPI of [69.8, 114.5] whereas the corresponding values for the Nelore were 32.9 and [20.1, 50.1], respectively. The posterior median variance due to the segregation between these breeds was 13.1 with a 95% PPI of [5.0, 33.8]. The common residual variance posterior median was 333.0 with a 95% PPI of [317.6, 347.8] using MBAM; corresponding values using AM were 348.5 and [332.7, 360.8], respectively. Bayesian model choice criteria heavily favored the MBAM over the AM for both simulated and PWG data, thereby having important implications for improved precision on breeding value predictions.

Key Words: Multiple-breed, Crossbreeding, Genetic evaluation

345 Feedlot performance and carcass traits of Bonsmara, Angus, and Brahman steers. J. J. Cleere*[1], F. M. Rouquette, Jr.[1], R. D. Randel[1], T. H. Welsh[2], J. W. Holloway[3], and M. F. Miller[4], [1]*Texas Agricultural Experiment Station, Overton,* [2]*Texas A&M University, College Station,* [3]*Texas Agricultural Experiment Station, Uvalde,* [4]*Texas Tech University, Lubbock*.

Bonsmara cattle, a composite of Africander x Shorthorn x Hereford, have been recently introduced into the United States with a limited number of grazing-feeding trials conducted on half blood animals, but none with purebreds. To document performance from weaning to harvest, Bonsmara (BON) (n = 10), BON x Angus (BOA) (n = 9), Angus (ANG) (n = 8), and Brahman (BRM) (n = 10) steers grazed 'TAM 90' annual ryegrass (*Lolium multiflorum*) and 'Maton' rye (*Secale cereale*) from January 4 to May 16, 2002 at TAMU-Overton. The BON, BOA, and ANG steers had similar ADG during the grazing period (0.92, 0.84, and 0.91 kg/d; P > 0.05); whereas BRM had lower ADG (0.75 kg/d; P < 0.05) during the grazing period than BON and ANG. At termination of grazing, steers were assigned to pens (n = 8) by breed type and weight with 4 to 5 animals per pen at the Texas Tech University Alltech research feedlot on May 22, 2002. The BON and BRM steers entered the feedlot at lighter weights than BOA and ANG steers (292 and 285 vs. 351 and 360 kg, respectively; P < 0.10). Feedlot ADG for BON steers (1.62 kg/d) was lower than ANG steers (1.87 kg/d; P = 0.02), lower than BOA steers (1.77 kg/d; P = 0.08), and greater than BRM steers (1.28 kg/d; P = 0.01). Final feedlot weights of steers fed to estimated one cm back fat thickness were 504 (BON), 512 (BOA), 530 (ANG), and 489 kg (BRM) (P > 0.05). Gain to feed ratios were similar among the four breed types. Also, adjusted fat thickness, kidney pelvic heart fat, and yield grades were similar among the four breed types. Hot carcass weights for the BON steers were similar to the BOA, ANG, and BRM steers (299 vs. 305, 314, and 296 kg). The BON steers had rib eye areas similar to the BOA, ANG, and BRM steers (79.7 vs. 78.3, 81.7, and 75.6 cm^2, respectively). Marbling scores among the BON steers were similar to the BOA, ANG, and BRM steers (367 vs. 346, 413 and 352, respectively). This first U. S. grazing-feedlot study with BON steers revealed that they are intermediate in feedlot performance and carcass quality to ANG and BRM steers.

Key Words: Bonsmara, Feedlot, Carcass

346 Redesigning beef cattle to have a more healthful fatty acid composition. T. J. Knight*, J. A. Minick, R. G. Tait, Jr., G. H. Rouse, D. E. Wilson, D. R. Strohbehn, J. M. Reecy, A. E. Wertz, A. H. Trenkle, and D. C. Beitz, *Iowa State University, Ames*.

Designing beef to meet the nutritional demands of consumers is essential for beef to compete in a market where a healthful product is emphasized. We initiated studies to evaluate the extent to which genetic variation controls beef fatty acid composition. Gas chromatography was used to determine fatty acid composition of the triacylglycerol and phospholipid fractions of the trimmed, edible portion of rib steak from 615 steers and bulls slaughtered at a typical market weight. Contemporary groups were based on year, farm of origin, feedlot, and harvest date. Restricted maximum likelihood (REML) with a sire-maternal grandsire relationship matrix was used to estimate variance components. There were 53 contemporary groups (1-59 cattle per group) and 63 sires (1-34 progeny per sire) represented in the data. In triacylglycerol, myristic acid (14:0) was highly heritable (h^2 S.E.; 0.50 0.28) as was palmitoleic acid (16:1) (0.51 0.23) and oleic acid (18:1) (0.58 0.29). Heritability estimates for phospholipid fatty acids were nearly equal to the respective standard error. To evaluate enzyme systems (fatty acid desaturase and fatty acid elongase), ratios of product to precursor were evaluated. The fatty acid desaturase index (16:1+18:1/16:0+18:0) was heritable in triacylglycerol (0.49 0.28). In contrast, heritabilities of the indices of fatty acid elongase activity were nearly equal to the respective standard error. Finally, an overall health index of the fatty acid composition ([4*(14:0)+(16:0)] all other fatty acids excluding 18:0) was evaluated and was heritable in triacylglycerol (0.60 0.30). The most favorable EPD for overall health index was -0.045, which represents a >5.5% change from the average for this data set. EPDs for individual fatty acids, in some cases, represent a 5-12% improvement of the particular trait. We conclude that fatty acid composition of beef is in part an inherited trait and that the lipid composition of beef could be improved with respect to human health by genetic selection.

Key Words: Beef, Fatty acid, Heritability

347 Genetic relationships of body condition score with carcass traits in Limousin cattle. D. R. Eborn* and D. W. Moser, *Kansas State University, Manhattan, KS*.

Body condition score (BCS, n=19,506) on Limousin cows (n=12,439) and carcass weight (CWT), longissumus muscle area (LMA) and fat thickness (FT) at the 12th rib, marbling score (MS), and % kidney, pelvic, and heart fat (KPH) on 4, 326 Limousin sired animals were used to estimate genetic parameters. Heritabilities (diagonal) and genetic correlations (below diagonal) were estimated by MTDFREML by single- and pair-wise analyses, respectively. The model for BCS included a fixed effect for contemporary group, covariates for age at measurement, and

random animal, permanent environment, and residual effects. Contemporary groups for BCS were defined by the cow's calf weaning weight contemporary group. The model for carcass traits included a fixed effect for contemporary group, covariate for age at slaughter, and random animal and residual effects. Estimates of heritabilities for carcass traits ranged from 0.14 ± 0.04 for CWT to 0.34 ± 0.05 for REA. Heritability of BCS was 0.19 ± 0.02. The genetic correlations between BCS and CWT, LMA, FT, MS and KPH were 0.28, 0.60, -0.04, -0.64, and 0.16, respectively. Our findings suggest that selection on LMA or MS may impact BCS in the cowherd. However, no significant correlation was found between FT and BCS.

	BCS	CWT	LMA	FT	MS	KPH
BCS	0.19 ± 0.02					
CWT	0.28	0.14 ± 0.04				
LMA	0.60	0.50	0.34 ± 0.05			
FT	-0.04	0.09	-0.19	0.24 ± 0.05		
MS	-0.64	-0.23	-0.40	-0.14	0.15 ± 0.04	
KPH	0.16	-0.23	-0.51	0.53	-0.20	0.16 ± 0.04

Key Words: Body condition score, Carcass, Genetic parameters

348 Heritability and repeatability of back fat and rump fat thickness in Angus cattle. A. Hassen*, D. E. Wilson, and G. H. Rouse, *Iowa State University, Ames, IA.*

The current study included data from 912 purebred Angus bulls and heifers born during the spring of 1998 to 2001. Each year calves were serially measured for back fat thickness (BFT), rump fat thickness (RFT) and other ultrasound measures starting at weaning time and with 4 to 6 weeks interval between scans. The objective of this study was to compare trends in variance components, heritability and repeatability of BFT and RFT measures of Angus cattle measured between mean ages of 27 to 62 weeks. Initially BFT and RFT observations were analyzed by scan session across years using multiple trait animal model. Data pooled across years and scan sessions were then analyzed using random regression models (RRM) to produce general trends in genetic parameter estimates. Bull and heifer RFT measures showed higher heritablility values than BFT for all scan sessions. Heritability of BFT increased from 0.13 at the 1st scan (mean age =35 weeks) to 0.29 at the 5th scan (mean age = 53 weeks). Heritability of RFT increased from 0.33 at the 1st scan to 0.44 at the 6th scan (mean age = 56 weeks). Genetic correlation between yearling BFT (5th scan) and earlier RFT measures including scans one to four were 0.58, 0.62, 0.77, and 0.83, respectively. Results from RRM showed higher additive genetic variance values for RFT measures until 48 weeks followed by larger genetic variances for BFT during the rest of the ages. However, BFT measures showed larger direct permanent environmental variances than RFT for most measurement ages. Heritability of RFT ranged from 0.27 to 0.39, as compared to 0.24 to 0.34 for BFT measures. At a year of age heritability of BFT and RFT were 0.34 and 0.38, respectively. Both traits showed similar repeatability values ranging from 0.71 to 0.91. Repeatability of yearling BFT and RFT were 0.88 and 0.86, respectively. The relatively higher heritability values of early RFT measures and the strong genetic association with yearling BFT suggest that RFT measures could be considered as additional sources of information for earlier evaluation of Angus cattle for fat cover and other related traits.

Key Words: Composition, Ultrasound, Heritability

349 Genetic parameter estimates of udder scores in Gelbvieh cattle. R. L. Sapp*, R. Rekaya, J. K. Bertrand, I. Misztal, and K. A. Donoghue, *The University of Georgia, Athens, GA.*

The objective of this study was to investigate genetic parameters for teat size score (T) and suspension (S) score in Gelbvieh (GV) cattle. Cows were scored, by the producer, within 24 hr of calving. The range of T and S is 0 (extremely large or very pendulous, respectively) to 50 (extremely small or extremely tight, respectively). Cows from sires that were at least 75 percent GV were retained for analysis. Bivariate analyses of data from first parity (FP) animals (n = 11,997) were performed. Second bivariate analyses of data with first and second parity (SP) records (n = 11,997) were performed, where T and S were considered different traits (T1, T2, S1, S2, respectively) across the two parities. A first parity animal was considered to be four yr of age or younger at first calving. Contemporary grouping included herd, year, season, percent GV, and birth group identification for both data sets. The model included the fixed effect of contemporary group, a covariate for the age at measurement, and random additive genetic effect. AIREMLF90 was used to estimate variance components. Heritability estimates from FP data for T and S were 0.22 and 0.19, respectively; heritability estimates of 0.22, 0.18, 0.39, and 0.28 were found for T1, T2, S1, and S2, respectively, from SP data. The genetic correlation between T and S in FP data was 0.87. The genetic correlations between T1-S1, T1-T2, S1-S2, and T2-S2 were 0.86, 0.76, 0.73, and 0.98, respectively. The approximate SD for the genetic correlations were higher then we expected. The moderate heritability estimates suggest that selection for T and S is possible. It is interesting to note that the genetic correlations, estimated from SP data, is higher between T and S within a parity than the correlation between the same score across parities. This may suggest that producers consider T and S to be the same response instead of two separate measurements. Further research is needed to determine the relationship between udder scores and milk production.

Key Words: Udder score, Genetic parameters, Beef cattle

350 Comparison of methods for handling missing fertility records in beef cattle data. K. A. Donoghue*[1], R. Rekaya[1], J. K. Bertrand[1], D. J. Johnston[2], and C. Teseling[3], [1]*The University of Georgia, Athens GA, USA,* [2]*Animal Genetics and Breeding Unit, Armidale NSW, Australia,* [3]*The Angus Society of Australia, Armidale NSW, Australia.*

The purpose of this study was to compare methods for handling missing fertility records in beef cattle data. Data were days to calving records from natural service matings of 33,176 first-calf females in Australian Angus herds. Three methods for handling records from females that did not calve (missing records) were evaluated, with three separate data sets created for analysis. Non-calvers were assigned penalty values on a within contemporary group basis in the first data set (DCPEN). In the second data set, records for non-calvers were treated as censored, and were drawn from their respective truncated normal distribution (DCSIM), while records on non-calvers were deleted from the third data set (DCMISS). Bayesian approach via Gibbs sampling was used to estimate variance components and predict breeding values. Posterior means (PM) (SD) of additive genetic variance for DCPEN, DCSIM and DCMISS were 29.87 (4.69), 25.74 (3.89), and 13.2 (2.91), respectively. PM (SD) of residual variance for DCPEN, DCSIM and DCMISS were 435.3 (5.38), 371.7 (4.63), and 262.4 (3.43), respectively. PM (SD) of heritability for DCPEN, DCSIM and DCMISS were 0.06 (0.01), 0.06 (0.01), and 0.05 (0.01), respectively. Simulating trait records for non-calving females resulted in similar heritability to the penalty method, but lower residual variance. Pearson correlation between posterior means of animal effects in DCPEN-DCSIM was 0.98, and for sires with more than 20 daughters with records, correlations between DCPEN-DCSIM, DCPEN-DCMISS and DCSIM-DCMISS were 0.98, 0.80 and 0.84, respectively. Of the 424 sires ranked in top 10% of sires in DCPEN, 88% were also ranked in top 10% in DCSIM. These results indicate that although most sires ranked similarly, there were exceptions. Further research to understand the differences in ranking of animals under these methods is underway.

Key Words: Fertility, Genetic evaluation, Beef cattle

351 Estimates of genetic parameters for respiratory disease in beef calves before weaning. G. Snowder*, D. Van Vleck, L. Cundiff, K. Gregory, and G. Bennett, *USDA, ARS, Roman L. Hruska U.S. Meat Animal Research Center.*

Respiratory disease is one of the most economically important illnesses affecting growth and survival of calves. The primary objective of this study was to estimate genetic parameters for respiratory disease in beef calves prior to weaning. Health records of 31,000 calves produced at the U.S. Meat Animal Research Center, Clay Center, NE from 1983 to 2001 were evaluated. Cows and calves were monitored daily for health until weaning at approximately 194 d of age. Breed groups consisted of nine purebred breeds (Angus, Braunvieh, Charolais, Gelbvieh, Hereford, Limousin, Pinzgauer, Red Poll, and Simmental), two reciprocal crosses

between Angus and Herefords, and three composite populations (MARC I, MARC II, and MARC III). Respiratory disease was detected by physical examination, necropsy, or laboratory analyses. To avoid multiple incidence, records on the same calf which may be due to lingering respiratory disease, only the initial infection during the preweaning period was considered. Overall average incidence of recorded respiratory disease was 11.6%. Incidence was highest in Braunvieh (18.1%) and MARC I (17.8%), a composite breed with one fourth Braunvieh heritage. Herefords and the Hereford x Angus cross had the lowest incidence (4.6 to 7.8%). Incidence was highest after d 84. Variance components were estimated using REML. Fixed effects included year of birth, age of dam, sex of calf, and breed type. Calf and dam of the calf were considered random effects. Variance due to permanent environmental effects of the dams was not significant. Phenotypic variance for respiratory disease was 0.095. Heritability estimates for the calf direct and maternal effects were low, 0.14 $\pm$ 0.01 and 0.04 $\pm$ 0.01, respectively. Estimate of the direct-maternal genetic correlation was large and negative, -0.93 $\pm$ 0.04. Large and significant breed differences for respiratory disease were found. Within breed, response to selection to reduce the incidence of respiratory disease in calves would be expected to be slow although breed differences suggest a potential to improve resistance by selection or crossbreeding.

Key Words: Pneumonia, Lung, Health

352 Simulation of net return using days to finish estimated breeding values in beef production. M. A. Cleveland*, R. M. Enns, W. J. Umberger, and B. L. Golden, *Colorado State University, Fort Collins, CO*.

The objective of this study was to determine if sire genotype and choice of finish endpoint for progeny interact to affect net return. A model was developed to determine the distribution of progeny for three carcass traits, carcass weight (CW), backfat thickness (BF) and marbling score (MS), when feeding to a CW, BF or MS endpoint. Days to finish carcass weight (DCW), backfat thickness (DBF) and marbling score (DMS) estimated breeding values (EBV) were used to simulate feeding costs, grid revenue, and net return. Three sire days to finish genotypes, high (H), medium (M) and low (L), as indicated by EBV, were considered for each trait. An H EBV suggests above average days to finish, while an L EBV indicates a shorter than average time on feed. All possible combinations of EBV resulted in 27 distinct sire genotypes for days to finish. Assuming an average of 130 days to each endpoint, results showed that progeny from sires with H EBV for days to finish needed an average of 142 days to reach a constant CW, and 148 days to reach constant BF and MS endpoints, while progeny from L EBV sires needed an average of only 118 days or less to reach each endpoint. The results from the model indicated that considerable re-ranking occurred among sires for net return, suggesting an interaction between genotype and finish endpoint. Re-ranking resulted in changes of up to 20 positions at alternative endpoints for some sire genotypes. Net return was calculated using average yardage costs and grid revenue. When feeding to a constant CW or BF, the LHL sire (first character indicates the DCW, second, the DBF, and third, the DMS EBV) realized the highest return, while the LLL sire was most profitable at the BF endpoint. Progeny from sires with H EBV for DMS, when fed to the MS endpoint, were overall least profitable. With the inclusion of more precise costs of production, this type of model has the potential to become a selection and management tool using days to finish genetic predictions to assist producers in maximizing profitability.

Key Words: Beef cattle, Days to finish, Simulation

353 Comparison of different selection criteria in populations simulated under growth curve parameters of Brazilian zebu cattle. E. S. Sakaguti*[1], E. N. Martins[1], and L.O.C. Silva[2], [1]*Universidade Estadual de Maringa, Maringa, Brazil,* [2]*Embrapa Gado de Corte, Campo Grande, Brazil*.

Recently the Brazilian Association of Zebu Breeders started to report the EPDs for a new growth trait, the number of days that an animal would take to gain 240 kg in the postweaning period (D240). This new trait can be used as a substitute of the traditional postweaning average daily gain (ADG) and is calculated as D240 = 240/ADG. However, there is some uncertainty about the consequences of this change. Then the objective of the present work is to evaluate the response to selection when four different traits (ADG, D240, live weight at 205 (WW) and 550 (YW) days of age) were individually considered in populations generated by Monte Carlo simulations. A FORTRAN 90 program generated the parameters (A, B and K) of the Von Bertalanffy function for each animal. The parameters were implemented as biological traits with Medelian inheritance, polygenic effect and phenotypic and genetic correlations. Estimates of genetic parameters from live weight data of Tabapua breed were employed. Two levels of heritability (approximately .1 and .5) were considered and 10 base populations were generated for each level of heritability. Approximately 25,000 progenies of 200 sires and 10,000 dams composed a population in each generation. Simulations of a random mating system with single calf per parturition produced populations with half-sib family structure that were evaluated by 10 generations of BLUP selection on each trait. The selection for ADW and D240 produced similar results. Both showed the highest increases of the mature weight (A) and the lowest decreases of the maturing rate (K). In the other hand, the selection for WW had the lowest increases of A and the highest decreases of K. Intermediate results where found with the selection for YW. The selection for D240 produced the highest inbreeding increases that can be a consequence of the smallest estimates of heritability of this trait in the early generations.

Key Words: Monte Carlo simulation, Growth curve, Selection responses

Companion Animals

354 A new approach to testing nutraceuticals in animals: A placebo-controlled evaluation of a milk-based "immuno-nutritional" product in dogs. D. A. Gingerich* and J. D. Strobel, *SMBI, Cincinnati, OH, USA*.

Functional foods and dietary supplements with structure/function claims have become important in the health care system in USA, especially since the passage DSHEA in 1994. Pet owners are interested in the therapeutic value of such products for their pets. However, few dietary supplements have been rigorously evaluated in animals. Furthermore, it is FDA/CVM's position that DSHEA does not apply to animal products. Milk is a food with biological functions in addition to its nutritional value. A special milk protein concentrate (SMPC) prepared from the milk of hyperimmunized cows was shown to express anti-inflammatory and anti-arthritic activity in humans. To determine if SMPC is also beneficial to dogs, an 8-week, placebo-controlled clinical study was conducted in older dogs with osteoarthritis. The study was designed to test the product and also to evaluate an owner-based questionnaire designed specifically for dogs. Fifty dogs in 5 veterinary practices were enrolled, of which 35 completed the study. Significant ($p < 0.05$) improvement in mean questionnaire scores and owner global assessments was detected in dogs in the SMPC group but not the placebo group. The treatment responses were significantly greater in the SMPC group than in the placebo group ($p<0.005$). The effect sizes (treatment response - placebo response/SD placebo response) for case-specific and client global outcomes were 1.61 and 0.90 respectively, which are considered large. No treatment-related adverse effects or changes in serum chemistry findings were detected. Unlike many dietary supplements with no recognized nutritional value, SMPC contains high quality dairy protein. Because there is laboratory evidence that the anti-inflammatory activity in the milk from hyperimmunized cows is exerted through immunological mechanisms, we describe SMPC as an "immuno-nutritional". The results of this study also indicate that the individualized owner-based questionnaire is a valuable tool in testing nutraceuticals and can be adapted to evaluate a variety of new products in pets.

Key Words: Nutraceutical, Milk-based, Anti-inflammatory

355 Measuring absorption of a purified, crystalline lutein additive in the canine. L. B. Deffenbaugh*, *Kemin Nutrisurance, Inc.*.

Lutein is one of numerous carotenoids with potential health benefits for companion animals. Natural sources include green leafy vegetables, marigolds, and maize, in which lutein is present as a fatty acid ester.

Lutein esters are commercially obtained via a solvent extraction process from marigolds and are commonly used as a pigmenter in poultry diets. Saponified (un-esterified) lutein exists in animal tissues and may play a beneficial role in eye and immune health for companion animals. A purified (>90%) source of free lutein is a promising functional ingredient for animal feeds. A minimally invasive canine model for measuring uptake from consumption of a crystalline lutein feed additive will be described. Factors affecting the presentation of lutein to the digestive system must be controlled to produce reliable results. These factors include fat content of the total diet in which the lutein additive is included and individual animal variability. Monitoring bioavailability of lutein additive forms is critical to demonstrating the utility of lutein for intended purposes. Utility data is crucial to justify using functional ingredients in feeds for companion animals as well as for preparing a submission for regulatory clearance of an ingredient.

Key Words: Lutein, Absorption, Canine model

356 Evaluation of stabilized rice bran as an ingredient in dry extruded dog diets. J. K. Spears*, C. M. Grieshop, and G. C. Fahey, Jr., *University of Illinois at Urbana-Champaign, Urbana, IL USA.*

During rice processing, lipase from testa and cross-cells hydrolyzes oil in the aleurone layer and germ, resulting in an unpalatable byproduct. Inactivating lipase prevents hydrolysis, resulting in stabilized rice bran (SRB). The purpose of this research was to evaluate the effect of SRB and defatted rice bran (DRB) on food intake, digestibility, fecal characteristics, and blood fatty acid, phospholipid, and eicosanoid concentrations in dogs. Diets contained 12% SRB or DRB, and poultry fat, beef tallow, or poultry fat:soybean oil (50:50) as the main fat sources. Two blocks of 18 dogs were used, with each block fed the diets for 42 d. Days 1 through 38 constituted an adaptation phase and d 39 through 42 was the collection phase during which a total fecal collection was made. Blood samples were collected on d 1 and 42. Blood fatty acid profile and eicosanoid data were analyzed as differences from baseline values (d 1 vs d 42). No differences ($P > 0.05$) were noted in food intake, digestibility, or fecal characteristics. Changes in blood profiles due to rice bran source could not be explained by diet because differences in rice bran fatty acid profiles were negated by the dietary fat sources. Dogs consuming DRB diets had lower ($P < 0.05$) plasma phospholipid total monounsaturated fatty acids, while plasma concentrations tended ($P < 0.12$) to decrease. Dogs consuming beef tallow diets tended to have lower ($P < 0.11$) RBC phospholipid PUFA and higher total saturated fatty acids ($P < 0.15$), while dogs consuming poultry fat diets tended to have higher ($P < 0.09$) n-6 PUFA. Dogs consuming beef tallow diets had lower ($P < 0.05$) RBC phospholipid 18:2 n6 and 20:2 n6 and increased plasma 20:3 n6. Trends were detected in individual fatty acids due to rice bran source, fat source, and the interaction. Eicosanoid concentrations did not change due to treatment. Stabilized rice bran is an acceptable ingredient when included in dog diets, but did not elicit an effect on inflammatory immune mediators in healthy dogs.

Key Words: Canine, Stabilized Rice Bran, Digestibility

357 Defining Safe Lower and Upper Limits for Selenium (Se) in Adult Cats. K. Wedekind*[1], C. Kirk[1], S. Yu[1], and R. Nachreiner[2], [1]*Hill's Pet Nutrition, Inc., Topeka, KS,* [2]*Michigan State University, East Lansing, MI.*

Petfood regulatory recommendations for minimum Se in adult cat foods are 0.1 mg Se/kg diet. No recommendations are given for safe Se maximums for the cat; however, 2 mg Se/kg diet is recommended as a maximum for the dog. Given the higher Se concentrations contained in cat vs dog diets, we felt it was important to define, if possible, both a safe lower and upper limit for Se in adult cats. Our study used 33 adult cats. Cats were fed a low Se (0.03 mg Se/kg diet) diet for 3 wk after which this same diet was supplemented with 6 levels of selenomethionine (0, 0.1, 1, 2.5, 5 and 10 mg Se/kg diet) and fed for 6 mo. Response variables measured included Se concentration, Se-dependent glutathione peroxidase (GSHpx) activity in serum and RBC, complete thyroid hormone profile, complete blood count (CBC), serum chemistry profile (SCP), hair growth rate and immune function measures. No significant changes in body weight, CBC, SCP or clinical signs were observed. All serum thyroid hormone concentrations were within normal ranges. A definitive breakpoint for serum GSHpx yielded a minimum recommendation of 0.10 mg Se/kg diet. Serum Se concentrations in cats, were significantly higher than dogs, even when fed similar Se levels. Unlike chicks and dogs, serum Se did not plateau above the cat's requirement for Se, but increased linearly. Hair growth rate was significantly decreased at Se concentrations below the breakpoint, but was unchanged at high Se concentrations. We were unable to define in our study, a safe upper limit or lowest observable adverse effect level (LOAEL) for Se in cats. Results indicate a minimum requirement of 0.1 mg Se/kg diet in adult cat foods.

Key Words: Selenium, Cat, Requirement

358 Docosapentaenoic acid accumulates in plasma phosphatidyl choline but not cholesteryl ester fractions in linseed oil fed dogs. J.E. Bauer*[1], A.L. Spencer[1], and M.K. Waldron[2], [1]*College of Veterinary Medicine, Texas A&M university, College Station, TX,* [2]*Nestle-Purina Pet Care, St. Louis, MO.*

We have previously observed that total plasma phospholipid is enriched with docosapentaenoic acid (DPA, 22:5n-3) when flaxseed supplemented diets are fed to dogs, but that cholesteryl ester is not. This observation suggests that DPA is not a substrate for the plasma enzyme, lecithin:cholesterol acyl transferase (LCAT). The present work was undertaken to determine whether the preferred substrate for LCAT, specifically plasma phosphatidyl choline (PC), and cholesteryl ester (CE) fatty acid contents are similarly composed in dogs when a diet containing a high concentration of alpha-linolenic acid from linseed oil is consumed and when compared to dogs fed preformed sources of long chain n-3 PUFA (including DPA). Forty adult mixed breed dogs were divided into 4 groups (n=10). A low fat basal diet was supplemented with either safflower oil (SFO), beef tallow (BTO), linseed oil (LSO), or Menhaden fish oil (MHO) for 28 days at a dosage of 18 g oil per 100 g basal diet. Blood samples were collected, plasma total lipids were extracted with chloroform:methanol (2:1, v/v), PC and CE were fractionated via thin-layer chromatograpy, and methyl ester derivatives of these fractions were analyzed by capillary gas chromatography. Fatty acid compositions were expressed as relative per cent and ANOVA was performed. The PC fraction of dogs fed the LSO diet contained significantly increased amounts of eicosapentaenoic acid (EPA) but no accumulation of either DPA or DHA was seen beyond that found in the BTO or SFO groups. By contrast, significantly increased amounts of EPA, DPA and DHA were found in the MHO group PC fraction. In the CE fractions, neither DPA nor DHA were seen with linseed oil feeding. Unexpectedly, DPA in CE fractions of dogs fed the menhaden oil also did not accumulate although there was an increase in DHA in this fraction. These data confirm that, when diets high in ALA (LSO group) or fish oil (MHO group) are fed, DPA is present in plasma PC but not in plasma CE. It is concluded that transfer of DPA from PC to CE mediated by LCAT may not occur under these conditions and that DPA may not be a suitable substrate for the enzyme. Such a mechanism would help assure that DPA is transported to tissues using n-3 fatty acids in some preferential manner via plasma phospholipids.

Key Words: DPA fatty acids, Cholesteryl ester, linseed oil

359 Lifetime diet restriction impact on carbohydrate metabolism affects survival and time-to-first treatment for chronic disease in dogs. B. T. Larson*[1], D. F. Lawler[1], E. L. Spitznagel, Jr.[2], and R. D. Kealy[1], [1]*Nestle Purina PetCare Company, St. Louis MO,* [2]*Washington University, St. Louis MO.*

Labrador retrievers (48) were used to assess carbohydrate metabolism effects on survival and time-to-first chronic disease treatment during lifetime diet restriction. Restricted dogs were fed 75% of same diet consumed by control-fed pair-mates. Intravenous glucose tolerance testing (IVGTT) was done annually (maximal stimulation, non-steady-state, ages 9-12). Time when it became necessary to treat a specific chronic disease condition for humane reasons was recorded for each dog. Forty-six of 48 dogs were eventually euthanatized for humane reasons and two died spontaneously. Euthanasia was carried out only after extensive diagnostic evaluation, careful monitoring and response-to-treatment assessment, serial clinical condition evaluation, and prognosis consideration, according to practices established for entire colony. Cox proportional hazards regression models analyzed IVGTT parameter relationships to survival. The Cox model was used to explain differences in survival due to varying IVGTT covariate levels, in terms of impact on the hazard function. As hazard increases, survival rates decrease more

rapidly. Survival was modeled in three ways: 1) time to death, 2) time to death or treatment for osteoarthritis, or 3) time to death or treatment for any chronic disease. Time-to-first osteoarthritis treatment or death was longer with lower basal glucose and higher insulin sensitivity (P = 0.021, P = 0.023), and median survival time tended to be greater with lower basal glucose and insulin (P = 0.065, P = 0.096), but diet restriction explained most variation. Higher insulinogenic indices associated with greater median survival (P = 0.053) and those with higher insulin sensitivity had less (P = 0.018) hazard of dying or receiving chronic disease treatment. These insulin indices added more information than diet restriction alone (P = 0.057, P = 0.055). Lifelong diet restricted glucose disposal efficiency and insulin response was associated with increased life quality and quantity.

Key Words: Diet restriction, Chronic disease, Dog

Forages & Pastures: Grasslands, forage supplementation

360 Effect of defoliation system and nitrogen input on nitrate losses from grassland systems.

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Nitrogen (N) recovery in specialized dairy farms is known to be low. This causes serious environmental problems due to increased losses of N as nitrate (NO_3) to the watercourse, as in northern central Europe intensive dairy farming is mainly located on freely draining sandy soils. As part of an integrated research project, a field experiment was conducted over a 4 year period to determine NO_3 leaching losses on grassland, which is the predominant forage crop in this region. The experiment consisted of all combinations of five defoliation systems, i.e. cutting-only, rotational grazing, mixed systems with one or two silage cuts plus succeeding rotational grazing respectively, and simulated grazing, four mineral N application rates (0, 100, 200, and 300 kg N ha^{-1} yr^{-1}), and two slurry levels (0 and 20 m# slurry ha^{-1} yr^{-1}). Prior to the start of the experiment, white clover was established in all plots by oversowing. Samples of leachate were taken by ceramic suction cups. Water fluxes were derived from water balance calculations. Due to the high N return by grazing animals leaching losses in rotational grazing systems generally caused NO_3-N concentrations exceeding the European Union (EU) limit for drinking water (50 mg NO_3 l^{-1}). NO_3 leaching losses in a rotational grazing system could be reduced by lowering the N fertilizer intensity and inclusion of one or two silage cuts in spring. However, even in unfertilized mixed systems NO_3 concentrations were well above the EU limit. In terms of leaching losses, the cutting-only system was the most advantageous. NO_3 leaching losses (y; kg N ha^{-1}) could be predicted by the amount of soil mineral N at the end of the growing season (x_m; kg N ha^{-1}) with: y = - 9.5498 + 0.6758 x_m; r^2=0.74; s.e. 11.2 and by the N surplus calculated from N balances at the field scale (x_s; kg N ha^{-1}) with: y = 17.2200 + 0.1907 x_s; r^2=0.77; s.e. 10.4. From the results obtained an adapted N fertilization and a reduced grazing intensity by integrating silage cuts are suggested.

Key Words: Grassland, Nitrogen losses, Environment

361 Metabolic changes in Brangus stocker calves grazing wheat pasture.

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Previous research suggests stocker calves do not effectively convert wheat forage to gain when first placed on pasture. The objective of this research was to investigate metabolic changes in stockers over the first 21 to 49 d on fall wheat pasture (39% CP, 35% NDF) by evaluating serum metabolites and rumen function in Brangus x Hereford calves. Calves were weaned (n = 24; 268 ± 36.4 kg), and offered Prairie hay *ad libitum* (6% CP, 76% NDF) and 40% CP supplement daily (1362 g hd^{-1}). Calves were sorted into three groups to be placed on wheat at successive 10 to 14 d intervals. Calf weights and serum samples were taken prior to and after grazing wheat. Rumen fluid was taken from two cannulated steers over 72 h on 10 d prior to and 4 d after placed on wheat to determine ammonia levels. Additional fluid was taken to evaluate potential changes in 48-h *in vitro* digestibility of wheat forage prior to and on d 6, 13, and 21 after grazing wheat. As expected, calves did not achieve a positive weight gain until after grazing wheat for 14 d. Calves gained 1.7 kg d^{-1} from d 28 to 49. Serum non-esterified fatty acid levels did not change in steers prior to or after grazing wheat for 6 or 13 d (295 vs avg 294 ± 23.7 mg dl^{-1}); however, levels decreased (P < 0.001) by d 20 and 27 (avg 213 mg dl^{-1}). Serum glucose levels increased (P < 0.01) after d 20 (87 vs 100 ± 5.0 mg dl^{-1}). Serum urea nitrogen was higher (P < 0.001) during the first 21 d on wheat regardless of sample day (9 vs 23 + 0.7 mg dl^{-1}). Rumen ammonia levels also increased (P < 0.001) after cannulated steers were placed on wheat (2.5 vs 22.7 ± 3.74 g dl^{-1}). Serum glucose and urea nitrogen remained elevated through d 49 (117 ± 5.0 and 21 ± 1.2 mg dl^{-1}). Day of rumen fluid collection did not change wheat forage *in vitro* digestibilities (90 ± 1.1%). From January 2 to April 9, 2002, calves gained 1.0 + 0.05 kg d^{-1}, and wheat quality declined to 26% CP, 51% NDF, and 83% *in vitro* digestibility. Serum urea nitrogen and glucose levels remained above 21 ± 0.8 and 83 ± 7.1 mg dl^{-1}. While potential digestibility of wheat forage remains high, results suggest stocker calves adjust metabolically when first introduced to wheat pasture before positive weight gains can be achieved.

Key Words: Wheat pasture, Metabolism, Adaptation

362 Effect of field pea based supplement on intake, digestion, and ruminal fermentation of nursing steer calves grazing native range in western North Dakota.

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Eight Angus x Hereford nursing steer calves (145 ± 44 kg initial BW) fitted with ruminal cannulas were used to evaluate effects of field pea-based supplement and advancing season on dietary composition, intake, digestion, and ruminal characteristics. Treatments were control (CON) and field pea-based creep (CREEP; 19.1% CP, DM basis) fed at 0.45% BW daily. Calves grazed native pasture with their dams from late June through early November. Collection periods were 10-d long and occurred in July, August, September, and October. Masticate samples from CREEP were lower in ADF ($P = 0.09$) and higher in CP ($P = 0.07$) than CON. Dietary CP and ADIN decreased linearly with advancing season ($P \leq 0.03$). In vitro OM digestibility decreased from July to October ($P < 0.01$; 58.5% to 41.3%). Forage intake was not different ($P = 0.89$) between treatments, but increased linearly with advancing season (1.67, 1.90, 3.12, 3.38 kg/d for July, Aug, Sep and Oct, respectively; $P = 0.03$). Milk intake (% BW) was similar ($P = 0.55$) between CON and CREEP, but decreased linearly ($P = 0.001$) with advancing season. Supplemented calves had greater total intake (forage + milk + creep; $P = 0.05$) than CON. Grazed forage OM and CP digestibilities were higher ($P = 0.004$) for the CREEP than CON. With advancing season, NDF, ADF, and OM digestibilities decreased linearly ($P < 0.01$). No treatment effects were observed for in situ DM disappearance rate of forage or creep ($P > 0.10$). Creep DM disappearance decreased linearly ($P = 0.02$) and forage DM disappearance decreased quadratically ($P = 0.03$) with advancing season. Supplementation reduced ($P < 0.01$) ruminal pH at several times measured. Ruminal ammonia levels were higher ($P < 0.01$) in CREEP compared with CON. These data indicate supplementation with field peas increases total intake but has no effect on forage or milk consumption of nursing calves.

Key Words: Calves, Intake, Digestion

363 Reproductive responses and carcass characteristics of ram lambs fed endophyte-infected tall fescue.

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The objective of this study was to examine the influence of endophyte-infected tall fescue on reproductive development and function and carcass characteristics of ram lambs. Hampshire and Suffolk rams, 214 d of age, were fed individually a diet of endophyte-free (EF; n = 8) or infected (EI; n = 9) fescue seed (34% of diet; 4.8 μg/g ergovaline) for six weeks. Intake was similar between treatments and averaged 2.7% BW (33.7 μg ergovaline/kg BW). Daily high temperature ranged between 16 and 27°C. Data were analyzed using the mixed models, repeated measures procedure of SAS and heterogeneity of regression. Signs of fescue toxicosis in EI fed rams included increased rectal temperature

(treatment × day, $P < 0.001$, $R^2 = 0.11$), increased respiration rate at higher ambient temperatures (treatment × day, $P < 0.003$, $R^2 = 0.07$), and reduced serum concentrations of prolactin (treatment × day, $P < 0.001$). Body weight of EI fed rams tended to decrease after 36 d of feeding (-3.0 vs 0.51 kg; $P < 0.07$); BCS was similar between treatments throughout the trial. Serum concentrations of testosterone were greater in EI compared with EF fed rams (treatment × day, $P < 0.005$, $R^2 = 0.08$). Spermatozoa concentration tended to be greater in EF compared with EI fed rams after 43 days of feeding ($P < 0.07$). Rate of forward movement of spermatozoa tended to be greater in EF compared with EI fed rams between Days 15 and 29 of feeding (treatment × day, $P < 0.08$). Scrotal skin temperature, scrotal circumference, semen volume, percent sperm motility, and percent abnormal sperm were similar between treatments. Weights of reproductive and vital organs, carcass cutability and quality characteristics were similar between EF and EI fed rams. Feeding of EI fescue seed to ram lambs led to decreased concentrations of spermatozoa in semen and increased serum concentrations of testosterone, perhaps due to decreased steroid clearance rate.

Key Words: Rams, Reproduction, Tall Fescue

364 Comparison of urea and soybean meal as nitrogen supplements to cool-season, low-quality forage: I. Daily and alternate day supplementation effects on digestion and ruminal fermentation in steers.

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Five steers (464 ± 26 kg BW) were used in an incomplete 5 × 4 Latin square with four 18-d periods to determine the influence of supplemental N source and supplementation frequency (SF) on nutrient intake and digestion in steers offered hard fescue straw (4.7% CP; 78% NDF). Treatments (TRT) included an unsupplemented control (CON) and a urea or soybean meal (SBM) supplement placed directly into the rumen daily (D) or every-other-day (2D) at 0700. Urea supplements were provided to meet 100% of the degradable intake protein requirement while SBM supplements were provided on an isonitrogenous basis. The D TRT were supplemented CP at 0.04% of BW/day while the 2D TRT were supplemented at 0.08% of BW every-other-day. Therefore, all supplemented TRT received the same quantity of supplemental CP over a 2-d period. Straw was provided at 120% of the previous 5 d average intake in two equal portions at 0730 and 1900. Ruminal fluid was collected 0, 3, 6, 9, 12, and 24 h post-supplementation on a day all supplements and a day only daily supplements were provided. Straw and total DMI increased ($P < 0.03$) with CP supplementation; however, DM and OM digestibility was not influenced ($P > 0.19$) by CP supplementation or SF. Ruminal indigestible ADF passage rate and NH_3N increased ($P < 0.04$) with supplemental CP on the day all supplements and the day only daily supplements were provided. However, CP source × SF interactions ($P < 0.05$) indicate that, as urea SF decreased, ruminal NH_3N increased on the day all supplements were provided and decreased on the day only daily supplements were provided with little change noted as SF of SBM decreased. These results suggest that urea or SBM can be used effectively as supplemental N sources by steers consuming low-quality forage without adversely affecting DMI and DM digestibility, even when provided every-other-day.

Key Words: Protein, Supplementation, Forage

365 Comparison of urea and soybean meal as nitrogen supplements to cool-season, low-quality forage: II. Daily and alternate day supplementation effects on efficiency of nitrogen use in lambs.

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Five wethers (52 ± 2 kg BW) were used in an incomplete 5 × 4 Latin square with four 18-d periods to determine the influence of supplemental N source and supplementation frequency (SF) on efficiency of N use in lambs offered hard fescue straw (4.7% CP; 77% NDF). Treatments (TRT) included an unsupplemented control (CON) and a urea (29% CP) or soybean meal (SBM; 26% CP) supplement provided daily (D) or every-other-day (2D) at 0700. The D TRT were supplemented CP at 0.10% of BW/day while the 2D TRT were supplemented at 0.20% of BW every-other-day. Therefore, all supplemented TRT received the same quantity of supplemental CP over a 2-d period. Lambs were provided straw at 120% of the previous 5 d average intake in two equal portions at 0730 and 1900. Experimental periods were 18 d with feces and urine collected on d 13 to 18. Blood samples were obtained 4 h post-supplementation on d 13 to 18 for analysis of plasma urea-N (PUN). Dry matter intake, OM intake, N intake, N retention, DM, OM, and N digestibility, and digested N retained were greater ($P < 0.01$) for supplemented wethers compared with CON with no differences ($P > 0.05$) because of N source or SF. There were no differences in fecal or urinary N excretion because of N supplementation or SF ($P > 0.10$). However, PUN was increased ($P < 0.01$) in supplemented lambs compared with CON (5.8 compared with 3.7 mM) and urea TRT had greater ($P < 0.01$) PUN compared with SBM. Also, PUN was increased ($P = 0.05$) for D compared with 2D TRT. These results suggest that supplements containing urea or SBM as the supplemental N source can be effectively used by lambs consuming cool-season, low-quality forage without adversely affecting N efficiency, even when provided every-other-day. However, SBM should have greater utility for use in supplements offered infrequently to ruminants because it is comparatively nontoxic compared with urea.

Key Words: Protein, Frequency, Supplementation

366 Animal performance and forage quality effects on steers intensively grazing summer perennials.

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A study to compare the performance of four forage systems Sumrall 007 bermudagrass (*Cynodon dactylon*) (S007), Tifton 44 bermudagrass (*Cynodon dactylon*) (T44), common bermudagrass (*Cynodon dactylon*)/dallisgrass (*Paspalum dilatatum*) (CD) and Alamo switchgrass (*Panicum virgatum*) (AS) in a summer stocker system was conducted from 2000-2002 at the Leveck Animal Research Center, Starkville, MS. Steers were intensively grazed with stocking rates varying by year, forage and forage availability. Forage systems were replicated three times. Pastures were 1.6 ha in size and were divided into 10 paddocks with electric fence. Fertilization was identical for all pastures and at a level suitable for the hybrid bermudagrasses. Animal and forage system performance measures were initial stocking rate, periodic (28 d) and overall average daily gain, and periodic and cumulative gain per ha. Forage samples, collected monthly from each pasture, were analyzed for DM, IVDMD, IVDMD followed by a NDF wash, NDF, and ADF. A mixed model analysis was used to analyze both the animal and forage data. Bermudagrass systems were analyzed against each other for three years. AS was included in only the last two years due to slow initial development. Stocking rate, kg/ha, was consistently greater ($P<0.05$) across all periods for the S007 and T44 than for the CD or AS, 2812.3 and 2851.6 vs. 2182 .6 and 2073.8 respectively. All other animal measurements were not significant. Cumulative ADG, kg/d, for each forage were 1.6 (CD), 1.5 (S007), 1.46 (AS), and 1.41 (T44). Forage analysis is only available for the first two years. IVDMD ($p=0.009$) was significant for period, greater for May (53.73) than June (49.40) and July (45.54) or August (45.79) and greater for CD (51.95) and S007 (49.19) than for T44 (44.72). CD (66.46) were significantly greater than S007 (60.97) and T44 (58.93) for IVDMD/NDF. NDF (64.65) and ADF (30.21) were significant for period with May less than all other months.

Key Words: Stocker steers, Intensive grazing, Summer perennials

367 Effect of protein supplementation of warm versus cool season forages on intake, digestibility, and ruminal fill in beef steers.

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Sixteen ruminally cannulated steers (BW 243 ± 4 kg) were used to evaluate the effects of warm vs cool season forages with or without protein supplementation on intake, digestibility, and ruminal fill in a completely random design. Treatments were arranged in a 2 x 2 factorial. Factors were; 1) forage type, warm season (**WS**, 6.3% CP 68% NDF) or cool season (**CS**, 6.3% CP 67% NDF), and 2) protein supplementation, no supplement (**NC**) or 0.45 kg/d of a 34% CP supplement (**S**). The trial was 28 d in length. Intake was determined on d 17 to 21, total fecal collections were conducted on d 18 to 22, and in situ digestibility was determined on d 23 to 24. Total ruminal evacuations were conducted four h after feeding on d 28. There was an interaction ($P = 0.01$) in BW change with CSNC and CSS steers having similar BW change (1.0 vs 0.0 kg respectively) while WSNC steers lost more weight than WSS steers

(-19.2 vs #2.5 kg respectively). Forage and total DM intake was greater ($P = 0.03$) in steers fed CS forage than WS forage and was greater ($P = 0.01$) in S steers than NC. Total tract DM digestibility was greater ($P < 0.01$) in steers fed CS forage than in steers fed WS forage. There were no differences ($P > 0.34$) in ruminal DM fill or volume. An interaction ($P < 0.03$) between forage type and supplementation occurred for *in situ* lag time and rate of digestion. With CS forage, protein supplementation decreased lag time and rate of digestion, but with WS forage, protein supplementation increased lag time and rate of digestion. An interaction ($P = 0.06$) also occurred for in situ 48 h extent of digestion. Cool season S and CSNC had similar extent of digestion (50.0 vs 50.6% respectively), while WSNC steers had a lower extent of digestion than WSS steers (38.6 vs 43.6% respectively). Results indicate WS forage decreases intake and digestibility compared to CS, and protein supplementation is a greater benefit with WS forage.

Key Words: Warm season forage, Cool season forage, Protein supplementation

368 Effect of backgrounding growth rate and forage or concentrate finishing on beef quality. C. E. Realini*[1], S. K. Duckett[1], J.P.S. Neel[2], J. Fontenot[3], and W. R. Clapham[2], [1]*The University of Georgia, Athens,* [2]*USDA-ARS Beaver, WV,* [3]*Virginia Tech University, Blacksburg.*

Meat quality was evaluated from 72 Angus cross steers finished on forage (FOR) or concentrate (CONC), after being backgrounded at low (LOW, ADG=0.36 kg), medium (MED, ADG=0.55), or high (HIGH, ADG=0.82) growth rates. Steers were harvested at a commercial meat plant, the rib (IMPS107) removed and transported to the UGA. The 9-10-11 rib section was dissected into lean, fat and bone. Data were analyzed as a 3 x 2 factorial design with backgrounding treatment, finishing treatment, and two-way interaction in the model. Total rib weight tended to be greater ($P < 0.10$) for HIGH than LOW backgrounding treatments, and greater ($P < 0.01$) for CONC than FOR finishing treatments. Percent lean was greater and percent fat lower for MED than LOW. Ribs from FOR had greater ($P < 0.01$) bone and lean percent, and lower ($P < 0.01$) fat percent than ribs from CONC. Backgrounding growth rate had no effect ($P > 0.05$) on longissimus or subcutaneous fat color (L* lightness, a* redness, and b* yellowness). Longissimus color of CONC was lighter ($P < 0.01$, higher L*) and redder ($P < 0.01$, higher a*) than FOR with no differences in yellowness. Subcutaneous fat color of FOR was darker ($P < 0.01$) and more yellow ($P < 0.01$) than CONC. Backgrounding did not alter ($P > 0.05$) shear force of longissimus steaks. Warner-Bratzler shear force was higher ($P < 0.05$) for CONC than FOR at 14 d postmortem; but did not differ ($P > 0.05$) at 28 d. Increased growth rate during backgrounding period (MED and HIGH) reduced ($P < 0.05$) sensory tenderness scores for CONC but not for FOR. Juiciness was higher ($P < 0.01$) for FOR than CONC when animals were backgrounded on HIGH, with no differences at LOW or MED growth rates. Panelists assigned higher ($P < 0.05$) beef flavor and lower ($P < 0.01$) off flavor scores to CONC compared to FOR. Increased growth rate during backgrounding period increased rib weight and altered composition. Finishing cattle on CONC resulted in greater rib weight and percent fat, and lower percent of lean and bone than FOR. Forage finishing reduced longissimus shear force at 14 d and increased sensory tenderness scores for higher backgrounding growth rates.

Key Words: Forage, Concentrate, Backgrounding

369 Effect of feed intake level and forage source on kinetics of fiber digestion in situ and nutrient digestibility in beef cattle. S. A. Bhatti[1], J. G. P. Bowman[1], A. V. Grove*[1], and C. W. Hunt[2], [1]*Montana State University,* [2]*University of Idaho.*

Four ruminally cannulated steers were used in a 4 × 4 Latin square design study with a 2 × 2 factorial arrangement of treatments to evaluate the effects of feed intake level and forage source on fiber digestion and nutrient digestibility. Treatments were: 1) ad libitum orchardgrass hay, 2) restricted feeding of orchardgrass hay, 3) ad libitum orchardgrass plus alfalfa in a ratio of 3:1, and 4) restricted orchardgrass plus alfalfa in ratio of 3:1. Dry matter intake was lowest ($P \leq 0.05$) for steers fed restricted diets (1.0% BW), intermediate for steers fed orchardgrass ad libitum (1.6% BW), and highest for steers fed orchardgrass plus alfalfa ad libitum (2.0% BW). Intake level and forage source had no effect ($P \geq 0.10$) on total tract nutrient digestibility, lag time of NDF disappearance, or CM-Case activity. Rate of NDF disappearance of orchardgrass was greater ($P \leq 0.06$) when incubated in animals consuming restricted diets versus ad libitum diets, and when incubated in orchardgrass plus alfalfa diets versus orchardgrass only diets. Extent of in situ NDF disappearance of orchardgrass did not differ ($P \geq 0.10$) between intake levels (56.1%), but was lower ($P \leq 0.01$) when incubated in animals consuming orchardgrass plus alfalfa compared to orchardgrass only (57.6 vs 54.4%). Mean retention times of large and small particles of orchardgrass were shorter ($P \leq 0.06$) when steers consumed ad libitum versus restricted diets. Mean retention time of small orchardgrass and small alfalfa particles tended ($P \leq 0.12$) to be shorter when orchardgrass plus alfalfa was fed compared to orchardgrass only. Small orchardgrass particles had a faster ($P \leq 0.09$) rate of passage under ad libitum versus restricted feeding conditions, and when alfalfa was fed with orchardgrass versus orchardgrass only. Rate of passage of large orchardgrass particles, and large and small alfalfa particles did not differ ($P \geq 0.10$) between intake level or forage source. Ad libitum intake resulted in shorter mean retention times of large and small orchardgrass particles and a faster passage rate of small orchardgrass particles. Alfalfa substitution resulted in a faster fiber digestion rate and passage rate of small orchardgrass particles.

Key Words: Particle size, Digestion rate, Passage rate

370 Milk production of dairy cows fed total mixed rations after a grazing period with or without supplementation. F. Bargo*, J. E. Delahoy, and L. D. Muller, *The Pennsylvania State University.*

Twenty multiparous Holstein cows (DIM = 101, BW = 631 kg, BCS = 2.65) were used in a completed randomized design with repeated measures to evaluate milk production when cows were switched to a TMR after a 6-wk grazing period. Starting in May, cows grazed in one group an orchardgrass/bromegrass pasture. Cows were assigned to two treatments: 1) unsupplemented (U): 1 kg/d mineral mix, and 2) concentrate supplemented (CS): 1 kg corn-based concentrate/4 kg milk. Total DMI was higher (26.5 vs. 22.0 kg/d, $P < 0.05$) but pasture DMI (estimated by Cr_2O_3) was lower (16.8 vs. 21.2 kg/d, $P < 0.05$) for CS cows because of the substitution rate of 0.49 kg pasture/kg concentrate. Overall, CS cows had higher 3.5% FCM (32.9 vs. 26.5 kg/d), and lower milk urea N (**MUN**, 9.6 vs. 14.7 mg/dl) and milk fat (3.13 vs. 3.88%) than U cows ($P < 0.05$). Milk response to supplementation averaged 1.08 kg milk/kg concentrate. Cows of both treatments lost BW (- 17 kg/d) and BCS (-0.33, $P < 0.05$). At the end of the 6-wk grazing period, all cows were abruptly switched to a TMR fed in confinement for 11 wk. Overall, DMI (24.3 kg/d), 3.5% FCM (30.6 kg/d), milk fat (3.26%), milk true protein (2.87%), and MUN (12.7 mg/dl) did not differ between the U and CS treatments ($P > 0.05$). Cows gained BW (53 kg) and BCS (0.33, $P < 0.05$). For the U cows, 3.5% FCM and milk true protein increased 3.7 kg/d and 0.45 % units, respectively, and milk fat decreased 0.5 % units ($P < 0.05$). For the CS cows, 3.5% FCM decreased 2 kg/d and milk true protein increased 0.21 % units ($P < 0.05$). A significant treatment by period by day interaction was found for milk yield ($P < 0.05$). The first day in confinement, milk yield was higher (30.9 vs. 19.3 kg/d, $P < 0.05$) for CS. After 10 days, milk yield between treatments did not differ (35.4 kg/d, $P > 0.05$). When cows were switched from only pasture to a TMR, milk yield was comparable to CS cows after 10 days.

Key Words: Pasture, TMR, Milk production

371 Effect of forage diversity on intake and productivity of grazing lactating dairy cows. K. J. Soder*[1], M. A. Sanderson[1], L. D. Muller[2], and J. L. Stack[2], [1]*USDA-ARS Pasture Systems and Watershed Mgmt. Research Unit, University Park, PA,* [2]*The Pennsylvania State University, University Park, PA.*

A study was designed to determine the effects of forage diversity on intake and productivity of grazing lactating dairy cows. Sixteen lactating Holstein cows (100 DIM, 634 kg BW, 4 ruminally cannulated) were assigned to four 4x4 Latin squares with 21-d periods. The four pasture treatments were: (2SP) Orchardgrass/white clover; (3SP) 2SP + chicory; (6SP) 3SP + tall fescue, perennial ryegrass, and birdsfoot trefoil; and (9SP) 6SP + red clover, alfalfa, and bluegrass. Pasture allowance was 25 kg DM/cow/d. Cows were fed a 13% CP corn-based concentrate (1 kg/4 kg milk) in two equal feedings after milking. Pasture DMI was measured using Cr_2O_3 as a fecal marker. Pasture CP

was highest for the 3SP mix. The 2SP mix had the highest NDF and lowest IVDMD. DMI, milk yield, milk fat and protein, and rumen NH_3-N were not affected by treatment. Milk urea N increased on the most complex mix (9SP). Rumen pH and VFA tended to be higher for the 2SP mix. Acetate:propionate decreased with increasing level of pasture diversity. Level of forage diversity did not have a major impact on DMI or productivity of grazing dairy cows. However, forage production and carrying capacity were greater on the complex mixtures than on the 2SP mix.

	2SP	3SP	6SP	9SP	SEM	P
Pasture CP, % DM	21.8	22.1	20.3	19.0	0.46	0.002
Pasture NDF, % DM	36.6	31.7	29.2	24.7	1.57	<0.001
Pasture IVDMD, % DM	66.6	70.4	67.2	70.9	1.20	0.02
Total DMI, kg/d	23.9	22.9	22.8	22.0	0.53	0.13
Pasture DMI, kg/d	14.7	13.7	13.6	12.8	0.46	0.08
Milk, kg/d	35.4	36.3	35.2	35.3	0.31	0.10
Milk Fat, %	3.55	3.38	3.44	3.46	0.07	0.41
Milk Protein, %	2.73	2.72	2.74	2.72	0.02	0.95
MUN, mg/dl	12.9	11.8	12.7	13.3	0.27	0.03
Rumen pH	5.84	5.68	5.64	5.76	0.06	0.11
VFA, mmol/mL	156.4	140.8	144.0	145.6	4.45	0.09
Acetate:Propionate	2.93	2.83	2.68	2.65	0.02	<0.001
NH_3-N, mg/dl	17.4	14.9	16.1	15.4	0.87	0.20

Key Words: Pasture, Dairy, Forage diversity

Growth & Development: Somatotropic axis and adipose development

372 Preadipocyte recruitment is enhanced by ciglitazone or troglitazone in subcutaneous adipose stromal-vascular (S-V) cell cultures, but not intramuscular S-V cell cultures.

S. Poulos* and G. Hausman, *Univ. of GA and USDA-ARS*.

Intramuscular adiposity enhances marketability of meat products. Our understanding of intramuscular adipocyte development is limited. Though studies have shown marbling fat can be modified, intramuscular S-V cultures show these cells do not respond to dexamethasone as do subcutaneous cells. The aim of this study was to determine the adipogenic potential of porcine S-V cells from subcutaneous adipose tissue (SQ) and semitendinosus muscles (STM) using the insulin sensitizing agents, ciglitazone or troglitazone. SQ and both STM from 5-7 day old pigs were asceptically removed and S-V cells obtained from each tissue following a standard collagenase digestion. STM S-V cells were plated on laminin coated culture dishes to maintain a myotube-rich environment. S-V cells from each tissue were plated in media containing fetal bovine serum and 0.01%DMSO supplemented with 0, 10, 25, 50 μM ciglitazone or troglitazone. Upon confluency, cells were switched to insulin containing media for 3 days. Immunohistological evaluation for AD3, a preadipocyte antibody, was used to assess preadipocyte recruitment. Differences between treatments were determined using least square contrasts and $p<0.05$ was considered significant. AD3 cell number per microscopic field was increased in SQ cultures as compared to STM cultures (24.1 16.4 vs 9.8 5.5; $p<0.0001$) regardless of treatment. A dose response curve reveals 10μM ciglitazone or troglitazone treatment increases AD3 cell number per field in SQ S-V cultures (15.3 7.8, DMSO control; 30.5 7.8, ciglitazone, 38.9 7.8, troglitazone; $p<0.05$) though increasing doses in either treatment did not increase AD3 cell number. This is in contrast to STM S-V cultures which did not show an increase in AD3 number at 10, 25, or 50 μM ciglitazone or troglitazone treatment ($p>0.05$). Myotube formation in STM S-V cultures was maintained regardless of treatment. These results suggest intramuscular adipogenesis regulation may be different than that of adipogenesis in subcutaneous adipose. This information is key to the use of STM S-V cultures as cell model systems for marbling fat.

Key Words: Adipose, Porcine, Intramuscular

373 Investigation of the molecular mechanism underlying the anti-adipogenic action of retinoic acid in cultured pig preadipocytes.

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Retinoic acid (RA), the active metabolite of vitamin A, inhibits adipocyte differentiation in vitro. However the mechanism by which RA exerts this effect is poorly understood. The objective of this study was to investigate the molecular mechanism underlying the anti-adipogenic action of RA in cultured pig preadipocytes. In order to determine which member of the RA receptor superfamily mediates this action, porcine stromal-vascular cells were cultured in induction medium (DME/F12 medium containing 100 nM insulin, 10 ng/ml transferrin and 500 ng/ml hydrocortisone) and treated with either carrier (DMSO) or increasing amounts (10 nM to 25 μM) of individual retinoid ligands. On day 8 of culture, glycerol-3-phosphate dehydrogenase activity (GPDH) was measured as a late marker of preadipocyte differentiation. Addition of either RA or 9-cis retinoic acid (9c-RA) to the medium reduced GPDH activity ($P<.001$). However, 9c-RA was less potent requiring a higher dose in order to exert an effect. Addition of TTNPB, a RAR-selective ligand, potently inhibited GPDH activity ($P<.001$). In contrast, methoprene acid, a RXR-selective ligand, significantly increased GPDH activity ($P<.001$). Next, increasing amounts (10 nM to 25 μM) of Ro61, a potent RAR-selective antagonist, were added in the presence of 10 nM TTNPB. Ro61 significantly blunted the ability of TTNPB to inhibit differentiation at all concentrations tested ($P<.0002$). These data taken together indicate that the RAR receptor mediates the anti-adipogenic action of RA in pig preadipocytes. We next investigated whether RA action is dependent upon MAP kinase activity by testing the ability of 10 nM TTNPB to inhibit differentiation in the presence of either 10 μM or 25 μM of PD98059 (MAP kinase inhibitor). PD98059 failed to blunt the anti-adipogenic action of TTNPB at either concentration. These results indicate that the anti-adipogenic action of RA is mediated by the RAR receptor and is independent of the MAP kinase pathway in cultured pig preadipocytes.

Key Words: Retinoic acid, Adipocyte differentiation, Pig

374 Effects of Ralgro implantation to gestating sows on sow and piglet performance and components of the somatotrophic axis.

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Objectives were to determine effects of an estrogenic compound (Ralgro; R) on maternal and neonatal piglet performance and components of the somatotrophic axis. On d 60 of gestation, sows were divided into two groups: R (n=7) and control (C; n=4). Treated sows were administered 36 mg R subcutaneously in the ear, and C sows were administered a sham implant. Sow blood samples were collected on d 60 and 80 of gestation and at parturition. Piglet blood samples and BW were collected within 12 hrs of birth. Thereafter, piglet BW were collected on d 7 and 14 of age. Serum was collected from blood samples and stored at -80C until analyzed for serum concentrations of IGF-I, IGF-II, and growth hormone (GH). Data were analyzed using ANOVA with treatment and pig sex as main effects. There were no differences ($P > 0.38$) in serum concentrations of IGF-I or GH between C and R sows; however, there was a trend ($P < 0.10$) for increased serum concentrations of IGF-II in R sows from d 60 of gestation to parturition. There was no difference in litter size ($P < 0.14$), number born alive ($P < 0.33$), or piglet survival to weaning ($P < 0.21$); however, there was a trend ($P < 0.11$) for greater total litter weight in C sows (19.4 $\pm$ 2.3 vs 15.4 $\pm$ 1.2 kg; C vs R). There was no difference ($P > 0.47$) in piglet BW at birth (1.4 $\pm$ 0.04 kg), but there was a treatment effect ($P < 0.002$) on ADG to 7 d of age, with increased ADG in R pigs (0.19 $\pm$ 0.01 vs 0.16 $\pm$ 0.01 kg/d; R vs C). There was a tendency ($P < 0.07$) for increased ADG in R pigs to 14 d of age (0.254 $\pm$ 0.01 vs 0.231 $\pm$ 0.01 kg/d; R vs C). Treatment affected piglet serum concentrations of IGF-I ($P < 0.006$; 52.8 $\pm$ 3.7 vs 38.4 $\pm$ 3.8 ng/mL; R vs C) and IGF-II ($P < 0.0004$; 83.2 $\pm$ 1.5 vs 74.6 $\pm$ 1.8

ng/mL; R vs C) at birth; but had no effect (P < 0.18) on serum concentrations of GH (14.4 ± 1.3 vs 17.2 ± 1.9 ng/mL; R vs C). These data indicate that *in utero* Ralgro treatment increases circulating concentrations of somatotrophic hormones, and improves piglet ADG during the first 14 d of life.

Key Words: growth, Ralgro, pigs

375 Level of nutrition and breed can influence basal and β-adreneregic stimulated fat mobilization in lambs. B. J. Leury[1] and F. R. Dunshea*[2], [1]*School of Agriculture & Food Systems, The University of Melbourne, Victoria, 3010,* [2]*Department of Primary Industries, VIAS, Werribee, Vic, 3030.*

Six four month old wether lambs were used in a study to investigate the interactions between breed and level of feed intake on lipolytic response to acute intravenous challenge with clenbuterol (CLEN). Three Merino (initial weight 24.2±1.05 kg) and three Border Leicester x Merino (23.1±1.55 kg) were fed at .5 maintenance (M) for 7 days followed by 1.5M for a further 7 days. On day 7 of each feeding period the lambs were injected intravenously with .122 and 9.9 μg/kg CLEN at 0830 and 1530 h, respectively. Blood samples were taken for 30 min before and 120 min after each injection and plasma analysed for non-esterified fatty acid (NEFA) concentrations. Basal NEFA concentrations were higher in wethers consuming .5 M as compared to 1.5 M (.77 v .45 mM, P<.001). While there was no significant main effect (P=.17) of breed on basal NEFA concentrations, there was an interaction (P=.07) between breed and feed intake such that while there was no difference in basal plasma NEFA concentrations in Merinos and crossbreds when fed at 1.5 M (.43 v .47 mM), basal plasma NEFA concentrations were increased to a lesser extent in Merinos than in crossbreds when fed at .5 M (.61 v .93 mM). CLEN caused an acute increase in plasma NEFA, with the response above basal being greater in wethers fed at .5M as compared to 1.5M (.89 v .61, P=.004). There was no effect of breed (P=.60) or dose of CLEN (P=.72) on the increase in plasma NEFA in response to CLEN. These data suggest that both breed and level of nutrition can influence basal and β-adreneregic stimulation of fat mobilization.

Key Words: Lambs, Clenbuterol, Fat mobilization

376 Peripheral leptin administration alters hormone and metabolite levels in the young pig. T. G. Ramsay*[1], J. A. Bush[2], J. P. McMurtry[1], M. C. Thivierge[2], and T. A. Davis[2], [1]*USDA-ARS,* [2]*USDA-ARS Children's Nutrition Research Center.*

The present study was conducted to determine if peripheral leptin administration can alter GH secretion or feed intake in the young pigs. Six, 6 kg female pigs were fed twice daily at 0800 (3%BW) and 1500 h (3 %BW) a diet containing 24% crude protein prior to the study. Animals were fasted overnight and randomly chosen to receive porcine recombinant leptin or saline injections. The dose of leptin given per pig was initially 500 μg/kg body weight (BW) (L500) in 0.2% BSA as a bolus injection into the carotid artery. Blood samples were obtained from the jugular vein over a 24- h period. Feed was presented to each pig at 1h following leptin injection with subsequent re-weighing of food every 2h. Three days later in a cross-over design, the experiment was repeated with a leptin dose of 100 μg/kg BW (L100) or saline. Three days following this experiment, the experimental protocol was repeated with a leptin dose at 200 μg/kg BW (L200) or saline. Leptin reduced intake in pigs treated with L500 and L200 (P<0.05), but did not affect pigs treated with L100 (P>0.05). Blood glucose was depressed in pigs treated with L500 or L200 (P<0.05). Plasma non-esterified fatty acid (NEFA) remained elevated following feed presentation in pigs treated with L500 or L200(P<0.05). Plasma insulin levels were elevated by feeding in control animals, while insulin levels were depressed in pigs treated with L500 or L200 (P<0.05). In all experiments, leptin injection elevated plasma leptin levels (P<0.05). Plasma growth hormone (GH) was significantly elevated in pigs treated with L200 (P<0.05) with three peaks apparent at 5, 8, and 13 h post injection. The ability for a single injection of leptin to produce significant changes in hormone and metabolite levels suggests that this peptide has a role in regulation of peripheral metabolism.

Key Words: Leptin, Pig, Growth hormone

377 Porcine somatotropin reduces the magnitude of, and the variation in, back fat. F. R. Dunshea*[1] and R. G. Trainor[2], [1]*Department of Primary Industries, VIAS, Werribee, Vic 3030, Australia,* [2]*Alpharma Animal Health, Toorak, Vic 3142, Australia.*

Data from 16 on-farm studies (average 28 days) conducted across Australia were analysed to determine the effect of pST and sex on growth performance and on descriptive statistics of back fat depth. All studies contained both boars and gilts (1452 pigs in total) and the statistical analyses were performed on the means or descriptive statistics from each study. Daily pST treatment increased daily gain (785 v 931 g/d, P<.001) and decreased feed intake (2.59 v. 2.30 kg/d, P<.001) and FCR (3.73 v. 2.60, P<.001) in both sexes. Final back fat at the P2 site was lower (P<.001) in boars than in gilts and decreased (13.9 v 12.0 mm, P<.001) by pST treatment. However, there was an interaction (P=.016) such that pST was reduced to a greater extent in gilts (- 2.2 mm) than in boars (-1.5 mm). The average maximum P2 observed in each study was not significantly different between boars and gilts (17.0 v. 17.7 mm, P=.13) but was decreased by pST treatment (18.2 v. 16.6 mm, P<.001). The average minimum P2 observed in each study was lower in boars than in gilts (9.2 v. 9.9 mm, P=.007) and tended to be decreased by pST treatment (18.2 v. 16.6 mm, P=.067). However, there was an interaction (P=.037) such that the minimum P2 was only reduced by pST in gilts. The P2 median and mode showed similar responses to sex and pST as the mean P2. The range in P2 was less in pigs treated with pST (8.4 v. 7.3 mm, P=.021). Likewise, the variance in P2 was reduced by pST treatment (5.2 v. 3.9 mm, P=.005). There was no effect of pST on kurtosis of the distribution but pST did tend to increase the skewness of the distribution (.33 v. .56 mm, P=.092). A higher value for the skewness suggest that there is a tail in the high region of P2. In conclusion, pST increases growth performance and decreases the magnitude of, and variation in, P2 back fat.

Key Words: Back fat, pST, Pig

378 Validation of a ghrelin radioimmunoassay (RIA) for use in evaluating physiological factors that influence plasma ghrelin concentrations in beef cattle. A. E. Wertz*, T. J. Knight, C. C. Ribeiro-Filho, D. C. Beitz, and A. Trenkle, *Iowa State University, Ames.*

Plasma pooled from beef steers was used to validate the efficacy of a commercial RIA for the first 11 amino acids of rat ghrelin. The first 11 amino acids that contain the n-octanoyl moiety necessary for biological activity are identical for rats and cattle. Binding of the anti-rat ghrelin antibody to ghrelin in the standard curve and ghrelin in serial dilutions of bovine plasma was parallel. This result indicates that anti-rat ghrelin antibody binds similarly to rat and bovine ghrelin in plasma. This assay was used to quantify plasma ghrelin concentrations of cattle assigned to a 3x2 arrangement of metabolizable energy (2.4, 2.7, or 3.0 Mcal/kg) and frame score (large or small). Large frame (n=18) and small frame (n=18) Angus crossbred steers were separated from a herd of 120, and metabolizable energy density was assigned to six steers of each frame size. Steers were allowed ad libitum access to their assigned diet for 196 d via Calan gate-equipped bunks. At 28-d intervals, a blood sample was collected via jugular venipuncture. Plasma ghelin concentrations were analyzed statistically as repeated measures in time by using the MIXED procedure of SAS, and steer nested within diet by frame score was used as a random variable. Differences that resulted from metabolizable energy density, frame score, or length of feeding period were separated by least squared means. Plasma ghrelin concentration increased (P $\leq$ 0.05) as length of the feeding period increased. However, plasma ghrelin concentration did not differ significantly as a result of frame score or metabolizable energy density. This nonsignificant difference in plasma ghrelin concentration is accounted for partially by increased intake of the low- and medium-energy diets to compensate for differences in metabolizable energy density. The commercial RIA for detecting n-octanoylated rat ghrelin is efficacious for detecting n-octanoylated bovine ghrelin. Among beef cattle, plasma ghrelin concentrations increase as length of the feeding period increases.

Key Words: Ghrelin, Cattle, Metabolizable energy

379 Dose dependent growth suppression of broiler chicks injected with 5α-dihydrotestosterone. S. E. Nicolich*, T. D. Faidley, and D. R. Thompson, *Merck Research Laboratories, Somerville, NJ* .

Selective androgen receptor modulation may offer some potential to influence musculature and skeletal structure of broilers. To examine the effects of the anabolic steroid 5α-dihydrotestosterone (DHT) on growth, broiler chicks were injected (5X weekly) with 0, 1, 3, or 10 mg/kg. Peterson X Arbor Acres, male broiler chicks, 8 days of age, were housed 5 per pen and given free access to water and a commercial broiler mash. There were 5 pens of chicks on each treatment level. After 3 weeks of injections, all the 10 mg/kg birds and 10 chicks from each of the other treatment levels were necropsied. Feed consumption, weight gain, and efficiency of gain were decreased with increasing DHT. Weights of breast fillet, thigh muscle, metatarsus, and femur were also decreased with increasing DHT. Heart weight, when expressed as a percent of carcass weight, was increased with DHT, as was comb weight and comb redness. DHT in broiler chicks did not improve growth performance or demonstrate anabolic effects on skeletal muscle.

Dose (mg/kg day)	0	1.0	3.0	10.0	SEM
Feed consumption (g/bird)	1503.8^a	1483.0^a	1324.2^b	1149.6^c	34.5
Wt. gain (g/bird)	1083.0^a	1035.0^a	893.6^b	681.0^c	48.2
Efficiency of gain (gain/feed)	0.72^a	0.70^a	0.67^b	0.63^c	0.01
Comb wt. (g)	0.8^a	2.1^b	3.3^c	4.7^d	0.2
Comb color (a*)	$11a^a$	20^b	$22^{b,c}$	23^c	1
(L*)	59^a	48^b	44^c	42^c	1
(b*)	16^a	$15^{a,b}$	$14^{b,c}$	12^c	1
Body wt. (g)	1284^a	1236^a	1029^b	843^c	48
Heart wt. (g)	7.3	7.6	7.2	7.0	0.6
Whole breast (g)	291^a	289^a	231^b	175^c	12.1
Breast fillet (g)	99^a	93^a	78^b	57^c	4.4
Whole right leg (g)	160^a	156^a	127^b	109^c	6.3
Right thigh muscle (g)	54^a	53^a	45^b	40^b	2.7
Right metatarsus (cm)	13.0^a	12.9^a	11.8^b	10.9^c	0.2
Right femur (g)	10.0^a	9.4^a	7.5^b	6.3^c	0.5
Right metatarsus (g)	29^a	29^a	23^b	20^c	1.3

^{abcd} Values with different superscripts differ (P<0.05).

Key Words: Growth, Anabolic steroid, Broiler

380 Expression of myostatin and myogenin in Landrace barrows selected for increased loin eye compared to a control line. G. N. Scheuermann[1,2], K. Nadarajah[1], D. L. Kuhlers[1], S. P. Lino[1], and D. R. Mulvaney*[1], [1]*Auburn University, Auburn, AL,* [2]*EMBRAPA, Brazil.*

Myogenin (MG) genotype or gene expression has been shown to be related to leanness in pigs and myostatin (MSTN), a member of the TGF-β family of growth factors, is a negative regulator of muscle mass through involvement in the myogenic regulatory gene pathway. Our objective was to compare their expression in 100 kg Landrace barrows (n=11) resulting from five generations of selection for increased ultrasound loin eye area (ULEA) compared to controls (n=9). Data characterizing these lines have been previously reported but in general, select line ULEA were 10.6 cm^2 larger and average ultrasound backfat (BF) 0.33 cm less than controls. Immediately after harvest, replicate samples of the longissimus muscle were placed in Trizol® , homogenized, frozen in liquid nitrogen and stored at -85 C. RNA was extracted, quantified and used as template in an RT-PCR procedure (Qiagen®) to amplify expression of myostatin, myogenin and 18S ribosomal PCR cDNA products. Primers for myostatin, myogenin and 18S amplified single electrophoretic bands of predicted size. Densitometric procedures were used to determine relative expression as normalized to 18S cDNA, and data were subjected to ANOVA using GLM procedures of SAS accounting for line and replicate as main effects. Myostatin mRNA expression was 10% higher (P<.05) and myogenin 14.5% lower (P<.05) in select line barrows compared to controls. Correlation analysis of MSTN or MG gene expression to typical carcass parameters (backfat, loin eye area, length, %lean cuts, ham, loin, shoulder, belly weights, slaughter weight, and carcass weight), revealed no significant relationships except for a negative correlation of MG to live and carcass weights (P < .05). These data show differences in MSTN and MG mRNA expression between the Select and Control line pigs, which differ in their leanness, and indicate that MG mRNA could be further explored for use in marker assisted selection strategies.

Key Words: Pigs, Myogenin, Myostatin

381 Insulin signaling in bovine myogenic cells. R. A. Hill*[1], M. V. Dodson[2], A. Gertler[3], N. J. Hughes[1], D. Henderson[1], and T. A. Kokta[1], [1]*University of Idaho,* [2]*Washington State University,* [3]*Hebrew University of Jerusalem, Israel.*

Intracellular insulin-signaling pathways have been well characterized across species, but the precise mechanisms in production animals are still not clear. Insulin mediates energy substrate uptake, storage, and oxidation in peripheral tissues; promotes protein accretion (particularly in muscle) and cell proliferation. Thus, insulin-signaling pathways are complex and interact with a host of other mediators in regulation of each specific metabolic activity. Our present investigations focused upon insulin mediation of energy substrate utilization, and aimed to characterize the signaling pathways activated in bovine muscle. Our data suggest that insulin receptor (IR) signaling results in activation of phosphatidylinositol-3-hydroxy kinase (PI3-K) in primary myogenic cell (PMC) cultures. PMC were cultured in complete medium (CM), washed and exposed to various insulin concentrations (850, 85, 8.5 or 0.85 nM) in a defined medium, or CM control for 24 hr. Cells were then rapidly frozen in liquid nitrogen and the cell lysate harvested and stored at #80 C. Lysates were immunoprecipitated with specific anti-insulin receptor antibodies or anti-PI3-K antibodies, resolved on SDS-PAGE, transferred to nitrocellulose and total and phosphorylated specific protein detected using the Li-Cor Odyssey infrared imaging system. Precipitating antibodies (raised in rabbits, used for total protein detection) or anti-phosphotyrosine antibodies (raised in mice, for detection of phosphorylated proteins) were used for simultaneous evaluation of immobilized proteins on immunoblots. Phosphorylated proteins were expressed as a proportion of total specific protein detected. Approximately 0.01 IR appeared to be phosphorylated, and no variation across treatments was detected (P>.05). However, PI3-K was detected as a doublet (52 and 55 kDa) and the proportion phosphorylated was greater (P < .01) compared to CM in response to the highest insulin concentration (850 nM). At lower insulin concentrations PI3-K phosphorylation was similar to CM (P>.05). Although a differential response in IR activation was not detected, it was evident in the highly abundant PI3-K. These data suggest that a more complete characterization of insulin-mediated activation of PI3-K and other signaling molecules in beef animals is warranted.

Key Words: Insulin signaling, Phosphatidylinositol-3-hyrdoxy kinase (PI3-K), Muscle

382 Two-site evaluation of the relation between *in vivo* and carcass dual energy x-ray absorptiometry (DXA) in pigs. A. M. Scholz*[1], A. D. Mitchell[2], M. Foerster[1], and V. G. Pursel[2], [1]*University Munich, Experimental Farm, Germany,* [2]*USDA, Agricultural Research Service, Beltsville, MD.*

An evaluation study was performed to compare the compatibility of body composition results of two pencil-beam DXA scanners of the same manufacturer (GE Lunar, Madison). One DXA scanner (DPX-L) is located at the USDA in Beltsville and the upgraded version (DPX-IQ) at the Experimental Farm in Oberschleissheim, Germany (LVG). Pigs between 60 and 138 kg live body weight were scanned *in vivo* (**IV**) and subsequently *post mortem* using the right carcass (**C**) half (without head and viscera) as DXA reference side – with n=220 for the USDA data and n=62 for the LVG data. A linear regression was used to analyze the relationship between the *in vivo* and carcass data (DXA; and chemical analysis or dissection – left **C** half). Basically, both devices share the same technical platform. The regression coefficient (R^2) for the relation between the DXA soft tissue attenuation coefficient and the DXA fat percentage (FAT%) is very high for the joint data **IV** and for the **C** data (R^2>.99, $\sqrt{}$MSE<.75). Generally, there is a medium to high relation between the **IV** and **C** DXA data considering the joint data of both sites. Fat% has a R^2=.66 ($\sqrt{}$MSE =5.03) for the relation between **IV** and **C** half results, while lean percentage (LEAN%) has a R^2=.59 ($\sqrt{}$MSE=5.59). The smallest agreement between **IV** and **C** DXA data exists for the bone mineral percentage (BM%: R^2=.09, $\sqrt{}$MSE=.30), while the **IV** and **C** measurements for bone mineral density (BMD) are highly related: R^2=.87, $\sqrt{}$MSE=.02 (only LVG). The R^2 values are higher within each of the two sites. FAT% has a R^2=.79 ($\sqrt{}$MSE=3.46),

and LEAN%: R^2=.76 ($\sqrt{}$MSE=3.77) for USDA. Slightly higher relationships exist for LVG (FAT%: R^2=.85, $\sqrt{}$MSE=1.6; LEAN%: R^2=.84, $\sqrt{}$MSE=1.65; BM%: R^2=.38, $\sqrt{}$MSE=.19). In addition, there is a high agreement between DXA fat% and chemical lipid% (**IV**: R^2=.84, $\sqrt{}$MSE=1.94, USDA) or dissection fat% (**IV**: R^2=.74, $\sqrt{}$MSE=1.70, LVG). The observed site differences in the relationship between *in vivo* (**IV**) and carcass (**C**) results may depend on several factors like different genetic material (distribution of fat tissue within the body), software versions, beam hardening due to 'age' differences of the DXA scanners, feeding, and housing conditions. Though, there is a moderate to high general agreement between *in vivo* and carcass results, site-specific constraints have to be considered in multi-site studies using comparable DXA scanners.

Key Words: Dual energy x-ray absorptiometry, Body composition, Accuracy

383 Development and evaluation of a growth model to assist individual cattle management. L. O. Tedeschi* and D. G. Fox, *Cornell University, Ithaca, NY 14853*.

A deterministic and mechanistic growth model was developed to dynamically predict growth rate, accumulated weight, days required to reach target body composition, carcass weight and composition of individual beef cattle for use in individual cattle management systems. Two iterative methods based on gain composition were derived to compute the efficiency of metabolizable energy to net energy for growth. This growth model was evaluated with data from 362 individually fed steers with measured body composition and feed energy values predicted with the NRC (2000). The model accounted for 89% of the variation with bias of -2.6% in predicting individual animal ADG and explained 83% of the variation with bias of -1% in estimating the observed weight at the actual total days on feed. When ADG was known, the growth model predicted the dry matter required for that ADG with a bias of 2% and r^2 of 74%. A sub-model was developed to predict accumulated body fat (FAT) for use in predicting carcass quality and yield grades during growth. This sub-model explained 84% of the variation and had a bias of -14.3% in actual body fat when animal ADG was known. Additionally, an equation developed with 407 animals to predict yield grade from empty body fat (% of empty BW) had an r^2 of 0.49. Equations developed to predict carcass weight from empty BW that adjust for stage of growth accounted for 89% of the variation with a bias of 3 kg. We conclude this growth model can be used to predict ADG, BW, days required to reach a target body composition, dry matter required, and carcass weight of individual growing beef cattle with an acceptable degree of accuracy.

Key Words: Modeling, Simulation, Marketing

384 A feedlot model: predicting carcass quality and yield grade at re-implant time using real-time ultrasound. P. B. Wall*, G. H. Rouse, D. E. Wilson, R. G. Tait, and W. D. Busby, *Iowa State University Ames, IA*.

Commercial feedlot steers (n=404) were serially scanned using Real-Time Ultrasound (RTU) at 30-day intervals from re-implant time until slaughter. Cattle were evaluated for rump fat depth, longissimus muscle area (REA), 12th rib fat thickness (FTK), and percent intramuscular fat (%IMF) to determine the predictability of carcass composition at extended periods before slaughter. Additional background information on the cattle, such as weight, gain, breed of sire, implant, and frame score was also utilized. Carcass data was collected by trained personnel at "chain speed," and samples of the 12th rib longissimus muscle were taken for ether extract analysis to determine %IMF estimates. Simple correlation coefficients showed moderately high positive relationships between RTU measures taken less than 7 days before harvest and carcass measures: REA (r=.66); FTK (r=.74); and %IMF (r=.61). Correlation coefficients for RTU measures taken 96- 105 days before harvest and carcass values were: REA (r=.52); FTK (r=.58); and %IMF (r=.63). Regression equations were then developed for the carcass measurements; 46% of the variation could be explained for REA, 40% of FTK and 45% of marbling at re-implant time. Average daily gain ($p<.01$) and frame score ($p<.10$) were significant predictors of REA. RTU 12^{th} rib fat and rump fat were significant predictors of FTK ($p<.0001$). When predicting pre- slaughter ultrasound measures, R-squared values were higher for REA (R^2=.64), FTK (R^2=.62), and %IMF (R^2=.46). Additional regressions at 60-70 days and 30-40 days before harvest showed similar results, with R-squared values logically explaining more of the variation towards the slaughter date. Live ultrasound measure is a viable option for assessing carcass composition at re-implant time and predicting final quality and yield grades. These models may allow feeders to make marketing decisions in multiple phases of the feeding period.

385 Phenotypical characterisation regarding growth, hormones, and meat quality in bulls of two types of cattle as a source for segregating family structures. O. Bellmann*, J. Wegner, F. Schneider, F. Teuscher, and K. Ender, *Research Institute for the Biology of Farm Animals*.

The physiological and genetical background for transforming nutrients into body fat in secretion type of cattle or into body muscle in accretion type of cattle is still unknown. For that reason, we designed a study of segregating family structures using a population of Charolais (CH) cattle as a model for the accretion type and a population of German Holstein (H) cattle as a model for secretion type of cattle. In a first step the P0-generation was characterised phenotypically. The results presented in this paper were obtained from bulls starting at birth up to slaughter (18 months of age). 13 bulls of each metabolic type (CH and H) were raised using a tethering system with individual feeding. Samples of the semitendinosus muscle were taken by shot biopsy at 6, 8, 10, 13, and 16 months of age. Blood samples were taken by a single injection from the jugular vein on the same days as the muscle biopsy but prior to both biopsy sampling and feeding. At nine months of age blood sample collection in a frequent manner was started. At this time growth rate was at maximum, i.e. the transformation of nutrients into accreted protein and fat was at high levels. CH bulls did show higher body weights and the carcass contained more muscle protein and less fat than H bulls did. The higher body weight of the CH bulls is linked with higher muscle fiber cross section area. No differences were seen in the fiber type frequencies. The average plasma concentration of growth hormone did not differ, but differences in pulse frequency (CH 4.7 vs. H 3.5 pulses/6h) and amplitude were observed (CH 6.3 vs. H 10.1 ng/mL). Plasma concentrations of insulin, glucagon, and leptin also differed (insulin: CH 18.7 vs. H 28.1 U/mL; glucagon: CH 82.3 vs. H 120.8 pg/mL; leptin: CH 2.4 vs. H 3.0 ng/mL). The results suggest that different genetic based utilization of nutrients leads to pronounced protein synthesis in CH and elevated fat synthesis in H to meet the episodic energetic demands during lactation in this type.

Key Words: Cattle, Growth, Development

Nonruminant Nutrition: Minerals and vitamins

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387 Effects of dietary L-carnitine on semen characteristics in boars. D. M. Kozink, M. J. Estienne, A. F. Harper*, and J. W. Knight, *Virginia Polytechnic Institute and State University, Blacksburg, VA*.

The objective was to determine the effects of dietary L-carnitine on semen characteristics in boars. In Exp. 1, terminal-line boars (270 d of age) were fed daily a control diet (n = 9) or the control diet with L-carnitine (500 mg/d; Carniking; Lonza, Inc., Fairlawn, NJ) (n = 9). Semen was collected weekly from wk 0 to 15 and on four consecutive days during wk 16. For the weekly collections, there were no effects of treatment or treatment x time ($P > 0.1$) for gel-free volume (148.0 ± 3.3 mL), or total (55.9 ± 1.4 billion), morphologically normal (85.3 ± 0.7 %), or motile (87.2 ± 0.7 %) spermatozoa. Sperm concentration (billion/mL) was affected by treatment ($P = 0.08$; controls: 0.42, L-carnitine: 0.36, SE = 0.02) but not by treatment x time ($P > 0.1$). During the intensive collections, volume and total spermatozoa were not affected ($P > 0.1$) by treatment or treatment x time. Sperm concentration (billion/mL) was affected by treatment ($P = 0.08$; controls: 0.28, L-carnitine: 0.23, SE = 0.02) but not by treatment x time ($P > 0.1$). Experiment 2 was similar to Exp. 1 except boars (n = 10/treatment) were 525 d of age.

For the weekly collections, there were no effects of treatment or treatment x time (P > 0.1) for volume (165.1 ± 2.3 mL), or total (47.8 ± 1.1 billion) or motile (72.4 ± 0.7 %) spermatozoa. Sperm concentrations were similar between groups at wk 0 (0.18 ± 0.03 billion/mL) but from then on were generally higher for L-carnitine-treated boars (treatment x time, P < 0.01). During the intensive collections, volume was affected by treatment (P = 0.07; controls: 176.4, L-carnitine: 144.5, SE = 12.1) but not treatment x time (P > 0.1). Sperm concentration was affected by treatment x time (P < 0.01), with concentrations being higher for L-carnitine-treated boars on d 0, 1, and 2, but not 3 (0.12 ± 0.07 billion/mL). Total spermatozoa was not affected by treatment or treatment x time (P > 0.1). Overall, there were no consistent positive effects of dietary L-carnitine supplementation on semen characteristics in boars.

Key Words: L-carnitine, Semen, Boars

388 Vitamins B9 (folic acid), B12 and methionine in growing-finishing pigs.

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The utilization of dietary methionine and its modulation by the supply in vitamins B9 and B12 was investigated in growing-finishing pigs using criteria such as growth performance, serum vitamin B12, sulfur amino acids and antioxidant status. Seventy eight pigs (37.8 ± 0.4 kg) were distributed in 13 repetitions of six factorial treatments with (M) or without (C) a dietary addition of 0.2 % synthetic DL-methionine (Met) and 3 combinations of dietary additions of vitamins B9 (ppm) and B12 (ppb), respectively, 0 and 0 (V1), 10 and 25 (V2) and 10 and 150 (V3). The basal corn-soybean meal diet contained 0.25 and 0.28% of Met (0.32 and 0.27% of cysteine (Cys)) for growing and finishing periods, respectively. Growth performance was recorded and blood samples were collected every 2 wk during 8 wk for determinations of serum B12, homocysteine (Hcy), Met, Cys, FRAP (as total antioxidant activity) and TBARS (as an index of oxidative stress). During the growing period (0 to 4 wk), ADG tended to be higher (P<0.08) in M than in C pigs (1.07 ± 0.02 vs1.02 ± 0.02 kg/day, respectively), an effect probably related to a decrease (P<0.05) of feed conversion ratio (2.35 ± 0.03 and 2.43 ± 0.04 for M and C pigs, respectively). During the finishing period (4 to 8 weeks), ADG tend to be higher (P<0.07) in V2 than in V1 pigs (1.10 ± 0.03 and 1.04 ± 0.02 kg/day, respectively), and apparently linked to an increase (P<0.05) in ADFI (3.10 ± 0.06 to 3.28 ± 0.08 kg/day for V1 and V2 pigs, respectively). There was no treatment effect on profiles of serum Cys (P>0.13), Met (P>0.12), FRAP (P>0.15) and TBARS (P>0.17). Plasma B12 was increased (P < 0.01)(137.7 ± 4.8, 185.3 ± 6.4, 212.3 ± 9.0 nM for V1, V2 and V3 pigs, respectively) and Hcy was decreased (P<0.01)(23.6 ± 0.5, 19.9 ± 0.6, 18.1 ± 0.5 μM for V1, V2 and V3 pigs, respectively) by the vitamin treatments. There was no interaction between Met and vitamin treatments whatever the criteria. Additional Met, during the growing period, and supplements of B9 and B12, during the finishing period, appeared beneficial for growth performance. The importance of the Hcy response to B9 and B12 remained to be further investigated on other aspects of metabolism in pigs.

Key Words: Vitamins, Methionine, Pigs

389 Transport of zinc chloride radiotracer in small intestine brush border membrane vesicles prepared from weanling pigs.

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This study was conducted to measure the transport of Zn into a pig intestinal brush border membrane vesicle (BBMV) preparation using radiolabeled Zn with cellulose as the carrier. Fresh samples of duodenum, jejunum and ileum were obtained from the small intestines of five crossbred pigs at 21 days of age. The BBMV were prepared using a magnesium chloride aggregation method. Assays for two apical enzyme markers, sucrase and alkaline phosphatase, were used to determine the purity of the BBMV. An increase in the marker enzymatic activities in the BBMV indicates an increase in the markers relative to crude lysate. An *in vitro* procedure designed to simulate the digestive system of the pig (Liu et al., 1998; Tsunoda et al., 2001) was used to 'digest' the sample prior to BBMV uptake studies. Preliminary trials with non-radiolabeled Zn found effective digestion of Zn with cellulose carrier between 0.25-0.5 g. Based on these results, we conducted transport assays at 2.0 and 10.0 ppm Zn as $ZnCl_2$ with ^{65}Zn radiotracer using the BBMV to determine Zn uptake. $T_{1/2}$ of Zn uptake in duodenum was between 1.0 and 2.5 minutes. Maximal duodenal uptake at 2.0 and 10.0 ppm Zn was ∼12.0 and 27.0 nmol Zn/mg protein, respectively. In the jejunum, $T_{1/2}$ of Zn uptake was less than 1 minute. Maximal jejunal uptake at 2.0 and 10.0 ppm Zn was ∼3.5 and 9.0 nmol Zn/mg protein, respectively. $T_{1/2}$ of Zn uptake in ileal vesicles was between 1.0 and 2.5 minutes. Maximal ileal uptake at 2.0 and 10.0 ppm Zn was ∼6.0 and 25.0 nmol Zn/mg protein, respectively. This suggests that BBMV from the duodenum and the ileum have a higher capacity for Zn uptake than the jejunum. This *in vitro* technique will allow us to determine if the rate of Zn transport in BBMV is affected by dietary source and concentration of Zn, factors that are important in minimizing supplementation and reducing excretion in manure.

Key Words: Weanling pigs, Zinc transport, Small intestine

390 Available phosphorus requirement to maximize growth and bone mineralization in 24 to 50-kg pigs.

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Eighty barrows initially weighing 23.7 kg BW were utilized in a 30-d feeding experiment to determine the dietary available phosphorus (aP) concentration that maximizes growth performance and bone mineralization. Prior to experimentation, pigs received dietary aP concentrations as recommended by NRC (1998) from weaning to 24 kg BW. Pigs were individually penned and allotted by weight to one of eight dietary treatments in a completely randomized design with eight replications per treatment. Experimental diets were formulated with varying concentrations of aP (0.075% to 0.425% at 0.05% increments) by the addition of monosodium phosphate (MSP). All diets were corn-soybean meal-based (1.15% true digestible lysine) and formulated to a fixed 1.2:1 calcium:total P ratio. The basal diet contained no added MSP. Average daily gain (ADG) was measured and feed intake calculated at the end of the 30-d test period. Breaking load and ash content of the left fibula were also determined on all pigs at termination of the experiment. ADG increased quadratically (P < 0.05) as aP concentration increased in the diet. Average daily feed intake (ADFI) and gain:feed increased linearly (P < 0.01) as aP concentration increased in the diet with ADFI having a tendency to increase quadratically (P = 0.09). Bone breaking load, grams of fibula ash, and percentage of fibula ash increased quadratically (P < 0.01) as dietary aP concentration increased. Two-slope regression was performed to estimate dietary aP requirements. Although the growth responses to increasing aP did not lend itself to accurate break-point analysis, the point of inflexion for bone breaking load and grams of fibula ash both occurred at 0.32% dietary aP concentration. These results indicate a dietary aP requirement of 0.32% for maximal bone mineralization for the 24 to 50-kg pig.

Key Words: Phosphorus, Pigs, Bone

391 Effect of dietary available/digestible phosphorus regimen on P and N utilization in pigs.

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Pigs were self-fed diets containing .2, .3, .4, .5, .6 or .7% bioavailable P (aP, based on analyzed P x % availability [NRC, 1998] of P in each ingredient) from 7 to 32 kg BW. Fifteen sets of six littermate barrows were allotted within litter to one of six P regimens consisting of a basal, corn-soy-whey diet (.56% analyzed P) supplemented with incremental additions of dicalcium phosphate at the expense of starch-limestone. Dietary calcium was either fixed in each of 6 diets at 1.15% (1.1 to 1 Ca/total P ratio in highest P diet) or adjusted in each diet to achieve a 2.5 to 1 Ca/aP ratio. P and N digestibility and accretion were determined in each pig for 4 days at BW (± 1.3 kg) of 10 and 30 kg. Digestible dietary P (dP) was determined to be .32, .42, .51, .56, .63 and .70% for the six P regimens. The P digestibility values for the basal and dical P were 1.6 and .7 times, respectively, of the bioavailable reference values. Daily body P accretion (3.1, 4.1, 5.1, 5.5, 5.6, 6.0 g, P<.01) and N accretion (22.6, 24.2, 26.2, 26.0, 23.5, 25.2 g, P<.03) increased but at a diminishing rate (quadratic response) as dietary concentrations of dP increased (pooled across Ca/P regimen and BW). The magnitude of responses in P accretion to increased dP was greater (P<.05) in 2.5/1 Ca/aP regimen and at 10 kg BW. The P (5.0, 6.6, 7.9, 8.1, 8.1, 8.7 g/kg) and N contents of BW gain and the ratio of P to N accrued in the body also increased but at a diminishing rate (quadratic dP, P<.03) as dP

concentrations increased with the greatest responses in body P contents occurring in the 2.5/1 Ca/aP regimen and at 10 kg BW. Based on these data, the dietary dP concentration needed to optimize accretion of proteineous tissues as well as efficiency of phosphorus utilization in 10 to 30 kg pigs is .48 -.53% in both Ca/P regimens. But, the biological response (i.e. accretion-excretion of P) to ingestion of higher amounts of dP is dependent on the dietary Ca/dP regimen which influences whether the additional dP is retained (likely in bone because N accretion not altered) or excreted in urine.

Key Words: Phosphorus, Nitrogen, Calcium

392 Evaluation of EcoPhos^{TM} phytase in growing pigs weighing 36 to 56 kg. R.W. Fent*[1], D.M. Webel[2], J.D. Spencer[2], T.S. Torrance[2], B.W. Ratliff[1], and G.L. Allee[1], [1]*University of Missouri-Columbia,* [2]*United Feeds Inc., Sheridan, IN.*

Sixty-four barrows initially weighing 35.7 kg BW were utilized in a 24-d feeding experiment to examine the phosphorus-releasing efficacy of increasing dietary concentrations of phytase (EcoPhos^{TM}, Phytex LLC, Portland, ME). Pigs were individually penned and allotted by weight to one of eight dietary treatments in a randomized complete block design with eight replications per treatment. A corn-soybean meal-based basal diet (1.0% true digestible lysine) was formulated to contain 0.06% available phosphorus (aP) (0.71% calcium). A standard curve, from which bioavailable phosphorus release could be calculated, was achieved by supplementing nonosodium phosphate to the basal diet at 0.06, 0.12, and 0.18%. Four concentrations (250, 500, 1000, and 2000 FTU/kg) of phytase premix were added to the basal diet to comprise the other four experimental diets. Average daily gain (ADG) was measured and feed intake calculated at the end of the 24-d test period. Following termination of the experiment, breaking load and ash content of the right fibula were also determined for all pigs. Increasing aP quadratically increased ADG ($P < 0.01$) and gain:feed ($P < 0.03$). No effect ($P > 0.10$) was observed for feed intake. Bone breaking load and grams of fibula ash increased linearly ($P < 0.02$ and $P < 0.01$, respectively) with increasing dietary aP from MSP. Increasing phytase supplementation from 0 to 2000 FTU/kg quadratically increased ADG ($P < 0.01$) and gain:feed ($P < 0.01$). Phytase supplementation quadratically increased grams of fibula ash ($P < 0.01$) and linearly increased bone breaking load ($P < 0.06$). Based on the linear regression of grams of fibula ash on supplemental phosphorus intake ($r^2 = 0.50$), phosphorus-releasing values for 250, 500, 1000, and 2000 FTU/kg dietary phytase concentrations were 0.136, 0.140, 0.184, and 0.196%, respectively. These results demonstrate the efficacy of EcoPhos phytase to improve the availability of dietary phosphorus for the 36 to 56-kg pig.

Key Words: Phytase, Phosphorus, Pigs

393 Effects of a solid-state fermented phytase on growth performance, bone traits and P digestibility of growing pigs fed corn-soybean meal diets containing wheat middlings. J. S. Park*[1], S. D. Carter[1], J. D. Schneider[1], T. B. Morillo[1], and J. L. Pierce[2], [1]*Oklahoma State University, Stillwater,* [2]*Alltech, Inc., Nicholasville, KY.*

A total of 24 barrows (avg BW = 20.9 kg) was used in a 35-d study to determine the effects of the addition of a solid-state fermented phytase complex (Allzyme SSF; Alltech, Inc) to low available P, corn-soybean meal (SBM) diets containing 20% wheat middlings (WM) on growth performance, bone traits, and P utilization. Pigs were blocked by weight and ancestry, and randomly allotted to one of four dietary treatments (6 pigs/trt). A basal diet (Diet 1) consisted of corn, SBM, and WM (20%) and was adequate in all nutrients, except available P. This diet contained 0.50% total P (0.13% avail. P), all of which was provided by corn, SBM, and WM. Diets 2 and 3 were the basal plus SSF to provide 250 and 500 phytase units (PU)/kg, respectively. The positive control diet (Diet 4) was corn-SBM-based with 20% corn starch (0.50% total P, 0.24% avail. P). All diets were formulated to 0.77% app. dig. Lys and a Ca:total P of 1.2:1. Pigs were housed individually with ad libitum access to feed and water. There were two 5-d periods (d 10-15 and d 25-30) for collection of feces and urine. On d 35, all pigs were killed and the femurs and 3rd/4th metacarpals and metatarsals (MM) were extracted. Overall, ADG and gain:feed (G:F) were, respectively: 590, 629, 637, 747 g/d and 467, 470, 491, 515 g/kg. Phytase did not affect ADG or ADFI ($P > 0.22$), but it increased G:F (linear, $P < 0.04$). Digestibility of P increased (linear, $P < 0.03$) with SSF addition, resulting in a 10% reduction in P excretion for pigs fed 500 PU/kg. Bone breaking strength (BS) of MM and femurs and ash (%) increased (linear, $P < 0.04$) with SSF (37, 46, 49 kg; 140, 171, 177 kg; 49.1, 50.9, 51.9%, respectively). However, pigs fed PC had higher ($P < 0.01$) ADG, G:F, BS, and bone ash compared to those fed diets containing WM. These data indicate that the addition of a solid-state fermented phytase improves P utilization of corn-soybean meal diets containing wheat middlings for growing pigs.

Key Words: Pigs, Phytase, Bone

394 Comparative effectiveness of *Aspergillus niger* wild-type and variant phytases in the hydrolysis of phytate-phosphorous in the diets for weanling pigs. S. E. Crowe*, T. W. Kim, K. R. Roneker, and X. G. Lei, *Cornell University, Ithaca, NY USA.*

Aspergillus niger PhyA phytase has a pH optimum (5.5) above the pH level in the stomach of swine. To improve its feeding efficacy, we have developed a series of PhyA mutants with altered pH profiles. The objective of this experiment was to test the relative effectiveness of two mutants with single mutations in the 300th amino acid sequence (Lys300Arg, Lys300Thr), compared with the wild-type enzyme, in diets for young pigs. Thirty-five male weanling pigs (5-wk old, 9.5 kg BW) were divided into five treatment groups. A corn-soybean meal basal diet (BD, no added inorganic phosphorus) was fed for 4 wk to each of the groups either alone, with 0.15% inorganic phosphorous, or with wild-type, Lys300Arg, or Lys300Thr phytases at 300 units per kg feed. At the end of the trial, pigs fed BD alone had lower ($P< 0.05$) ADG, ADFI, and plasma inorganic phosphorous concentration, but higher ($P < 0.05$) plasma alkaline phosphatase activity than those fed BD + 0.15% inorganic phosphorus. Pigs fed the wild-type enzyme had improved growth performance and higher ($P < 0.05$) plasma inorganic phosphorus concentration than pigs fed BD. However, there was no significant difference in any of the measures between the pigs fed the wild-type and the mutant enzymes. In conclusion, the two mutants did not show efficacy improvements over the wild-type enzyme, indicating possible inadequate alterations in pH profile of these two mutants or inappropriate dietary and stomach conditions in the present study for an overall feeding effectiveness difference.

Key Words: Phytase, Pig, Mutation

395 Pharmacological levels of zinc reduce phytase efficacy *in vivo*. N. R. Augspurger*[1], D. M. Webel[2], J. D. Spencer[2], and D. H. Baker[1], [1]*University of Illinois at Urbana-Champaign,* [2]*United Feeds Inc., Sheridan, IN.*

The efficacy of phytase has been shown to be negatively affected by zinc (Zn) and several other cations *in vitro* (Maenz et al., 1999). Therefore, the objective of this work was to determine the effect of growth-promoting levels of Zn from two sources on the efficacy of phytase in young pigs fed phosphorus (P)-deficient diets. Ninety-nine individually-fed pigs (7.2 kg) were given ad libitum access to one of 11 experimental diets for a period of 21 d. Pigs were fasted overnight before final body weights were taken, after which the five median-weight blocks of pigs were euthanized and the right fibula was harvested for determination of bone ash. Fibula ash (mg) was regressed against supplemental inorganic P (iP) intake (g) to set up the standard curve to which phytase treatments were compared to determine P-releasing efficacy. The basal diet was a corn soybean meal diet with no supplemental P (21% CP, 0.075% estimated available P, 129 mg/kg Zn). Diets included three graded levels of supplemental iP (0, 0.075, 0.150%) from reagent-grade KH_2PO_4, two levels of phytase (500 and 1,000 FTU/kg) from EcoPhos^{TM} (Phytex LLC, Portland, ME), 1,500 mg/kg of Zn from either Waelz ZnO or tetrabasic Zn chloride (TBZC, $Zn_5Cl_2(OH)_8$; Micronutrients Corp., Indianapolis, IN), and all combinations of EcoPhos^{TM} and Zn. All response criteria responded linearly ($P < 0.01$) to supplemental iP. EcoPhos^{TM} improved ($P < 0.01$) weight gain, feed intake and gain/feed ratio, as well as fibula ash (% and mg). Bone ash (mg) was highest ($P < 0.01$) for 1,000 FTU/kg EcoPhos^{TM}. Supplemental Zn had no effect ($P > 0.10$) on growth performance, but reduced ($P < 0.05$) fibula ash (% and mg). Regression of fibula ash on supplemental iP intake resulted in an excellent fit ($r^2 = 0.87$). In the absence of Zn, 500 FTU/kg of EcoPhos^{TM} released 0.130% P, while in the presence of TBZC or ZnO,

P-release values were reduced ($P < 0.01$) to 0.085 and 0.099% P, respectively. At 1,000 FTU/kg of EcoPhos^{TM}, Zn reduced ($P < 0.01$) P-releasing efficacy from 0.195% P to 0.140 and 0.124% P for the TBZC and ZnO treatments, respectively. These results suggest that growth-promoting levels of Zn chelate the phytate complex, thereby reducing its availability for hydrolysis by phytase.

Key Words: Pigs, Phytase, Zinc

396 Differences in total tract and ileal digestibility coefficients of calcium and phosphorus in growing pigs fed low phytate corn, normal corn, soybean meal, and corn soybean meal based diets. R. A. Bohlke*, H. H. Stein, A. R. Wirt, and R. C. Thaler, *South Dakota State University*.

The primary objective of this experiment was to determine the apparent ileal digestibility coefficients (AID) and the apparent total tract digestibility coefficients (ATTD) of calcium (Ca) and phosphorus (P) in low phytate corn (LPC), normal corn (NC), soybean meal (SBM), and corn-soybean meal-based diets by growing pigs. The second objective was to determine if there were differences between the AID and the ATTD for Ca and P. Eight diets were formulated and fed to nine growing barrows. Three diets contained LPC, NC, and SBM as the sole source of Ca and P. Three similar diets contained supplemental inorganic Ca (iCa) and P (iP) to bring the contents up to the requirements of the animals (i.e. 0.5% Ca and 0.2% digestible P). Two diets containing LPC-SBM and NC-SBM were also supplemented with iCa and iP to reach the animals requirements. Each diet was fed to the pigs for nine days with ileal digesta being collected from 0800 to 2000 on d 8 and d 9. Fecal samples were collected on d 7 and d 8. The AID and the ATTD (70 and 69%, respectively) of Ca in LPC were higher ($P < 0.05$) than in NC (47 and 50%) and SBM (51 and 47%). The addition of iCa did not affect ($P > 0.05$) the AID or the ATTD of Ca for any of the three feed ingredients. No differences ($P > 0.05$) in the AID of Ca were found between the LPC-SBM (55%) and NC-SBM (51%) diets. The AID and the ATTD of P in the LPC diet were higher ($P < 0.05$) than that of the NC and SBM diets (57 and 55% vs. 28 and 29% and 37 and 38%). When iP was added to NC and SBM, the AID and the ATTD of P increased ($P < 0.05$). However, the addition of iP did not ($P > 0.05$) improve the AID or the ATTD of P in LPC. For both Ca and P, there were no differences ($P > 0.15$) between the AID and the ATTD. In conclusion, LPC has a higher Ca and P digestibility than NC and SBM. There appears to be no net absorption or excretion of Ca and P in the large intestine of growing pigs fed corn or soybean meal based diets.

Key Words: Pigs, Digestibility, Low phytate corn

397 Phytase additions to conventional or low-phytate corn-soybean meal diets on performance, bone traits, and phosphorus excretion of growing pigs. E. G. Xavier*, G. L. Cromwell, and M. D. Lindemann, *University of Kentucky, Lexington*.

Effects of phytase in diets containing low-phytate (LP) or normal (N) corn and LP, low-oligosaccharide or N soybean meal (SBM) were evaluated. The corn and SBM were provided by Pioneer Hi-Bred International, Johnston, IA. The LP-corn, N-corn, LP-SBM, and N-SBM contained 0.26, 0.31, 0.77, and 0.70% total P and 0.09, 0.25, 0.22, and 0.48% phytate P with estimated P bioavailabilities of 75, 20, 50, and 20%, respectively. Individually-penned pigs (six/treatment) were fed eight corn-SBM diets (1.05% lysine, 0.65% Ca) from 15 to 42 kg (40 d). Diets 1-5 were N-corn + N-SBM with 0.20, 0.10, 0.10, 0.00, and 0.00% added P from monocalcium phosphate. Diets 6-8 were LP-corn + LP-SBM with 0.10, 0.00, and 0.00% added P. Phytase (Natuphos$^{®}$, BASF) was added to Diets 3, 5, and 8 at 750 units/kg. The N and LP diets without added P contained 0.39 and 0.37% total P and 0.08 and 0.23% bioavailable P, respectively. Diet 1 met the P requirement for pigs of this weight range (NRC, 1998). At termination, metatarsals, metacarpals, and femurs were obtained from all pigs. Reducing dietary P negatively affected ($P < 0.01$) growth rate, feed/gain, and mean bone strength (relative to pigs fed Diet 1) to a greater extent in pigs fed N vs LP diets (751, 700, 723, 571, 660, 791, 685, and 706 g/d; 1.80, 1.95, 2.01, 2.55, 2.23, 1.86, 1.87, and 1.88; 100, 73, 98, 45, 67, 103, 78, and 97 for Diets 1-8), and phytase prevented ($P < 0.01$) some of the effects of reducing dietary P level. Apparent digestibility of P (using Cr_2O_3) for Diets 1-8 was 44, 33, 49, 25, 40, 60, 55, and 70% ($P < 0.01$). Fecal P excretion was influenced ($P < 0.01$) by type of corn-SBM, P level, and phytase addition (4.49, 4.45, 3.67, 4.26, 3.39, 2.79, 2.11, and 1.45 g/d). Soluble P in feces was low (1.69, 1.74, 1.63, 1.56, 1.96, 1.81, 1.94, and 2.16% of total P), but increased when phytase was added to the low-P, N ($P < 0.01$) or LP ($P < 0.05$) diets. The results indicate that growing pigs fed LP-corn and LP-SBM require less P to optimize performance and bone density; and when phytase is included in LP-corn-SBM diets, pigs excrete up to 68% less fecal P than pigs fed conventional corn-SBM diets without phytase.

Key Words: Pigs, Phosphorus, Phytase

Physiology: Nutrition-reproduction, stress, and growth

398 Effects of experimental fascioliasis on pubertal development in heifers. M. J. Paczkowski*, T. M. Craig, D. D. Magee, J. A. Thompson, and D. W. Forrest, *Texas A&M University, College Station, TX*.

Angus-sired heifers were allotted by age (mean=4 mo), BW (mean=135 kg), and sire (n=4) to either a control (uninfected, n=10) or infected group (n=11). Metacercariae of *Fasciola hepatica* were administered (intraruminally, d 0) to study effects on interval to puberty, circulating ovarian steroids, serum liver enzymes and BW. Blood samples were collected bimonthly from d 0 to 56 and biweekly from d 60 through 210 for analysis of serum estradiol 17β (E_2) and progesterone (P_4) concentrations by RIA. At 2-wk intervals, BW was recorded, a blood sample was obtained to quantify serum aspartate-aminotransferase (AST) and γ-glutamyltranspeptidase (GGT) and a fecal sample was collected to assess excretion of *F. hepatica* eggs. Puberty was defined by the occurrence of the first luteal phase (serum P_4 concentrations >1.0 ng/ml for a minimum duration of 10 d). A univariate ANOVA using the RANDOM statement in PROC GLM was used to determine significant linear and curvilinear responses to treatment in prepubertal heifers (from d 0 to 113) for BW, E_2, P_4, AST, and GGT. Treatment effects at d 113 were determined by one way ANOVA. *F. hepatica* eggs were detected in all infected heifers after day 92. Linear ($P<0.01$) and curvilinear ($P<0.05$) responses for AST and a linear ($P<0.05$) response for GGT concentrations were detected over time in infected heifers. On d 113, mean GGT levels were higher ($P<0.01$) in infected than in control heifers (116.4 $\pm$ 31.2 vs 20.2 $\pm$ 2.8 U/L, respectively). Mean BW, serum AST, E_2, and P_4 concentrations did not differ between treatment groups on d 113. By d 210, 60% (six of 10) of heifers in the control group and 36% (four of 11) of heifers in the infected group attained puberty. We conclude that *F. hepatica* infection induced elevated levels of serum enzymes which are indicative of liver damage, and there was a more persistent elevation in GGT than the elevation in AST levels. Experimental fascioliasis resulted in a lower percentage of heifers that reached puberty within 7 mo of infection as compared to control heifers.

Key Words: Heifer, Fascioliasis, Puberty

399 Leptin modulates fertility in oMt1a-oGH transgenic mice. A. T. Thomas*, T. R. Famula, J. D. Murray, and A. M. Oberbauer, *University of California, Davis, California*.

Elevated growth hormone (GH) changes body composition and suppresses fertility in livestock and rodents. The ovine metallothionein 1a-ovine growth hormone (oMt1a-oGH) transgenic mouse model allows the study of GH effects on body composition and fertility, as the transgene is easily activated and inactivated to express GH by provision of 25 mM zinc in the drinking water. Chronic expression of the transgene results in a lean phenotype and activation followed by inactivation of the transgene causes obesity. Plasma leptin concentrations reflect adipose stores within the body and also influence reproduction. We hypothesize that reproductive function will be reduced in obese oMt1a-oGH mice due to elevated leptin levels. Thus, the purpose of this study was to determine how fertility changes as a function of body composition

and how plasma leptin levels vary with transgene expression and reproductive performance in oMt1a-oGH mice. At weaning oMt1a-oGH transgenic (TG) and wild type (WT) females were allocated to a treatment: oMt1a-oGH females chronically expressing the transgene (TG ON, n=170), oMt1a-oGH females expressing the transgene from 3 to 8 weeks of age (TG ON/OFF, n=172), WT females receiving the transgene stimulus from 3 to 8 weeks of age (WT ON/OFF, n=177), and WT females never receiving the transgene stimulus (WT OFF, n=190). Eight-week-old females were housed with males for a 2-week period, after which females were isolated from males and allowed to carry pregnancies to term. Body and gonadal fat pad (GFP) weight, plasma leptin concentrations, and pregnancy rate for each animal were recorded. The transgene stimulus did not affect any parameter measured in the WT animals (P>0.1) and the data for the WT animals were pooled. TG ON mice were larger and leaner than TG ON/OFF mice that became obese (P<0.001). Plasma leptin correlated with GFP (r^2=.63) and were approximately 2 and 2.5 fold higher in TG ON/OFF than WT and TG ON, respectively (P<.05). Leptin was elevated in infertile versus fertile females in all groups, suggesting that elevated leptin, reflecting altered adipose depots, in combination with GH, may impair fertility in these animals.

Key Words: Leptin, Obesity, Infertility

400 Orexin-B modulates LH and GH secretion: Interaction with the brain-pituitary axis in the pig. C. R. Barb*[1], J. B. Barrett[1], R. R. Kraeling[1], and R. L. Matteri[2], [1]*USDA-ARS, Athens, GA,* [2]*USDA-ARS, Columbia, MO.*

Two experiments (EXP) were conducted to test the hypothesis that orexin-B affects LH and GH secretion. In EXP I, prepuberal gilts received intracerebroventricular (ICV) injections of 0.9% saline (S; n = 2), 10 ug (n = 2) or 100 ug (n = 2) of orexin-B in S. Blood was collected every 15 min for 2 hr before and 2 hr after ICV injections. In EXP II, anterior pituitary cells from prepuberal gilts were studied in primary culture. On d 4 of culture, 10^5 cells/well were challenged with 10^{-10}, 10^{-8} or 10^{-6} M GnRH; 10^{-8}, 10^{-7} or 10^{-6} M [Ala^{15}]-hGRF-(1-29)NH_2 or 10^{-10}, 10^{-9}, 10^{-8} or 10^{-7} M orexin-B individually or in combinations with 10^{-10} and 10^{-6} M GnRH or 10^{-8} and 10^{-6} M GRF. Secreted LH and GH were measured at 4 hr after treatment. In EXP I, serum LH and GH concentrations were similar among pigs before treatment and were unaffected by orexin-B treatment; averaging 0.5 0.2, 1.0 0.2 and 1.0 0.2 ng/ml for LH and 2.1 3.4, 6.1 3.4 and 5.8 3.4 ng/ml for GH after ICV injection of S, 10 ug or 100 ug orexin-B, respectively. In EXP II, basal LH and GH secretion (control; n = 9 wells) was 183 18 and 108 4.8 ng/well, respectively. Relative to control at 4 hr, all doses of GnRH and GRF increased (P<0.001) LH and GH secretion. All doses of orexin-B increased (P <0.001) GH secretion, while only the 10^{-10} M dose increased (P<0.005) LH secretion. Secreted LH and GH were unaffected by addition of 10^{-10}, 10^{-9}, 10^{-8} or 10^{-7} M orexin-B in combinations with 10^{-10} and 10^{-6} M GnRH or 10^{-8} and 10^{-6} M GRF compared to GnRH or GRF alone, except 10^{-9} M orexin-B suppressed (P<0.02) the LH response to 10^{-6} M GnRH. These results indicate that orexin may directly modulate LH and GH secretion at the level of the pituitary gland, but not the brain.

Key Words: Orexin, Hormone, Pig

401 Associations among circulating concentrations of IGF-1 and GH during the postpartum period with resumption of estrus, calf weights, and milk production in mature crossbred cows fed varying levels of energy intake. A. J. Roberts*[1] and T. G. Jenkins[2], [1]*USDA-ARS, Fort Keogh LARRL, Miles City, MT,* [2]*USDA-ARS, MARC, Clay Center, NE.*

Circulating concentrations of IGF-1 and GH fluctuate in response to nutritional status. Objectives of this study were to evaluate usefulness of circulating profiles of IGF-1 and GH during the postpartum period as predictors of capacity to resume estrus and level of production (milk and calf growth). Mature crossbred cows produced from Angus, Hereford, Shorthorn, Galloway, Longhorn, Nellore, or Salers sire breeds were fed at 132 or 189 kcal ME/kg metabolic BW or ad libitum (6 to 8 cows/sire breed/feed level). Concentrations of progesterone in weekly blood samples collected 2 through 14 wk post-calving were used to estimate length of anestrus. Concentrations of IGF-1 and GH were determined in serum samples collected at wk 2, 4, 8, and 14 postpartum. Within cow regressions were used to obtain estimates (i.e., slopes) of changes in IGF-1 and GH concentrations over time. Analyses of covariance were used to evaluate linear effects of concentration at wk 2 and slope of IGF-1 or GH, fixed effects of sire breed, and interactions among linear and fixed effects on length of anestrus, peak week and level of milk production, and adjusted weaning weight (**WW**) of calf. Breed of sire accounted for variation ($P < 0.02$) in all variables except peak week of milk production. Length of anestrus was influenced ($P < 0.03$) by interactions between IGF-1 covariate terms with breed of sire. Peak level of milk production was associated negatively ($P < 0.01$) with IGF-1 at wk 2. Time of peak milk production was influenced ($P < 0.1$) by the interaction of GH at wk 2 with breed of sire. Adjusted WW of calf was associated negatively with both GH covariate terms ($P < 0.01$). Within breed, initial concentrations (wk 2) and pattern of change in IGF-1 and(or) GH concentration during the postpartum period are predictive of capacity to resume cycling and potential for productivity (milk and calf wt).

Key Words: GH, IGF-1, Postpartum

402 Endocrine responses to 72 h feed deprivation in weanling pigs. B. E. Salfen*[1], J. A. Carroll[1], and D. H. Keisler[2], [1]*Animal Physiology Research Unit, Agricultural Research Service-USDA,* [2]*University of Missouri-Columbia.*

The study objective was to assess endocrine and tissue responses to 72 h feed deprivation in weaned pigs. Thirty-two barrows were weaned at 18 d of age and placed on a complex nursery diet. At 27 d of age, pigs were non-surgically fitted with an indwelling jugular vein catheter. Starting at 28 d of age, pigs were either fed for 72 h (CON72; n = 8), fed for 96 h (CON96; n = 8), feed deprived for 72 h (FD72; n = 8), or FD72 and then re-fed from 72-96 h (FD72/RF24; n = 8). Pigs were sacrificed at 72 h (CON72 and FD72) or 96 h (CON96 and FD72/RF24) for collection of tissues. Body weights were determined at cannulation and sacrifice, and feed consumption was determined at 23 d, 26 d, 28 d and at sacrifice. Blood was collected at 12 h intervals starting at -12 h relative to the start of the feed deprivation period and continuing until sacrifice. Mean body weights of pigs in the FD72 treatment was less than CON72 at sacrifice ($P < 0.05$); however, the mean body weight of FD72/RF24 pigs did not differ from CON96 ($P > 0.05$). Concentrations of ghrelin in the FD72 and FD72/RF24 groups differed throughout time ($P < 0.001$) and when presented as values relative to 0 h were 89% at 12 h ($P < 0.03$), then increased to 112% at 36 and 48 h ($P = 0.10$), then decreased to 75% at 72 h ($P < 0.001$). Serum IGF-I and leptin decreased following feed deprivation ($P < 0.001$) and remained low until re-feeding. Cortisol was elevated from 12 h to 72 h during feed deprivation ($P < 0.01$). Expression of ghrelin mRNA tended to be lower in the FD72 pigs' stomachs, pituitary glands, and hypothalami ($P = 0.06$, 0.07, and 0.08, respectively), compared to CON pigs. These results provide evidence that feed deprivation is accompanied by multiple changes in the endocrine and neuroendocrine axis which influences feed intake, somatotrophic regulation and stress hormone concentrations.

Key Words: Piglet, Food deprivation, Weaning

403 Influence of short-term fasting on ovarian follicular development in ewes. M. McFarland*, Z. Kiyma, E. A. Van Kirk, and G. E. Moss, *University of Wyoming, Laramie.*

The objective of this experiment was to determine if fasting during the luteal phase of the estrous cycle influenced ovarian follicular development during the ensuing proestrus. Fasted (n = 15) ewes were not fed from d 7 to 12 of the estrous cycle. Control (n = 10) ewes were fed ad libitum. On d 12 ewes were treated with $PGF_2\alpha$ and ovarian follicles present after 0 and 72 h in control and 0, 72 and 96 h in fasted ewes were enumerated and categorized as small (< 2 mm), medium (3 to 4 mm) or large (>5 mm). At 0 h, ovaries from fasted ewes contained fewer small ($P < 0.05$) and medium ($P < 0.05$) follicles than control [19.6 vs. 9.4 ($\pm$ 2.9) and 8.4 vs. 3.4 ($\pm$ 1.5) for small and medium follicles, respectively]. Three fasted ewes exhibited an LH surge and ovulated by 96 h and were removed from analysis. When follicular populations were compared in the remaining animals at approximately 16 to 21 h prior to the anticipated preovulatory LH surge no differences ($P = 0.63$) were detected among groups. Serum concentrations of estradiol following administration of $PGF_2\alpha$ were influenced by a treatment by time interaction ($P < 0.01$). At comparable times prior to the anticipated LH surge (i.e. 72 h in C vs. 96 h in F) concentrations of estradiol were nearly 2-fold greater in control than fasted ewes. Serum concentrations of FSH were influenced ($P < 0.01$) by a treatment by time interaction and were greater

(32.3 ± 2.2 vs. 25.0 ± 3.0 ng/mL) in control than fasted ewes. Concentrations of LH were not influenced ($P > 0.43$) by treatment, time, or interactions. In summary, fasting during the luteal phase of the estrous cycle acutely decreased numbers of small and medium ovarian follicles. Realimentation resulted in a rapid equilibration in follicular populations, however, concentrations of estradiol during proestrus remained depressed perhaps due to diminished secretion of FSH.

Key Words: Ewes, Fasting, Proestrus

404 Effect of fish meal supplementation on endometrial sensitivity to oxytocin in beef heifers having low luteal phase progesterone. N. E. Wamsley*, P. D. Burns, T. E. Engle, and R. M. Enns, *Colorado State University, Fort Collins, CO.*

The objective of this study was to evaluate the ability of n-3 fatty acids in fish meal to attenuate oxytocin-induced release of uterine prostaglandin F2a (PGF) in heifers having low luteal phase concentrations of progesterone (P4). Heifers were individually fed a corn silage-based diet supplemented with either fish meal (FM; 5% DM; n=12) or corn gluten meal (CM; 6% DM; n=13). After d 25 of supplementation, heifers were given 25 mg of PGF to induce estrus. On d 3 after estrus, half of the heifers in each supplement group were given 3 injections of PGF (25 mg/injection) at 12 h intervals to induce formation of corpora lutea that secrete lower concentrations of P4. Jugular blood samples were collected daily from d 1 to d 16 after observed estrus and assayed for P4. On d 16, heifers were challenged with oxytocin (100 IU; iv). Jugular blood samples were collected at -60, -30, -15, 0, 15, 30, 45, 60, 90, and 120 min post oxytocin injection and assayed for 13, 14 dihydro 15-keto PGF2a (PGFM). Administration of PGF on d 3 induced low luteal phase concentrations of P4 in 5 FM heifers and 3 CM heifers. Non-responding heifers were sorted to the high luteal phase group. One FM heifer and 3 CM heifers receiving no PGF on d 3 had low luteal phase P4 and were sorted to the low group. After sorting, treatments consisted of high luteal P4 + FM (n=6), low luteal P4 + FM (n=6), high luteal P4 + CM (n=6), and low luteal P4 + CM (n=7). Dietary supplement had no effect (P>0.20) on serum concentrations of P4, but concentrations of P4 were lower in heifers in the low luteal phase group (P<0.01). Serum concentrations of PGFM following oxytocin stimulation were greater in heifers having low luteal phase concentrations of P4 compared to heifers having high luteal phase P4 (P<0.01). Fish meal supplementation attenuated this response in heifers having low luteal phase concentrations of P4 (P<0.05), but had no effect on heifers having high luteal phase concentrations of P4 (P>0.10). In conclusion, the n-3 fatty acids in fish meal appear to decrease uterine PGF synthesis in heifers having low luteal phase concentrations of P4.

Key Words: Heifer, Fish meal, Prostaglandin

405 Growth hormone (GH) binding in liver of periparturient Holstein cows is correlated with growth hormone receptor (GHR) 1A mRNA. R. P. Radcliff*[1], B. L. McCormack[1], B. A. Crooker[2], and M. C. Lucy[1], [1]*University of Missouri, Columbia,* [2]*University of Minnisota, St. Paul.*

Growth hormone plays a central role in metabolic adaptations that occur during the initiation of lactation. The primary liver GHR transcript (GHR 1A mRNA) is transiently decreased around parturition. The decrease in liver GHR 1A mRNA may cause a reduction in GH-dependent signaling that leads to low blood IGF-I concentrations in periparturient cattle. We tested the hypothesis that the decrease in GHR 1A mRNA at parturition is associated with a decrease in GH binding (i.e., GHR protein expression) in liver. Blood and liver samples were collected from Holstein cows (n = 12) on d -12 ± 1, +3 and +17 relative to parturition. Total cellular RNA was isolated from a sub-sample of liver and reverse transcribed (RT) to cDNA. The GHR 1A and IGF-I cDNA were measured by quantitative real-time polymerase chain reaction. Microsomal membranes were isolated from the remaining liver sample and assayed for GH binding. Liver GHR 1A mRNA (183, 31 and 132 ± 27 fg/25 ng RT, $P < 0.004$), liver IGF-I mRNA (172, 31 and 83 ± 20 fg/25 ng RT, $P < 0.001$), and blood IGF-I concentrations (130, 55 and 71 ± 8 ng/ml on d -12, +3 and +17, respectively, $P < 0.001$) were coordinately decreased on d +3. A decrease ($P < 0.03$) in specific ^{125}I-GH binding also occurred on d +3 (5.2 ± 0.8, 1.7 ± 1.0 and 5.1 ± 0.8% on d -12, +3 and +17, respectively). Across all days, ^{125}I-GH specific binding was correlated with GHR 1A mRNA ($R^2 = 0.68$; $P < 0.001$). Saturation binding analysis of pooled microsomal membranes demonstrated a 30- and a 3-fold decrease in GH receptor number (B_{max}) for liver on d +3 and +17 relative to d -12 (4.95 ± 0.57, 0.16 ± 0.03 and 1.38 ± 0.06 fmole/mg protein on d -12, +3 and +17, respectively). We conclude that the decrease in GHR 1A mRNA leads to a decrease in GHR protein and a decrease in GH binding to liver. This reduced GH binding likely contributes to decreased liver IGF-I synthesis and secretion and the postpartum reduction in circulating IGF-I in periparturient cows.

Key Words: Growth hormone, receptor, parturition

406 Obesity disrupts the duration of the estrous cycle in the mare. B. P. Fitzgerald*, S. E. Reedy, D. R. Sessions, M. M. Vick, and B. A. Murphy, *University of Kentucky, Lexington KY.*

In several species obesity is associated with anovulation, cystic or polycystic ovaries or increased interovulatory intervals. In the horse, aberrant estrous cycles occur in transition to or from the breeding season. However, it is unknown whether obesity specifically disrupts reproductive activity in the mare. To test the hypothesis that obesity disrupts estrous cycles in the mare, a group of mature mares were feed restricted or fed ad-libitum during a period encompassing the breeding and non-breeding seasons (July–Feb). Specifically, 12 mares (aged >15 years) were maintained on a dry-lot (Group 1; restricted, n=6) or pasture (Group 2; ad-libitum, n=6). Feed restriction was initiated in July and comprised a period of adaptation followed by a maintenance diet. Mares were initially fed timothy hay (6.5-6.8 kg/d; 10.5 and 11.0 Mcal DE/d). Once the target body condition (score 4/10) was achieved, mares were maintained on dry-lot and fed timothy hay (13.5 - 14.0 kg/d; 22-22.8 Mcal DE/d) until completion of the study. Beginning Sept 6, blood samples were collected three times per week until Feb 26; bodyweights were determined at 3 week intervals. Blood samples were assayed for progesterone, thyroxine, leptin and insulin. In unrestricted mares, increased adiposity (condition score 7 and above) was accompanied by lengthened luteal phases, compared to lean mares (32.060.83 versus 18.250.78 days; P<0.001, n=6/group). Mean interovulatory intervals appeared longer in obese versus restricted mares (40.139.17 versus 26.770.51 days). Mean monthly bodyweight (P<0.01) insulin (P<0.001) and leptin (P<0.001) were higher in obese versus lean mares, whereas T4 was lower (P<0.01). In summary, obesity leads to aberrations in the estrous cycle, specifically a lengthened luteal phase and is associated with significantly increased circulating concentrations of leptin and insulin.

Key Words: Equine, Obesity, Estrous cycle

407 Characterization of equine bacterial artificial chromosomes (BACs) relevant to endocrine and immune system regulation. T. M. Bryan*, C. A. Abbey, T. Raudsepp, B. P. Chowdhary, C. A. Gill, T. L. Blanchard, N. H. Ing, and T. H. Welsh, Jr., *Texas A&M University System, College Station.*

The long-term objectives of this project are to increase the number of endocrine and immune system genes on the horse cytogenetic map and to develop horse specific cDNA probes for use in physiological studies. The glucocorticoid (GR), luteinizing hormone (LHR), and Toll-like receptors (TLR4) are pivotal regulators of adrenal, gonadal, and immune functions, respectively. Consensus primer sequences were designed for the GR, LHR and TLR4 using multiple species sequence alignment. Based on human genome sequence data, these genes are predicted to map to chromosomes 14 or 21, 15 or 18, and 23 or 25, respectively in the equine genome. Primers were used to screen the CHORI-241 Equine BAC library and PCR-positive BAC clones were confirmed by sequencing. Verified BACs are being mapped by fluorescence in situ hybridization (FISH). One set of primers specific for the alpha isoform of GR is in the 3# UTR of exon 9A. The equine sequence shows 97% identity with human genomic sequence. A five nucleotide deletion in the equine sequence is 1288 bases from the exon 9A stop codon. Primers were designed that amplify a product in exon 2 of GR, which hybridizes to both alpha and beta isoforms. This nucleotide sequence in the horse shows 91% identity with human genomic sequence. A deletion is present in the equine coding sequence eliminating Lys-Leu at amino acid 182-183. Also, there are ten amino acid substitutions in the PCR product for exon 2. Beta specific GR primers have been identified in the 3# UTR of exon 9B and are currently under development. The PCR product for LHR is in the twelfth exon predicted by NCBI Model Maker and there is 92% sequence identity between horse and human sequence. There are eleven amino acid substitutions in the LHR PCR product for the horse.

A BAC clone amplifying a product of the expected size has been identified for TLR4 and will be verified by sequencing prior to FISH. These methods overcome the disadvantage associated with limited availability of whole genomic sequence information for domestic animals. Confirmed sequence analysis of equine BAC clones permits chromosome assignment and physiological investigation of genes that are primary regulators of stress responsiveness, fertility and immunity in the horse.

Key Words: Glucocorticoid receptor, Luteinizing hormone receptor, Toll-like receptor 4

408 Breedtype influences adrenal responsiveness to corticotropin-releasing hormone (CRH) in beef steers. R. J. Hollenbeck*[1], D. A. Neuendorff[2], A. W. Lewis[2], T. A. Strauch[2], R. D. Randel[2], and T. H. Welsh, Jr.[1], [1]*Texas Agricultural Experiment Station, College Station,* [2]*Texas Agricultural Experiment Station, Overton.*

Adrenal responsiveness to exogenous bovine CRH was studied using Angus, Brahman, Bonsmara and Bonsmara X Angus steers (BW=33239 kg; n=6 for each breedtype). Blood samples were collected via indwelling jugular cannula at 120, 90, 60, and 30 min prior to, and at 10, 20, 30, 60, and 120 min after CRH administration (Time 0; 0.1 ug/ kg BW). Plasma cortisol (CS) concentration was determined by RIA. During the 120-min period prior to CRH administration Brahman steers had higher plasma CS (19.32.1 ng/ml) than Angus (14.22.1 ng/ml, P<.1), Bonsmara X Angus (11.32.1 ng/ml, P<.01), and Bonsmara (6.92.1 ng/ml, P<.01). Plasma CS did not differ (P>.10) among breeds at Time 0. Amplitude of the CS response was lower (P<.08) in Bonsmara X Angus (14.33.3 ng/ml) than Angus (22.73.3 ng/ml), Bonsmara (20.43.3 ng/ml) and Brahman steers (203.3 ng/ml); peak plasma CS was greater in Angus (32.23 ng/ml) than Bonsmara (24.33 ng/ml, P<.07) or Bonsmara X Angus (18.53 ng/ml, P<.01), but not Brahman steers (28.73 ng/ml). Angus and Bonsmara X Angus steers displayed a more rapid CS peak response to CRH (11.72 and 13.32 min, respectively) than Brahman (21.72 min, P<.01), or Bonsmara steers (26.72 min, P<.01). Plasma CS returned to basal concentration more slowly in Bonsmara (83.314.4 min) than Angus (5014.4 min, P<.1), Brahman (4014.4 min, P<.04), or Bonsmara X Angus steers (4014.4 min, P<.04). Following re-establishment of basal CS post-CRH, the Brahman steers had higher plasma CS (14.31.8 ng/ml) than the Angus (8.71.8 ng/ml, P<.04), Bonsmara (6.61.9 ng/ml, P<.01), or Bonsmara X Angus (5.91.8 ng/ml, P<.01). Relative to the other breedtypes, the Bonsmara and Bonsmara X Angus maintained lower plasma CS throughout the pre- and post-CRH sampling periods. In summary, plasma CS varied among breedtypes prior to and after administration of CRH. These data are useful in evaluating adrenal function and/or stress-responsiveness in various tropically-influenced cattle breeds.

Key Words: Corticotropin-releasing hormone, Cortisol, Beef cattle

409 Effect of transportation on hypothalamic-pituitary-adrenal axis activation and subsequent responsiveness to trophic hormone stimulation in cattle. M. Knights* and G. W. Smith, *Michigan State University, East Lansing, MI.*

In the present study, we examined the effect of transportation on circulating ACTH and cortisol concentrations and the subsequent responsiveness of the anterior pituitary (AP) to corticotropin releasing factor (CRF) and arginine vasopressin (AVP) stimulation in cattle. Holstein steers (n = 13; 227.3 5.1 kg, 5.4 0.1 months of age) were transported for 10 h or used as un-transported controls. Blood samples were collected via indwelling jugular cannula at 0, 1, 2, 3, 4, 6, 8 and 10 h relative to start of transportation for subsequent assay of plasma ACTH and cortisol concentrations. After 2 weeks, treatments were switched and the experiment repeated. All animals were transported or used as controls only once. No effect of replicate was observed and data for transported and control steers were pooled (n = 13). To test AP responsiveness to trophic hormones, steers were challenged with either CRF (0.5 mg/kg) or AVP (1 mg/kg) administered i.v. immediately after the end of transportation in each replicate, and blood samples were collected for another 3 h at 30 min intervals. Transportation resulted in an increase (P < 0.001) in plasma ACTH within 1 h that remained elevated for 6 and 8 h relative to controls (P < 0.01) and time 0 (P < 0.05), respectively. Plasma cortisol showed a similar pattern except that concentrations were higher (P < 0.05) in transported steers at the end of transportation. Injection of CRF or AVP resulted in a significant increase in plasma ACTH within 30 min (P < 0.001) and concentrations remained elevated for 60 min in control animals. However, the magnitude and duration of ACTH secretion in response to CRF or AVP was dramatically reduced in transported steers (Transport, P < 0.05; Transport X Time, P < 0.01). In conclusion, transportation stress results in an increase followed by a gradual suppression of AP secretion of ACTH accompanied by a decrease in AP responsiveness to CRF and AVP stimulation. Supported by USDA 2001-35204-10801 (GWS) and the Michigan Agricultural Experiment Station.±±

Key Words: Transportation stress, HPA axis, Tropic hormones

410 Effects of bromocriptine treatment on prolactin, prolactin receptor, and immune function of calves on different photoperiods. T. L. Auchtung* and G. E. Dahl, *University of Illinois, Urbana, IL.*

Photoperiod enhances milk production in lactating cattle. In addition, we have observed photoperiod manipulation alters function of immune cells. For example, dry cows exposed to short day photoperiod (SD; 8h light: 16h dark) have increased immune cell competence relative to cows maintained on long days (LD; 16L: 8D). Photoperiod also has a profound effect on prolactin (PRL) concentrations and PRL is known to be a mediator of various functions of the immune system. The objective of this experiment was to determine if PRL mediates changes in immune cell function seen under different photoperiods. Our model was Holstein steers (n = 6) exposed to 12:12 lighting for acclimation, then maintained under LD or SD. Steers were exposed to LD for two periods of 14 d each and SD for one period. Bromocriptine (0.05 mg/kg) was administered subcutaneously to each animal during one of the periods when they were on LD in a balanced randomized design. Bromocriptine was administered to reduce PRL in LD animals to concentrations similar to that of SD steers. Each steer was injected daily for 7 d with either bromocriptine (LD-b) in vehicle (ethanol:methanol) or vehicle alone (LD-v, SD-v). Blood was collected daily during each treatment period and PRL was measured using RIA. Lymphocytes were isolated from heparinized blood and used for RNA isolation or a proliferation assay. Neutrophils were isolated from blood collected on EDTA and chemotaxis was performed using interluekin-8 and C5a as chemoattractants. Prolactin receptor (PRL-R) mRNA was estimated in lymphocytes using real-time PCR. Relative to SD-v and LD-b, LD-v steers had greater PRL concentrations ($P < 0.05$), whereas PRL of SD-v and LD-b steers did not differ. LD-v lymphocytes had lower PRL-R mRNA expression ($P < 0.05$) than either SD-v or LD-b. Both chemotaxis and lymphocyte proliferation were enhanced in SD-v and LD-b steers compared with LD-v. Our results suggest that shifts in PRL sensitivity may mediate the SD photoperiod enhancement of certain immune cell functions in cattle.

Key Words: Cattle, Photoperiod, Bromocriptine

411 Weight gain, carcass and meat characteristics of pasture fed LHRH immunocastrated, castrated and intact bulls. E. Ribeiro*[1], J. Hernandez[2], E. Zanella[3], M. Shimokomaki[1], S. Ferreira[1], E. Youssef[1], H. Ribeiro[1], and J. Reeves[2], [1]*Universidade Estadual de Londrina,* [2]*Washington State University,* [3]*Universidade e Passo Fundo.*

This experiment was carried out to evaluate the effect of surgical and immunocastration on growth and carcass characteristics of beef cattle slaughtered at 3 years of age. Seventy bulls (Nellore-cross) were divided into three groups: 1) immunized against LHRH fusion protein, 2) castrated and 3) intact control. The animals were 24 mo old at the initiation of the study and ranged on Brachiaria grass, in Mato Grosso, Brazil. Testes and epididymides weights were heavier (P < 0.05) for intact bulls than immunized bulls (460, 140 g and 45, 20 g, respectively). At slaughter intact bulls had higher body weights, and ADG compared to immunized and surgically castrated animals (517, 485, 478 kg and 0.672, 0.513, 0.488 kg/d, respectively). Intact bulls had higher carcass weights and muscle percentage compared with the other two groups. Both castrated and immunized animals had greater marbling (3.5 and 5.0) and percent carcass fat (23.9 and 25.2 %) than the intact bulls (2.1 and 17.9 %, respectively). Although averages for tenderness, measured by a trained panel (scale from 1 to 9) and by a texturometer (Newton's force), were inferior for intact bulls, they did not reach statistical significance (P = 0.12 and P = 0.13, respectively). The tenderness averages for castrate, immunized and intact bulls determined by the panel were 5.5, 5.8 and 5.0, and by the texturometer, 119, 125 and 145, respectively.

Other quality meat traits, as juiciness, flavor, thawing and cooking losses did not differ among the three groups. Carcass yield was also similar for the groups. Immunocastration was effective in producing carcass traits similar to that of surgical castration. Therefore, this vaccine appears to have practical utility in the management and castration of grazing bulls in Brazil.

Key Words: LHRH immunization, Carcass, Bulls

Ruminant Nutrition: Nutritional management & transition

412 Nutritional management of the dairy cow: Minimizing disorders to optimize production and maximize profitability. T. R. Overton* and M. R. Waldron, *Cornell University, Ithaca NY.*

Successful lactation depends on sound nutrition and management programs that are interdependent. Attention to detail in these areas, especially during the periparturient period, is a major determinant of farm profitability. Sound reproductive and nutritional management during the breeding period and gestation are required to achieve optimal body condition (BCS) at parturition. Typical recommendations for BCS at parturition are 3.5 to 3.75; however, recent data indicate that cows of BCS ∼3.0 may have improved health and early lactation performance. Management of periparturient BCS is critical to minimize the extent of negative energy balance and its associated mobilization of adipose that results in elevated plasma NEFA levels. Plasma NEFA can accumulate in the liver as triacylglycerol (TAG) and impair both metabolic and immune function. Superior nutrition and management can avert excessive TAG accumulation during the peripartum period. Dietary supplementation or oral administration of nutrients or compounds such as choline, niacin, calcium propionate, propylene glycol, glycerol, fat, and trace minerals are used as prophylactic measures when nutrition or management is suboptimal. Though commercial use of these supplements is common, recent data and review of the research literature indicates efficacy only under certain circumstances and when administered by specific methods. Recent data also have provided possible physiological links between the associations of primary infectious disease with the occurrence of secondary metabolic disorders, thereby emphasizing the importance of sound energy, protein, and macromineral nutrition for immunocompetence of the periparturient cow. Dietary vitamin and trace mineral supplementation above NRC requirements or from alternative sources have been emphasized to promote immune function. Although in vitro data sometimes are supportive of this practice, research into the requirements of these nutrients to optimize immune function in lactating dairy cows needs to be conducted.

Key Words: periparturient cow, metabolism, immune function

413 Feeding glycerol to transition dairy cows: Effects on dry matter intake, milk production, and blood metabolites. J. M. DeFrain*[1], A. R. Hippen[1], K. F. Kalscheur[1], and P. W. Jardon[2], [1]*South Dakota State University, Brookings,* [2]*West Central Soy, Ralston, IA.*

Twenty-one multiparous and nine primiparous Holstein cows blocked by parity and expected calving date were used in a randomized block design to evaluate the effects of feeding glycerol from 14 d prepartum until 21 DIM. Energy density and crude protein were 1.50 and 1.65 Mcal/kg and 16.5 and 18.6 % for pre- and postpartum diets, respectively. Treatments (kg/d) were: 1 of corn starch (CON), 0.5 corn starch + 0.5 glycerol (MIX), or 1 glycerol (GLY), topdressed, and hand-mixed into the upper 1/3 of the TMR. Prepartum DMI was greater for cows fed CON compared with MIX or GLY (13.0, 10.9, and 10.9 ± 0.36 kg/d, respectively). Postpartum DMI was not affected by treatments. Milk yields during the first 70 DIM were greater for multiparous cows fed CON or MIX than for GLY (44.7, 44.1, and 39.9 ± 1.48 kg/d, respectively) whereas milk yields of primiparous cows fed CON or GLY were greater than for MIX (29.2, 29.1, and 26.1 ± 2.32 kg/d). The MIX and GLY diets decreased MUN relative to CON (14.04, 12.52, and 12.59 ± 0.46 mg/dl, respectively). Prepartum plasma glucose, BHBA, and NEFA were not affected by treatments. At 7 and 14 DIM, plasma glucose was similar among treatments; however, plasma glucose in cows fed CON and MIX were greater than those fed GLY at 21 DIM (67.5, 64.9, and 50.2 ± 3.71 mg/dl, respectively). Feeding GLY decreased plasma NEFA at 7 DIM compared with CON and MIX (458, 855, 896 ± 118 μEq/L, respectively); however, NEFA were similar among treatments at 14 and 21 DIM. There was a tendency ($P = 0.07$) for animals fed GLY to have greater concentrations of plasma BHBA postpartum (7, 14, and 21 DIM) compared with CON, but BHBA levels in cows fed MIX were intermediate to those fed CON and GLY. These data indicate glycerol fed at 1 kg/d delayed the onset and degree of fat mobilization during the first 3 wks postpartum. The greatest potential for glycerol to prevent ketosis was observed during the first 7 DIM and the optimal inclusion rate is between 0.5 and 1 kg/d.

Key Words: Periparturient, Glycerol, Metabolites

414 Effects of prepartum diet and postpartum drenching on production performance and blood parameters of early lactation primiparous and multiparous Holstein cows. B. M. Visser*, J. G. Linn, S. M. Godden, and M. L. Raeth-Knight, *University of Minnesota, St. Paul, MN, USA.*

This study was a 2 x 3 factorial with 3 prepartum dietary treatments and a propylene glycol (PG) drench of 0 (-) or 300 (+) ml on day 1 and 2 postpartum. Prepartum diets were control (C), anionic supreme (A), and base supreme (B). Diet C was 75% forage and a 25% mixture of corn, soybean meal, minerals and vitamins. Supreme diets were 61% forages and a 39% mixture of corn, soybean meal, sugar, soluble fiber, yeast, enhanced minerals and vitamins with (A) and without (B) anionic salts. All cows received the same postpartum diet the first nine weeks of lactation. Seventy multiparous (M) cows were assigned to diets A, B and C and 32 primiparous (P) cows were assigned to diets B and C starting 21 days before parturition. Half of the M and P cows assigned to each dietary treatment received the PG drench. Diet A reduced DMI prepartum of M cows compared to cows fed diet B and C over the 21 days prepartum (12.1, 13.5 and 14.4 kg/d for diet A, B, and C), however, cows fed diet C had the largest decline in DMI week -1 prepartum (20%, 13%, and 12% for diet C, A, and B). There was no effect of diet, drench or diet by drench interaction within parity on milk yield or milk components the first nine weeks of lactation. Milk production for M cows was 49.1, 48.1, 49.3, 48.2, 46.9, and 46.7 kg/d for treatments A-, A+, B-, B+, C-, and C+ the first nine weeks of lactation. Milk production for P cows was 34.4, 32.6, 33.0, and 33.3 kg/d for treatments B-, B+, C-, and C+ for the first nine weeks of lactation. Milk fever incidences of M cows fed diets A, B, and C were 0%, 4.8%, and 22.7%. Ketosis incidences were 12% and 25% for P cows and 17% and 13% for M cows on drench (+) and (-), respectively. Blood calcium concentrations of M cows fed diet A were higher ($P<0.05$) at parturition (8.3 mg/dl) than for cows fed diets B and C (7.9 and 7.4 mg/dl). Blood glucose concentrations of P cows were higher ($P<0.05$) the first 7 days of lactation (87.4 vs 76.8 mg/dl) with drenching (+).

Key Words: Transition, Metabolic, Drench

415 Interrelationships of prepartum dry matter intake with postpartum intake and hepatic lipid accumulation. J. K. Drackley*, *University of Illinois, Urbana, IL.*

Grummer (JAS 73:2820) reported a correlation (r=0.54) between dry matter intake (DMI) 1 d prepartum and DMI 21 d postpartum. We reported previously, however, that cows fed restricted amounts of diet during the dry period had greater DMI postpartum and less lipid accumulation in liver (JDS 81[Suppl. 1]:295). The hypothesis tested here was that extent of prepartum DMI decrease is more important than actual prepartum DMI for postpartum DMI and hepatic lipid content. Multiparous Holstein cows (n=50) were fed 1 of 5 diets during the dry period; anionic salts were added during the last 14 d prepartum. Three diets were fed for ad libitum intake; two were fed to supply only 80% of calculated NE_L requirements. All cows received a lactation diet postpartum. Mean DMI for wk -3 and wk -1 were 12.0 kg/d (range 6.2 to 21.3 kg/d) and 9.2 kg/d (3.0 to 18.3 kg/d). Decreases in DMI at wk -1 from wk -3 and at d -1 from d -7 averaged -20.0% (-10.0 to -77.1%) and -23.3% (-31.5 to -93.0%), respectively. Contents (wet weight) of total lipid and triglyceride (TG) at d 1 postpartum averaged 7.0% (3.7 to 16.9%) and 4.6% (0.3 to 15.5%), respectively. DMI for wk 3 postpartum was not correlated with DMI prepartum. DMI for wk 1 postpartum was

correlated with DMI for wk -1 (r=0.44, P<0.01). In contrast, DMI for wk 3 postpartum was correlated (P<0.01) with percent changes in DMI during the last 3 wk (r=0.43) or last 2 wk (r=0.41) prepartum. DMI for wk 1 postpartum was correlated (P<0.01) with percent changes in DMI during the last 3 wk (r=0.34), last 2 wk (r= 0.49), or last week (r=0.39) prepartum. Contents of total lipid and TG in liver at d 1 postpartum were negatively related to decreases in DMI during the last 3 wk (r= -0.63 and -0.63), last 2 wk (r= -0.67 and -0.65), and last 1 wk (r= -0.42 and -0.38) prepartum. Liver total lipid and TG were positively correlated to actual DMI for wk -3 or -2, and were not correlated with DMI for wk -1. Early postpartum DMI and hepatic lipid content are more highly related to changes in DMI during the last 3 wk prepartum than to actual DMI prepartum.

Key Words: Dry matter intake, Dry period, Liver

416 Compariosn of three fresh cow feeding programs. W. F. Miller*, J. E. Shirley, E. C. Titgemeyer, A. F. Park, A. K. Hammond, M. V. Burgos, and M. V. Scheffel, *Kansas State University*.

Thirty-three multiparous and 27 primiparous Holstein cows were utilized in a randomized block design to evaluate the impact of long-stem alfalfa hay top dress to a total mixed ration (TMR) on lactation performance and plasma metabolites of early lactation dairy cows. Cows were blocked by parity and calving date with 11 replicates for multiparous cows (BW=722 ± 11.9 kg; BCS=2.73 ± 0.12) and nine replicates for primiparous cows (BW=609 ± 13.2 kg; BCS=3.30 ± 0.13). All cows were fed a total mixed ration (TMR) containing 22% chopped alfalfa hay, 27% ground corn, 10% corn silage, 20% wet corn gluten feed, 9% whole cottonseed, 7% soy bean expeller meal, 1.3% fish meal, 1% molasses, and 2.7% mineral-vitamin premix. Treatments were: 1) TMR (R), 2) TMR top dressed with 1.36 kg long-stem alfalfa hay at 0600 h (A), 3) TMR top dressed with 1.36 kg long-stem alfalfa hay at 0600 h and 1.36 kg dry rolled corn at 1200 h (AC). The TMR was offered for ad libitum intake at 0600, 1200, and 1600 h daily. For the initial 5 d of lactation body temperature, BW, BCS, rumen contractions, and milk ketones were recorded, and plasma was harvested from coxygeal blood. Milk yield was recorded for 30 d postpartum with samples (a.m. / p.m. composite) analyzed for fat, protein, lactose, and urea content weekly. Milk and milk components were similar among treatments. Plasma glucose and urea nitrogen was not affected by treatment but significantly affected by day (P < 0.05) and age (P < 0.05). Primiparous cows were lighter and had a higher BCS (P< 0.05) than multiparous cows. Average plasma NEFA concentration, as well as those on d 2 and 3 were lower (P < 0.05) for multiparous cows consuming diet R (693, 743, and 661 mmol/L, respectively) than for multiparous cows consuming diet A (928, 1099, and 1039 mmol/L, respectively). Rumen contractions were greater (P < 0.05) for multiparous cows than for primiparous cows. Top dresses of long-stem alfalfa hay or of long-stem alfalfa hay and ground corn was not beneficial for the TMR fed in this study.

Key Words: Alfalfa hay, Fresh cow, NEFA

417 Effects of prepartum dietary energy concentration and Ca-propionate on transition performance. A. E. Beem*[1], H. G. Bateman[1], C. C Williams[1], C. C. Stanley[1], D. T. Gantt[1], Y. H. Chung[1], and F. R. Valdez[2], [1]*LSU AgCenter, Baton Rouge, LA,* [2]*Kemmin Americas, Des Moines, IA*.

Forty-one Holstein cows (mean BWT 669 kg) were grouped by anticipated calving date and assigned to one of four treatments that were arranged as a 2x2 factorial of 105 or 145% (NRC, 2001) of prepartum dietary energy requirements with or without addition of 113.5 g Ca-Propionate/d (NutroCAL^{TM}, Kemin Americas, Des Moines, IA). All cows were fed the same basal diet postpartum. Ca-propionate supplementation continued postpartum. Cows were individually fed and DMI was measured daily. Milk production was measured and sampled at each milking. Blood samples were collected 3x/ wk and analyzed for β-hydroxybutyrate (BHBA). Urine was collected 3x/ wk and analyzed for pH, acetoacetate, and BHBA. Due to factors unrelated to treatment diets, there was a high incidence of health disorders such as retained fetal membranes, uterine infections, displaced abomasums, and laminitis observed during this trial that probably impacted any observed treatment responses. There were no statistical differences ($P > 0.05$) observed in these data.

	Normal (-) Ca-prop	Energy (+) Ca-prop	High (-) Ca-prop	Energy (+) Ca-prop	SEM
DMI, Prepartum	9.5	8.7	9.9	8.8	0.97
Postpartum	12.6	10.3	13.3	10.8	1.61
Milk, kg	26.2	20.8	25.3	23.1	2.80
Fat, %	4.1	4.3	4.3	4.2	0.28
kg	1.1	0.9	1.1	0.9	0.12
Protein, %	2.7	2.7	2.9	2.8	0.12
kg	0.7	0.6	0.8	0.6	0.09
SCCS	3.1	4.3	4.1	4.3	0.57
Urine pH	8.0	8.0	7.9	7.9	0.08
Urine acetoacetate	15.2	17.6	16.1	12.2	6.12
Urine BHBA	6.6	15.7	16.1	12.2	6.16
Plasma BHBA	7.9	8.3	9.6	7.2	2.07

Key Words: Calcium propionate, Transition cow, Ketone

418 Prepartum dry matter intake, serum nonesterified fatty acids, liver lipid and glycogen contents, body weight, and body condition score for cows fed different diets during the dry period. H. M. Dann*, N. B. Litherland, J. P. Underwood, M. Bionaz, and J. K. Drackley, *University of Illinois, Urbana*.

Multiparous Holstein cows (n=74) were fed different diets during the far-off (FO; dry-off to -25 d before expected parturition) and close-up (CU; -24 d to parturition) periods in a 3 (FO) x 2 (CU) factorial arrangement to determine the effects of prepartum nutrient intake on prepartum dry matter intake (DMI), concentration of nonesterified fatty acids (NEFA) in serum, liver lipid and glycogen contents, body weight (BW), and body condition score (BCS). During the FO period, cows were fed a control diet (FOC; 1.29 Mcal NE_L/kg, 12.7% CP) at ad libitum (A) intake or a diet with excess nutrients (FOE; 1.59 Mcal NE_L/kg, 15.1% CP) at either A or restricted (R; 80% of calculated NE_L requirement at dry-off) intake. During the CU period, cows were fed a diet (CU; 1.54 Mcal NE_L/kg, 14.5% CP) at either A or R (80% of calculated NE_L requirement at dry-off) intake. During the FO period, DMI was higher (P<0.05) and serum NEFA lower (P<0.05) for FOEA (2.0% BW; 123 μEq/L) than FOCA (1.5% BW; 174 μEq/L) or FOER (1.0% BW; 218 μEq/L). Body weight was lower (P<0.05) for FOER (679 kg) than FOEA (711 kg) or FOCA (701 kg). Body condition score was higher (P<0.05) for FOEA (3.16) than FOCA (3.04) or FOER (2.94). At -30 d before parturition liver total lipid and glycogen contents averaged 4.1 and 4.4%, respectively and did not differ (P>0.05) among treatments. During the CU period, cows fed CUA had higher (P<0.05) DMI (1.8 vs 1.0% BW), BW (727 vs 713 kg), and BCS (3.15 vs 2.99) than cows fed CUR. Cows fed CUA had lower (P<0.05) serum NEFA (204 vs 307 μEq/L) and liver total lipid content (-14 d; 4.2 vs 4.7%) than cows fed CUR. Liver glycogen content (-14 d; 3.4%) did not differ (P>0.05). The FO diets affected (P<0.05) serum NEFA, BW, and BCS during the CU period. Cows fed FOEA had higher serum NEFA, BW, and BCS than FOCA and FOER in the CU period. Prepartum changes in serum NEFA, BW, BCS, and liver lipid content were consistent with plane of nutrition.

Key Words: Transition cow, Nutrient intake, Liver

419 Prepartum nutrient intake alters metabolism by liver slices from peripartal dairy cows. N. B. Litherland*, H. M. Dann, A. S. Hansen, and J. K. Drackley, *University of Illinois, Urbana*.

Understanding impacts of plane of nutrition before parturition on hepatic partitioning of long chain fatty acids to CO_2, acid soluble products (ASP) and esterified products (EP) may provide a basis for improved health and productivity. Multiparous Holstein cows (n = 71) were fed different amounts of nutrients during the far-off (FO) and close-up (CU) dry periods in a 3 (FO diet)× 2 (CU diet) factorial arrangement. During the FO period (d -60 to -25) cows received a control diet fed ad libitum (FOCA) to meet NRC (2001) recommendations, a diet fed ad libitum to exceed NRC recommendations for NE_L by 20% (FOEA), or a diet fed at restricted intake to meet 80% of FO NE_L requirements

(FOER). During the CU period (d -24 until parturition), cows were fed a diet ad libitum (CUA) to meet NRC recommendations or in restricted (CUR) amounts to provide 80% of calculated NE_L requirements. All cows received a lactation diet postpartum. Liver slices from biopsies at d -30, -14, +1, +14, and +28 relative to parturition were utilized to determine in vitro conversion of [1-^{14}C] palmitate (PALM) to CO_2, ASP, and EP. Conversion of PALM to CO_2 decreased on d 1 for FOEA (FO × day, $P < .03$). As a percent of total PALM metabolism, conversion to CO_2 decreased at d 1 for all FO treatments; FOEA declined most (FO × day, $P = .07$). Conversion of PALM to ASP increased on d 1 for FOCA and FOER, with FOCA significantly higher than FOEA ($P < .03$). Esterification of PALM increased on d 1 for all treatments. As a percent of total PALM metabolism, EP formation tended to be greater on d 1 for the combination of FOEA plus CUA than for cows fed FOCA or FOER (FO × CU × day, $P = .06$). Total PALM metabolism increased on d 1; cows fed FOCA had greater rates than FOEA ($P = .05$). Excessive energy intake during FO and CU promotes decreased hepatic oxidation and increased esterification of PALM, consistent with triglyceride accumulation postpartum; CU diet had less effect than did FO diet. Supported by USDA-NRI no. 2001-35206-10946 and Illinois C-FAR.

Key Words: Liver, Dry period, Fatty acid metabolism

420 Prepartum nutrient intake has minimal effects on postpartum dry matter intake, serum nonesterified fatty acids, liver lipid and glycogen contents, and milk yield. H. M. Dann*, N. B. Litherland, J. P. Underwood, M. Bionaz, and J. K. Drackley, *University of Illinois, Urbana*.

Multiparous Holstein cows (n=74) were fed different diets during the far-off (FO; dry-off to -25 d before expected parturition) and close-up (CU; -24 d to parturition) periods in a 3 (FO) x 2 (CU) factorial arrangement to determine the effects of prepartum nutrient intake on postpartum dry matter intake (DMI), serum nonesterified fatty acids (NEFA), liver lipid and glycogen contents, body weight (BW), body condition score (BCS), and milk yield. During the FO period, cows were fed a control diet (FOC; 1.29 Mcal NE_L/kg, 12.7% CP) at ad libitum (A) intake or a diet with excess nutrients (FOE; 1.59 Mcal NE_L/kg, 15.1% CP) at either A or restricted (R; 80% of calculated NE_L requirement) intake. During the CU period, cows were fed a diet (CU; 1.54 Mcal NE_L/kg, 14.5% CP) at either A or R intake. Cows were fed a lactation diet (1.61 Mcal NE_L/kg, 17.5% CP) from 0 to 56 days in milk (DIM). From 0 to 21 DIM, cows fed FOEA tended ($P<0.1$) to have lower DMI (2.59% BW) and higher BCS (2.57) than cows fed FOER (2.89% BW; 2.34) or FOCA (2.87% BW; 2.42). Cows fed FOER tended ($P<0.1$) to have lower NEFA (464 μEq/L) than cows fed FOEA (603 μEq/L) or FOCA (574 μEq/L). Milk yield (32.6 kg) and BW (634 kg) did not differ ($P>0.05$) among FO diets. CU diet did not alter ($P>0.05$) DMI (2.78% BW), milk yield (32.6 kg), NEFA (548 μEq/L), or BW (635 kg). From 0 to 56 DIM, neither FO nor CU diets affected ($P>0.05$) DMI (3.4% BW), NEFA (336 μEq/L), BW (629 kg), BCS (2.36), or milk yield (37.8 kg). At 1 DIM, liver lipid content tended to be lower ($P<0.1$) for FOER (5.5%) than FOEA (7.0%) or FOCA (6.9%) and tended to be lower ($P<0.1$) for CUR (5.9%) than CUA (7.0%). Liver glycogen content (mean of 1, 14, 28, 49 DIM) did not differ ($P>0.05$) among FO diets (2.9%) but tended to be higher ($P<0.1$) for CUR (3.0%) than CUA (2.7%). Preventing excessive nutrient intake in the FO or CU periods may improve DMI and energy status in the transition period but the effects may diminish as lactation progresses.

Key Words: Transition cow, Nutrient intake, Liver

421 Responses to epinephrine challenges in peripartal Holstein cows fed two amounts of metabolizable protein in prepartum diets. J. P. Underwood*, J. K. Drackley, G. E. Dahl, and T. L. Auchtung, *University of Illinois, Urbana, IL*.

To determine the effects of prepartum dietary metabolizable protein (MP) supply on lipolytic and glucose response to epinephrine stimulus during the periparturient period, 12 nonlactating cows in second or greater pregnancies were assigned to a low MP diet (LMP) formulated to provide 900 g MP/d or a high MP diet (HMP) to provide 1100 g MP/d. Cows received prepartum diets from 28 d before expected parturition to day of parturition, and then received a common lactation diet until 35 d postpartum. Blood was sampled weekly to d -7, daily to d 7, and weekly through d 35 for analysis of glucose, NEFA, BHBA, urea-N, and total protein concentrations. Epinephrine challenges were conducted on d -10 before expected parturition, and d 7 and d 14 postpartum. Epinephrine (1.4 μg/kg BW) was administered via jugular vein and blood was collected from the opposite jugular vein from -45 min to +120 min relative to epinephrine administration. Plasma was analyzed for glucose and NEFA concentrations. Prepartum DMI (14.5 and 12.2 kg/d for LMP and HMP, respectively, P=0.29), postpartum DMI (22.9 and 21.1 kg/d for LMP and HMP, P=0.25), and 4% FCM (37.0 and 36.8 kg/d for LMP and HMP, P=0.95) were similar between diets. Cows fed HMP had higher concentrations of urea-N prepartum (P<0.01) than cows fed LMP (14 vs 9 mg/dL). Cows fed HMP tended (P=0.11) to have greater prepartum concentrations of total protein in plasma than those fed LMP (7.4 vs 6.9 g/dL). Area under the curve (AUC) for NEFA response to epinephrine did not differ between diets (P=0.25) but differed by day (P<0.001) relative to parturition (8,282; 28,854; and 21,027 μeq (L x min) for d -10, d 7, and d 14, respectively). Glucose AUC did not differ between diets or among days (P=0.91). Lipolytic response, but not glucose response, to epinephrine is enhanced during the early postpartum period relative to the late dry period. However, those responses are not affected by prepartum MP supply.

Key Words: Epinephrine, Metabolizable protein, Lipolysis

422 Metabolism of dairy cows as affected by prepartum dietary carbohydrate source and supplementation with chromium throughout the periparturient period. K. L. Smith*[1], M. R. Waldron[1], T. R. Overton[1], J. K. Drackley[2], and M. T. Socha[3], [1]*Cornell University,* [2]*University of Illinois, Urbana,* [3]*Zinpro Corporation, Eden Prairie, MN*.

Holstein cows (n=74) entering second or later lactation were used to determine whether metabolic parameters are affected by source of carbohydrate in the prepartum diet and chromium-L-methionine (CrMet) supplementation throughout the periparturient period. From 21 d before expected parturition until parturition, cows were fed either a TMR with the concentrate portion based on starch-based cereals (NFC) or a TMR with the concentrate portion based on nonforage fiber sources (NFFS). The CrMet was supplemented once daily via gelatin capsule at 0, 0.03, or 0.06 mg/kg $BW^{.75}$. Thus, treatments were in a 2 x 3 arrangement. Feeding NFFS prepartum increased prepartum (60.3, 59.1 mg/dl; P<0.02) and postpartum (46.5, 45.0 mg/dl; P<0.09) plasma glucose concentrations. BHBA concentrations were not different (6.0, 5.9 mg/dl) prepartum, but tended (9.4, 11.0 mg/dl; P<0.12) to be lower postpartum for cows fed NFFS. Liver triglyceride concentrations were greater on d 1 postpartum and lower on d 21 postpartum for NFC (P<0.04). Cows fed NFFS prepartum tended (P<0.10) to have greater postpartum liver glycogen content. Insulin and NEFA did not differ (P>0.15) pre- or postpartum between NFFS and NFC. Supplementing 0.03 mg/kg $BW^{.75}$ of CrMet increased (59.4, 60.9, 58.8 mg/dl; P<0.01) prepartum plasma glucose concentrations and tended (P<0.10) to lower prepartum NEFA concentrations (206, 179, 208 uEq/l) for 0, 0.03, and 0.06 mg/kg $BW^{.75}$. Postpartum plasma glucose decreased linearly (46.7, 46.0, 44.5 mg/dl; P<0.04) and insulin concentrations were affected quadratically (P<0.03) by CrMet (0.21, 0.16, 0.20 pg/ml). Supplementing CrMet did not affect prepartum insulin and BHBA, postpartum NEFA or BHBA, nor liver composition. Overall, prepartum carbohydrate source and CrMet had modest effects on metabolic variables.

Key Words: periparturient cow, carbohydrate, chromium

423 Influence of cobalt supplementation to dry and lactating dairy cow diets with monensin on microbial fermentation in continuous culture. R.L.K. Hulbert*[1], G. I. Crawford[1], K. A. Caperoon[1], M. D. Stern[1], and M. T. Socha[2], [1]*University of Minnesota, St. Paul,* [2]*Zinpro Corporation, Eden Prairie, MN*.

An experiment was conducted to determine if the level of cobalt supplementation to dry and lactating dairy cow diets with monensin would affect fermentation by ruminal microbes maintained in dual flow continuous culture fermenters. A dry cow diet and a lactating cow diet formulated to contain monensin at 200 and 300 mg/h/d, respectively, were supplemented with 0.5, 1, 2, and 4 ppm of cobalt glucoheptonate. These treatments were evaluated in eight flasks inoculated with ruminal fluid from a cannulated cow during four 10-d experimental periods to achieve four replications for each of the eight dietary treatments. The experimental design was a completely randomized 4 x 2 factorial arrangement

of treatments with four concentrations of cobalt glucoheptonate and two diet types (dry and lactating dairy cow diets). Differences *(P < 0.05)* between dry and lactating dairy cow diets, respectively, were observed for pH (6.40 vs 6.12), true OM digestion (42.8 vs 59.3 %), ADF digestion (42.3 vs 50.7 %) and total VFA concentration (75.1 vs 103.8 mM). Neutral detergent fiber digestion (35.0 vs 40.0 %) and total nonstructural carbohydrate digestion (80.9 vs 83.4 %) were similar *(P > 0.05)* between dry and lactating dairy cow diets. Crude protein digestion (22.8 vs 33.7 %) and N flow (2.18 vs 2.88 g/d) were lower *(P < 0.05)* for the dry cow diets compared with the lactating dairy cow diets. Efficiency of bacterial synthesis (20.2 vs 21.6 g of N/kg of OM truly digested) was similar *(P > 0.05)* between diets. There were no effects *(P > 0.05)* of cobalt supplementation on nutrient digestion and microbial fermentation nor were there any interactions *(P > 0.05)* with type of diet. Results indicate that supplementation with cobalt at various concentrations in either a dry or lactating dairy cow diet with monensin did not have any impact on fermentation by ruminal microbes.

Key Words: Cobalt, Continuous culture, Monensin

424 Prediction of urine volume and urinary output of nitrogen and minerals in lactating dairy cows. T. D. Nennich*[1], J. H. Harrison[1], L. Johnson[1], D. Meyer[2], W. Weiss[3], N. St-Pierre[3], R. L. Kincaid[4], M. Wattiaux[5], and D. L. Davidson[1], [1]*Washington State University, Puyallup,* [2]*University of California, Davis,* [3]*The Ohio State University,* [4]*Washington State University, Pullman,* [5]*University of Wisconsin.*

The objective of this study was to develop prediction equations for estimating urinary volume, nitrogen, and mineral excretion of lactating dairy cows. A data set was assembled from total urine collection studies (n = 25) that used multiparous Holstein cows. The studies were conducted by Washington State University, University of California-Davis, The Ohio State University, and the University of Wisconsin. Metabolizable protein (MP) supply was estimated for each individual cow using the 2001 Dairy NRC Model. Based upon their estimated MP intake, cows were assigned into treatments of LOWMP that included cows with MP supply at 110% or less of their calculated MP requirements, and HIGHMP that included cows with MP supply greater than 110% of MP requirements. Milk production for cows in LOWMP ranged from 9.8 to 86.1 kg/d and 1.4 to 52.6 kg/d for HIGHMP. Dietary crude protein (CP) concentration was 17.1±5.9% and 18.2±5.8% for LOWMP and HIGHMP, respectively. Urinary nitrogen ranged from 63 to 499 g/d for LOWMP and 90 to 436 g/d for HIGHMP. Regression analysis performed using the PROC MIXED procedure of SAS included study as a random variable. The regression equations predict urine volume, urinary nitrogen, and urinary excretion of P, K, Na, Ca, Mg, Cu, and Zn. Predictors used in the equations include days in milk (DIM), body weight (BW), dry matter intake (DMI), dietary CP concentration, milk CP content, and milk urea nitrogen (MUN). The best equation for the prediction of urinary nitrogen (g/d) using the LOWMP data set was: 0.12∗DIM + 0.18∗BW + 4.29∗DMI + 14.47∗diet CP% + 4.35∗MUN # 321 (n = 230) compared to: 0.28∗BW + 4.85∗DMI + 7.95∗diet CP% + 4.62∗MUN + 20.77∗milk CP% - 334 (n = 154) for the HIGHMP data set. Prediction equations can be used to more accurately estimate urinary nitrogen and mineral excretion of lactating dairy cows than current tabular values.

Key Words: Urine, Nitrogen, Dairy cows

Ruminant Nutrition: Feedlot

425 Effect of wintering system and feedlot sorting on performance and economics of yearling steer production systems. J. D. Folmer*[1], C. N. Macken[1], M. P. Blackford[1], G. E. Erickson[1], and T. J. Klopfenstein[1], [1]*University of Nebraska, Lincoln, NE.*

An experiment was conducted to evaluate the effects of different winter management and feedlot sorting on the performance and economics of a yearling steer production system. Two hundred steers (239 kg) were stratified by weight and assigned randomly (n = 100) to one of two winter management strategy treatments. Intensive (INT) or normal (NOR) management strategies consisted of 91 d of winter corn residue grazing (CRG) and 52 d of dry-lot hay feeding with wet corn gluten feed (WCGF) supplementation. NOR steers received 2.27 kg of WCGF DM daily while INT steers received 2.72 kg. INT steers also received Bovatec (170 mg/d) with the WCGF, and were implanted with Ralgro on d 1, and with Synovex S on d 91. All Steers received a Revelor G implant on d 143 and began the summer grazing period. INT steers were placed on feed at d 220 and NOR steers on d 264. At initiation of feedlot finishing, steers were implanted with Revelor S, and stratified by weight and assigned randomly (n = 50) to one of two additional treatments in two replications, sorted (S) or unsorted (U). S steers were divided in to three weight groups, the heavy 25%, the middle 50%, and the light 25%, and marketed at a common fat thickness target of 1.14 cm fat thickness. Heavy steers were marketed 14 d prior, middle 7 d after, and light 21 d after the unsorted control group. Results from the experiment indicate that INT managed steers had greater wintering phase ADG than the NOR managed steers 0.83 vs. 0.68 kg/d, respectively. Feedlot initial weights were 446 kg for INT steers on d 220, and 456 kg for NOR steers on d 264. NOR (P<.01), and S (P<.05) steers had significantly greater ADG, DMI, hot carcass weight (HCW), final weight (FW), and lower feed conversion than INT and U steers. NOR steers had fewer days on feed, while S had additional days on feed. INT steers performed better resulting in heavier, more profitable steers after the wintering phase. NOR steers were heavier and more profitable after the summer grazing and feedlot finishing phases. Sorting steers into marketing groups when they enter the feedlot resulted in heavier, more profitable steers versus unsorted controls.

Key Words: Steers, Systems, Sorting

426 Effects of live cultures of *Lactobacillus acidophilus* (Strains 45 and 747) *Propionibacterium freudenreichii* on performance, carcass and intestinal characteristics, and *Escherichia coli* O157:H7 shedding of finishing beef steers. N. A. Elam*, J. F. Gleghorn, J. D. Rivera, M. L. Galyean, M. M. Brashears, and S. M. Younts-Dahl, *Texas Tech University.*

Two hundred forty beef steers (British and Continental; initial BW = 332.8 ± 23.1 kg) were used to determine the effects of live cultures of *Lactobacillus acidophilus* (LA) and *Propionibacterium freudenreichii* (PF) on performance, carcass and intestinal characteristics, and prevalence of *Escherichia coli* O157:H7 (EC) shedding during the finishing phase. Cattle were fed a steam-flaked corn-based 92% concentrate diet for an average of 170 d. The four treatments included: 1) control (CON) lactose carrier only; 2) 1×10^9 cfu of LA Strain 747 plus 1×10^6 cfu of LA Strain 45 plus 1×10^9 cfu of PF-24 per animal daily (G); 3) 1×10^9 cfu of LA Strain 747 plus 1×10^9 cfu of PF-24 per animal daily (Y); and 4) 1×10^6 cfu of LA Strain 747 plus 1×10^6 cfu of LA Strain 45 plus 1×10^9 cfu of PF-24 per animal daily (B). A randomized complete block design was used with pen as the experimental unit (12 pens/treatment). No differences ($P > 0.10$) among treatments were detected for final BW, DMI, ADG, gain:feed, and hot carcass weight. In addition, dressing percent, longissimus muscle area, fat thickness at the 12^{th} rib, percentage of internal fat, and yield grade did not differ ($P > 0.10$) among treatments. A trend ($P = 0.08$) was detected for treatment differences in ileal lamina propria (LP) thickness. The average LP thickness for Y and G steers was less ($P < 0.05$) than the average for CON and B steers (0.38 vs 0.45 mm). Moreover, Y and G steers had a lower ($P < 0.10$) incidence of EC shedding than CON and B steers. Under the conditions of this study, live cultures of LA plus PF did not greatly affect feedlot performance and carcass characteristics. Some of the cultures used in this study decreased fecal EC shedding, which might be related to the results for ileal LP thickness.

Key Words: Beef Cattle, Direct-fed Microbials, Lamina Propria

427 Influence of sire breed on residual feed intake as an indicator of efficiency in steers. C. L. Ferrell*, T. G. Jenkins, and H. C. Freetly, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

The objective was to evaluate residual feed intake (RFI) as an indicator of efficiency. Steers (107) sired by Angus (A), Hereford (H), Belgian

Blue (B), Piedmontese (P), Boran (Bo), Brahman (Br), and Tuli (T) and from A, H, or MARC III dams were used. Eight additional steers of each sire breed were used as initial slaughter animals. Steers were individually fed (half near maintenance and half at ad libitum) a high-concentrate diet (83.8% corn) in pens of eight for 140 d. Steers were weighed at 14 d intervals, and feed allotments were adjusted at those times. Steers were slaughtered at the MARC abattoir and retained energy (RE) was determined by comparative slaughter procedures. Initial weight (IWT), final weight (FWT) and ADG were calculated from regressions of weight on time for each steer. Similarly, DMI and MEI was calculated from regressions of cumulative feed consumed on time for each steer. Residual feed intake (RFI) was determined as the residual from within feed level regressions of MEI (kcal/kg$^{0.75}$/d) on retained energy (kcal/kg$^{0.75}$/d), and residual retained energy (RRE) was determined as the residual from the regression of RE (kcal/kg$^{0.75}$/d) on MEI (kcal/kg$^{0.75}$/d). Increased feed level increased intake and retained energy (P<0.01), RRE (P=0.06), but not RFI (P=0.99). Sire breed influenced all traits (P<0.01), but feed level × sire breed did not influence RRE (P=0.25) or RFI (P=0.35). Mean RRE and RFI for A, B, H, Bo, P, Br, and T sire breeds were: 2.17, 0.52; -10.04, 7.3; 3.28, 6.25; 3.65, -16.34; -8.68, 24.95; 4.83, -10.74; and 3.34, -11.77, respectively. The five of 107 steers identified as most efficient based on RFI were from the ad libitum group and averaged 4.95 kg DMI/d and 5.02 Mcal RE/d (means for ad libitum were 7.11 kg/d and 5.67 Mcal/d) suggesting potential negative consequences of over emphasizing RFI as a means to improve efficiency. These results suggest important differences exist among sire breeds in efficiency as measured by RRE or RFI.

Key Words: Breed, Efficiency, Feed level

428 Ruminal biohydrogenation and conjugated linoleic acid formation in beef cattle fed finishing diets containing crude fish oil and/or different oil sources.

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Four Hereford steers (550 kg) cannulated in the proximal duodenum were used to assess the effect of dietary oil source with or without the addition of fish oil on ruminal biohydrogenation (BH) and flow of long chain fatty acids to the duodenum. The steers were fed one of four diets in a 2 by 2 factorial arrangement of treatments (oil source: canola vs. corn oil; fish oil level: 0 or 1%) in a 4 x 4 Latin Square design. The dietary treatments included: 1) 4% corn oil (CO), 2) 4% canola oil (CA), 3) 3% corn oil plus 1% fish oil (COFISH), and 4) 3% canola oil plus 1% fish oil (CAFISH) added to a high concentrate diet (12% grass hay, 84% concentrate). All four diets were designed to be isonitrogenous and isolipid. Chromic oxide was added to the diets as an external marker for the determination of duodenal output. Experimental periods lasted 14 d with 10 d for diet adaptation and 4 d for sample collection. Data were analyzed with animal, period, oil source, fish oil and oil source by fish oil interaction in the model. Addition of canola oil increased ($P < 0.05$) BH of oleic and linolenic acids compared to corn oil addition. Fish oil addition increased ($P < 0.05$) linoleic acid BH in canola oil but did not alter BH of linoleic acid in corn oil diets. Overall BH of unsaturated 18C fatty acids was lower ($P < 0.05$) for CA and COFISH than CAFISH with CO being intermediate. Oil source did not alter ($P > 0.05$) flow of stearic, trans-octadecenoic, and oleic acids to the duodenum. Linoleic acid flow to the duodenum was greater ($P < 0.05$) for corn than canola oil; whereas, linolenic acid flow was greater ($P < 0.05$) for canola than corn oil. Addition of fish oil reduced ($P < 0.05$) the flow of stearic and linoleic acids to the duodenum. and increased ($P < 0.05$) flow of trans-11 vaccenic acid by 1.5 fold. Flow of conjugated linoleic acid (CLA) and omega-3 fatty acids was greater ($P < 0.05$) for diets containing fish oil regardless of oil source. Addition of fish oil increased flow of trans-11 vaccenic, CLA, and omega-3 fatty acids to the duodenum regardless of oil source.

Key Words: Beef, Conjugated linoleic acid, Fish oil

429 Effect of source of energy, and rate of growth in the growing phase on performance and carcass characteristics of steers.

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One hundred and eighty four steers (init. BW 161.7 ± 3.4 kg) were used to determine the effect of source and amount of energy in the growing phase on performance and carcass characteristics. Steers were allotted to one of four growing phase regimens. For three regimens, steers were weaned at 119 d of age and 1) fed a high grain diet ad libitum (**ALC**), 2) limit-fed a high grain diet to achieve a gain of 0.8 kg/d from 119 to 192 d of age, and 1.2 kg/d from 193 to 259 d of age (**LFC**), or 3) fed a high forage diet ad libitum from 119 to 192 d of age, and an intermediate level forage diet ad libitum from 193 to 259 d of age (**ALF**). For the fourth regimen, steers were weaned at 204 d of age and fed a high grain diet from 205 to 259 d of age (**NW**). From 260 d of age to slaughter all steers consumed a common diet. LFC and ALF spent the most, and NW the least amount of time (P<0.01) in the feedlot to achieve a target fat depth of 1.25 cm. ALC steers were the youngest, and NW the oldest at slaughter (P<0.01). Overall ADG was greatest for ALC, and lowest for NW steers (P<0.01). ALF steers consumed the most DM (P<0.01). While in the feedlot, LFC and ALC steers were more efficient in converting feed to BW gain (P<0.01), than ALF and NW steers. NW had the lowest and ALC the greatest (P<0.01) fat depth at 260 d of age. Consequently, NW steers produced the heaviest, and ALC the lightest (P<0.01) carcasses at slaughter. Fat depth at slaughter did not differ among treatments (P>0.56). NW steers had the largest, and ALC and LFC steers had the smallest longissimus muscle area (P<0.06). Growing phase dietary treatments did not affect (P>0.20) yield grade. Marbling score did not differ (P>0.35), but laboratory analysis revealed that ALC steers had the lowest percent fat (P<0.02) in the longissimus muscle. Shear force was greatest (P<0.08) for steaks from ALC and LFC steers, and lowest for steaks from ALF and NW steers. Feeding steers an ad libitum forage diet from 119 to 260 d of age, as well as normal-weaning extended the growth curve, improved intramuscular fat content, and increased muscle tenderness. Limit feeding a high concentrate diet did not extend the growth curve or increase muscle tenderness, but did improve intramuscular fat content, indicating that source and amount of energy affected partitioning of fat deposition.

Key Words: Beef cattle, Early-weaned, Limit-feeding

430 Effect of source of energy, and rate of growth in the growing phase on adipocyte cellularity, and lipogenic enzyme activity in the intramuscular and subcutaneous fat depots of Holstein steers.

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Seventy-three Holstein steers (init. BW 138.5 ± 4.3 kg), approximately three mo. of age, were allotted by BW to one of three growing phase treatments to determine the effect of source and amount of energy on feedlot performance, and characteristics of subcutaneous (**SC**) and intramuscular (**IM**) adipose tissue. Treatments were: 1) high concentrate diet fed ad libitum (**ALC**), 2) high forage diet fed ad libitum for 55 d, then a mid-level forage diet fed ad libitum for 98 d (**ALF**) or 3) limit-fed a high concentrate diet to achieve a gain of 0.8 kg/d for 55 d, then 1.2 kg/d for 98 d (**LFC**). All steers were fed the ALC diet from d 154 to slaughter. Eight steers per treatment were selected after an average of 145 and 334 d on feed for determination of adipocyte cellularity and lipogenic enzyme activity. Remaining steers were slaughtered after an average of 334 d on feed. At initial slaughter, ALC steers had approximately twice as much (P<0.01) SC and IM fat. At final slaughter, LFC steers had the greatest (P<0.09) fat depth, and greatest (P<0.08) longissimus muscle ether extract. Increased fat depth for ALC steers at initial slaughter was a result of a greater (P<0.01) mean adipocyte diameter in the SC depot. Mean IM adipocyte diameter followed the same trend (P=0.16). The number of adipocytes/g of SC fat was lowest for ALC and greatest for ALF (P<0.09) at initial slaughter. Mean diameter and number of adipocytes/g of IM and SC fat did not differ (P>0.52) among treatments at final slaughter (after 174 d on a common finishing diet). Amount of energy (ALC) increased activities of ATP-citrate lyase, fatty acid synthetase, 6-phosphogluconate dehydrogenase, glucose-6-phosphate dehydrogenase, and malate dehydrogenase in the SC depot (P<0.02), and increased activities of ATP-citrate lyase and glucose-6-phosphate dehydrogenase in the IM depot (P<0.10) at initial

slaughter. Lipogenic enzyme activity in the SC depot at final slaughter, did not differ (P>0.33) among treatments. Glucose-6-phosphate dehydrgenase activity in the IM depot at final slaughter was decreased (P<0.08) in ALF. Hypertrophy made a greater contribution to fat tissue growth than hyperplasia. Hypertrophy was affected by amount, whereas hyperplasia was affected by source of energy. Differences diminished when cattle were placed on the common finishing diet.

Key Words: Early-weaning, Limit-feeding, Adipocyte characteristics

431 Ground flaxseed as a component of finishing cattle diets. E. J. Good*, J. S. Drouillard, T. J. Kessen, E. R. Loe, M. J. Sulpizio, M. A. Greenquist, S. P. Montgomery, J. J. Sindt, J. N. Pike, and K. A. Hachmeister, *Kansas State University, Manhattan, KS*.

Ground flaxseed fed to feeder cattle at approximately 10% of the diet has been shown to increase plasma and longissimus muscle concentrations of alpha linolenic acid and eicosapentanoic acid, and to increase quality grades, while decreasing retail display life of the product. An experiment was conducted to determine the effects of combinations of ground flaxseed and vitamin E on feedlot performance, carcass quality, retail display life, and fatty acid composition. Steers (n=79; 338 kg BW) were individually fed diets containing ground flaxseed at 0, 5, 10, or 15% of the diet, with and without the addition of 220 IU vitamin E/kg DM. All diets were fed throughout a 120-d finishing period. After completion of the finishing period, carcass data, including hot carcass weight, yield grade, marbling score, subcutaneous fat thickness, ribeye area, and percentage of kidney, pelvic and heart fat, were determined for each animal. Also, retail display life, 2-Thiobarbituric Acid Reactive Substances (TBARS), fatty acid composition, and sensory attributes of longissimus dorsi muscles were evaluated. Cattle fed flax had a linear tendency (P=0.08) for increased average daily gain, DMI was increased (P<0.05), but gain:feed was not affected. There was a quadratic effect (P<0.05) of flax level on KPH, and the amount of fat over the 12th rib (P<0.05). Additionally, there was a linear increase in dressing percent as level of flax was increased (P<0.05). Feeding flaxseed tended (P=0.08) to increase the percentage of carcasses grading USDA Choice, with 5% flax as the optimum level. There were no differences in TBARS or Warner Bratzler sheer force among any of the treatments. A trained taste panel evaluated myofibrillar tenderness, juiciness, flavor intensity, connective tissue amount, overall tenderness, and off-flavor intensity on the steaks, but observed no differences among treatments. Retail display life display was improved (P<0.05) by feeding any level of flax with vitamin E. Vitamin E did not improve retail shelf life in the absence of flax. Dietary treatments combining vitamin E and ground flaxseed produced no negative effects on meat quality. Flax is an acceptable source of energy and may enhance growth and carcass quality attributes of cattle.

Key Words: Flaxseed, Vitamin E, Carcass quality

432 Comparison of concentrated separator byproduct with cane molasses and the relationship of blood glucose concentration at arrival to finishing performance and carcass characteristics of heifers. E. R. Loe*, J. S. Drouillard, T. J. Kessen, S. P. Montgomery, J. N. Pike, J. J. Sindt, and M. J. Sulpizio, *Kansas State University*.

To determine the effect of diet and arrival blood glucose concentration on finishing performance and carcass characteristics, 394 crossbred heifers (298 2 kg initial BW) in 24 pens were used in a completely randomized design with a 2 × 2 factorial arrangement of treatments. Factors were cane molasses or concentrated separator byproduct (CSB) and high or low initial blood glucose. Blood samples were taken at arrival and 9 d prior to slaughter. Heifers were sorted into two groups based on blood glucose concentrations at arrival (low glucose = heifers < 66 mg/dL; high glucose = heifers > 66 mg/dL). Mean initial glucose in whole blood was 57 and 78 2 mg/dL and in plasma was 96 and 117 3 mg/dL for low- and high-glucose groups, respectively. Diets contained (DM basis) 77% steam-flaked corn, 8% alfalfa hay, 5% cane molasses or CSB, 3% tallow, and 10% supplement which contained vitamins, minerals, and feed additives. Heifers were fed a common receiving diet for 26 d and the cane molasses or CSB diet for 148 d. No interactions between diet and arrival glucose were detected ($P > 0.42$). Diet did not affect feedlot performance ($P > 0.23$), final glucose concentrations ($P > 0.49$), apparent dietary NE_g ($P > 0.21$), or carcass characteristics ($P > 0.10$). Low-glucose heifers had lower final plasma glucose ($P = 0.009$; 114 vs 139 mg/dL); consumed more feed ($P = 0.02$); had heavier final live BW ($P = 0.02$); and greater fat thickness ($P < 0.05$). Glucose concentration did not affect feed efficiency or morbidity ($P > 0.65$). Apparent NE_g for cane molasses and CSB were not different ($P = 0.20$). Concentrated separator byproduct is a suitable replacement for cane molasses. Cattle that had low glucose at arrival had improved finishing performance and fatter carcasses compared to heifers with high blood glucose at arrival.

Key Words: Concentrated separator byproduct, Cane molasses, Blood glucose

433 Effects of dietary crude protein level and degradability on performance and carcass characteristics of growing-finishing beef steers. J. F. Gleghorn*[1], N. A. Elam[1], M. L. Galyean[1], G. C. Duff[2], and N. A. Cole[3], [1]*Texas Tech University, Lubbock, TX,* [2]*University of Arizona, Tuscon, AZ,* [3]*USDA-ARS-CPRL, Bushland, TX*.

Two experiments were conducted at two locations to determine the effects of dietary CP level and source on performance and carcass characteristics of beef steers. British x Continental steers were blocked by BW (357 ± 28 and 305 ± 25 kg initial BW; n=360 and 225; four and five pens/treatment in Exp. 1 and 2, respectively). Steam-flaked corn-based diets were arranged in a 3 x 3 factorial with three CP levels (11.5, 13, 14.5% of DM) and three sources of supplemental CP (N basis): 100% urea (U), 50:50 blend of urea and cottonseed meal (B), or 100% cottonseed meal (C). Steers in both experiments were initially implanted with Ralgro and reimplanted with Revalor-S on d 56. Performance and carcass data were pooled over location and analyzed with mixed model procedures using pen as the experimental unit. Crude protein level quadratically affected ADG (P < 0.05) and carcass-adjusted (to a common dress) ADG (P < 0.10). Increasing the level of supplemental urea linearly increased carcass-adjusted ADG and gain:feed (P < 0.05) and carcass-adjusted gain:feed (P < 0.001). Dry matter intake was not affected by CP level or source (P > 0.10). Dry matter intake was not affected by CP level or source (P > 0.10). Hot carcass weight (HCW), longissimus muscle area (LMA), and dressing percent tended to increase linearly with increasing urea level (P < 0.06), whereas increasing CP level quadratically affected HCW (P < 0.05), with a maximum value at 13% CP. Differences in back fat thickness and yield grade were negligible across treatments. Neither marbling score nor percentage of carcasses grading Choice was affected by CP level or source. Results indicate that increasing CP levels from 11.5 to 13% slightly increased ADG and carcass-adjusted ADG, whereas increasing the proportion of supplemental urea increased carcass-adjusted ADG, gain:feed, carcass-adjusted gain:feed, HCW, LMA, and dressing percent. A CP level above 13% seemed to be detrimental to ADG and HCW.

Key Words: Beef cattle, Crude protein, Urea

434 Processing Methods that Influence Characteristics of Steam-Flaked Corn. J. J. Sindt*, J. S. Drouillard, S. P. Montgomery, and E. R. Loe, *Kansas State University, Manhattan*.

We evaluated surfactant (SRF) concentration, tempering (TMP) moisture concentration, duration of steam (STM) conditioning, and flake density (DEN) as variables that potentially influence characteristics of steam-flaked corn. Samples of whole corn (n=12; 89% DM; 2 kg/sample) were weighed and placed into individual glass jars (3.785 L). Samples were then tempered in water (6, 10, or 14% added water to achieve 17, 21, and 25% moisture after TMP) containing 0 or 0.67 g/L of SRF and rotated continuously for 2 h at 20° C. Samples were then subjected to STM for either 20 or 40 min in a 12-chamber STM conditioner. After STM conditioning, samples were flaked to a common DEN. This procedure was replicated three times daily using three flake DEN (360, 335, and 310 g/L) and repeated for three consecutive days to complete a 2 × 3 × 2 × 3 factorial arrangement of treatments. Samples of corn were collected following TMP, STM, and flaking. As expected, TMP increased (linear, P<0.0001) flaked-corn moisture content, however, moisture content was not altered by SRF (P=0.38), STM (P=0.17) or DEN (P=0.86). Adding the SRF during TMP reduced (P<0.05) the amount of moisture lost from corn between steaming and flaking. In vitro gas production was not affected by TMP (P=0.62), SRF (P=0.31), or STM (P=0.33), however, decreasing DEN increased (linear, P<0.01) the volume of gas produced. Flake durability was tested by tumbling the flakes for 10 min in a commercial durability tester and measuring the amount of flakes

retained on a 9.5 mm screen. Increasing STM duration while increasing TMP moisture concentration increased the proportion of grain retained on a 9.5 mm screen (P<0.05; STM duration × TMP moisture interaction). Additionally, decreasing DEN improved (linear, P<0.05) flake durability. Fermentation characteristics are most influenced by DEN, and flake integrity can be improved by increasing TMP moisture and STM duration, or by reducing DEN.

Key Words: Steam-flaked corn, Grain processing, Tempering

435 Effect of full-fat corn germ and vitamin E on performance and carcass characteristics of beef cattle fed finishing diets containing dried-rolled or steam-flaked corn. S. P. Montgomery*, J. S. Drouillard, J. J. Sindt, M. A. Greenquist, B. E. Depenbusch, E. J. Good, E. R. Loe, M. J. Sulpizio, and T. J. Kessen, *Kansas State University*.

Two experiments were conducted to evaluate full-fat corn germ (FFCG) as a fat source in finishing diets. In Exp. 1, crossbred beef steers (n = 358; BW = 319 kg) were blocked by previous treatment and assigned randomly to each of four dietary treatments providing six pens per treatment. Treatments consisted of diets containing dry-rolled corn and 35% wet corn gluten feed (DM basis) and 0, 5, 10, or 15% FFCG. Diets were offered once daily for the entire 155-d finishing period. Increasing FFCG decreased ADG (quadratic, P < 0.02) (1.29, 1.36, 1.39, and 1.33 kg) and DMI (linear, P < 0.02) of steers but increased gain efficiency (linear, P < 0.01). Addition of FFCG increased (linear, P < 0.04) kidney, pelvic, and heart fat, and USDA Yield Grade. In Exp2, crossbred beef heifers (n = 888; BW = 380 kg) were allotted randomly to pens and pens were blocked by date of implanting. Pens were assigned randomly to each of 8 dietary treatments arranged in a 4 × 2 factorial providing six pens per treatment. Treatments consisted of diets formulated to provide no added fat (Control), 4% tallow, (Tallow), or 10% or 15% FFCG on a DM basis with or without 2000 IU of additional vitamin E. Diets were offered once daily for the entire 105-d finishing period. No fat × vitamin E interaction was detected (P > 0.20). Fat addition decreased (P < 0.01) DMI, marbling score and the number of carcasses grading USDA Choice. Effects of Tallow and 10% FFCG were not different (P > 0.06). Increasing FFCG decreased (quadratic, P < 0.03) ADG (1.29, 1.31, 1.20 kg) and gain efficiency (0.146, 0.154, 0.147 kg gain/kg DMI). Increasing FFCG decreased (linear, P < 0.05) DMI, marbling score, and the percentage of carcasses grading USDA Choice. No affect of vitamin E was detected. These data suggest that full-fat corn germ can serve as a supplemental fat source in cattle finishing diets.

Key Words: Full-fat corn germ, Fat source, Finishing cattle

436 Influence of dietary crude protein on potential ammonia emissions from beef cattle manure. N. A. Cole*[1], R. N. Clark[1], R. W. Todd[1], C. R. Richardson[2], A. Gueye[2], L. W. Greene[3], and K. McBride[3], [1]*USDA-Agricultural Research Service, Bushland, TX,* [2]*Texas Tech University, Lubbock, TX,* [3]*Texas Agricultural Experiment Station, Amarillo, TX*.

Atmospheric emissions of ammonia are a growing concern of livestock producers, the general public, and regulators. The concentration and form (rapidly degradable vs. undegradable in the rumen) of CP in beef cattle diets may affect urinary and fecal excretion of nitrogen and thus may affect ammonia emissions from beef cattle feedyards. To determine the effects of dietary CP concentration and degradability on potential ammonia emissions, 54 steers were randomly assigned to nine dietary treatments in a 3 x 3 factorial arrangement. Treatments consisted of three dietary CP concentrations (11.5, 13, and 14.5 percent, DM basis) and three supplemental urea:cottonseed meal ratios (100:0, 50:50, and 0:100 of supplemental N). On three occasions during the feeding period (approximately 35, 75, and 115 d) steers were confined to tie stalls and feces and urine excreted were collected for five d and frozen. One percent of thawed daily urine and feces excretion were mixed and added to polyethylene chambers containing 1,550 g of soil. Chambers were sealed and ambient air was drawn through the chambers at a rate of 1.5 L/min using a vacuum pump. Ammonia in the outgoing air was trapped in a 0.9 M sulfuric acid solution for seven days. Ammonia emissions were highly correlated to urinary N excretion and application [ammonia emissions = 0.723(urine N) - 10.29: r = 0.78; P < 0.01; ammonia emissions and urine N in mg]. As the CP concentration in the diet increased from 11.5 to 13 percent, potential daily ammonia emissions increased 60 to 225 percent (d 30 and 115, respectively). Ammonia losses for steers fed the 13 and 14.5 percent CP diets were not significantly different, probably because urinary N excretions were not different. As days on feed increased, in vitro ammonia emissions also increased due to increased urinary N excretion (P < 0.01). On days 75 and 115 urinary N excretion and ammonia emissions increased (P < 0.10) as the proportion of urea in the supplement increased. This study indicates that dietary CP concentration and degradability may affect daily emissions of ammonia from beef cattle feedlots. However, daily ammonia emissions must be balanced with possible effects on animal performance to determine optimal CP concentrations and forms in finishing diets.

Key Words: Beef cattle, Protein, Ammonia

437 Finishing diets with elevated levels of α-linolenic acid increase adipose tissue α-linolenic acid, but do not alter stearoyl Co-A desaturase activity. S. L. Archibeque*[1], D. K. Lunt[1], R. K. Tume[2], and S. B. Smith[1], [1]*Texas A&M University, College Station, TX,* [2]*Food Science Australia, Tingalpa D. C. Queensland, Australia*.

Forty-five Angus steers (358 kg BW) were used in a 3 x 3 factorial, completely randomized block design evaluate the hypothesis that dietary α-linolenic acid (from corn, corn with flaxseed, or milo) and whole cottonseed (**WCS**) inclusion (0, 5, or 15% DM) would interact to alter fatty acid metabolism and deposition of conjugated linoleic acid (**CLA**) in subcutaneous (**s.c.**) and interfasicular (**i.f.**) adipose tissues. Lipogenesis from acetate in s.c. adipose tissue was greater (P<0.01) in steers fed flaxseed (5.42 nmol·h^{-1}·10^5 cells^{-1}) than in the corn (3.10 nmol·h^{-1}·10^5 cells^{-1}) or milo (1.92 nmol·h^{-1}·10^5 cells^{-1}) groups. Stearoyl-CoA desaturase activity (SCD) in s.c. adipose tissue decreased (P< 0.04) from 53 nmol·mg protein^{-1}·7 min^{-1} in the 0% WCS group to 20 nmol·mg protein^{-1}·7 min^{-1} in the 15% WCS group. The i.f. saturated fatty acid percentages increased (P< 0.01) with increasing levels of WCS, and there was a tendency (P< 0.09) for a similar effect in subcutaneous adipose. The i.f. cis-9, trans-11 CLA percentage increased with increasing WCS in the steers fed the corn diet, whereas it remained unchanged or even decreased slightly in the steers fed the flaxseed or milo-based diets (interaction, P< 0.02). Steers fed flaxseed had a greater (P< 0.01) s.c. adipose concentration of vaccenic acid (18:1trans-11) than the steers fed milo and tended (P< 0.07) to have greater amount of vaccenic acid than steers fed corn alone. Steers fed flaxseed also had greater (P< 0.01) s.c. and i.f. percentages of the α-linolenic acid (18:3n-3) than steers fed either of the other grain sources, and this effect accompanied a similar increase (P< 0.01) in total polyunsaturated fatty acid percentages. Steers fed flaxseed had a larger mean adipocyte volume in i.f. adipose tissue (P< 0.01), which tended to be larger in s.c. adipose tissue (P< 0.06). The increases in saturated fatty acids in s.c. adipose tissue appear to be a result of the decreased SCD activity in s.c. adipose tissue with increased inclusion of WCS. Increased dietary α-linolenic acid from flaxseed may have increased s.c. adipocyte volume by stimulating lipogenesis.

Key Words: Steers, Adipose metabolism, Linolenic acid

438 Conjugated Linoleic Acid in tissues from beef cattle fed different lipid supplements. S. F. Porter*[1], T. R. Dhiman[1], D. P. Cornforth[1], R. D. Wiedmeier[1], K. C. Olson[1], B. R. Bowman[1], and N. D. Luchini[2], [1]*Utah State University, Logan, UT,* [2]*Bioproducts Inc., Fairlawn, OH*.

The objective was to utilize fat supplements mixed with a high-grain ration to increase Conjugated Linoleic Acid (CLA) levels in beef cattle tissue and provide beef that is desirable to the consumer. Sixteen steers and 8 heifers were blocked according to body weight and assigned to 1 of 4 treatments. Animals were fed a TMR consisting of ground barley (78%), alfalfa hay, and corn silage plus 300 g/hd/d of either Megalac® (ML) as control, fish oil (FO), partially rumen-protected trans fat (TF), or linseed oil (LO) as a fat supplement mixed into the TMR. Animals were fed for an average of 148 d and then slaughtered between 450 and 590 kg live body weight. At slaughter, muscle and adipose tissue samples were collected from the loin and round and analyzed for fatty acid profile. There was no tissue-by-treatment or site-by-treatment interaction (P<0.05), so all samples were pooled and the overall treatment means were reported. Tissues from TF and LO cattle had higher average cis-9 trans-11 CLA levels than FO and ML treatments (P<0.05). Cis-9 trans-11 CLA levels for ML, FO, TF, and LO were 0.24^b, 0.26^b, 0.45^a, and 0.41^a, % of total fatty acids, respectively. Trans-10 cis-12 CLA levels

were not different between treatments (P<0.05) and averaged 0.016% of total fatty acids. Color stability tests were performed tri-weekly on top loin steaks for 21 d. By day 7, FO steaks had a higher hue angle (indicating brownness), which continued until day 20 (P<0.05). Neck muscle vitamin E levels in FO were lower than in LO and TF, but not different from ML (P<0.05). Vitamin E values for ML, FO, TF, and LO were 2.35^{ab}, 1.58^{b}, 3.29^{a}, and 2.99^{a}, g/kg of neck muscle, respectively. Off-flavor was stronger in FO (P<0.05) according to a trained taste panel. In the present study, supplementing trans fat and linseed oil increased cis-9 trans-11 CLA levels in beef tissue by 88% and 71% compared to control, respectively. The TF and LO treatments had 108% and 89% higher tissue vitamin E levels than FO, respectively. Feeding fish oil decreased color stability and introduced an off-flavor to the beef.

Key Words: Beef, Fat, Conjugated linoleic acid

Dairy Foods Symposium: Dairy foods research success stories

439 Dairy foods research success stories. W. Sandine*[1], C. White[2], D. Hettinga[3], J. Hotchkiss[4], R. Thunell[5], M. Mangino[6], and D. Willrett[5], [1]*Oregon State University,* [2]*Mississippi State University,* [3]*Land O' Lakes, Inc.,* [4]*Cornell University,* [5]*DSM,* [6]*Ohio State University.*

This symposium results from the need to remind federal granting agencies and legislators of the economic and social benefits from agricultural research. While research funding from NSF and NIH has increased dramatically since 1990, that for agriculture has decreased,especially for agricultural experiment stations. Examples will be given. Research success stories benefiting this nation will be presented: A brief history of dairy foods research and its contribution to the American way of life; the dramatic impact of increased market milk shelf life for consumers and industry profits; the value of cheese starter culture media developments to industry and consumers; the defined strain starter culture program for Cheddar cheese plants; carbon dioxide and shelf life extension in cottage cheese for an expanded market; and successful whey research yields new products and eliminates an environmental polluant. From these and other success stories the 38 member societies of CAST along with N-CFAR and other agencies are developing Fact Sheets to distribute to members of the U.S. congress and administrators to heighten their awareness of needed funding increases for agricultural research.

Key Words: Research, Funding, CAST

Beef Species: Beef cattle performance

440 Influence of breed on performance and dry matter intake by feedlot bull calves in Brazil. R. Almeida*[1,2] and D.P.D. Lanna[2], [1]*UFPR and PUCPR, PR, Brazil,* [2]*LNCA-ESALQ/USP, SP, Brazil.*

Performance and daily feed intake records from the largest bull test in Brazil were analyzed to determine differences attributable to breed. Postweaning performance of purebred calves was evaluated from seventeen pens, which held 145 Angus, 342 Brangus and 911 Nellore, for a total of 1,398 bulls tested in 2000, 2001 and 2002. Bulls calves arrived at 8 months of age and initial weight of 218 kg, and were fed for 28 days of adaptation and 112 days of test. A high forage diet (50% of DM as concentrate; 14% CP and 67% TDN) typical of brazilian feedlots was used and monensin included at 27 ppm. Data were analyzed using GLM procedure of SAS. The first data set (performance data) included 1,398 individual records and the second set used 17 pens monitored daily for dry matter intake. Breed type affected weights at 8, 9 (P<.01) and 11 (P<.05) months, but not (P>.05) at 13 months of age (end of feedlot period). Nellore bulls started on test with heavier weights but had the same final weight (13 months) as Angus and Brangus. Breed type also affected (P<.01) average daily gain. Brangus and Angus had higher gains (1.34 ± 0.04 and 1.27 ± 0.03 kg/d) than Nellore bulls (1.19 ± 0.02 kg/d). Angus and Brangus consumed more feed (P<.01) than Nellore calves. During the 112 day-evaluation period intakes for Angus, Brangus and Nellore calves were: 7.23 ± 0.12, 7.19 ± 0.10 and 6.71 ± 0.06 kg/day, and 2.55 ± 0.05, 2.49 ± 0.04 and 2.20 ± 0.02% of BW, respectively. There were no differences (P>0.05) in feed efficiency among breeds. NRC (1984 and 1996) equations were used to predict DMI. The biases were -0.3, +0.6 and +10.0% for the NRC (1984) and -3.0, -2.1 and +7.2% for the NRC (1996), and for Angus, Brangus and Nellore, respectively. NRC equations overpredicted DMI for *Bos indicus* breeds. New DMI prediction equations for high roughage and purebred Zebu cattle need to be developed and validated.

Key Words: Beef cattle, Feed intake, Nellore

441 Evaluation of yearling bull sale prices at six regional locations. D. Dean* and A. Herring, *Texas A&M University, College Station.*

During the spring of 2001, a seedstock marketing cooperative conducted six sales in CO, IA, ID, MO, and SD. Breeders delivered bulls to locations approximately 150 d prior to sale date; bulls were fed to gain approximately 1.4 kd/d. The purpose of this study was to evaluate specific areas of selection used by commercial producers and their effect on sale prices of yearling purebred bulls. Data on Gelbvieh (GV, n = 675), Angus (AN, n = 65) and Red Angus (RA, n = 50) bulls were analyzed. Specific traits available included sale price, age-adjusted ultrasound ribeye area (ADJREAU), age-adjusted ultrasound intramuscular fat percentage (ADJUIMF), age-adjusted ultrasound 12th and 13th rib backfat thickness (ADJUBFT), actual birth weight (BWT), actual weaning weight (WWT), average daily gain (ADG), ADG ratio, adjusted yearling weight (ADJYW), Frame score (FRAME), scrotal circumference (SC), birth weight EPD (BWTEPD), weaning weight EPD (WWTEPD), yearling weight EPD (YWEPD), milk production EPD (MILKEPD), total maternal EPD (TMEPD). AN and RA bulls were combined into one group and analyzed separately from GV bulls. RA EPDs were adjusted to the AN base according to 2001 across breed EPD adjustments. Sale price was analyzed by GLM procedures of SAS with independent variables of sire, with regressions on ADJREAU, ADJUIMF, ADJUBFT, BWT, WWT, ADG, ADG ratio, ADJYW, FRAME, SC, BWTEPD, WWTEPD, YWEPD, MILKEPD, and TMEPD. EPDs did not account for differences in sale price for GV bulls. Sire (P = 0.0005), BWT (P = 0.0288), WWT (P = 0.055), ADG (P = 0.0386), ADGRATIO (P = 0.0159), SCROTAL (P = 0.0006) and ADJREA (P = 0.0001) affected prices paid by customers buying GV bulls with a slight trend for ADJBACKFAT (P = 0.0628). Among GV bulls, sale price difference per unit change of the independent variables BWT, WWT, ADG, ADG ratio, SC, ADJREAU, and BACKFAT were -$7.79, $1.09kg, -$256.88, $9.95, $41.71, $82.66, and $116.87, respectively. Among ANRA bulls, only ADJYWEPD affected (P = 0.05) sale prices, with a price per unit change of $34.24. EPDs were not influential in sale prices of these yearling bulls that had actual performance data reported in sale catalogs.

Key Words: Sale prices, Yearling bulls, Performance data

442 Evaluation of forage sources for finishing diets containing wet corn gluten feed. C. R. Dahlen[1], A. DiCostanzo*[2], R. T. Ethington[3], T. L. Durham[4], J. E. Larson[2], and G. C. Lamb[5], [1]*Northwest Research and Outreach Center, University of Minnesota,* [2]*Department of Animal Science, University of Minnesota,* [3]*Kansas Feeds, Inc,* [4]*ADM Corn Processing,* [5]*North Central Research and Outreach Center, University of Minnesota.*

Two hundred twenty-three Angus crossbred steers (308 kg) were used to evaluate effects of various forage sources in diets containing wet corn gluten feed. Steers were assigned by weight and origin to one of sixteen pens (14 or 15 steers/pen). Pens were randomly assigned to one of five dietary treatments. Dietary treatments consisted of diets balanced (1.39 Mcal NE_g/kg DM; 12.5% CP) using high moisture and dry rolled corn (50:50 DM basis) with one of the following forage sources: corn silage (n = 3), wet corn gluten feed (n = 3), or wet corn gluten feed in combination with corn silage (n = 3), grass-legume hay (n = 3), or both (n = 4). Effects of forage source on performance and carcass characteristics were determined using non-orthogonal contrasts. Steers fed diets containing

wet corn gluten feed had similar (P > 0.05) performance and carcass characteristics as those fed the corn grain and corn silage diet. Steers fed the diet containing wet corn gluten feed without added forage gained faster (P = 0.05), required fewer (P < 0.05) kg DM/kg gain and were heavier at slaughter (live and carcass weights; P < 0.05) than steers fed diets containing wet corn gluten feed with additional forage. Steers fed the diet containing wet corn gluten feed and hay gained faster (P < 0.05), reached heavier final and carcass weights (P < 0.01), and greater dressing percentage (P < 0.01) than those fed the diet containing wet corn gluten feed and corn silage. Steers fed diets containing wet corn gluten feed in combination with both forage sources and those fed diets containing wet corn gluten feed in combination with either forage source had similar (P > 0.05) feedlot performance and carcass characteristics. Diets containing corn, wet corn gluten feed and corn silage either alone or with hay resulted in negative associative effects on estimated energy content of the diet (R^2 = 0.71; P < 0.01). The magnitude of this effect was greater (more negative) for the diet containing wet corn gluten feed in combination with corn silage. Combining wet corn gluten feed with corn silage, hay, or both lead to associative effects that reduced feedlot performance.

Key Words: Steers, Corn gluten feed, Associative effects

443 Evaluation of implants containing different combinations of trenbolone acetate and estradiol on performance and carcass merit of short-fed finishing heifers.
W. T. Nichols*, J. P. Hutcheson, C. D. Reinhardt, and G. E. Sides, *Intervet, Inc., Millsboro, DE.*

There has been speculation as to whether short-fed finishing heifers require exogenous estrogen in addition to trenbolone acetate (TBA) when melengestrol acetate (MGA) is fed only in the final finishing ration. The objective of this study was to evaluate the effects of implants containing different levels of estradiol (E_2) and TBA compared to implants containing TBA alone on performance and carcass traits of short-fed finishing heifers. A total of 1,796 yearling heifers (352 kg.) were used in a randomized complete block study. Treatments were: 1) REV-IH (80 mg of TBA and 8 mg of E_2), 2) REV-H (140 mg of TBA and 14 mg E_2), 3) REV-200 (200 mg TBA and 20 mg E_2), and 4) FIN-H (200 mg TBA). All heifers were fed .4 mg of MGA per head daily, starting with the finishing ration (d 24-27) and were fed for a total of 121 days. Heifers implanted with REV-200 tended to gain faster (P<0.10), were more efficient (P<0.05) on a carcass-adjusted basis, and tended to have heavier hot carcass weights (P<0.10) than heifers in any other treatment group. Implanting with REV-200 tended to cause a reduction in percentage of Prime & Choice carcasses (P<0.10) and increased the percentage of Select carcasses (P<0.05) compared to FIN-H or REV-H. However, differences in quality grade corresponded to differences in Yield Grade. In this study, REV-200 tended to improve rate of gain and hot carcass weights and improved and efficiency of gain and dressing percentage compared to other implant treatments. When single implant strategies are utilized in short-fed finishing heifers, and MGA is included only in the final finishing diet, implanting with higher levels of E_2/TBA may improve rate and efficiency of gain, carcass weight, and dressing percentage.

Item	REV-IH	REV-H	REV-200	FIN-H
Carc. Adj. ADG, kg	1.41^{ef}	1.42^{e}	1.48^{d}	1.38^{f}
Carc. adj. G/F	$.168^{h}$	$.166^{h}$	$.174^{g}$	$.166^{h}$
Dressing %	63.59^{gh}	63.23^{i}	63.74^{g}	63.31^{hi}
HCW, kg[a]	331^{f}	334^{e}	338^{d}	330^{f}
Pr+Ch, %[b]	64.3^{de}	67.1^{d}	59.2^{e}	70.4^{d}
EBF, %[c]	32.35	32.53	32.35	32.46
Yield Grade	2.45^{d}	2.56^{e}	2.47^{d}	2.55^{e}

[a] HCW=hot carcass weight; [b] Pr+Ch=Percentage of carcasses grading Prime and Choice; [c] EBF=Empty Body Fat, Calculated using equations from Perry and Fox (J. Anim. Sci. 75:300); Values in a row without common superscripts differ: ^{d,e,f} (P<0.10); ^{g,h,i} (P<0.05)

Key Words: Implants, Feedlot, Heifers

444 Evaluation of Revalor®-IS, Revalor®-S and Component®-ES on performance and carcass merit of short-fed finishing steers.
J. P. Hutcheson, C. D. Reinhardt, G. E. Sides*, and W. T. Nichols, *Intervet, Inc., Millsboro, DE.*

Eight hundred and three, English × Exotic crossbred yearling steers (431 kg) were used in a randomized complete block study. The objective of the study was to evaluate the performance of heavy yearling steers given one of 3 different dosage implants. Treatments were: 1) Revalor-S (RS; 120 mg trenbolone acetate (TBA) and 24 mg estradiol (E_2) 2) Revalor-IS (IS; 80 mg TBA and 16 mg E_2), 3) Component-ES (ES; 20 mg estradiol benzoate and 200 mg progesterone). Steers were blocked by weight into 4 pen blocks per treatment with 67 head per pen. Steers were implanted at initial processing and fed for a total of 118 days. Steers implanted with RS and IS gained 7.7 and 5.0% faster (P<0.05) and had 4.0 and 3.4% (P<0.05) better dry matter feed conversion when compared to ES steers. Also, RS and IS increased (P<0.05) hot carcass weight 11.3 and 7.7 kg over ES implanted steers. Steers implanted with RS had increased (P<0.05) ribeye area when compared to IS and ES steers. Dressing percent was similar (P=0.99) across all treatments. There were no differences in percent Choice and Prime carcasses, which averaged 52, 56 and 57% for RS, IS and ES, respectively. In heavy, short-fed yearling steers, utilizing either a reduced-dose or full-dose combination E_2/TBA implant increased performance when compared to using an estrogen-based implant, with no adverse impact on quality grade. The data indicates that the use of Revalor-S and Revalor-IS can improve performance while maintaining a similar number of carcasses grading Choice and Prime when compared to Component-ES implanted steers.

Key Words: Implants, Feedlot, Steers

445 Evaluation of single and re-implant programs on performance and carcass merit of finishing steers. .
C. D. Reinhardt*, J. P. Hutcheson, W. T. Nichols, and G. E. Sides, *Intervet, Inc., Millsboro, DE.*

One thousand three hundred forty-four English × Continental crossbred steers (avg. 307 kg) were used in a randomized complete block study. The objective of the study was to evaluate the performance of feedlot steers given different dose implants either as single or re-implant programs. Treatments were: 1) Revalor-S (120 mg trenbolone acetate (TBA) & 24 mg estradiol (E_2) day 0 (RS), 2) Revalor-IS (80 mg TBA & 16 mg E_2) day 0 (IS), 3) Revalor-IS day 0 and Revalor-IS day 50 (IS-IS), and 4) Revalor-IS day 0 and Revalor-S day 50 (IS-RS) 5) Component-ES (20 mg estradiol benzoate & 200 mg progesterone) day 0 (ES). Steers were blocked by weight, and there were 4 pens per treatment with 67 steers per pen. Steers were fed for 186 days. Data were analyzed using GLM of SAS with pen as the experimental unit, and means were separated using LSD with a protected F-test (P<0.10). Steers implanted with IS-RS tended to have higher average daily gains and heavier final weights than any of the single implant treatments (P<0.10) on a live basis and higher average daily gain and better feed conversion vs. all other treatments on a carcass adjusted basis (P<0.10). Steers implanted with IS-RS also tended to have significantly heavier carcass weights than any of the single implant treatments (P<0.10). Percentage of carcasses grading Prime + Choice combined were 36, 34, 34, 43, and 41%, for IS-RS, IS-IS, RS, IS and ES, respectively and were not different (P=0.35) between treatments but steers implanted with ES and IS tended to have a higher percentage of carcasses (18 and 17.6%) which graded Prime + upper 2/3 Choice combined than IS-RS or RS, (11.5 and 12.3%; P<0.10), with IS-IS being intermediate (12.5%). However, differences in marbling and quality grade were explained by differences in empty body fatness, as there was a correlation between empty body fat and both marbling score (r=.46; P=.04) and percent Prime + Choice combined (r=.57; P=.09). These data indicate that daily gain, efficiency and carcass weight may be improved using Revalor-IS followed by Revalor-S compared to single implant programs in steers fed for 186 days, with minimum impact on quality grade, provided cattle are marketed at a similar body fatness endpoint.

Key Words: Implants, Feedlot, Steers

446 Response to selection by marker assisted BLUP with use of approximate gametic variance covariance matrices. L. R. Totir*, R. L. Fernando, and J.C.M. Dekkers, *Iowa State University*.

Under additive inheritance, Henderson's mixed model equations (HMME) provide an efficient approach to obtain genetic evaluations by marker assisted best linear unbiased prediction (MABLUP) given pedigree relationships, trait, and marker data. For large pedigrees with many missing markers, however, it is not feasible to calculate the exact gametic variance covariance matrix required to construct HMME. The objective of this study is to investigate the consequences of using approximate gametic variance covariance matrices on response to selection by MABLUP. Two methods were used to generate approximate variance covariance matrices. The first method (Method A) completely discards the marker information for individuals with unknown linkage phase between two flanking markers. The second method (Method B) makes use of the marker information at only the most polymorphic marker locus for individuals with unknown linkage phase. Data sets were simulated with complete or incomplete marker data for flanking markers with 2, 4, 6, 8 or 12 alleles. Several missing marker data patterns were considered. The genetic variability explained by marked quantitative trait loci (MQTL) was modeled with one or two MQTL of equal effect. Response to selection by MABLUP using Method A or Method B were compared with that obtained by MABLUP using the exact genetic variance covariance matrix, which was estimated using 15,000 samples from the conditional distribution of genotypic values given the observed marker data. For the simulated conditions, the superiority of MABLUP over BLUP based only on pedigree relationships and trait data varied between 0.0% and 10.6% for Method A, between 1.1% and 16.2% for Method B, and between 4.1% and 18.5% for the exact method. The difference between response to selection obtained for the model with one MQTL and the model with two MQTL was small.

Key Words: Marker assited selection, BLUP, Gametic variance covariance matrix

447 A simulation program using finite loci with infinite possibilities, FLIP. P. L. Spike*[1], R. R. Benson[1], R. L. Fernando[1], J. C. M. Dekkers[1], P. J. Berger[1], and B. R. Skaar[1], [1]*Iowa State University*.

A simulation program was developed in C++ for instructional use in animal breeding and genetics classes and for simulation research. The purpose of the program is to simulate animal performance for a species of choice with multiple traits and multiple breed populations. Animal performance is simulated by combining the effects of a finite number of loci in diploid organisms with random variation. The core of the program consists of "known" alleles assigned to loci on a variable number of pairs of homologous chromosomes and a single pair of sex chromosomes. Alleles can be genes or other unique DNA sequences that may serve as markers. The effects of the "known" gene combinations can be assigned such that both additive and non-additive effects can be defined for both allelic and non-allelic sets of gene pairs. The effects of "known" gene combinations can include the effects of imprinting. Optionally, the program can create additional "unknown" genes to increase the genetic variance-covariance resulting from the "known" genes to a desired level. These "unknown" genes are assumed to be inherited independently. In addition, more "unknown" genes can be added to increase the level of inbreeding depression expected from the "known" genes to a desired level of inbreeding depression. Finally, additional "unknown" genes can be created for use with multiple populations that will increase the levels of heterosis expected from the "known" genes to a desired level of heterosis. Genetic evaluation software will be used to produce genetic evaluations consistent with industry practices. Work continues on the development of a student interface to access animal performance, exchange genetic material among students and incorporate some economic evaluation of student progress.

Key Words: Genetic Simulation, Finite Locus

448 A simple method for joint analysis of multiple binary responses. R. Rekaya* and T. Averill, *The University of Georgia*.

Genetic evaluation for secondary traits has increased considerably worldwide. Several secondary traits (e.g. fertility, health data) are now of crucial economical interest in different genetic improvement programs. Developments in Markov Chain Monte Carlo methods for analysis of binary data made use of the threshold model (TM) as a standard tool to deal with such data. In the animal breeding field, given the theoretical and computational complexity of analysis of multiple binary traits, such analysis was done assuming a Gaussian distribution for the binary traits. In a Bayesian joint analysis of several binary responses using a TM, the major problem resides in the sampling of the residual (co)variance (RCV) matrix as results of the fixation of some of the diagonal elements of such matrix to overcome the identification problem. Hence, several alternative sampling techniques have been proposed based on the partition of the RCV matrix. Although these methods are theoretically sound, some computational and implementation problems can emerge, especially with large number of binary traits. The method we propose overcomes all the computational and implementation problems associated with the sampling of the RCV matrix. It consists in working with the non-identifiable TM. Once draws from the non-identifiable model are obtained, they are transformed to the identifiable scale using the square root of the diagonal elements of the non-identifiable residual variance matrix. Two simulations with 3 and 8 binary traits were conducted to test the proposed method. Based on five replicates, the bias was less than 3 and 2% for the genetic and RCV, respectively, in both cases. Such bias is well within the Monte Carlo error. Compared two actual methods (Metropolis-Hastings or matrix decomposition) used in analysis of multiple binary responses, the proposed method yielded more accurate results (less bias) and was extremely superior from computational point of views. The proposed method was applied to test-day mastitis data where mastitis status in each test-day was treated as different trait.

Key Words: Binary traits, Threshold model, Residual variances

449 Comparison of estimation methods for heterogeneous residual variances with random regression models. S. Tsuruta*[1], I. Misztal[1], and T. Druet[2], [1]*University of Georgia, Athens GA*, [2]*Station de Gntique Quantitative et Applique, INRA, Jouy-en-Josas Cdex, France*.

The objective of this study was to compare estimation methods of heterogeneous residual variances with random regression models. (Co)variance components were estimated with two data sets; milk yields (69,816 test day records for 7354 cows in the first lactation) and final scores (30,041 first records with 1 record per cow) in Holsteins. Up to third order Legendre polynomials for additive genetic effects were included in the models as random regressions on days in milk for milk yields and on year at first calving for final scores. Heterogeneous residual variances were estimated by logarithmic third order polynomials via AI-REML, intervals via Gibbs Sampler, or an extra error effect via REML. In the interval method, ten and five intervals for residual variances were assigned in the models for test day records and for final scores, respectively. Additive genetic variances were not different among heterogeneous residual variance estimation methods. Estimates of heritability and heterogeneous residual variances were similar for all methods except the interval method, in which the data size for each interval may not have been sufficient. Estimating heterogeneous residual variances with an error effect did not require program modifications and was easily applicable to multiple traits, but was computationally about five times more expensive. The extra error method and the logarithmic polynomial method may be better if variations of residual variances are small or regular. Also, the logarithmic method may have better estimating properties due to fewer parameters. When changes of residual variances are irregular, the interval method may be adequate. In practice, less expensive methods such as the interval method with sufficient data or the logarithmic polynomial method may be better choices for estimating heterogeneous residual variances with random regression models.

Key Words: Heterogeneous residual variances, Genetic parameters, Random regression models

450 Plotting covariance functions from random regression models. A. Legarra*[1], I. Misztal[1], and J. Jamrozik[2], [1]*University of Georgia, Athens, GA,* [2]*University of Guelph, Guelph, ON, Canada.*

Covariance functions estimated by fitting random regression models can contain artifacts (e.g. very high variances or correlations) due to small data sets, data structure or limitations of random regression models. These functions contain variances along trajectories and covariances between any two points for any given combination of traits. However, their high dimensionality makes it difficult to thoroughly check all these aspects. A library of functions was written in a matrix-algebra package to visualize time-dependent (co)variances and correlations among and within traits for different effects (additive direct and maternal, permanent...). Two sets of parameter estimates were analyzed. The first set, obtained using 4th order Legendre polynomials, is used in routine test-day evaluation of Canadian Holstein for 12 traits: milk, fat and protein yields and somatic cell scores in three parities. Covariance functions generally showed smooth patterns. Correlations decreased regularly with time within the same trait or among production traits. Correlations of yields with somatic cell score exhibited a more undulating shape. Values were generally small and negative, oscillating between 0.19 and -0.25, with high positive values seen only in the extremes of the trajectories. The second set, obtained using cubic Legendre polynomials, was an analysis of sequential weights of animals up to 2 years of age in Brasilian Nellore, fitting direct and maternal effects. Small peaks in the correlation patterns occurred relatively frequently. Correlations among maternal and direct additive effects dependent on the age oscillated between 0.35 and -0.65. Negative values were seen along most of the trajectory, and the value of 0.35 was observed in the correlation between direct additive effect at day 10 and maternal additive effect at day 570. Visual analysis of (co)variances and correlations allows to observe problems and can aid in constructing covariance functions without artifacts.

Key Words: Covariance functions, Random regression

451 Joint optimisation of the number of animals to test and to select. M.E. Goddard*, *University of Melbourne and Victorian Institute of Animal Science, Australia.*

Some species, especially with the aid of modern reproductive technology, can produce a very large number of gametes, so that the number of breeding stock needed to replace the herd does not limit the number that must be selected. Therefore the number selected can be optimised to balance the benefits from intense selection against the disadvantages of small effective population size. The intensity of selection also depends on the number available for selection (the number tested) and this can also be optimised to balance selection intensity against the costs of breeding and testing more animals. By differentiating a formula for the net benefit of selection, expressions for the optimum number to test and to select have been found. The optimum number to select depends largely on the ratio of the benefit from selection to the cost of low effective population size. The optimum number to test depends largely on the ratio of the cost of testing to the benefit from selection. The accuracy of selection can sometimes be increased usually at an increased cost. The approach used makes it possible to optimise the accuracy of selection jointly with the other two variables. As an example, the accuracy of a progeny testing was optimised by optimising the number of daughters per bull. Some of the costs of testing are proportional to the number of bulls tested and some are proportional to the total number of daughters. If these costs are decreased, the optimum solution changes very little in total costs, but the number of bulls increases as the cost per bull decreased and the number of daughters per bull increased as the costs per daughter decreased. In practice there is usually some selection of bulls prior to progeny testing. This can be optimised by optimising the number tested and selected at all stages in the process. Even if selection prior to progeny testing is of low accuracy, the optimum is to select intensely at this stage provided the cost per bull is small compared to the cost of progeny testing. This has implications for the use of DNA markers that might be used to select bulls for progeny testing.

Key Words: Progeny testing, Marker assisted selection

Extension Education: Management and profitability

452 Entrepreneurial characteristics of dairy farming differences between Dutch and Pennsylvania farmers. R.H.M. Bergevoet*[1] and L. A. Holden[2], [1]*Wageningen University,* [2]*Penn State University.*

The objective was to investigate the impact of different farming environments, European Union (EU) versus the northeastern US, on the dairy farmer's goals, values, and strategies for success. Dairy farmers in the Netherlands and Pennsylvania completed a common questionnaire assessing their goals, objectives, assessment of their business environment, and perception of success. Netherlands questionnaires (n=256) were completed by mail and Pennsylvania questionnaires were completed in person (n=73). The Mann-Whitney test was used to evaluate differences between groups of farmers. Results indicated that the main reasons for becoming involved in farming for both groups were more freedom, owning a business, and the potential for high income; however the degree of importance of these factors differed ($P<.05$) by group. Both groups placed a higher value on non-economic goals compared to economic goals, but with differing degrees of importance ($P<.05$). Both groups considered the image of their product and the development of the Internet as opportunities and legislation and local planning as threats, but they value consumer's concerns about the environment, animal welfare and food safety differently ($P<.05$). Netherlands farmers considered consumer concerns as opportunities while Pennsylvania farmers viewed them as threats ($P<.01$). Both groups valued farming in an "environment friendly" way, and neither group saw "going organic" as a serious option. Netherlands farmers especially evaluated their success on the criteria: ability to expand, net farm income and cost of production per hundredweight of milk. Pennsylvania farmers placed the most emphasis on net farm income. With different economic systems between the EU and northeastern US, there were common goals, values and business strategies shared by dairy farmers.

Key Words: Goals and objectives, Farmer characteristics, Assessment of environment

453 Whole farm planning for the production of grass-finished beef. T. M. Johnson*[1], R. E. Morrow[1], C. A. Wells[1], M. L. Thomas[1], and J. K. Apple[2], [1]*National Center for Appropriate Technology, Fayetteville, AR,* [2]*University of Arkansas, Fayetteville.*

Beef calves in the US are predominately produced on small farms then transported to feedlots prior to harvest. Some beef producers with adequate resources have been attempting to improve sustainability and capture more value by selling retail beef products; however, challenges exist that must be overcome to make the production of retail beef possible on the farmstead. In Northwest Arkansas, 11 farms participated in a SARE project to evaluate the potential of producing and direct marketing, grass-finished beef. In this pilot study, 50 crossbred calves from 11 producers were moved to a common site and rotationally grazed on wheat, cereal rye and annual rye pastures, from December 3, 2001 until June 25, 2002. No grain was fed. Calf initial weight was 307 $\pm$ 10.5 kg. Thirty-four calves were harvested from May 6 to June 25 in four groups when body condition score reached 6 when palpated by hand. Number of days grazed was 175 $\pm$ 3.9 d. Harvest weight was 456 $\pm$ 11.9 kg with an ADG of 0.86 $\pm$ 0.029 kg. The following carcass characteristics were observed: 54.4 $\pm$ 0.28% dressing percent, 249 $\pm$ 7.4 kg hot carcass weight, 2.01 $\pm$ 0.099 yield grade, with 85% of the carcasses grading select, 12% standard and 3% choice. Carcasses were dry-aged an average of 21-d and the retail yield was 145 $\pm$ 4.3 kg. Carcasses were processed into 25 retail cuts, with emphasis on boneless product. Products have been marketed through word of mouth, newspaper advertising, radio features, presentations to civic organizations, and a display booth during a local community fair. Sales during the first six months resulted in 36% of the product being sold. Data from this project has been presented at 11 meetings or workshops for beef producers and will be used in beef marketing publications produced on the ATTRA project. As a result, nine of these producers have formed a limited liability corporation, hired a professional marketing firm, and are pursuing additional marketing opportunities for grass-finished beef.

Key Words: Grass-finished Beef, Marketing, Sustainability

454 A model for data collection and reporting for cow/calf and feedlot operations. M. Coe*[1], D. ZoBell[2], and B. Bowman[2], [1]*Global Animal Management/Schering-Plough Animal Health,* [2]*Utah State University.*

The livestock industry has been working for several years to develop data collection and reporting models. The need for completion and implementation of traceability from birth to slaughter and eventually consumption has been elevated with the passage of the latest farm bill and specifically Mandatory Country of Origin Labeling. To be successful, individual data collection requires additional input costs associated with the labor, equipment, and software necessary to read, record, and store the individual animal data at each of the production segments. Data systems must be reliable, efficient, easy to use and include identification beginning at an early age and allow for data collection throughout the animal's life cycle. Realization of value requires the ability to coordinate and share data across all industry segments. A collaborative industry/Utah State University effort evaluated and demonstrated a Windows based desktop/PDA Palm based software application for collecting cattle registration records, health observations, diagnoses, and treatments for new calves in the university cow herd. A second Windows based desktop software application was evaluated to collect processing information at arrival in the University feedlot. An internet-based portal application was utilized to provide a secured environment for warehousing relevant business data for reporting, analysis, and information exchange. The data collected was made available locally and was uploaded to off-site data storage for disaster data protection and consolidated data reports. The use of a large database in conjunction with the internet allowed for reports to be generated at the production facility as often as management demanded. This model will also allow facilitation of audit or verification systems and electronic record delivery systems necessary for Country of Origin Labeling.

Key Words: Beef cattle, Identification, Data collection

455 Comparison of feedyard performance and profitability by percent Bos indicus in TAMU Ranch to Rail-South steers. J. C. Paschal*[1], N. C. Tipton III[2], M. J. De la Zerda[3], S. F. Allen[1], and J. W. McNeill[2], [1]*Texas Cooperative Extension,* [2]*Texas A&M University,* [3]*Texas Beef Council.*

Steers enrolled in the Texas A&M Ranch to Rail Program from 1992 until 2001 were compared for feedyard performance and profitability by percent Bos indicus (B) influence. Steers were categorized as either 0 (n=687), 25 (n=3248), 37.5 (n=1452), 50 (n=1380), or 100% (n=218) based on reported sire and dam breed composition. Data were analyzed using GLM procedures of SAS with year and percent Bos indicus as main effects. Data included on feed weight, ADG, final weight, days on feed (DOF), medicine costs, total cost of gain and feeding and marketing margins. On feed weights (kg), ADG (kg/d), final weights (kg) and DOF were 268, 1.4, 543 and 199; 274, 1.38, 541 and 194; 273, 1.42, 544 and 192; 273, 1.4, 532 and 187; and 292, 1.37, 510 and 163 for 0, 25, 37.5, 50 and 100% B, resp. Medicine costs, feed cost of gains, and net profitability ($/hd) were $6.63, $59.25, and $58.04; $5.25, $59.30, and $48.06; $5.66, $58.16, and $58.66; $4.06, $58.23 and $64.63; and $.79, $56.36, and $111.24 for 0, 25, 37.5, 50 and 100% B, resp. Feeding and marketing margins ($/hd) were $14.13 and $43.91; $13.55 and $34.52; $26.14 and $32.51; $21.72 and $42.91; and $41.66 and $69.58 for 0, 25, 37.5, 50 and 100% B, resp. There were few significant differences except for 100% B which were heaviest on feed, had less DOF, were lighter for final weight, had less medicine costs and the highest feeding and marketing margin and greatest net returns. These results show few differences in feedyard performance and profitability between 0 and 50 %Bos indicus steers.

Key Words: Feedyard performance, Profitabilty, Bos indicus

456 Comparison of carcass merit and tenderness by percent Bos indicus in TAMU Ranch to Rail-South steers. J. C. Paschal*[1], N. C. Tipton III[2], M. J. De La Zerda[3], S. F. Allen[1], and J. W. McNeill[2], [1]*Texas Cooperative Extension,* [2]*Texas A&M University,* [3]*Texas Beef Council.*

Steers enrolled in the Texas A&M Ranch to Rail Program from 1992 until 2001 were compared for measures of carcass merit and tenderness by percent Bos indicus (B) influence. Steers were categorized as either 0 (n=687), 25 (n=3248), 37.5 (n=1452), 50 (n=1380), or 100% (n=218) based on reported sire and dam breed composition. Data were analyzed using GLM procedures of SAS with year and percent Bos indicus as main effects. Data included on carcass weight (CW), fat thickness (FAT), REA, KPH fat, USDA Yield (YG) and Quality (QG) grades and Warner-Bratzler shear force (WBS). Carcass data was collected 36 h postmortem. All carcasses were electrically stimulated. Carcass weight (kg), FAT (cm), REA (cm2), and KPH (%) were 346, .13, 94.2, and 2.09; 344, .15, 91.6, and 2.16; 345, .17, 87.7, and 2.19, 338, .17, 85.8, and 2.19; and 321, .13, 80 and 2.05 for 0, 25, 37.5, 50 and 100% B, resp. USDA YG and QG were 2.03 and Se77, 2.3 and Se70, 2.6 and Se65, 2.66 and Se61, and 2.55 and Se60 for 0, 25, 37.5, 50 and 100% B, resp. Carcasses were sampled for WBS (0, n=54; 25, n=181; 37.5, n=85; 50, n=70; and 100, n=9) and recorded after 14 d ageing. WBS was 2.74, 2.75, 2.94, 3.26 and 3 kg for 0, 25, 37.5, 50 and 100% B, resp. There were few significant differences between % B except that 100 B had lighter CW and smaller REA. As % B increased CW, REA and QG decreased and FAT, KPH, YG and WBS increased but not significantly. These results show few differences in carcass merit and tenderness between 0 and 50% Bos indicus steers

Key Words: Carcass merit, Tenderness, Bos indicus

457 CalfTrack: A system of dairy calf workforce management, training, and evaluation and health evaluation. A. J. Heinrichs*[1], C. M. Jones[1], L. R. VanRoekel[2], and M. A. Fowler[2], [1]*The Pennsylvania State University,* [2]*Land O'Lakes Animal Milk Products, Co.*

Getting calves off to a good start is the first step in producing healthy, well grown replacement animals that are ready to enter the milking herd at 22 to 24 months of age. To meet this goal, employees must provide consistent, quality care for calves, particularly during the preweaning period. Several years of extension programming in the calf management area have culminated in the development of a comprehensive program entitled Calf Track. The Calf Track, Calf Management Training System is farm administered and employee oriented, and most materials are available in both English and Spanish. Calf Track is a complete training, education, and development program designed to ensure that employees consistently meet the biological, managerial, personnel, and resource requirements of the calf. The program includes an orientation video; chore plans, which are instruction sheets that sequentially teach new or experienced employees the standardized procedures required to perform a calf care task; a trainers guide containing detailed technical information for the herdsman; and a health scoring system. The chore plans cover a range of topics, including calving assistance, colostrum feeding, use of an esophageal feeder, mixing and feeding milk replacer, evaluating calf environments, normal appearance and behavior, and routine health treatments. The scoring system teaches animal monitoring and observation techniques; provides an action-oriented method of evaluating calf health, administering treatment, and recording health history; and offers a simple system of employee evaluation. The complete Calf Track Calf Management Training System is designed to help employees master daily calf-raising chores with confidence, independence, and a sense of accomplishment, while raising healthy dairy calves that can become productive and profitable herd replacements. This is an educational and training program that helps farm employees understand how to do their job and why it is important. In addition, the program outlines standard procedures for common calf care tasks and provides managers with an employee evaluation system.

Key Words: Calf management, Calf health, Calf nutrition

Food Safety: A look at antimicrobial resistance in dairy and swine

458 Serotype prevalence and anti-microbial resistance of *Salmonella* isolated from dairy cattle in the Southwestern United States. T. S. Edrington*[1], K. M. Bischoff[1], M. L. Looper[2], T. R. Callaway[1], K. J. Genovese[1], Y. S. Jung[1], R. C. Anderson[1], and D. J. Nisbet[1], [1]*USDA-ARS, Food and Feed Safety Research Unit, College Station, TX,* [2]*USDA-ARS, Dale Bumpers Small Farm Research Center, Booneville, AR.*

Mature dairy cattle were sampled over a two-year period (2001 to 2002) on six farms in New Mexico and Texas. Fecal samples were collected via rectal palpation, cultured for *Salmonella*, and one isolate from each positive sample serotyped. Three isolates of each serotype, with the exception of *Salmonella* Newport (n = 12), were examined for antimicrobial susceptibility using the broth micro-dilution technique. Twenty-two different serotypes were identified from a total of 393 *Salmonella* isolates. Montevideo was the predominant serotype (27%) followed by Mbandaka (15%), Senftenberg (11.4%), Newport (6.4%), Anatum (4.8%) and Give (4.8%). *Salmonella* Typhimurium and Dublin, two frequently reported serotypes, accounted for only 1% of the observed serotypes in this study. Sixty-four percent of the serotypes were susceptible to all of the antimicrobials, 14% were resistant to a single antibiotic, and 22% were multi-resistant (2 to 11 types of resistance). All isolates tested were susceptible to amikacin, apramycin, imipenem, ceftriaxone, nalidixic acid, and ciprofloxacin. The most frequent types of resistance were to sulfamethoxazole, tetracycline, streptomycin, kanamycin, chloramphenicol, and ampicillin (ranging from 8.9 to 22.4%). Serotypes demonstrating multiple resistance included Dublin and Give (resistant to 3 or more antibiotics), Typhimurium (resistant to 5 antibiotics) and Newport (4 and 2 isolates resistant to 6 and 9 antibiotics, respectively). Class 1 integrons were present in only three isolates, two *Salmonella* Dublin and one *Salmonella* Newport. The most prevalent resistance patterns observed in this study were for antimicrobial agents commonly used in cattle, while all *Salmonella* isolates were susceptible to ceftriaxone and ciprofloxacin, antibiotics used in human medicine.

Key Words: *Salmonella*, Antimicrobial resistance, Dairy cattle

459 Molecular epidemiology of beta-lactam resistant Gram-negative bacteria in dairy cattle. A. A. Sawant* and B. M. Jayarao, *Pennsylvania State University, University Park, PA.*

Beta-lactam antibiotics are widely used for therapeutic purposes in dairy cattle. A survey on use of beta-lactam antibiotics revealed that ceftiofur (78%), and ampicillin (48.5%) were the most frequently used beta-lactams, however the use of pencillins and cephapirin were restricted mostly for dry cow therapy. Resistance to ceftiofur and ampicillin was observed in 3 and 60% of dairy farms and 1 and 32% of cows, respectively. It was observed that dairy farms that used ampicillin were 6-fold more likely to have lactating cows shedding ampicillin resistant gram-negative bacteria (AMP-GNB) in feces. A total of 98 of 313 (31.3%) lactating cows on 20 of 33 (60.6%) farms were shedding AMP-GNB. The AMP-GNB accounted for 0.01 to 96.5% of the total GNB in the feces. The diverse AMP-GNB comprised of *E. coli* (n=74), *C. koseri* (n=14), *E. aerogenes* (n=4), *K. oxytocia* (n=3), *M. morganii* (n=1), *P. alcaligenes* (n=1), and *Pseudomonas* spp. (n=6). The 74 *E. coli* isolates showed 12 resistance patterns. Resistance to oxytetracycline (86%), spectinomycin (22%), florfenicol (20%), neomycin (11%), and ceftiofur (8.1%) was observed. A total of 7 isolates of *E. coli* encoded for shiga toxin (stx) genes, of which 1, 4 and 2 isolates encoded for Stx1, Stx2 and Stx1 and 2, respectively. A total of 69 Amp-R *E.coli* isolates belonged to 44 pulsed-field gel electrophoresis subtypes (PFGE). It was observed that PFGE subtypes were unique to each farm, however 2 subtypes were seen in more than one farm. The TEM gene that encodes for resistance to beta-lactams was observed in 94% of *E. coli* isolates. A total of 6 *E. coli* isolates were resistance to one or more of the four extended spectrum beta-lactams (ceftriaxone, cefpodoxime, ceftazidime, cefotaxime), as per NCCLS recommended guidelines for potential extended beta-lactam resistance. It can be inferred that resistance to extended beta-lactams is perhaps an emerging problem in dairy cattle.

Key Words: Beta-lactam resistance, *E. coli*, Dairy cattle

460 Prevalence, distribution, and characterization of oxytetracycline resistant *Escherichia coli* in lactating dairy cattle. A. A. Sawant * and B. M. Jayarao , *Pennsylvania State University, University Park, PA.*

A study was conducted to gather relevant information on the epidemiology (descriptive and molecular) of oxytetracycline-resistant Gram-negative bacteria (OXY-GNB) in dairy cattle. The findings of our study showed that 97 of 313 (31%) lactating cows on 21 of 33 (63.6%) dairy farms shed OXY-GNB in feces. The OXY-GNB from 23 farms accounted for 0.01 to 100% of the total gram-negative fecal flora. A total of 113 isolates resistant to oxytetracycline from 90 cows on 23 farms were identified as *E. coli*. It was observed that 105 of 113 (92.9%), and 8 (7.1%) isolates encoded for Tet B and Tet A genes, respectively. None of the 113 isolates encoded for shiga-toxin I and II genes. Farms that fed milk replacers containing oxytetracycline were 12-fold more likely to have lactating cattle shed OXY-GNB in their feces as compared to farms that did not use milk replacers. The 113 isolates of *E. coli* belonged to 9 resistance patterns. Resistance to florfenicol (14.2%) was most frequently observed followed by ampicillin (7.1%), spectinomycin (4.4%), and neomycin (2.7%). A total of 99 isolates belonged to 60 pulsed-field gel electrophoresis (PFGE) subtypes. It was inferred that the PFGE subtypes were unique to each farm, however 4 clonal types were seen in more than one farm. Genetic analysis of the Tet B suggested that the gene was not located on a plasmid or an integron. Preliminary results suggest that the Tet B is more likely to be a part of a transposon located on the chromosome. Based on the findings of this study thus far, it can be inferred that prevalence of OXY-GNB is associated with use of milk replacers on dairy farms. Further OXY-GNB from dairy cattle, are likely to be highly diverse and multidrug resistant.

Key Words: Milk replacer, *E. coli*, Dairy cattle

461 The commensal bacterial populations of swine feces and stored swine manure: Reservoirs of antibiotic resistance? T. R. Whitehead*[1], M. A. Cotta[1], G. Whittle[2], N. Shoemaker[2], and A. A. Salyers[2], [1]*National Center for Agricultural Utilization Research, Peoria, IL,* [2]*University of Illinois, Urbana, IL.*

In order to facilitate improved growth and reduce infection, a number of antimicrobial compounds are commonly added at subtherapeutic levels to the feed of domestic animals in the United States. This practice has come under intense scrutiny of late, as a number of recent reports have suggested that increased microbial resistance to the antibiotics may have an impact on human health. Most investigations have centered on antibiotic resistance in known pathogens and aerobic bacteria. However, the great majority of the bacteria present in the commensal microflora found in the feces and stored manure of domestic animals, including swine, are anaerobic bacteria. These normal residents may serve as natural reservoirs of antibiotic resistance genes. We have initiated an investigation of antibiotic resistant (AR) anaerobic bacteria present in both pig feces and manure storage pits. Samples were collected from a local swine facility where tylosin was used at subtherapeutic levels. AR anaerobic bacteria were enumerated on complex media with and without tetracycline (Tc), erythromycin (Em), or tylosin (Ty) at 10 μg/ml. AR bacteria were found in all samples, and the level of resistance ranged from 4% resistant to 32% resistant. Several Em/Ty resistant strains were also Tc resistant. Results of PCR and DNA sequencing analyses of pure cultures and total DNA from both ecosystems demonstrated the presence of various classes of *erm* and *tet* resistance genes, including the first reported identification of *erm*T in the United States. In addition, new classes of erythromycin (*erm*(35)) and tetracycline (*tet*(36)) resistance genes have been recently identified in the isolates. The *tet*(36) gene has been identified in Gram-positive and Gram-negative isolates, suggesting that the gene is being transferred between microorganisms. The finding of a high number of identified and unidentified AR eubacteria and gene classes in swine feces and manure storage pits suggests that these ecosystems may serve as reservoirs of antibiotic resistance genes. The influence of feeding antibiotics on the levels of AR resistance in these populations has yet to be ascertained.

Key Words: Antibiotic, Resistance, Swine

462 Late gestation and advanced lactation at cessation of milking do not delay mammary epithelial apoptosis in dairy cattle. E. L. Annen*[1], A. V. Capuco[2], P. C. Gentry[1], L. H. Baumgard[1], and R. J. Collier[1], [1]*University of Arizona, Tucson,* [2]*USDA-ARS, Bovine Functional Genomics Lab, BARC, Beltsville, MD.*

Advanced pregnancy and concurrent lactation until cessation of milking are two factors thought to slow mammary involution in dairy animals. Our objective was to characterize the temporal pattern of apoptosis in the bovine mammary gland following milk stasis. Serial mammary biopsies were performed on 11 Holstein cows during late lactation and the dry period. Cows were dried-off 60d before expected calving. Mammary biopsies were taken at -5, 0, 1, 2, 3, 4, 5, 6, 7, 8, 10, 14, and 21d relative to cessation of milking. Tissues were fixed in neutral buffered formalin, and paraffin sections were subjected to TUNEL assay for immunohistochemical detection of apoptotic cells. The incidence of mammary epithelial cells undergoing apoptosis was lowest in lactating tissue, peaked ($P< 0.0001$) 2d following cessation of milking and then declined through d8. At d2, the incidence of apoptosis was 4 to 8-fold greater than that in lactating tissue. By d8, the number of apoptotic mammary epithelial cells did not differ ($P > 0.05$) from pre-stasis values. Rodents and ewes typically initiate apoptosis by 2d post-stasis and reach peak apoptosis at approximately 4d. Because these species are not typically in advanced gestation and lactation when milk removal ceases, we hypothesized that onset of apoptosis would be slower and incidence of apoptosis reduced in cows as compared to sheep and rodents. Our data indicate that onset of epithelial apoptosis in cows is rapid but transient and alveolar integrity is maintained throughout the 21d post dry-off. Further, a second wave of apoptosis involving intralobular stromal elements appears to initiate at d4 and peak at d5 ($P<0.05$). The balance between apoptosis and cell proliferation during this time frame is currently under investigation. Data are consistent with rapid initiation of tissue remodeling of both epithelium and stroma during the dry period of dairy cows.

Key Words: Mammary apoptosis, Involution

463 Microarray analysis of bovine mammary gene expression following abrupt cessation of lactation. S. R. Davis*[1], A. J. Molenaar[1], K. Stelwagen[1], T. T. Wheeler[1], C. J. McMahon[1], D. B. Baird[3], H. V. Henderson[1], V. C. Farr[1], L. Good[1], K. Odin[1], K. Singh[1], D. L. Hyndman[2], and T. Wilson[2], [1]*AgResearch Hamilton,* [2]*Dunedin,* [3]*Lincoln, New Zealand.*

This work identified early changes in gene expression triggered by mammary engorgement that lead to apoptosis. Alveolar tissue was obtained from 36 non-pregnant cows in mid-lactation slaughtered at 6, 12, 18, 24, 36 and 72h (n=6/group) after last milking. mRNA was extracted from 6 and 36h tissue using TRIZOL, cDNA prepared and labeled with Cy3 and Cy5 dyes using an Ambion kit. Samples were hybridized to bovine ESTs arrayed on glass slides. Each slide had 23954 ESTs arrayed (including limited replication) representing 16550 ESTs with known SwissProt hits and 6772 with no known hit, selected from mammary and immune bovine libraries. Microarray slides (n=24) were analysed in a "daisy chain" design. Each cow at each time point (6 cows) was compared with 2 cows from the opposite time point along with its dye reversal. Hybridized slides were read on a Packard array reader and images analysed by GenePix software. For each slide log ratio data were normalized using a mixed model with spatial autocorrelation using REML in GenStat. Means and SE of corrected log ratios across the 24 slides were calculated for each EST. Results at 36h showed expression of 5300 ESTs ($P<0.01$) and 3300 ESTs ($P< 0.001$). At $P<0.01$, 941 ESTs changed expression by >50%; at $P<0.001$ the comparable figure was 766. In this latter group 122 ESTs were signal peptide +ve. β-casein and α-lactalbumin were down-regulated (25% and 50%) and lactoferrin up-regulated (80%), with multiple ESTs of each gene exhibiting similar behavior. Northern analysis of major milk protein RNA indicated increased expression of lactoferrin and decreased expression of α-lactalbumin by 24h. Expression of all milk proteins was still apparent at 72h. Early up-regulation of acute-phase proteins was also apparent. Microarray analysis has provided evidence of widespread changes in bovine mammary gene expression occurring within 36h post milking and provides an effective base for testing refined hypotheses.

Key Words: Microarray, Mammary, Involution

464 Evidence of cisternal recoil after milk letdown in the udder of dairy cows. G. Caja*[1], M. A. Ayadi[1], and C. H. Knight[2], [1]*Universitat Autonoma de Barcelona, Spain,* [2]*Hannah Research Institute, UK.*

A delay between activation of the milk letdown reflex and milk evacuation from the udder can negatively affect milk yield. Linzell (1955) was the first to demonstrate back-flux of milk from ducts into alveoli of mice after milk letdown, and here we investigate the possibility that the elastic nature of the udder cistern results in an equivalent phenomenon in dairy cows. Two groups of Holstein cows in early (n=3; 80 DIM, 31 kg/d) and late lactation (n=4; 301 DIM, 17.5 kg/d) were used. Udder cistern size was measured by real time ultrasonography. Left and right front udder quarters were scanned in duplicate at 0, 3, 15, 30 and 60 min after an i.v. oxytocin (OT) injection. For the first udder scan, cows were injected i.v. with an OT receptor blocking agent (Atosiban; 10 μg/kg BW) to prevent spontaneous milk letdown. Cistern measures were repeated for 8 and 16 h milking intervals. Values of cistern area (1.1 to 33.6 cm^2) differed according to stage of lactation ($P<0.01$), time after OT injection ($P<0.001$) and milking interval ($P<0.01$). Average cistern area increased dramatically (93%) at 3 min after OT injection at which time the cistern reached its maximum distension (16.8 vs 8.7 cm^2; $P<0.001$), and decreased slowly thereafter (14.6, 13.5 and 12.8 cm^2 at 15, 30 and 60 min, respectively). The decrease in cistern size was significant at 15 min and later time points ($P<0.05$) but not at earlier time points. The 0 and 3 min data provide clear evidence of milk letdown. The decrease in cistern size thereafter provides the first report, to our knowledge, documenting the return of milk to the ductal and alveolar compartments of the cow udder following the end of milk letdown. We term this cisternal recoil. The process will result in a mixing of milk that has been stored for some time with freshly synthesized milk. Given the presence in milk of putative inhibitory bioactive factors, this could have consequences for further secretory activity.

Key Words: Residual milk, Cisternal milk, Udder physiology

465 Kinetics of glucose transport and metabolism in lactating bovine mammary glands measured in vivo with a paired nutrient/indicator dilution technique. F. Qiao*, C. Xiao, D. R. Trout, and J. P. Cant, *University of Guelph, Ontario, Canada.*

Twenty-four paired glucose and extracellular indicator (p-aminohippuric acid) venous dilution curves across intact bovine mammary glands were obtained from bolus injections into the external iliac artery to measure kinetics of glucose transport and metabolism. A compartmental capillary, convolution integration model was used to interpret the curves. Four different capillary submodels, describing hypothetical mechanisms of glucose transport and metabolism, were expressed in ordinary differential equations and fitted to the observed curves by an iterative approach to least-squares. Submodel I, assuming first-order unidirectional uptake and metabolism of glucose, was unable to fit the peak and tail of glucose dilution curves ($r^2 = 0.96$). Submodel II, considering transport as a first-order bidirectional process, yielded good fits ($r^2 = 1.00$), but errors of estimation of the transport parameter were high (428 times the estimate, on average). Transport rate constants were 5 to 50 times greater than metabolism rate constants and, when expressed as clearance values, 5 times greater than blood flow rates. Submodel III assumed instantaneous mixing between extra- and intra-cellular glucose distribution spaces and first-order kinetics of metabolism. This submodel yielded $r^2 = 0.99$ and low errors of parameter estimation (<32% of estimate). The metabolism rate parameter $k_c = 0.406 \pm 0.083$ min^{-1} was not different from that calculated from background arterial and venous glucose concentrations ($k_{c\_bg} = 0.404 \pm 0.119$ min^{-1}). Assuming Michaelis-Menten kinetics of glucose metabolism in Submodel IV did not improve goodness-of-fit and parameters were less identifiable. It was concluded that glucose is rapidly translocated into an intracellular space that is 34% of intracellular volume, that once glucose enters the cytosol proper where metabolism occurs, there is negligible efflux out of the cell, and that glucose sequestration follows first-order kinetics between 0 and 5 mM extracellular glucose.

Key Words: Glucose transport, Mammary glands, Indicator dilution

466 The effect of phenotypic selection for milk production on hepatic expression of prolactin receptor. P. H. Luimes*[1], E. H. Beaupre[1], J. H. White[1], W. J. Weber[2], H. Chester-Jones[2], L. B. Hansen[2], B. A. Crooker[2], and J. R. Knapp[1], [1]*University of Vermont, Burlington,* [2]*University of Minnesota, St. Paul.*

The effect of phenotypic selection for milk production on hepatic expression of the prolactin receptor gene was evaluated in a line of dairy cattle selected solely for milk production. Selection since 1964 resulted in increases of approximately 5500 kg of milk per lactation as compared to a control line. Liver biopsies were taken at -14, 14, 21 and 70 days relative to parturition (5 cows from each line). Total RNA was isolated and purified. Northern blots of the samples were hybridized with an RNA probe homologous to the extracellular portion of the bovine prolactin receptor. Normalization of RNA loading on the membranes was determined by hybridizing with an 18S RNA probe. RNA expression was quantified as relative pixel intensity. The selected cows had approximately 42% greater expression of prolactin mRNA at both 14 days prior to and after calving relative to the control cows ($P < 0.05$). These differences disappeared by day 21 such that, at days 21 and 70, there were no differences in prolactin receptor mRNA expression between selected and controls cows. Little is known about the importance of prolactin on hepatic tissue metabolism in ruminants. These data suggest the prolactin receptor has a role in regulating hepatic metabolism in support of lactation, though the mechanism by which this occurs is unknown.

Key Words: Prolactin receptor, Milk yield, Phenotypic selection

467 Quantitative analysis of estrogen-related receptor α, estrogen receptor α and estrogen receptor β mRNAs throughout bovine mammary gland development. E. E. Connor*[1], A. V. Capuco[1], T. S. Sonstegard[1], A. F. Mota[1], D. L. Wood[1], W. Garrett[1], G. L. Bennett[2], and J. Williams[3], [1]*USDA-ARS, Beltsville, MD,* [2]*USDA-ARS, Clay Center, NE,* [3]*Roslin Institute, Roslin, Midlothian, Scotland.*

The estrogen-related receptor α (ESRRA) belongs to the steroid hormone receptor family and is thought to function in regulation of estrogen-responsive genes including lactoferrin and medium-chain acyl coA dehydrogenase. The role of ESRRA in bovine mammary gland development and function is unknown. Expression of ESRRA mRNA was characterized in mammary parenchyma obtained from multiple stages of bovine mammary gland development in relation to estrogen receptor α (ESR1) and estrogen receptor β (ESR2) using quantitative real-time RT-PCR. Stages of development included prepubertal heifers, pregnant heifers, lactating non-pregnant cows, lactating pregnant cows and non-lactating pregnant cows (n = 2 to 3 animals/stage). In addition, the *ESRRA*, *ESR1* and *ESR2* genes were mapped to chromosomes 29, 9 and 10, respectively by linkage and radiation hybrid mapping. Results indicated expression of ESRRA mRNA was greatest in mature cows, regardless of state of pregnancy or lactation and ranged from 20 to 120-fold more than ESR1 and ESR2 transcripts. Expression of ESR2 mRNA was low across all physiological stages and generally less than ESR1 and ESRRA. In pregnant heifers (approx. 100-200 d of pregnancy), levels of all three transcripts were at their lowest or non-detectable. Similar decreases during pregnancy have been reported for mice and may indicate down-regulation by high levels of estradiol during this developmental period. In prepubertal heifers, ESR1 mRNA was at its maximal level of expression but was half as abundant as ESRRA. Our results demonstrate expression of ESRRA, ESR1 and ESR2 mRNAs in bovine mammary gland and suggest a functional role of ESRRA in mammary gland development and lactation.

Key Words: Estrogen receptors, Mammary gland, Bovine

468 Effects of varying energy intakes on estrogen receptor, cell proliferation, and tissue composition in mammary tissue of pre-pubertal heifers. J. W. Forrest*[1], R. M. Akers[1], R. E. Pearson[1], E. G. Brown[2], M. J. VandeHaar[2], and M. S. Weber Nielsen[2], [1]*Virginia Tech, Blacksburg,* [2]*Michigan State University, East Lansing.*

Our objective was to determine how varying energy intakes between 2 and 14 wk of age affect mammary parenchymal development. At 2 wk of age, Holstein calves were assigned to 1 of 4 treatments (HH, HL, LH, and LL) with 2 levels of energy intake (High or Low) and 2 periods of growth (2 to 8 and 8 to 14 wk of age). Period 1 gains were 379 and 666 g/d for L and H calves, respectively. Period 2 gains were 439 and 1095 g/d for L and H calves. At 14 wk, parenchyma at the stromal interface (I), mid-gland (M), and above the cistern (C) were collected, fixed, and embedded in paraffin. Digital images of stained sections were used to determine tissue composition (% epithelial, lumenal, and stromal area). Immunocytochemistry revealed estrogen receptor and Ki67 (nuclear proliferation antigen) positive cells (ER^+ and $Ki67^+$). Epithelial area was not affected by treatment (18.0 to 20.9%). However, lumenal and stromal areas were 3.5 ± 1.4% lower ($p<0.01$) and 4.0 ± 1.7% higher ($p<0.01$), respectively, in LL+LH heifers compared to HH+HL heifers. Zone I contained 3.9 ± 1.5% less ($p<0.01$) lumen and 5.3 ± 1.8% more ($p<0.005$) stroma than zones M and C. Treatment did not alter percent ER^+ epithelial cells, but there was a tendency ($p<0.2$) for zones M and C to have more ER^+ cells than zone I. Percent ER^+ cells in subtending ducts (SUBs) and terminal ductular units (TDUs) was 47.2 ± 1.2% and 53.2 ± 1.4%. Percent proliferating cells tended ($p<0.2$) to be higher in zone I compared with zones M and C. $Ki67^+$ labeling in TDUs and SUBs was 2.1 ± 0.8% ($p<0.01$) and 1.4 ± 0.7% ($p<0.05$) higher for LL+LH heifers compared with HH+HL heifers. Percent $Ki67^+$ cells for SUBs and TDUs was 4.4 ± 0.5% and 5.1 ± 0.5%, respectively. A high rate of gain between 2 and 8 wk of age resulted in greater lumenal area but reduced cell proliferation in mammary parenchyma at 14 wk of age. Positive effects of a reduced rate of gain on cell growth became evident only after 2 months of age.

Key Words: Heifers, Mammary, Calves

Physiology: Gamete physiology

469 Combining *in vitro* embryo production and sexed semen technologies. R. D. Wilson*, K. A. Weigel, P. M. Fricke, M. L. Leibfried-Rutledge, D. L. Matthews, and V. R. Schutzkus, *University of Wisconsin - Madison, Madison, WI.*

The objective of this research was to explore the synergy between sexed semen and *in vitro* embryo production and to assess costs and benefits of these technologies on commercial farms. Genetically superior cull cows were used as donors, and ovaries were collected via colpotomy or at the time of slaughter. Oocytes were aspirated from the ovaries, fertilized 20-24 hours later, and matured to the blastocyst stage. Embryos were transferred into recipient cows and heifers on the same farms. Seven Wisconsin herds have participated thus far, and 154 embryos have been produced from 55 donor cows. Sexed semen from three Holstein sires was used. On average, 2.8 ± 3.3 transferable embryos were created per donor. Individual farms ranged from 1.5 to 4.3 embryos per donor. Recipient data revealed interesting trends. Recipient cows that showed standing estrus had a conception rate of 0.16 ± 0.37, while those resulting from a synchronization program had a mean conception rate of 0.21 ± 0.41. Recipient heifers (all with standing estrus) had a mean conception rate of 0.50 ± 0.52. Interestingly, recipients that were synchronized to ovulate one day later (than for conventional embryo transfer) had slightly higher conception rates than other recipients in both cows (0.21 ± 0.41 vs. 0.19 ± .40) and heifers (0.67 ± 0.52 vs. 0.38 ± 0.52). These results, although preliminary, suggest that low cost in vitro embryo production may have promise as an early system for utilizing sexed semen in dairy cattle breeding programs.

Key Words: In vitro production, Sexed semen

470 Timed insemination of superovulated heifers with sexed sperm. J. L. Schenk*[1], W. B. Henderson[2], and G. E. Seidel, Jr.[3], [1]*XY, Inc.,* [2]*Cyagra/EmTran,* [3]*Colorado State University.*

The objective was to study production of transferable embryos in superovulated Holstein heifers following a fixed-time single insemination with sex-sorted (2×10^6 or 20×10^6) or non-sexed (40×10^6) cryopreserved sperm. Sexed inseminates were enriched for the X-chromosome (90%) by flow sorting using a MoFlo® SX sperm sorter. Three subgroups of 12 heifers each were allocated to one of 3 Holstein bulls. Each heifer within a subgroup was inseminated with semen from each treatment. Heifers received a CIDR® on Day 0 and were superstimulated starting

on Day 4 using twice daily i.m. injections of FSH (Follitropin®-V) for 4 days (40, 30, 20, 10 mg). $PGF_2\alpha$ (40 mg) was injected i.m. on Day 6 p.m. and Day 7 a.m. (25 mg). The CIDR® was removed on Day 7 p.m. Heifers were artificially inseminated (AI) one time, 70–72 h following $PGF_2\alpha$. Ova/embryos were collected nonsurgically 7 days after AI. Heifers not responding to superstimulation were not flushed and omitted from the analysis. Percentage data were transformed to the arc sine for ANOVA. Least squares means are presented in the table. Fewer ova were fertilized with sexed treatments relative to non-sexed and as sexed dosage was reduced to 2 x 10^6 sperm (P<0.05). Assuming an embryonic sex ratio of 9:1 with sexed sperm and 1:1 ratio with non-sexed sperm, more embryos of the desired sexed can be obtained with 20 x 10^6 total sex-selected sperm following timed AI in superovulated heifers.

Treatment	No. flushes	No. ova	% Fertilized	% Degenerate	No. transferable
40 x 10^6					
Non-sexed	33	4.4	72^a	22	3.1^a
20 x 10^6					
Sexed	34	4.4	49^b	17	2.0^b
2 x 10^6	31	4.2	28^c	11	1.3^b

^{a,b,c} Means without common superscripts differ (P<0.05).

Key Words: Sex, Sperm, Superovulation

471 Fertility and distribution of estrus among cows following prostaglandin induced embryonic/fetal mortality. T. W. Geary*, *USDA-ARS, Fort Keogh LARRL, Miles City, MT.*

Late embryonic mortality occurs in approximately 10% of beef cattle. The objective of this study was to evaluate the distribution and fertility of estrus following early pregnancy loss in beef cattle. Pregnant cows (n = 124) and non-pregnant cows (control; n = 173) were divided across 2 yr to receive PGF (25 mg, i.m.) at d 25 (PG25; n = 40), 30 (PG30; n = 43), or 35 (PG35; n = 41) of gestation or during the mid-luteal phase of their estrous cycle (controls). Control cows were further divided into three approximately equal groups to receive PGF on the same dates as PG25, PG30, and PG35 cows. All cows were placed with fertile bulls immediately after PGF and were observed for estrus twice daily for 45 (PG25 and 60 control cows), 40 (PG30 and 56 control cows), or 35 d (PG35 and 56 control cows). Pregnancy was confirmed among PG25, PG30, and PG35 cows by ultrasonography and detection of a fetal heartbeat at the time of PGF (d 0). Synchronization rate (5-d) was greater ($P < 0.05$) in yr 2 (87%) than yr 1 (77%), and greater ($P < 0.05$) for PG35 (98%) and PG30 (91%) cows than control (78%) or PG25 (72%) cows. The interval from PGF to estrus was 4.0 ± 0.2, 4.6 ± 0.4, 4.1 ± 0.4, and 3.3 ± 0.4 d for control, PG25, PG30, and PG35 cows, respectively ($P > 0.10$). Synchronized pregnancy rates were higher ($P < 0.05$) for PG30 (66%) and PG35 (68%) cows than for PG25 (40%) cows. Synchronized pregnancy rates of control cows (54%) were not different ($P \geq 0.10$) than previously pregnant cows. Breeding season pregnancy rates (yr 1) were lower ($P < 0.05$) for control cows (84%) than for PG35 (100%) cows, but not different ($P > 0.10$) than pregnancy rates of PG25 (95%) or PG30 (95%) cows. In summary, cows that received PGF early during gestation exhibited an estrus of normal fertility within 5 d. Cows that experience early pregnancy losses during a breeding season likely exhibit a fertile estrus soon afterwards to prevent low overall breeding season pregnancy rates from being realized in beef cow herds.

Key Words: Embryonic mortality, Synchronization, Fertility

472 Insulin like growth factor-I (IGF-I), IGF binding proteins (IGFBP), and steroids in dominant follicles of postpartum beef cows. F. J. White*, I. Rubio, C. A. Lents, N. H. Ciccioli, R. P. Wettemann, and L. J. Spicer, *Oklahoma Agricultural Experiment Station, Stillwater.*

The effect of interval before the first postpartum estrus and ovulation on IGF-I, IGFBP, and steroids in dominant follicles (DF) was evaluated in Angus x Hereford cows. Growth of DF (> 9 mm) was monitored daily by ultrasonography and fluid from DF was collected in vivo at either 22 to 28 d or 42 to 48 d postpartum. Follicular fluid (FF) was also aspirated from DF of contemporary proestrous cows. Estrous behavior was monitored continuously with HeatWatch, and progesterone in plasma collected twice weekly was used to access luteal activity. Time of follicular aspiration was classified as short (< 35 d) or long (>35 d) interval before the first estrus and ovulation, or proestrus. Amounts of IGFBP and steroids in FF were not influenced by day postpartum. However, the amounts of IGFBP-3 and -4b (20-kDa) in FF were greater ($P < 0.05$) in DF aspirated < 35 d before the first estrus, or at proestrus, than in DF aspirated > 35 d before estrus. Concentrations of progesterone in FF were less ($P < 0.01$) in DF > 35 d (30 ± 6 ng/mL) than in DF < 35 d (81 ± 15 ng/mL) before estrus and in proestrous follicles (91 ± 10 ng/mL). Concentrations of androstenedione in FF were greater ($P < 0.01$) in proestrous follicles (41 ± 10 ng/mL) than in DF aspirated at > 35 d (4 ± 5 ng/mL) and < 35 d (10 ± 2 ng/mL) before the first postpartum estrus, and tended ($P = 0.08$) to be greater in DF < 35 d than in DF > 35 d before estrus. Proestrous follicles had greater ($P < 0.01$) estradiol (538 ± 148 ng/mL) than DF > 35 d (72 ± 39 ng/mL) or < 35 d (95 ± 32 ng/mL) before estrus. Concentrations of IGF-I in FF and plasma were not influenced by reproductive stage. In conclusion, estradiol production by DF of postpartum anestrous cows may be limited by decreased androstenedione production, and alterations in IGFBP in FF during the postpartum interval may influence follicular maturation.

Key Words: Beef cow, IGF-I, Insulin like growth factor binding proteins

473 Effect of dietary fat prepartum on first ovulation and reproductive performance in lactating dairy cows. M. Frajblat and W.R. Butler*, *Cornell University, Ithaca, NY.*

The objective of this study was to test the effects of prepartum and postpartum (PP) dietary supplements on the interval to first ovulation and reproductive performance. Multiparous Holstein cows (n=81) were fed isoenergetic diets (2.9 or 4.6 % fat; supplemental fat was prilled long chain fatty acids, Energy Booster) for 3 weeks preceding calving and control or glucogenic supplemented diets (0.23 kg/d of soluble sugars and 0.29 kg/d of Ca propionate) during the first 4 weeks PP. Daily energy balance (EB) was determined from calving to day 30 PP. Ovarian follicular development was monitored by ultrasonography and blood samples were analyzed for estradiol, progesterone, insulin, IGF-I, NEFA, and IGFBP's (ligand-blot). Beginning after day 55 PP, cows were injected with prostaglandin F2α (PGF) every Friday and were inseminated following estrus. Cows remained on the PGF schedule until estrus was detected or day 100 PP. Thereafter, cows were inseminated at every observed estrus prior to 220 days PP and PGF was used when cows were palpated non-pregnant after insemination. There was no effect of prepartum fat supplementation or PP glucogenic supplementation on any metabolic or hormonal parameter nor on follicular dynamics PP. By survival analysis earlier first PP ovulation was associated (P < 0.05) with less negative EB, less BCS loss, lower NEFA prepartum and PP. IGFBP-3, but not plasma IGF-I levels, tended (P<0.08) to be more abundant in cows with ovulatory first dominant follicle. Both ovulation prior to 50 days of lactation (P < 0.05) and prepartum supplemental fat (P < 0.03) were associated with a higher pregnancy rate during lactation. For cows fed supplemental fat prepartum, pregnancy rate was 86% versus 58% in controls (median PP days to pregnancy = 110 and 141, respectively). Effects of PP supplementation on first ovulation or pregnancy rate were non-significant. In conclusion, prepartum supplemental dietary fat and earlier first PP ovulation significantly increased pregnancy rate during lactation.

Key Words: Prepartum fat, Pregnancy rate, Cows

474 Ovarian follicular populations before weaning in sows are dependent on GnRH-induced LH release. C. J. Bracken*, B. L. McCormack, T. C. Cantley, R. P. Radcliff, and M. C. Lucy, *University of Missouri.*

The factors affecting follicular growth and the variation in weaning to estrus and weaning to ovulation intervals in sows are poorly understood. The objective was to determine if follicular populations before weaning in sows are dependent on GnRH-induced LH release. The posterior vena cava anterior to the ovarian vein was cannulated in 8 sows at 10.6 ± 0.7 d after farrowing. Blood samples were collected thrice daily (0700, 1500, and 2300 h) beginning on the day of cannulation and continuing until ovulation. Serum FSH and estradiol concentrations were measured by radioimmunoassay. Sows were randomly assigned to receive either 2 mL of GnRH (1μg/mL, n=4) or 2 mL saline (n=4) every 0.5 hour for 48 hours beginning 96 h before weaning and ending 48 h before weaning (weaning = 17.4 ± 0.6 d after farrowing). Average follicular diameter was determined once daily by transrectal ultrasonography. Follicular diameter (P < 0.001) and serum estradiol concentrations (P < 0.05)

were greater during infusion in GnRH-infused sows compared to saline-infused sows. Serum FSH decreased in sows infused with GnRH ($P < 0.001$). After GnRH infusion follicular diameter and serum estradiol decreased in GnRH-infused sows and FSH concentrations rebounded above saline control. We conclude that follicular populations before weaning in sows are dependent on GnRH-induced LH release but cannot be sustained in the absence of LH support prior to weaning.

	Estradiol	pg/mL*	FSH	ng/mL*	Diameter	(mm)*
Hour	GnRH	Saline	GnRH	Saline	GnRH	Saline
-96[a]	5.5±4.8	8.7±4.2	13.8±2.4	12.4±2.0	1.8±0.3	2.4±0.3
-48[b]	21.2±4.2	5.6±4.2	10.5±2.4	13.7±2.3	3.5±0.3	2.8±0.3
0[c]	3.1±4.8	7.7±4.8	13.6±2.9	11.0±2.3	4.3±0.3	2.6± 0.4
48	9.7±4.8	10.6±4.8	24.3±2.4	12.5±2.3	2.9±0.3	3.2±0.3
96	7.9±5.9	9.8±4.8	14.9±2.9	8.6±2.3	5.2±0.3	5.2±0.3

*lsmeans ± SEM
[a]start of infusion, [b]end of infusion, [c]day of weaning

Key Words: GnRH, Follicle, Lactating sows

Production, Management, & the Environment

475 Interrelationship between various measurements of temperament in Brahman cows and their Brahman calves.

K. O. Curley*, D. A. Neuendorff, A. W. Lewis, and R. D. Randel, *Texas A&M University Agricultural Experiment Station, Overton, TX.*

Animal temperament has been inversely associated with carcass quality and feedlot performance traits. Temperament can be assessed through both subjective and objective methodologies. The objectives of this study were 1) to compare temperament evaluations of exit velocity from a squeeze chute, chute score, pen score and temperament ratings obtained from longtime knowledge of the dam's reaction to handling; and 2) identify any correlations between calf and dam temperaments. A group of Brahman females (n= 47; 4-13 yrs old) and their spring-born Brahman-sired calves was utilized. Cow temperament rating (T) was identified as (1= calm, 2= normal, and 3= wild). Three other assessments were obtained while working the cattle through a manual squeeze chute at weaning. Chute scores (CS) were determined from behavioral responses to restraint on the scale (1=quiet to 5=wild). Exit velocity (EV) was measured (m/sec) as the animals exited the chute and traversed a fixed distance (1.83m). A set of infrared sensors acted as remote triggers for the start and stop of the timing device. Pen scores (PS) (1=quiet to 5=wild) were ascertained from calf behavior while the animals were in small groups (n<10) after exiting the squeeze chute. Pearson correlation coefficients (r) and ANOVA were utilized for statistical comparisons. Cow T influenced (P<.02) EV (1=.77 ± .02, 2=1.13 ±.13 and 3=1.61 ±.20 m/sec). There was no significant influence of dam T or calf sex on calf EV, CS, or PS. In cows T was correlated with EV r=.45 (P<.01) and with CS r=.39 (P<.01). T was not measured in the calves due to a lack of observations necessary to make this rating. Calf EV was correlated to calf CS r=.47 (p<.01) and PS r=.55 (P<.01). As T, CS, and PS are subjective scores and EV is an objective continuous measurement EV may prove to be a valuable measurement of temperament.

Key Words: Temperament, Chute score, Pen score

476 Interrelationship between various measurements of temperament in Brahman cows and their Hereford-sired calves.

K. O. Curley*, D. A. Neuendorff, A. W. Lewis, and R. D. Randel, *Texas A&M University Agricultural Experiment Station, Overton, TX.*

Animal temperament has been inversely associated with carcass quality and feedlot performance traits. Temperament can be assessed through both subjective and objective methodologies. The objectives of this study were 1) to compare temperament evaluations of exit velocity from a squeeze chute, chute score, pen score and temperament ratings obtained from longtime knowledge of the dam's reaction to handling; and 2) identify any correlations between calf and dam temperaments. A group of Brahman females (n=55; 3-13 yrs old) and their spring-born Hereford-sired calves was utilized. Cow temperament rating (T) was identified as (1=calm, 2=normal, and 3=wild). Three other assessments were obtained while working the cattle through a manual squeeze chute at weaning. Chute scores (CS) were determined from behavioral responses to restraint on the scale (1=quiet to 5=wild). Exit velocity (EV) was measured as the animals exited the chute and traversed a fixed distance (1.83m). Pen scores (PS) (1=quiet to 5=wild) were ascertained from calf behavior while the animals were in small groups (n<10) after exiting the squeeze chute. Pearson correlation coefficients (r) and ANOVA were utilized for statistical comparisons. Cow T influenced (P<.01) cow EV (1=.90.20, 2=1.45 .14, and 3=2.28.18 m/sec) and cow CS (1=1.13.18, 2=1.22.12, and 3=2.06.16). Cow T influenced (P<.05) calf EV (1=1.60.33, 2=1.72.22, and 3=2.65.30 m/sec), calf CS (1=1.53.20, 2=1.64.13, and 3=2.44.18) and calf PS (1=1.86.29, 2=2.29.19, and 3=2.86.26). Cow T was correlated with cow EV r=.61 (P<.01) and cow CS r=.47 (P<.01). T was not measured in the calves due to a lack of observations necessary to make this rating. Cow T was correlated to calf EV r=.33 (P<.02), CS r=.46 (P<.01) and PS r=.33 (P<.02). Calf EV was correlated to calf CS r=.60 (p<.01) and PS r=.78 (P<.01). Cow EV was correlated with calf EV r=.31 (P<.03) and calf CS r=.38 (P<.01). Temperament of a calf can be associated with dam temperament.

Key Words: Temperament, Chute score, Pen score

477 Breed type and gender effects on chute exit velocity and chute temperament score in beef calves.

J. F. Baker*[1], R. D. Randel[2], and C. R. Long[2], [1]*University of Georgia, Tifton, GA/USA,* [2]*Texas Agricultural Expt. Station, Overton, TX/USA.*

Time to travel a short distance after release from a squeeze chute and subjective chute temperament score (1 = calm, quiet - 5 = attempt to escape, highly agitated) have both been correlated with feedlot and meat quality traits. Objectives of this study were: evaluate effects of breed type and gender on exit velocity (EV, m/s) and chute temperament score (CS), and measure relationships between EV and CS two times near weaning. Braford (BO, n = 62), and Brangus (BN, n = 92) calves were weighed on a platform scale and CS was assigned. Calves were then released to a squeeze chute and restrained with head caught. After a blood sample was obtained the calf was released and time recorded to travel 1.83 m. Measurement one (T1) occurred when half of the calves within breed type and gender were weaned. Measurement two (T2) was fifty d later when the remainder were weaned. Least squares means were obtained from PROC MIXED with main effects breed type and gender with weaning group included for T2. Breed type was a significant source of variation in EV and CS but gender and the two-factor interaction were not significant for T1. Braford (1.86 ± 0.10 m/s) were slower than BN (2.23 ± 0.08 m/s). Breed type and gender were significant but weaning time was not significant at T2 for EV. Braford were still slower than BN (1.45 ± 0.10 m/s and 1.92 ± 0.08 m/s, respectively). Heifers were faster than steers (1.91 ± 0.09 and 1.45 ± 0.09 m/s, respectively). The correlation coefficient (r) between the two EVs was 0.54 ($P < 0.01$). The r between EV and CS were 0.29 ($P < 0.01$) for T1 and 0.31 ($P < 0.01$) for T2. In conclusion significant differences exist between breed types for EV and CS. Although the correlation coefficients between velocity and score were significantly different from zero the magnitudes were only moderate in magnitude. The exit velocity may be preferred due to the subjective nature of the score and the limited ability to distinguish subtle differences between animals.

Key Words: Temperament, Beef cattle, Weaning

478 Breed of sire and gender effects on chute exit velocity and chute temperament score in beef calves. R. C. Vann*[1] and R. D. Randel[2], [1]*MAFES/Brown Loam Experiment Station-Raymond,* [2]*Texas Agricultural Experiment Station-Overton.*

The objectives of this study were to evaluate effects of breed of sire, age of dam and gender on exit velocity (EV, m/s), chute temperament score (CS; 1=calm, no movement to 5=jumping and rearing, highly agitated) and pen temperament score (PS; 1=non-aggressive, not excited by humans to 5=aggressive, runs into fences and at humans if approached) and measure relationships between EV, CS and PS at two times near weaning. Crossbred calves (n=195) were assigned a PS, then calves were weighed on a platform scale and CS was assigned. Calves were then released to a squeeze chute and restrained. After a blood sample was obtained the calf was released and time recorded to travel 1.83 m. Measurement one (T1) occurred 21 d after weaning and the second measurement (T2) 90 days later. Least square means were obtained from PROC MIXED with main effects of sire breed, gender and age of dam. Breed of sire (Angus or Brangus) was not a significant source of variation for EV, CS or PS. Gender was a significant source of variation for EV and PS at T1 and was different for EV at T2 ($P < 0.06$). Heifers had a greater EV at T1 and T2 (1.75 ± 0.10 and 2.48 ± 0.14 m/s, respectively) compared to steers (1.56 ± 0.10 and 2.22 ± 0.15 m/s, respectively). The correlation coefficient (r) between EV at T1 and T2 was 0.68 ($P < 0.001$). The r between EV and CS was 0.26 ($P < 0.002$) at T2. The r between EV and PS were 0.489 ($P < 0.001$) at T1 and 0.487 ($P < 0.001$) at T2. In conclusion, breed of sire was not a significant source of variation in chute exit velocity however, differences existed between steers and heifers. Although the correlation coefficients between velocity and temperament score were significantly different from zero the magnitudes were only moderate. In this case, pen score had a better correlation with velocity than chute score. The exit velocity may be preferred due to the subjective nature of the temperament score.

Key Words: Temperament, Beef Cattle, Weaning

479 Effects of ranch management on performance of newly received feedlot calves. S. M. Holt*, R. H. Pritchard, and T. A. Wittig, *South Dakota State University.*

The effect of ranch management on weaning and relocation stress was investigated using spring born steer calves from a single source. Steers on mature dams (age >4y) were not weaned (NW) until shipped. Steers on young dams (<4y) were previously weaned (PW) 1 mo prior to shipment by the cooperating ranch. The steers were reared on native range prior to weaning. At shipment in late October tympanic temperature (TT) loggers were placed in 13 steers from each management group at shipment. All calves were then transported 580km to a feedlot. After resting (36 h) steers were vaccinated, dewormed and weighed individually (weaning weight (WW)). A cracked corn-grass hay diet (1.69 Mcal/kg NEm and 1.03 Mcal/kg NEg) was fed for 21d. WW was similar (P>.10) for PW (266kg) and NW (263kg) groups. Body weight after 21d in the feedlot (291kg vs 293kg) and DMI (6.7kg vs 6.8kg) were similar (P>.10) between PW and NW steers, respectively. Average daily gain (1.21 vs 1.44kg) and gain efficiency (181 vs 212g/kg) were higher (P<.05) in NW steers. Morbidity and mortality were nil for both PW and NW groups. Time series analysis was used to determine TT differences due to management. NW steers recorded higher TT (0.67^0C;P<.05) than PW steers during loading and transportation from the ranch, indicating a greater initial stress associated with NW. After 10h, TT of management groups converged and followed similar diurnal patterns for the remaining 5 d of recording. Diurnal TT patterns begin to mimic those of PW within approximately 1 h of arrival at the feedlot (12h post-weaning), suggesting that recently weaned calves were able to rapidly achieve homeostatic conditions for TT. During the first 4d at the feedlot DMI was lower for NW steers (5.06 vs 2.76kg/d; P<.05) and was slightly below maintenance. There were no differences (P>.05) in TT associated with this period of negative energy balance. Results indicate that pre-transit weaning, as a part of feedlot transition, did not add sufficient stress to alter TT compared to previously weaned calves.

Key Words: Cattle, Tympanic temperature, Stress

480 Thermoregulation and weight change in Hereford and Senepol steers as affected by forage type and estrogen therapy. R. Browning, Jr.*, S. H. Kebe, M. Byars, E. Lane, and C. Johnson, *Tennessee State University, Nashville.*

Hereford (n = 30; H) and Senepol (n = 26; S) 3-yr-old steers were fed endophytic tall fescue (T) or orchardgrass (O) hay and seed for 8 wk during July and August to assess breed, diet, and estrogen effects on thermal and weight status. Half of the steers in each breed-diet group received s.c. estradiol implants (E) and half were not implanted (N). Implant × breed × diet interaction and implant as a main effect did not influence ($p > 0.2$) respiration rates, shade use, or skin temperature. Breed × diet affected ($p = 0.01$) respiration as SO steers (66 ± 4 breaths/min) had lower rates compared to HO, ST, and HT (88, 89, 92 $\pm$ 4 breaths/min, respectively). Breed and diet as main effects affected ($p < 0.05$) shade use and skin temperatures. Shade use was lower for O vs. T steers (47 vs. $60 \pm 3\%$) and lower for S vs. H (20 vs. 87 $\pm$ 3%). Skin temperatures were lower for O vs. T (37.55 vs. $37.77 \pm 0.14^\circ$C) and lower for S vs. H steers (37.07 vs. $38.25 \pm 0.13^\circ$C). Implant × breed × diet affected weight gain ($p = 0.14$) and the percentage of steers gaining weight ($p = 0.03$). Weight was gained by $100 \pm 13\%$ of SOE, SON, HOE, and HON steers (ADG = 946, 572, 413, and 321 ± 156 g/d, respectively), 86% of STN (230 g/d), 68% of STE (269 g/d), 50% of HTE (-132 g/d), and 1% of HTN (-443 g/d) steer. The remaining steers lost weight. The percentage of HTN steers gaining weight was lower ($p = 0.05$) than all other groups, HTE differed ($p = 0.05$) from all groups except STE, and percentages did not differ among STE, STN, HON, HOE, SON, and SOE steers. Means separation test ranked and grouped (alpha = 0.05) treatments from high to low ADG: [SOE, SON], [SON, HOE, HON, STE, STN], [STN, HTE], [HTE, HTN]. As main effects, weight gain was greater ($p = 0.03$) for E vs. N (375 vs. 169 ± 85 g/d), greater ($p < 0.01$) for S vs. H (505 vs. 39 ± 85 g/d), and greater ($p < 0.01$) for O vs. T steers (567 vs. -23 ± 101 g/d). Forage, breed, and hormone therapy affected weight change in older steers during summer. Thermal status of steers may explain some of the variances in weight gain.

Key Words: Senepol, Tall fescue, Weight gain

Ruminant Nutrition: Beef cows and heifers

481 Fat supplementation and reproduction in beef females. R. N. Funston*, *University of Nebraska, Lincoln.*

Inadequate dietary energy intake and poor body condition can negatively affect reproductive function. Supplemental lipids have been used to increase energy density of the diet and may also have direct positive effects on reproduction in beef females. Several fatty acid sources have been studied as they relate to reproductive function. Plant derived oils appear to have the greatest impact on reproduction, common sources include: sunflower, safflower, cottonseed, rice hulls, and soybeans. Animal tallow and calcium salts of fatty acids escape rumen biohydrogenation to a greater extent and are incorporated into adipose tissue and milk. Effects on reproductive function appear to be more variable. Polyunsaturated fatty acids such as those in fishmeal also bypass the rumen but have been documented to affect reproductive processes. Fats have been fed before and after calving, during the breeding season, and during heifer development. Response to fat has been investigated through measuring: body weight and body condition score, age at puberty, postpartum interval, first service conception rates, pregnancy rates, calving interval, mammary gland development, milk yield, milk composition, calving difficulty, and calf birth and weaning weight. Animal response appears to be dependent on body condition score, age (parity), nutrients available in the diet (pasture or range conditions), and type of fat supplemented. To elucidate potential mechanisms of action scientists have investigated: changes in follicular and uterine development, hormonal profiles, brain function, and embryonic development. Feeding supplemental fat has resulted in varied and inconsistent results on reproductive function. Elucidating mechanisms of action of how supplemental fat can influence reproductive function has been a difficult process. The complexity of the reproductive system and makeup of fat supplements are often confounded by management conditions and forage quality both in research and commercial feeding situations. This has contributed to inconsistencies in research findings.

Key Words: Fat supplementation, Beef cattle, Reproduction

482 Microbial crude protein efficiency in nursing calves and gestating cows. M.J. Lamothe, J.C. MacDonald*, T.J. Klopfenstein, D.C. Adams, G.E. Erickson, and J.A. Musgrave, *University of Nebraska - Lincoln; Lincoln, NE*.

Two trials were conducted to determine effects of forage type and degradable intake protein (DIP) source on microbial crude protein (MCP) efficiency in nursing calves and gestating cows. In Trial 1, sixteen cow/calf pairs were assigned randomly to graze upland native range or subirrigated meadow to determine the effects of forage type on calf forage intake, milk consumption, and MCP efficiency from May through September. Calf forage intake and milk consumption were estimated by total fecal collections and weigh-suckle-weigh, respectively. Allantoin and creatinine were used as markers of MCP flow and urinary excretion, respectively. Fluid milk intake decreased linearly ($P < 0.01$) from May to September for calves grazing both forage types. This was accompanied by increases in forage OM intake for each month ($P < 0.05$), and a quadratic increase in MCP flow ($P < 0.05$). There were no changes over time in MCP efficiency which averaged 190g/kg digestible OM. In Trial 2, twenty four gestating cows grazing dormant native range were assigned randomly to one of three treatments to determine the effects of supplemental DIP source on MCP efficiency. Treatments were: 1) non-protein nitrogen (urea); 2) true protein (corn gluten feed); and 3) no supplementation. Forage intake was estimated from fecal output determined with intra-ruminal slow releasing chromium devices. Allantoin and creatinine were used as markers of MCP flow and urinary excretion, respectively. While statistical significance was found, differences in forage intake were likely related to forage availability rather than treatment effects because the control diet was not deficient in DIP (10.5% digestible OM intake). There were no differences in MCP efficiencies among treatments which averaged 85g/kg digestible OM. The MCP efficiencies measured in Trial 2 closely match those predicted by NRC, suggesting allantoin is an accurate marker of MCP flow. MCP efficiencies for calves grazing forage appear to be higher than 130g/kg digestible OM assumed by NRC.

Key Words: Microbial Crude Protein, Cows, Calves

483 Effect of age, pregnancy, and diet on urinary creatinine excretion in heifers and cows. K. M. Whittet*, T. J. Klopfenstein, G. E. Erickson, T. W. Loy, and R. A. McDonald, *University of Nebraska, Lincoln, NE*.

Urinary creatinine has been used as an output marker to predict output of metabolites in urine such as allantoin. Therefore, the use of creatinine as a reference material in nutrient balance studies depends upon a uniform and constant excretion of creatinine. A series of total urine collections were conducted to evaluate the effect of age, pregnancy, and diet on creatinine excretion in heifers and cows. For each collection, urine was collected over a 5-d period and composited by animal within day. Daily samples were analyzed for creatinine then each animal was averaged over the 5 d period. All animals were fed in individual stanchions at 2.0% of BW. To test the effect of age on creatinine excretion, 31 animals (BW range = 98-672 kg) ranging from 5 to 104 months of age were fed a forage diet supplemented with dried distillers grains (DDG). There was no difference in creatinine excretion across all ages (mean = 0.026 g/kg BW; P=0.34). Fifteen cows (BW = 572 ± 59 kg) fed a forage diet supplemented with DDG were sampled to determine the effect of pregnancy on creatinine excretion. Pregnancy did not change daily creatinine excretion (P=0.46). To determine if diet alters creatinine excretion, 11 heifers (BW = 441 ± 49 kg) were sampled for 2 urine collection periods. In period 1, heifers were fed a forage diet supplemented with DDG. In period 2, heifers were fed a finishing diet (90% concentrate:10% forage). Creatinine excretion was suppressed in heifers on the finishing diet (P<0.05) with forage fed heifers excreting 0.002 g/kg BW more creatinine in their urine. Age and pregnancy do not influence changes in creatinine excretion; however, diet may affect creatinine excretion in growing heifers.

Key Words: Creatinine, Age, Pregnancy

484 Methionine improves nitrogen retention of young gestating beef cows consuming low quality forages. R. C. Waterman*, W. D. Bryant, C. A. Loest, and M. K. Petersen, *New Mexico State University*.

Inadequate supply of metabolizable methionine or other limiting amino acids may limit protein accretion in gestating beef cows. Five ruminally cannulated gestating beef cows (490 ± 27 kg) were used in a 5 × 5 Latin square to evaluate the effects of post ruminal D,L-methionine (Met) supplementation on N retention, serum metabolites, and plasma amino acid concentrations during late gestation. Cows were allowed ad libitum access to water, mineralized salt, and experimental diet comprised of 67% wheat straw (1.9% CP and 78.7% NDF, OM basis) and 33% alfalfa (17.0% CP and 43.2% NDF, OM basis). Daily experimental diet was individually fed and refusal weights recorded for N intake determination. Treatments consisted of no urea (NU), urea (U), urea + 5 g/d Met (5MU), urea + 10 g/d Met (10MU), and urea + 15 g/d Met (15MU). Urea was administered into the rumen via rumen cannula once a day at 0600 h in two gelatin capsules to achieve a diet of 6.8% CP as fed. Methionine was infused into the abomasum twice a day at 0600 and 1800 h. Cows were adapted to the diet 30 d prior to the initiation of the experiment. Experimental periods were 14 d; 4 d to allow clearance of previous treatment affects, 4 d for adaptation to treatments, and 6 d for total fecal and urinary collection. Serum and plasma samples were collected every 4 h for 24 h on day 13 of each period for analysis of serum urea nitrogen, glucose, non-esterified fatty acids, and plasma amino acids. Nitrogen retention was improved (P < 0.05) with urea and incremental amounts of methionine (32.3, 41.6, 48.1, 48.7, and 51.6 ± 3.4 g/d for NU, U, 5MU, 10MU, and 15MU, respectively). No differences (P > 0.05) were identified for serum urea nitrogen, glucose, or non-esterified fatty acids. A quadratic response was determined (P < 0.05) for plasma Met (36.9, 30.1, 55.9, 96.6, and 196.3 ± 20.5 μM for NU, U, 5MU, 10MU, and 15MU, respectively). Responses observed in N retention and plasma Met indicates that methionine is a limiting amino acid in low quality forage diets for gestating beef cows.

Key Words: Cattle, Methionine, Supplementation

485 Domperidone administered to heifers can ameliorate deleterious reproductive parameters and weight gain reductions associated with ingesting endophyte-infected fescue. K. L. Jones*[1], S. S. King[1], K. E. Griswold[1], D. Cazac[1], and D. L. Cross[2], [1]*Southern Illinois University, Carbondale, IL,* [2]*Clemson University, Clemson, SC*.

Fescue toxicosis is a poorly defined, widespread phenomenon affecting ruminant and nonruminant grazing livestock species. Fescue toxicosis results in estimated losses to the beef industry of nearly 800 million dollars annually due to lowered conception rates and depressed body weight gains. The aim of this study was to evaluate luteal and follicular function and weight gains in nonpregnant heifers consuming endophyte-infected (EI) tall fescue. Thirty crossbred heifers (Angus x Holstein or Hereford x Holstein) 18 to 24 months of age and weighing 390 ± 3.5 kg were divided equally amongst three treatment groups; endophyte-free (EF) fescue diet, EI fescue diet or endophyte-infected diet and treated with the dopamine (DA) antagonist, domperidone injected s.c. at 0.44mg/kb BW (EID). Heifers were weighed weekly and data analyzed using ANOVA with LSD post hoc testing. After 28 days on the experimental treatments, heifers fed EI diets had reduced weight gains (20.5 ± 4.0) when compared to heifers fed EF (35.5 ± 6.6) or EID (35.5 ± 3.7; p<0.05). The heifers' ovarian structures were monitored via transrectal ultrasound to determine follicle size and day of ovulation. Blood plasma samples were collected daily and analyzed for progesterone (P4) concentration by RIA. Data were analyzed using PROC MIXED with repeated measures followed by least square means post hoc testing. Heifers ingesting EI diets had shorter duration interovulatory intervals (EF=22.5 ± 0.6 d, EI=20.7 ± 0.37 d), and lower mid-cycle P4 concentrations than heifers in the EF or EID treatments (p<0.05). These results suggest that domperidone supplementation of heifers eating EI fescue may ameliorate certain symptoms of fescue toxicosis.

Key Words: Fescue, Domperidone, Interovulatory interval

Ruminant Nutrition: Feed intake

486 Recently identified signals for feed intake regulation. J. L. Miner*, *University of Nebraska*.

Both gastrointestinal distension and presence of nutrients in the digestive tract exert satiating effects. This has been recognized for many decades. However, our understanding of the specific mechanisms by which these stimuli are communicated and translated remains incomplete. Investigation of feed intake regulation in ruminants has historically been aided by descriptions of this biology in rodent models. Thus the role in intake regulation of absorbed chemicals, gut hormones, the vagus nerve, and specific brain nuclei has been confirmed (or modified) in ruminant species. However, much has remained unknown. For example, despite recognition that the brain peptide, NPY, is an extremely potent stimulant of feeding, and concurrent inhibitor of gonadotropes, we have not understood how undernutrition promoted its activity. The recent characterization of leptin in mice, however, has lead to the demonstration in sheep that this protein secreted from adipocytes is capable of signaling energy status to the brain, and that at least some of its effects on intake and reproductive hormone secretion are mediated via NPY. Other mechanisms of intake regulation in rodent have recently been described. Agouti-related protein and melanocyte concentrating hormone seem key to hypothalamic intake-stimulating mechanisms. Cocaine-amphetamine-related transcript (CART) peptide and malonyl CoA appear to be part of hypothalamic satiety mechanisms. We may also expect that recently described gut peptides that appear to function in determining feed intake in rodents, perform similar functions in ruminants. For example, glucagon-like peptide-1 and ghrelin are inhibitory and stimulatory, respectively, in rodents. In summary, application of modern molecular biology techniques has lead to discovery of several regulatory molecules, some of which have only been characterized in model species. At least one of these, leptin, has significantly contributed to models of how nutritional status is communicated for modulation of feed intake and reproduction in ruminant animals.

Key Words: Cattle, Feed intake, Endocrine

487 Ghrelin, a growth hormone secretagogue, is expressed by bovine rumen. P. C. Gentry*, J. P. Willey, and R. J. Collier, *University of Arizona*.

The growth hormone secretagogue ghrelin is an important regulator of energy metabolism, nutrient partitioning and feeding behavior. Although it has been detected in a variety of tissues, the stomach is the primary source of ghrelin, while receptors are located in the pituitary and hypothalamus. Ghrelin levels peak prior to a meal and subside dramatically immediately after. In addition to stimulating pituitary growth hormone secretion, exogenous ghrelin reduces fat utilization, induces adiposity and provokes food intake in humans and mice. Thus, ghrelin is an important endocrine link between the gastrointestinal tract and brain. To date, the role of ghrelin in ruminants remains unexamined. Our objective was to determine if ghrelin is expressed in preruminant and ruminant calves and to assess distribution of ghrelin mRNA expression throughout the gastrointestinal tract. Expression of ghrelin was assessed by semi-quantitative RT-PCR in Holstein bull calves at 4 (n=6) and 12 (n=5) wk of age. Calves were fed colostrum at birth and for at least three subsequent feedings, followed by a commercial milk replacer. Calves were fed twice daily at 7 AM and 6 PM. Beginning on d 12, calves were offered a corn-based calf starter feed, free choice. Calves were euthanized at 7 AM on the day of slaughter and were not fed. Primers spanning nucleotides 40-488 of the ghrelin coding region were used to amplify ghrelin from total cellular RNA from rumen, reticulum, omasum, abomasum, duodenum, jejunum, ileum and abdominal adipose tissue. Ghrelin was detected in rumen and abomasum but not in other tissues. When corrected for differences in RNA input by normalizing to the housekeeping gene G3PDH, ruminal expression was greater in 12 wk calves than in 4 wk calves, corresponding to the increase in rumen function occurring during this period. Further studies characterizing ghrelin expression in cattle under differing dietary and growth conditions are in currently in progress, as are experiments to determine cellular sites of ghrelin expression.

Key Words: Ghrelin, Energy metabolism, Ruminant

488 Evaluation of the DMI predictions of the Cornell Net Carbohydrate and Protein System model with Holstein and dual-purpose lactating cattle in the tropics. D. O. Molina*[1], I. Matamoros[2], Z. Almeida[2], L. O. Tedeschi[1], and A. N. Pell[1], [1]*Cornell University. Ithaca, NY, USA,* [2]*Escuela Agrcola Panamericana Zamorano. Honduras*.

Data from three experiments were used to evaluate the DMI predictions of version 5.0 of the Cornell Net Carbohydrate and Protein System (CNCPS) in tropical conditions in 3 production settings in Honduras. Experiment 1 was conducted with 12 lactating Holstein cows in individual stalls at a research farm. The cows received known amounts of supplements and fresh, chopped *Panicum maximum* cv Tobiatá grass and intake was measured daily. Intake of grazing cattle was evaluated in Experiments 2 and 3 using the alkane technique over 8-d periods. Experiments 2 (commercial farm) and 3 (research farm) included 12 and 13 crossbreed dual-purpose cows rotationally grazing *Cynodon nlemfuensis* cv Alicia and *Panicum maximum* cv Tobiatá grass, respectively, with appropriate supplementation. Model predictions were evaluated by regressing the observed (obs) values (Y variable) on the predicted (pred) values (X variable). Mean bias and mean square prediction error (MSPE) were calculated. Differences between obs and pred values were evaluated using a 2-tailed t-test. Model-predicted DMI (18.2 kg/d)was close to the observed values (18.0 kg/d), with a mean bias of - 0.19 kg DM/d, suggesting that the CNCPS accurately predicted intake of confined lactating animals in tropical conditions. The intake predictions by the CNCPS for the grazing dual-purpose lactating cows were not as accurate. The CNCPS model underpredicted DMI in experiment 2 (10.7 kg/d obs versus 12.8 kg/d pred), with a mean bias of - 2.04 kg DM/d, and DMI was overpredicted in experiment 3 (12.5 kg/d obs versus 12.2 kg/d pred), with a mean bias of 0.45 kg DM/d. For the three experiments, the slope of the regression between observed and predicted DMI did not differ from unity, but the intercept differed ($P < 0.05$) from zero, indicating a prediction bias. Accurate intake data from grazing animals is difficult to obtain and errors in the estimation of herbage intake using the alkane method may have contributed to the bias in the predictions by the CNCPS model.

Key Words: CNCPS, Dry mater intake, Tropical pasture

Sheep: Sheep production and management

489 Out-of-season breeding in hair sheep using Melengestrol Acetate (MGA). N. C. Whitley[1], D. J. Jackson*[1], and S. Schoenian[2], [1]*University of Maryland Eastern Shore,* [2]*Maryland Cooperative Extension, WMREC*.

Thirty-two Katahdin and crossbred Katahdin ewes were group-fed one of two diets, a commercial diet containing MGA (n=16; MGA) or a commercial diet with no MGA (n=16; CON) for a period of 10 d after being removed from rams for 21 days prior to the start of treatment. The MGA group was fed to provide approximately .25 mg/ewe of MGA/day while the CON group was fed an equivalent amount of a control diet. Following the treatment period, ewes were grouped for mating (=d0) with two rams wearing marking harnesses for 14 days. Ewes were checked twice daily for estrus and numbers mated was recorded to determine days to first mating and percentage mated. Blood samples were collected for serum estrone sulfate (ES) radioimmunoassay at approximately 52.1±.5 and 112.2±.5 days after mating for pregnancy detection. Days to first mating tended ($p<.08$) to be lower for MGA-treated ewes compared to CON ewes, averaging 2.3±.6 and 4.3±.9, respectively. The percentage of ewes mated was higher ($p<.01$) for MGA-treated ewes (100±8.8%) compared to CON ewes (37.5±8.8%). Pregnancy rates could not be determined based on serum ES concentrations in this study and concentrations were not influenced by treatment, averaging .7±.1 and 5.9±1.1 ng/ml for days 52 and 112, respectively. Lambing rate per ewe exposed and per ewe mated were both higher ($p<.01$) for MGA-

treated ewes (75.010.9 for both) compared to CON ewes (6.3±9.05% and 16.7±17.8%, respectively). Number of lambs born per ewe mated was also greater (p<.03) for ewes treated with MGA (1.4±.23 lambs) compared to CON ewes (.33±.38 lambs), but number of lambs born per ewe lambing (1.8±.15 lambs) and total litter birth weight (7.0±.36 kg) was not influenced by treatment. Day 112 serum ES concentrations for ewes lambing tended to be positively correlated with total litter birth weight (r^2=.30, p<.07), but not with number of lambs born (r^2=.21, p<.14). Overall, progesterone priming in combination with the ram effect in hair sheep increased fertility and fecundity of ewes bred during summer.

Key Words: MGA, Hair sheep, Ram effect

490 Effect of breed type on shear force, sensory analyses and fatty acid content of lamb. S. P. Greiner*[1], S. K. Duckett[2], and D. R. Notter[1], [1]*Virginia Polytechnic Institute and State University, Blacksburg,* [2]*University of Georgia, Athens.*

Eighty eight lambs from two locations (L1, L2) were evaluated to assess breed differences in longissimus muscle tenderness, sensory attributes, and fatty acid content. At L1, Dorper (DP) and Dorset (DO) crossbreds (out of -DO, -Rambouillet, -Finnsheep ewes) were produced in 2000 and 2001, along with straightbred Katahdin (KT) and Barbados Blackbelly x St. Croix (HH) wethers in 2001. At L2, DP and Suffolk (SU)-sired lambs (out of SU ewes) were produced in 2001. Lambs were weaned at 90 d of age, grazed, and then fed a high-concentrate diet prior to slaughter at 8 mo of age. Racks from carcasses were aged at 4°C for 10 d and frozen at -20°C for subsequent Warner-Bratzler shear force (WBS), sensory, and fatty acid (FA) analyses. Chops were rated by a trained sensory panel for tenderness (T), juiciness (J), lamb flavor (LF), and off-flavor (OF) using a 8-point scale (1 = extremely tough, dry, and bland; 8 = extremely tender, juicy, and intense). FA content of intramuscular lipid was determined by GLC. A model that fit location and breed type was used to evaluate DP vs non-DP (ND; DO and SU) breed types. No breed by location interactions were observed. WBS values were 0.62 kg lower (P < 0.01) for DP than ND (2.38 vs 3.00 SEM = 0.15). Similarly, panelists rated DP more T (P < 0.01) than ND (5.51 vs 5.02 SEM = 0.08). J, LF, and OF were similar (P > 0.32) for DP and ND. Concentrations of stearic, palmitic, and lauric acids were higher (P < 0.05) in DP-sired lambs, whereas the percentage of linoleic acid was lower (P < 0.05). DP tissues had higher (P < 0.05) percentages of total saturated FA, along with lower (P < 0.05) percentages of monounsaturated and polyunsaturated FA than ND. At L1 in 2001, WBS values were higher (P < 0.05) for DO than DP and KT. WBS values were similar (P > 0.05) for DP, KT, and HH lambs. HH lambs received higher (P < 0.05) and more desireable T scores than DO and KT lambs. However, no differences were detected between breed types for J, LF, or OF. Longissimus tenderness was improved with Dorper genetics.

Key Words: Lamb, Sensory evaluation, Fatty acid

491 Effects of low protein and limit-fed corn based diets on diet digestibility and metabolism of N and P in sheep. M. Abdullah*[1], S. C. Loerch[2], P. Tirabasso[2], and G. D. Lowe[2], [1]*University of Agriculture, Faisalabad, Pakistan,* [2]*OARDC, The Ohio State University, Wooster, OH 44691.*

Low protein and limit-fed diets decrease excretion of N and P and help decrease environmental pollution. Twelve wether lambs(42kg BW) grouped into three blocks and kept in metabolic crates, were fed the experimental diets to determine the effects of low protein and limit-fed corn-based diets on DM digestibility and N and P metabolism. Treatment were; i) ad libitum intake, corn-SBM control, ii) limit-fed(2.5% of BW), low N and P corn diet, iii) ad libitum intake, low N and P soy hull-corn silage diet, and iv) limit-fed(2.5 % of BW), low N and P soy hull-corn silage diet. The trial consisted of a 19 d period, 14 d for adaptation and 5 d for total collection of feces and urine. N intake by lambs fed the low N diets was about 38% lower($P<.05$) than that of lambs fed the control diet. Lambs fed the soy hull-corn silage based diets consumed 45% less ($P<.05$) P than those fed the corn-based diets. Fecal output (g/d) by lambs fed soy hull-corn silage-based diets was nearly two times greater ($P<.05$) than that of lambs fed corn-based diets. Fecal N output followed a similar trend, but fecal P output was not affected ($P>.05$) by diet. DM ($P< .001$) and N ($P< .01$) digestibility was lower for ad libitum or limit-fed soy hull-corn silage diets than for the control or limit-fed (low N and P) corn diet. N and P retention (g/d) was also lower ($P< .05$) for the limit-fed corn diet and ad libitum or limit-fed soy hull-corn silage diet. N retention was negative for the limit-fed low N and P soy hull-corn silage diet. Similar trend was observed for N retention as % of N intake. N retention as % of N digested was negative ($P< .05$) for the limit-fed low N and P soy hull-corn silage diet, whereas, no difference was found between control, limit-fed corn and limit-fed soy hull-corn silage diets. High fiber, lower digestibility diets increase N excretion and decrease N retention (regardless of intake level), compared with corn-based diets.

Key Words: Low protein diets, Limit feeding, N and P metabolism

Animal Behavior & Well Being Symposium: Alternative housing for livestock

679 Current and future trends in dairy housing. G. L. Bethard*[1] and J. G. Martin[2], [1]*G&R Dairy Consulting, Inc.,* [2]*Joseph G Martin Consulting Engineer.*

Dairy Housing has changed markedly over the last 30 years. Most new dairy facilities in the United States are either free stall confinement housing, or dry lot housing in areas with minimal rainfall. Many older facilities were designed to provide worker comfort and labor efficiency. Buildings in warm and cold weather climates were designed to minimize worker exposure while restricting ventilation. The impact of facility design on animal performance was rarely measured. More recently, researchers have measured the impact of facilities on the cow's ability to handle stressful environmental conditions such as heat, cold, and overcrowding. In particular, heat abatement has been a critical design component in most regions of the United States. Handling waste has become a major issue, with scrape or flush systems predominant. The dairy industry has moved away from worker comfort to cow comfort, realizing that comfortable cows are healthier, more productive and profitable. Dairy design goals are to ease manure handling and maximize cow comfort, labor efficiency, and productivity while minimizing investment. Future trends will focus on improving cow comfort and productivity, with an increasing emphasis on heat abatement.

Key Words: Dairy housing, Free stall, Heat abatement

619 Housing the sow without crates - challenges and solutions. J. N. Marchant-Forde*, *USDA-ARS.*

Confining sows in crates throughout gestation, farrowing and lactation is commonplace in North America. In Europe, crating the sow throughout gestation will be prohibited from 2013 and the farrowing crate continues to be scrutinized by a powerful animal well-being lobby. In North America, major retailing chains are already introducing welfare guidelines and the issue of sow housing is an area that is attracting a great deal of attention, not least because of recent legislation enacted in Florida. However, loose housing of the gestating and farrowing sow does present real challenges that need to be addressed in order to safeguard pig well-being and ultimately, productivity. The major challenge of group housing the gestating sow is that of inter-sow aggression. Sows will fight especially when mixed and when having to compete for access to resources. Therefore, the ways in which sows are introduced to each other and how they are fed are major factors in determining the success or failure of a system, both in well-being and productivity terms. For loose-housed farrowing sows, the major challenge is that of safeguarding the well-being of her piglets, in terms of pre-weaning mortality and ensuring even growth. Over the last decade, aspects of sow housing have undergone a great amount of research. Although the majority of this work has been carried out outside of North America, many of the research results are likely to be directly applicable to the swine industry here. This paper will highlight work done to date with a focus on the development of practical solutions, derived from both system design and system management techniques, that allow the skilled and motivated stockperson to work what are called

alternative housing systems. At the end of the day, it is the stockperson who will ensure the success or failure of any sow housing system and the well-being of sows within that system. However, the tools do exist to safeguard pig well-being and productivity when removing them from confinement systems and, importantly, perhaps address some of the negative public perceptions about the swine industry.

Key Words: Sows, Alternative housing, Well-being

492 Animal welfare and international trade: European and American perspectives. A. Lawrence* and D. Oglethorpe, *The Scottish Agricultural College*.

International trade in agriculture has developed enormously since the 2nd World War, and with it demands for liberalisation of the trade have grown. In 1994 the pressure for liberalisation resulted in agriculture being included in the General Agreement on Tariff and Trade (GATT). Despite this attempt to arrive at globally applied rules on agricultural trade, many countries still operate "systems", which in various ways are designed to protect national agriculture industries. Since 1995 the GATT rules have been enforced by the World Trade Organisation (WTO), and the EU and the US have so far initiated the majority of disputes over application of the rules. This tension between the US and EU over agriculture trade has relevance to the debate over animal welfare and its incorporation in international trade rules.

In recent WTO negotiations the EU has proposed that the growing importance of animal welfare as a socio-economic issue, requires that international trade agreements take account of it. Specifically, the European Commission would like to see support for animal welfare fall into the "Green Box" of agricultural support payments — those payments seen as delivering public goods and services and not influencing production decisions. Although it is likely that improved margins could be gained from improving the animal welfare attributes of a product, the EU contend that improved animal welfare is partly a public good that is demanded by society at large.

The EU has proposed three approaches to resolve the incorporation of animal welfare into international trade negotiations: multilateral agreements on protection of animal welfare, appropriate labelling to allow consumers to make informed choices, and the use of some form of compensatory payments to balance any increased costs of production resulting from raising animal welfare standards. What is important to provide however, is evidence to suggest that society does actually derive a non-market benefit from the existence of animal welfare farm systems. If this is the case, it will then be worthwhile comparing the costs of delivering those animal welfare benefits, compared to the cost of delivering other public goods or services from agriculture, such as biodiversity or amenity. We will examine these two issues and we will discuss the role that public/consumer attitudes in the EU and the US may play in determining the market for 'animal welfare foods'.

Key Words: Welfare, Trade policy, European

Forages & Pastures Symposium: Forage strategies for arid climates

493 Supplementing grazing beef cattle: If, when, with what, and especially how often? J. E. Huston*, *Texas Agricultural Experiment Station, Texas A&M University System*.

The literature was reviewed on the needs for and responses to supplementation by beef cattle grazing range forages. Only cases of adequate quantity of forage were considered. Rangelands vary in climatic conditions and plant species composition thereby causing differences in diet quality among occupied areas and during seasonal periods within those areas. Also, nutrient requirements of the cow unit vary with genetic potential and stage of production. An extensive dataset collected in western Texas (average annual rainfall = approximately 500 mm) over a 17-year period was used to illustrate responses to supplemental feeding and various feeding practices. Unsupplemented, mature beef cows lost 18.4% of their fall weight (including reproductive tissues) before the beginning of the breeding season (April 1) and conceived at a rate of 81%. Cows fed the equivalent of one-half of their daily protein requirements in a concentrated supplement lost 12.9% of fall weight and had a 91% conception rate, a satisfactory reproductive rate in a mixed-age herd. Various preparations and supplementary nutrients were tested against this standard response. Several experiments were conducted to compare the relative responses from feeding identical weekly amounts of supplemental feeds but broken into daily, three times per wk, and weekly portions. Generally, feeding interval did not affect mean responses in reduced body weight and condition score under the conditions of these studies and with the supplements offered. Those fed weekly (approximately 6.5 kg at a single weekly feeding) showed less variability in supplement and forage consumed and in changes in body weight. These data and inferences drawn are summarized in "The Eleven Commandments of Supplemental Feeding of Beef Cattle."

Key Words: Beef-cattle, Supplemental-feeding, Feeding-interval

494 Complementary forages and grazing systems for beef cattle production on arid rangelands in the Western US. T. DelCurto*, D. W. Bohnert, C. S. Schauer, and G. D. Pulsipher, *Eastern Oregon Agricultural Research Center, Oregon State University, Union and Burns*.

Western beef cattle producers are faced with numerous challenges relative to forage resources and nutritional opportunities. Specifically, much of the western US is characterized by high elevation rangelands that typically have short growing seasons and limited, highly-variable, precipitation. As a result, forage availability and quality are often low throughout much of the grazing period and limit optimal beef cattle production. Numerous opportunities exist, however, to improve the nutritional plane of beef cattle grazing arid rangelands. The introduction of complementary forages can lengthen the period of adequate nutrition. Forage species including alfalfa, forage kochia, crested wheatgrass, and winterfat have all been shown to offer unique nutritional advantages. Likewise, forage species that tolerate winter grazing and snow can provide economic advantages to western producers by decreasing the reliance on feeding harvested hays to cattle during the winter period. Grazing systems that utilize topographical characteristics of rangelands to enhance the nutrition of cattle production are also potential opportunities. For example, using pastures with southern exposures early and northerly aspects late can effectively increase the nutritional plane of grazing cattle. In addition, the use of rangelands that have diverse forb and shrub components late in the grazing period will improve the nutritional plane of the cattle. Care must be taken, however, to develop grazing systems that maintain or enhance the biological diversity of the forage base and long-term sustainability of the rangeland resource. In summary, nutritional opportunities do exist to improve the nutritional plane of cattle grazing western rangelands. Specific strategies need to be tailored to the resources available to beef cattle producers and will necessarily differ from location to location.

Key Words: Complementary forages, Grazing systems, Western rangelands

495 Management strategies for optimal distribution and use of arid rangelands. D. W. Bailey*, *Montana State University*.

Application of existing and novel management techniques can alter traditional livestock grazing patterns and significantly improve the sustainability of arid rangelands. Livestock often congregate and heavily graze riparian areas and other sensitive rangeland while abundant forage remains in other areas. Increasing the uniformity of grazing can help protect fisheries, wildlife habitat and other vegetative and watershed resources. For years, managers have improved grazing distribution in extensive arid pastures by developing new water sources. In addition, strategic supplement placement can be used to lure cattle to graze areas that typically receive little use. Placement of low moisture molasses blocks in steeper areas that were far from water increased forage use by 14% at distances up to 600 m from supplement in foothill rangeland. Recent research has examined the potential of breed and individual animal selection to improve grazing distribution patterns. Cattle breeds developed in mountainous terrain utilize rugged rangeland more ($P < 0.05$) uniformly than breeds developed in more gentle terrain. In pastures that were grazed by cattle identified as "hill climbers" (previously observed on rugged terrain), more residual vegetation ($P < 0.05$) was left on gentle slopes and areas closer to water than in pastures grazed

by cattle identified as "bottom dwellers" (previously observed on gentle terrain near water). Cattle may use rugged rangeland more uniformly after weaning and during periods when temperatures are more moderate (spring, early summer, and fall). Herding shows great promise for protecting sensitive rangeland. Preliminary data show that residual riparian forage in pastures where livestock were herded was up to two times higher than in a control pasture. The integration of herding and strategic supplement placement appears to be more effective than herding alone. Many concerns associated with the sustainability of grazing on arid rangelands can be resolved by manipulating livestock grazing behavior through management.

Key Words: Grazing, Distribution, Behavior

496 Whole ranch management systems to optimize forage use and meet multiple use goals. L. R. Roath*, *Colorado State University*.

Optimal forage use must account for the needs of the land and of the grazing animals, simultaneously! The challenge in designing systems to meet these criteria is to: 1) account for food choices of an array of grazing animals in time and space; 2) recognize what that means to relative food availability and relative depletion rates; 3) determine what the standing quantity of quality is and how many animals of what types it can supported (i.e. stocking rate); 4) determine the influence of the grazing use on the forage resource and feedback mechanisms; and 5) find and monitor reliable indicators of both plant and animal performance that will provide information on a time scale that will allow managers to adjust management choices to create sustainable management systems. This is a daunting job!

Prototype conceptual and applied models are being developed at Colorado State University to take some of the mystery out of this enormous task. The question of distribution of forage use and removal has been addressed scientifically by Dr. Larry Rittenhouse and Dr. Tom Hobbs. Progress is being made to use this conceptual information in predicting landscape use patterns and then making predictions of relative stocking rates for multiple grazing animal species. This work has allowed assessment of landscape level stocking rates and is now being tested for reliability. Preliminary indications are that the application of these models provides much additional information for the decision process about appropriate stocking rates but does not supplant the need for monitoring protocol for plants, plant communities, individual animals and populations. Monitoring tools like fecundity rates, animal weight, body condition for wild and domestic grazing animals and the Grazing Response Index, community dynamics, grazing pattern and rate of forage depletion for plants will be discussed, as well as, discussing the influences weather and growth dynamics of forage quality and availability. How managers might use these approaches to affect decisions on their operations will be suggested.

Goat Species Symposium: Assisted reproduction in goats

497 Update on estrus synchronization in a minor species. N.C. Whitley*, *University of Maryland Eastern Shore, Princess Anne, MD*.

Estrus synchronization allows for parturition at the most suitable time to take advantage of niche markets, feed supplies, labor and/or rising price trends. In the past, the synchronization of estrus in goats has focused primarily on dairy goats to allow for optimal timing of milk production. However, recent interest in meat goat production has resulted in attempts to use dairy goat, sheep and cattle synchronization regimes in meat goat management systems. Methods of synchronization have included techniques as simple as alteration of light patterns or manipulation of social inputs (i.e. the buck effect) and those as complex as varying timed hormonal treatments combined with light alteration and the buck effect. The synchronization of estrus using timed hormonal treatments seems to be more convenient in many meat goat production situations. Examples of hormones used include melatonin, progestagens (administered orally, as an injection or by using intra-vaginal releasing devices), gonadotropins/GNRH (or agonists) and/or prostaglandins alone or in combination. As is seen with sheep and cattle, breed and/or breed type, stage of production and environmental impacts can influence synchronization success in goats. The introduction of breeds developed in other countries for rapid growth, such as the Boer goat, and increased consumer and producer interest have added to the impetus for developing cost efficient and/or highly effective estrus synchronization regimes. New research is being conducted and various synchronization methods are being attempted in goats, a minor species, and the objective of this paper is to review these efforts.

Key Words: Estrus Synchronization, Meat Goats, Hormone

498 Current status of cryopreserving goat semen. P. H. Purdy*, [1]*USDA-ARS National Animal Germplasm Program, Fort Collins, CO*.

The success of goat sperm cryopreservation may be evaluated by multiple cellular characteristics. Classically, sperm cell motility, viability, acrosomal membrane integrity as well as other in vitro assays have been used to assess the success of cryopreservation and fertilizing potential. Ideally, multiple evaluations would be performed to evaluate how successful a freezing protocol is or how successfully a particular semen sample freezes. Successful cryopreservation of mammalian sperm is a relative concept, particularly when compared with sperm from other species. Dairy bulls have been selected for the ability to "freeze well" for generations and consequently these bulls have repeatedly high percentages of motile, viable sperm cells post-thaw that are capable of fertilizing oocytes. On the other hand, buck, ram, boar and stallion sperm is less consistent in these and other attributes post-thaw and potentially less fertile. The purpose of this review is to assess the current status of cryopreserving goat sperm and will include a review of literature that describes post-thaw motility, viability, acrosomal integrity, in vitro fertilization and other sperm cell attributes. In addition, the review will also compare the post-thaw sperm cell attributes of goats with that of other species to identify areas of research with consistent satisfactory results and those areas that could be enhanced to match the other species.

Key Words: Goat, Sperm, Cryopreservation

499 Effects of short-term nutritional priming and multiple superovulation regimes on superovulated dairy goats. N. Buzzell, S. Blash, M. Cutler, D. Melican, J. Jameson, P. Flanagan, M. Olson, and W. Gavin, *GTC Biotherapeutics Inc., Spencer MA*.

This study examined the effects of nutritional priming (NP) and multiple superovulation regimes on oocyte production in superovulated dairy goats using 389 non-lactating does, 1-10 years old, during the non-breeding season (December to May). The does were body condition scored (BCS scale: 1-5) and then randomly assigned to 2 equal groups. All does were fed hay ad lib; but the experimental group received an additional 0.5 kg/head/day of concentrated feed (DM crude protein = 19%) 2-3 weeks prior to oocyte collection. The donors were synchronized with progesterone vaginal implants (300 mg) on Day 0 and PGF2α (5 mg IM) on Day 7. The superovulation regime consisted of FSH twice daily (64mg/day IM) on Days 12-15. The implants were removed on Day 14 or 15 and GnRH was given (5mg IM) on Day 16. Estrus was detected by vasectomized bucks on Days 15 & 16. The reproductive response was assessed by exposing the uterus through a midline incision and by retrograde flushing of both oviducts to collect oocytes. The ova collected in donors with BCS 2, 3, 4 were 10.6$\pm$1.4, 10.1$\pm$0.5, 6.2$\pm$2.7 for NP does, and 8.7$\pm$1.0, 9.7$\pm$0.6, 12.6$\pm$3.7 for nonNP does, respectively. Two tendencies emerged that could not be verified statistically because of the variability of oocyte collection. First, nutritional priming appears to reduce oocyte production in overconditioned does. Second, compared to underconditioned does in the nonNP control group, experimental does with lower BCS tended to be more reproductively responsive to nutritional priming. Additionally, historical data for does with repeat superovulatory regimes were analyzed. Ova collected from donors in their first superovulation regime (12.10.5) were significantly greater than ova from donors in their fourth regime (40.9). Thus, when devising a protocol to maximize oocyte production, nutritional priming should be considered for underconditioned does but not for overweight

animals. Furthermore, multiple superovulation regimes will decrease the number of ova collected.

Key Words: Superovulation, Nutrition, Goat

500 Effect of breed and progesterone priming on pregnancy rates in anestrous meat goats in response to the buck effect. L. Nuti*, S. Woldesenbet, and G. Newton, *Prairie View A&M University, Prairie View, Tx 77446*.

Our goal was to test the effects of male introduction, with and without progesterone (P_4) priming on pregnancy rates in three breeds of meat goats. Female Boer (B, n=35), Spanish(S, n=46) and Myotonic (M, n=57) goats were selected during seasonal anestrus(May/June). Half of the does of each breed were vaginally implanted with a P_4) controlled internal drug release(CIDR-G) device on May 7. After 12 days each doe received 1 ml(5 mg)of prostaglandin F2-alpha(Lutalyse). After 14 days all does were sorted by breed into one acre breeding traps. A buck was then introduced for 30 days. Ultrasound examination 30 days after buck removal revealed differences in pregnancy rates occurred between breeds. None (0/46) of the S, 21% (12/57) of the M and 40.6%(13/35) of the B breed became pregnant overall for all groups combined. CIDR-G treatment had little effect on pregnancy rate in the B breed (6/18, 33% vs 7/17, 41%) but a marked effect on the M breed(11/25, 44% vs 1/32, 3%). P_4 profiles before male introduction (blood samples taken on day of CIDR-G implant, day 9 post implant and on days 3,5,7 15 and 20 after implant removal) indicated that 40%(14/35) of B, 24%(11/46) of S and 24%(14/57) of M goats had P_4 levels greater than 1.0ng/ml serum, which is indicative of luteal activity. However, few of those with P_4 greater than 1.0 ng/ml serum became pregnant (B=2/14, S=0/11, M=4/14). P_4 profiles in each breed after male introduction indicated that some does (B=7, S=1, M=9) exhibited typical estrous P_4 patterns but did not become pregnant which may be indicative of silent heats or sires which had low libido.

Key Words: Goats, Male effect, Anestrus

501 Ovarian response and fertility in postpubertal does and hair sheep ewes to an induced estrus using either MGA feeding or progesterone sponges. S. Wildeus*[1], J. R. Collins[1], and D. H. Keisler[2], [1]*Virginia State University, Petersburg, VA,* [2]*University of Missouri, Columbia, MO*.

There are few commercial products available for estrus synchronization in small ruminants in the U.S. Melengestrol actetate (MGA), used for estrus suppression in feedlot heifers, has potential as an extra-label use product to induce and synchronize estrus in sheep and goats. This experiment evaluated the use of dietary MGA (0.5 mg/head/day) and two types of vaginal sponges (500 mg progesterone, P4; and 50 mg methylhydroxy progesterone acetate, MPA) in 30 postpubertal does and ewes to induce and synchronize estrus in May. Species were equally allocated to treatment groups and either group-fed once daily a MGA/corn/soybean meal supplement at 1.5% BW (n=14), or fitted with P4 (n=8) or MPA (n=8) sponges for 8 d. All animals received ad lib chopped hay, and sponge-treated animals received a corn/soybean meal supplement. At the end of treatment, all animals were injected (im) with 2.5 ml of PG-600 (200 IU eCG/100 IU hCG) and placed with a fertile, libido-tested male of the appropriate species fitted with a marking harness. Estrus was observed at 4-h intervals for 96 h. The incidence and rate of ovulation was determined after 4 d via laparoscopy, and pregnancy and fetal numbers were determined via transrectal ultrasound after 28 d. Data were analyzed using GLM and chi-squares procedures of SAS. MGA and sponge protocols did not significantly differ in estrus response (50 and 80%, respectively) and time to estrus (57.7 and 52.1 h, respectively), but pregnancy rate (7 and 44%, respectively) and ovulation rate (0.4 and 1.5, respectively) were lower ($P<0.05$) in MGA-treated animals. There were no differences in response between sheep and goats, and no differences between the two sponge types. Results suggest that MGA feeding can be used to induce estrus, but that efficacy was lower than was observed for vaginal sponge treatments.

Key Words: Melengestrol Acetate, Goats, Hair Sheep

502 Effect of fat supplementation of goats in different body condition and under increased photoperiod upon ovarian activity and preovulatory endocrine profiles. C. A. Meza H.*[1,3], M. E. Hernandez L.[1], J. G. Chavez-Perchez[2], H. Salinas[3], J. Urrutia M.[3], and M. Mellado[4], [1]*Universidad Autonoma Chapingo-URUZA,* [2]*Radiodiagnostico y Ultrasonografia,* [3]*INIFAP,* [4]*UAAAN*.

The effect of fat supplementation level (FSL) and body condition (BC) upon ovarian activity (OA) and the preovulatory serum profile of GH, LH and insulin (INS) in goats subjected to natural increases in photoperiod (March and April), was evaluated. The study was carried out in northern Mexico (25 NL, at 1,117 m). Goats, 14 months old, were classified as low body conditioned (LBC, n=10, 26.811.2 kg, BCS=3.0) or high BC (HBC, n=11, 33.81.2 kg, BCS=3.8), and received either no by-pass fat (NF) or Ca fatty acid salt (WF, 120 g hd d-1), equivalent to 0.768 Mcal NE, during a 42-d experimental period. Goats received a basal diet of alfalfa hay (2.0% BW, 14.6% CP), water, shade and mineral salts. Once synchronized (two PGF2a injections, 11 d apart), blood samples were collected during the late follicular phase of the second estrus at 15-min intervals for 6 h to quantify pulsatility (PULSE) and area under the curve (AUC) of GH and LH, as well as serum INS levels. The number of follicles (TF), corpus luteum (CL) and total ovarian activity (TF+CL=TOA) was scanned during the late luteal phase after blood sampling. No differences ocurred ($P>0.05$) for either FSL or BC with respect to TF (2.90.35) and CL (2.50.28). Average serum concentrations for LH, GH, and INS, were 3.460.55, 7.490.96 and 1.640.05 ng/mL, respectively. While GH-AUC (2791.2366.6), GH-PULSE (3.50.52), and LH-PULSE (3.70.7) did not differ ($P>0.05$) between BC and FSL, supplemented goats depicted the largest TOA (5.0 vs 6.00.28, $P=0.04$) with concomitant increases ($P=0.07$) in LH-AUC and INS. Fat-by pass supplementation of yearling goats with only 56% of adult weight during the anestrus season positively affected their metabolic status and the hypothalamic-hypophyseal-ovarian axis response.

Key Words: Goats, Energy, Ovarian activity

Production, Management, & the Environment Symposium: Impact of animal feeding operations on the environment

503 Overview of nitrogen in the environment. J. N. Galloway*, *University of Virginia*.

Nitrogen is essential for life but useable N is in short supply; thus ecosystem productivity is often limited by N availability. Historically, biological nitrogen fixation (BNF) was the primary process that converted unusable molecular diatomic nitrogen to useable reactive N (Nr). However, in the current world, human activities (Haber-Bosch process, cultivation-induced BNF and fossil fuel combustion) are now more important than natural BNF in creating Nr. In addition, since denitrification is not keeping pace with enhanced Nr creation, Nr is accumulating in the atmosphere, hydrosphere and biosphere. There are a large number of consequences on ecosystems and people that occur as enhanced Nr moves along its biogeochemical pathway. Referred to as the Nitrogen Cascade, the same nitrogen atom can cause sequential effects in the atmosphere, in terrestrial ecosystems, in freshwater systems, in marine systems, and on human health. This presentation will review the cycling of N in the natural environment, in contrast with the current environment, and will include projections for nitrogen cycling in the future. The Nitrogen Cascade will be used to illustrate the impacts of Nr on environmental systems. The presentation will address a challenge facing society–namely, while the consequences of Nr accumulation are severe, the introduction of Nr into agricultural systems is necessary to sustain food production. The challenge facing society is how to optimize nitrogen management in food (and energy) production while maintaining environmental quality.

Key Words: Nitrogen, Cascade, Fertilizer

504 Management to reduce nitrogen losses in animal production. C. Alan Rotz*[1], [1]*USDA / ARS*.

Reduction of N losses in animal production requires whole-farm management. Reduced loss from one component of the farm is easily negated in another component if all components are not properly managed. Animal excretion of N can be reduced by improving the balance of protein fed to that required by individual animals or animal groups or by improving production efficiency. Management to improve milk or meat production reduces the maintenance protein per unit of production, thus improving N utilization. Large losses of N occur on farms due to ammonia and nitrous oxide emissions to the atmosphere and nitrate leaching to ground water. Animal housing design and manure collection procedures influence the volatile loss in the housing structure. More frequent flushing or scraping of floors provides some reduction in loss, and experimental methods for separating feces and urine promise much greater reductions. Manure storage units are used to reduce application losses and improve the timing of nutrient application with crop needs. Maintaining a surface crust in storage tanks reduces volatile loss, and the use of covers or enclosed tanks can greatly reduce storage loss. Irrigation and surface spreading of manure without rapid incorporation often assures the loss of all remaining ammonia N. Rapid incorporation, band spreading, and shallow injection methods reduce this application loss, and deep injection into the soil essentially eliminates this loss. For grazing animals, the use of rotational grazing and half-day grazing practices can improve the distribution and utilization of manure nutrients. Reducing volatile losses between the animal and the soil can lead to greater leaching and denitrification losses if this additional N is not used appropriately. Use of a crop rotation that can efficiently recycle these nutrients and applying these nutrients near the time they are needed by the crop reduces the potential for further loss. Maintaining the proper number of animals per unit of land available for manure application is always critical for efficient recycling of nutrients with minimum loss to the environment.

Key Words: Nitrogen loss, Management, Farm system

505 Quantitative assessment of phosphorus transport to surface and groundwaters. J. L. Havlin*, *North Carolina State University, Raleigh, NC*.

National water quality survey data illustrate that increased eutrophication of fresh waters is related to increased P and N delivered from both non-point and point sources. As a result of increasing information and concerns regarding P delivery and water quality, the USDA-NRCS revised its nutrient management policy in May 1999 to reflect the potential contribution of P to water quality degradation. The policy requires each state to revise the Nutrient Management (590) standard in its Field Office Technical Guide. The revised standard must include an assessment of potential P loss from agricultural fields. As soil test P levels increase, through applications of animal waste and other P sources, the potential P delivery to surface and groundwater greatly increases. There are many interacting factors that influence P delivered from an agricultural field to surface or groundwater. These include the quantity and type of P applied, timing and method of application, soil type (soil chemical, physical, and biological properties), extent of soil erosion and sediment delivery, runoff and leaching potential, proximity to the water body, and other factors. We have developed a P Loss Assessment Tool (PLAT) that provides a means to assess the relative risk of P delivery to surface and groundwater. The PLAT is a "P index" method that was developed using the most current and relevant scientific data supporting P transport to surface and groundwaters. To quantify P delivered to surface and groundwater, PLAT includes four components or submodels: sediment bound or particulate P in surface runoff water, soluble P in surface water runoff, soluble P on leaching water, and P source contributions. The model also enables the user to evaluate how adoption of best management practices impact or reduce P loss. The quantitative estimates from each component are added to obtain an estimate of total P loss. These values are then assigned to categories of very high, high, medium, and low P loss. The presentation will discuss P loss pathways, technical components of PLAT, and an impact assessment of fields in North Carolina receiving animal waste.

Key Words: Water quality, Phosphorus

506 Animal management to reduce phosphorus losses to the environment. K. F. Knowlton*, *Virginia Polytechnic Institute and State University, Blacksburg, VA*.

Water quality in the United States is threatened by contamination with nutrients, primarily nitrogen and phosphorus. Animal manure can be a valuable resource for farmers, providing nutrients, improving soil structure, and increasing vegetative cover to reduce erosion potential. At the same time, application of manure nutrients in excess of crop requirements can result in environmental contamination. Environmental concerns with phosphorus are primarily associated with pollution of surface water (streams, lakes, rivers). This pollution may be caused by runoff of phosphorus when application to land is in excess of crop requirements. Increased specialization and concentration of livestock and crop production has led to the net export of nutrients from major crop producing areas of the country to areas with a high concentration of animal agriculture. Concentrated animal agriculture has been identified as a significant source of phosphorus contamination of surface water. Livestock utilize phosphorus inefficiently, excreting 60 to 80% of that consumed. The majority of phosphorus brought on to the farm in feed is land-applied in manure rather than being exported in meat or milk, and thus may runoff. Areas facing the dilemma of an economically important livestock industry concentrated in an environmentally sensitive area have few options. If agricultural practices continue as they have in the past, continued damage to water resources and a loss of fishing and recreational activity are almost inevitable. If agricultural productivity is reduced, however, the maintenance of a stable farm economy, a viable rural economy, and a reliable domestic food supply are seriously threatened. In this paper, animal management practices that reduce phosphorus losses from farms without impairing profitability will be reviewed.

Key Words: Phosphorus, Livestock management

507 Water quality and the grazing animal. R. K. Hubbard*[1], G. L. Newton[2], and G. M. Hill[2], [1]*USDA-ARS, Tifton, GA*, [2]*University of Georgia, Tifton, GA*.

Grazing animals and pasture production impact water quality both through urine and feces dropped by the animals and through fertility practices associated with production of high quality pasture. The two nutrients of primary concern relating to animal production are nitrogen (N) and phosphorus (P). Nitrogen is of concern because high concentrations in drinking water in the nitrate form cause methemoglobinemia (blue baby disease) while other forms of N (primarily nitrite) are considered to be potentially carcinogenic. Phosphorus in the orthophosphate form is of concern because it causes eutrophication of surface water bodies. The impact of grazing animals on soil and water quality is best evaluated at the watershed scale. Such evaluation must include both direct input of animal wastes from the grazing animal and also applications of inorganic fertilizers to produce quality pastures. Watershed scale studies have primarily used the approach of nutrient loadings per land area and nutrient removals as livestock harvests. A number of studies have measured nutrient loads in surface runoff from grazed land and compared loads with other land uses. Concentrations in discharge have been regressed against standard grazing animal units per land area. Watersheds with concentrated livestock populations have been shown to discharge 5 to 10 times more nutrients than watersheds with other land uses. Another major concern with animal production including grazing animals is pathogens, which may move from the wastes into surface water bodies. Major surface water quality problems associated with pathogens have been associated with grazing animals, particularly when they are not fenced out from the streams and farm ponds. This paper presents an overview of water quality findings and concerns relating to grazing animals.

Key Words: Nutrients, Pathogens, Surface runoff

508 Governmental policies and measures regulating agricultural nitrogen and phosphorus in the European Union. O. Oenema*, *Wageningen University and Research Center, Wageningen, The Netherlands*.

This paper discusses governmental policies and environmental regulations that influence nitrogen and phosphorus in animal manure and fertilizers in the European Union (EU-15). It starts with an introduction of changes in governmental policies during the last century. Secondly, it summarizes the basics of environmental policies and measures,

then summarizes the main characteristics of agriculture in the EU-15. Thirdly, it provides an overview of the common agricultural policy CAP in the EU and of environmental regulations and directives. Finally, it discusses implementation of the EU Nitrate Directive in the Netherlands and Denmark. Systematic interference of governments with European agriculture started in the 19th century. Marked effects of policies on agriculture followed after the foundation of the EU with its CAP. Environmental issues in agriculture were addressed following the reform of the CAP in 1992 and following the implementation of various environmental regulations and directives from the 1980's and 1990's onwards. The EU Nitrate Directive has as yet the strongest influence on N and P in agriculture, especially through its objectives to designate areas vulnerable to nitrate leaching, to establish action programs and to establish a code of good agricultural practice. These measures must ensure that, for each farm, the amount of N applied via livestock manure shall not exceed 170 kg per ha per year. The Nitrate Directive was agreed to by all member states in 1991, but there are variations between member states in the interpretation, implementation and enforcement of the Nitrate Directive. Differences in the progress of implementation appear in part to be related to differences in the structure of agriculture, as shown by a comparison between Denmark and The Netherlands.

Key Words: Nitrogen, Nitrate, Europe

Breeding & Genetics: Dairy cattle breeding for nonproduction traits

509 Selection for mastitis in Norwegian dairy cattle. A. Karlsen*[1], B. Heringstad[2], E. Sehested[1], and M. Svendsen[1], [1]*GENO Breeding and A.I. Association,* [2]*Department of Animal Science, Agricultural University of Norway.*

Clinical mastitis (CM) is the most frequent and costly disease in dairy production. Mastitis has been recorded through the health card system as an integrated part of the Norwegian Dairy Herd Recording System (NDHRS) since 1978, and includes recording of all veterinary treatments on individual cows. In 2002, 96% of the cows belonged to herds in the NDHRS. In Norway, antibiotics can only be prescribed by veterinarians, and it is compulsory to record diagnosis and treatment on the cow's health card. Information is then transferred to the NDHRS on routine basis. Mastitis has been included in the total merit index of Norwegian Dairy Cattle (NRF) since 1978, and the relative weight in the total merit index is currently 22%. In 2002, progeny testing for mastitis was based on an average of 210 daughters. Since 1990 there has been a favourable genetic trend for mastitis resistance. In 2002 the phenotypic average of CM (from 15 days prior to calving to120 days after first calving) was 11.5%. Results from a Norwegian selection experiment, including one group of cows selected for high protein yield (HPY) and one group selected for low clinical mastitis (LCM), clearly demonstrates the effect of direct and indirect selection on CM. After 3 cow-generations the genetic difference between LCM and HPY cows was 8.6 % CM. The genetic trend for the LCM cows, equivalent to a reduction of 0.9 % CM per year, shows that considerable selection response can be achieved for mastitis if sufficient selection pressure is put on the trait. If mastitis is ignored in the breeding program, selection for increased milk production will result in an unfavourable correlated response in CM. Results from the selection experiment indicate that an increase of 0.23 % CM per year may be expected as a correlated response. Genetic trends for the NRF population shows that with a broad breeding objective it is possible to obtain genetic improvement for health, fertility, and milk production simultaneously, despite unfavourable genetic correlations and low heritabilities for some of the traits.

Key Words: Mastitis resistance, Selection, Norwegian dairy cattle

510 Associations of lactoferrin concentrations in milk with indicators of mastitis in dairy cows. A. A. Martin*, M. A. Faust, L. J. Rowe, and E. J. Lonergan, *Iowa State University, Ames 50011.*

Objectives were to determine levels of lactoferrin in milk and associations of lactoferrin with mastitis indicators. Milk samples were collected from 180 Holstein cows in the Iowa State University genetic research herd. For each cow, one 60 ml aliquot was evaluated for milk constituents by a commercial milk testing laboratory, and one 5 ml aliquot was frozen immediately for subsequent analysis for lactoferrin. Lactoferrin in milk was quantified by sandwich ELISA (Bethyl Laboratories, TX). A standard curve ranging from 7.8 - 500 ng/ml lactoferrin was used on each plate. Milk samples were diluted at 1:2000 (milk:diluent) in 10% Tween 20, 1% BSA, 50 mM Tris pH 8.0. Detection antibodies were conjugated with horseradish peroxidase. The substrate, 3,3',5,5'-tetramethyl-benzidine, was used to detect the bound detection antibodies. Samples were read in a microtiter plate at a wavelength of 450 nm. Detailed mastitis treatment records for 2002 were acquired and used to determine incidence of mastitis, number of days treated, and mastitis severity for individual cows. Projected mature equivalent fat corrected milk (FCM) and lactation average somatic cell score (SCS) were obtained from Dairy Herd Improvement records. Means for mastitis incidence, days treated, and lactation average SCS were .94, 19.3, and 3.2, respectively. Several chronic cows skewed results for days treated consequently this variable was transformed using the natural log function. Mean lactoferrin was .336 mg/ml (SD = .222 mg/ml). Highest FCM was associated with lowest concentration of lactoferrin in milk. Lactoferrin levels were lowest for youngest cows ($P < .01$). Stage of lactation was not important for lactoferrin concentration when cows with 10 or fewer days in milk were eliminated from the analysis. Correlations of mastitis indicators with lactoferrin and SCS measures were similar and indicated that highest days treated was associated with highest lactoferrin and highest SCS ($P < .05$). Correlation of lactoferrin and lactation average SCS was .36. In this small data set, heritability for lactoferrin was considerably higher than estimates for SCS related measures. Lactoferrin may be useful for genetic selection to control increases in mastitis that accompany selection for high yields.

Key Words: Lactoferrin, Mastitis, Somatic cell score

511 Measure of the impact of somatic cell count on longevity of Holstein and Jersey cows using survival analysis. D. Z. Caraviello*, K. A. Weigel, G. Shook, and P. Ruegg, *University of Wisconsin - Madison.*

Survival analysis through a Weibull proportional hazards model was applied to evaluate the effect of somatic cell count (SCC) on survival of 1,892,919 Holstein and 250,835 Jersey cows with first calving from 1990 to 2000 in the United States. Herds were divided in 5 levels for Holsteins (2 replicates per level) and 3 levels for Jerseys by average somatic cell count. Survival was defined as days from first calving until culling or censoring corrected for 305-d mature equivalent milk production. Our model included time-dependent effects of herd-year-season, parity-stage of lactation and within-herd-year quintiles for mature equivalent milk production, as well as the time-independent effect of age at first calving. Different rho and gamma parameters for the Weibull distribution were estimated for each of the herd levels. SCC was divided into 15 classes and its impact on functional survival, after accounting for all other factors listed above, was evaluated. Survival analysis methodology allowed a nonlinear relationship between SCC and longevity. Average censoring and failure time decreased as average SCC level of the herd increased. Results showed differences between levels of herds in the risk of culling; cows in the high SCC class had 3.4, 2.7, and 2.3 for Holsteins and 4.0, 2.9 and 2.2 for Jerseys times higher risk of being culled than cows in the average SCC class in herds with low, medium and high average SCC, respectively. This suggests stricter culling for SCC in herds with low average SCC. Cows in the lowest class for SCC also showed higher risk of culling than cows in the average SCC class, particularly in herds with high average SCC.

Key Words: Survival analysis, Somatic cell count, Longevity

512 Effect of synchronization protocols on genetic parameters of reproductive traits in dairy cattle. R. C. Goodling*[1], G. E. Shook[1], K. A. Weigel[1], N. R. Zwald[1], and R. D. Welper[2], [1]*University of Wisconsin-Madison,* [2]*Alta Genetics, Inc.*

Genetic evaluation for female reproduction is one strategy for improving performance. Many producers utilize synchronization of ovulation or estrus to manage reproduction. Our objective was to examine the effects of synchronization protocols on parameter estimates of days to first breeding (DFB). Data were collected from producers participating in an AI progeny testing program, and utilizing DC305 herd management software to record reproductive treatments and events. Analysis was performed on 13,134 records from 42 herds. Data were split into

three subsets: all first breedings (ALL), non-synchronized first breedings (NSYN), and synchronized first breedings (SYN). DFB was truncated to range from 25 to 300 d, with overall mean 73.9 d and SD of 26.9 d. NSYN data consisted of 7760 records with mean 73.0 d and SD 31.1 d. SYN data consisted of 5374 records with mean 75.2 d and SD 19.3 d. Only the earliest parity for each cow was included. Both animal and sire models were used to estimate genetic parameters. Fixed effects for both models were herd-year-season, parity, and calving age. Random effects were animal or sire. SYN was included as a fixed effect in the models of ALL. Variances were calculated using the REMLF90 program of Misztal. Heritabilities may be higher in SYN than in NSYN, ranging from 0.024 to 0.080 (Table 1). Variances were substantially lower in SYN records (Table 1). The SYN and NSYN data should be analyzed as different traits, or may be combined with an adjustment for heterogeneous variances.

	Sire model				Animal model		
	Sire var.	Residual var.	Herit-ability	—	Animal var.	Residual. var.	Herit-ability
ALL	4.914	469.1	0.041	—	30.95	442.5	0.065
NSYN	3.729	624.4	0.024	—	33.52	593.8	0.053
SYN	2.218	181.9	0.048	—	14.82	169.3	0.080

Key Words: Days to first breeding, Heritability, Synchronization

513 The effect of using body condition score and dairy character as indicators for genetic resistance to diseases in Danish Holstein. J. Lassen*[1,3], M. Hansen[1], M. K. Sorensen[1], G. P. Aamand[2], L. G. Christensen[3], and P. Madsen[1], [1]*Danish Institute of Agricultural Sciences, Denmark.*, [2]*The Danish Agricultural Advisory Centre, Denmark.*, [3]*The Royal Veterinary and Agricultural University, Denmark.*.

The aim of this study was to investigate the genetic relationship between body condition score (BCS), dairy character (DC), mastitis and other diseases than mastitis in first parity Danish Holsteins in order to explore the possibilities for using BCS and DC for indirect selection for disease resistance. The data set included 30,470 records on conformation scores and 366,286 on diseases. Mastitis was defined in the period from #10 to 50 days from calving (MS50) and other diseases were defined in the period #10 to 100 days from calving (OD100). Both traits were bivariate. These definitions are adapted from the current Danish evaluation system. A multivariate linear sire model was fitted and (co)variances were estimated using REML. The fixed effects were herd-year-season and age in months at calving for all traits. In addition fixed effects of classifier and regression on days in milk at classification was included for BCS and DC. The accuracy of an index for disease resistance with direct (OD100) and indirect (BCS and DC) information sources with different size of progeny group was estimated. By including DC as an indicator for diseases, the accuracy of the index for diseases increased especially when the progeny group was small and even when direct information on diseases was included. Using BCS as an additional indicator of diseases did not increase the accuracy. Breeding for cows with less DC is a way to achieve a cow genetically more resistant to diseases.

Trait	BCS	DC	OD100	MS50
BCS	0.25 (0.027)	-0.37 (0.01)	-0.05 (0.002)	0.008 (0.007)
DC	-0.60 (0.06)	0.22 (0.025)	0.03 (0.007)	0.010 (0.007)
OD100	-0.21 (0.10)	0.44 (0.09)	0.022 (0.004)	0.011 (0.007)
MS50	-0.15 (0.09)	0.22 (0.09)	0.31 (0.07)	0.036 (0.004)

Heritabilities (diagonal), genetic (below diagonal) and residual (above diagonal) correlations.

Key Words: Body condition score, Dairy character, Disease resistance

514 Comparison of First-Parity Holstein, Holstein-Jersey crossbred, and Holstein-Normande crossbred cows for dystocia and stillbirths. B. J. Heins*, L. B. Hansen, and A. J. Seykora, *University of Minnesota, St. Paul*.

First-parity Holstein, Holstein-Jersey crossbred, and Holstein-Normande crossbred cows calving from June 2001 to December 2002 were compared for dystocia and stillbirths from six California herds. Dystocia scores ranging from 1 (no assistance) to 5 (hard pull) and stillbirths (1 for alive and 0 for dead) were recorded for 1268 Holstein cows, 243 Holstein-Jersey cows, and 66 Holstein-Normande cows. Cows were bred to Brown Swiss, Holstein, Jersey, Montbeliarde, Normande, and Scandinavian Red sires. Investigated were effects of calf sex, breed composition of cow, age at calving, breed of service sire, sire of calf within breed composition, and herd. For dystocia, sex of calf, and herd were significantly different (P<.01). The least squares mean for calf sex were 1.71 for males and 1.35 for females. Breed composition of dam did not differ significantly, however, there was a tendency for less calving complications for the crossbred cows compared to Holsteins. Mean scores were 1.59 (H) 1.46 (HxJ), and 1.54 (HxN). Brown Swiss sired calves (1.64) differed significantly (P<.05) from Jersey sires (1.32), and Brown Swiss sires differed (P<.02) from Holstein (1.67) sires. For stillbirths, calf sex, age at calving, and breed of sire were significantly different (P<.01). Male calves (14%) had higher stillbirths than females (3%). Holstein sires had the highest rate of stillbirths (15%), and rates for the other breeds of sires were 8% for Brown Swiss, 8% for Jersey, 12% for Montbeliarde, 4% for Normande, and 6% for Scandinavian Red sires. Holstein sires differed significantly from Normande (P<.05) and Scandinavian Red (P<.01) sires. Montbeliarde differed significantly (P<.05) from Scandinavian Red sires. Although not significantly different, Holstein cows had 12% stillbirths, Holstein-Jersey cows had 9% stillbirths, and Holstein-Normande cows had 6% stillbirths.

Key Words: Crossbreeding, Dystocia, Stillbirths

515 Effect of mating Holstein females to Holstein versus Jersey AI sires on fertility, dystocia, calf weight, and retained placenta. B. J. Heins, A. J. Seykora*, L. B. Hansen, J. G Linn, D. G. Johnson, and W. P. Hansen, *University of Minnesota, St. Paul*.

First services from AI were recorded on 270 Holstein cows and on 181 Holstein heifers. One half of cows and heifers were mated to Holstein AI sires and the other half were bred to Jersey AI sires. Cows and heifers were randomly assigned to either a Holstein or Jersey service sire, except coefficients of inbreeding were not allowed to surpass 6.25% for mating of Holstein sires to Holstein females. First service conception rates did not differ by breed of service sire for lactating cows. For virgin heifers, Holstein sires had significantly higher first service conception rates than Jersey sires (P<.01). From September 2001 to January 2003, 135 Holstein and 152 Holstein-Jersey crossbred calves were born at the University of Minnesota research herds at the St. Paul campus and at the West Central Research and Outreach Center, Morris. Dystocia was scored with a range of 1 (no assistance) to 5 (hard pull). Mean dystocia score was 1.65. Independent variables for analysis were herd, parity (1st versus 2nd and later), sex of calf, and breed of sire. Differences between Holstein and Jersey sires were significant for dystocia score, calf weight, and retained placenta (P<.05). Least squares means for Holstein and Jersey sires, respectively, were dystocia score, 1.94 versus 1.32; calf weight, 43.5 kg versus 35.6 kg; and retained placenta, 6.5% versus 1.0%. Stillbirth rate was 8.6% for Holstein sires and 6.7% for Jersey sires, but not significantly different (P>.05).

Key Words: Crossbreeding, Dystocia, Fertility

516 Genetic correlation estimates among body condition score, dairy form, days open and production traits for US Holsteins. C. D. Dechow*[1], G. W. Rogers[1], T. J. Lawlor[2], L. Klei[2], and P. M. VanRaden[3], [1]*University of Tennessee*, [2]*Holstein Association USA Inc.*, [3]*Animal Improvement Programs Laboratory*.

The objectives of this study were to estimate genetic correlations among body condition score (BCS), dairy form (DF), days open (DO), ME milk, ME fat and ME protein production. Body condition score and DF obtained from the Holstein Association USA Inc. were merged with DO and production data from the Animal Improvement Programs Laboratory at USDA. Edits applied to the data included: a valid BCS observation, a minimum of 20 daughters per sire, a minimum of 10 cows per herd-classification visit (HV) or herd-year-season of calving (HYS), age between 24 and 60 months at classification, less than 336 days in milk (DIM) at classification and minimums of 25 days open and 4,537 kg of ME milk. Only one record per cow was used and DO greater than 250 were set to 250. The final data set included 166,222 records. Fixed effects were age within lactation group, 5th order polynomials of DIM and HV for BCS and DF, age within lactation group and HYS for production traits and lactation number and HYS for DO. Random sire and error were included for all traits and all analyses were performed with AS-REML. Heritability estimates ranged from 0.04 for DO to 0.30 for ME protein. The genetic correlation estimate between BCS and DO was

-0.33. The genetic correlation estimate between DF and DO was 0.51. The genetic correlation estimate between BCS and DO was -0.10 when DF was included as a covariable and the genetic correlation estimate between DF and DO was 0.49 when BCS was included as a covariable. Genetic correlation estimates among BCS and production traits ranged from -0.20 to -0.30, whereas genetic correlation estimates among DF and production traits ranged from 0.41 to 0.52. These genetic correlations can be used to help develop appropriate weights for an index that includes days open evaluations. Using dairy form evaluations as an indicator trait would increase the accuracy of days open evaluations for newly proven bulls.

Key Words: Body condition score, Dairy form, Days open

517 Seasonality of days open in US Holsteins. S. Oseni and I. Misztal, *University of Georgia, Athens, GA, USA*.

The objectives of this study were to establish a pattern for the seasonality of Days Open (DO) by state and region within the US and to present statistics on regional trends for DO. Data included 6,871,265 records from 1998 to 2001. Fixed effects in the model included region, herd, year and month of calving (MOC), parity, milk-class, region*MOC, herd*MOC, year of Calving*MOC and parity*MOC. Results showed that DO were longest for March/April and shortest for September/October calvings for all regions, years and parities. Regional mean DO were 156 (Southeast), 145 (Midwest), 142 (Northeast), 143 (Northwest), and 140 (Southwest). Mean DO by state ranged from 135 (AZ) to 161 (FL). States with DO > 150 included: KY, OK, TX, and most parts of the Southeast. Monthly variations by state ranged from 7 (OR) to 64 (AR, MS). States with monthly variations > 40 d were AZ, MO, AR, OK, TX, GA, SC, NC, MS, AR, TN, AL and LA. Regularity of calving was computed as the ratio of calvings in months with the least and most calvings. Regularity varied from 0.16 (LA) to 0.88 (MA). It was below 0.4 for AZ, TX, OK and all of Southeast. Exceptions in the general patterns were FL, where regularity was higher and variations of DO were lower than in adjacent states, and in CA, where, despite hot weather, regularity was high and variations were low. Studies on the effect of heat stress on days open in the Southeast are limited by the small number of cows compared to other regions and by low fraction of cows bred during the peak of heat stress. Therefore, such studies could use data from all regions associated with hot weather including lower Midwest and parts of Southwest.

Key Words: Days open, Seasonality, Month of calving

518 A new genetic evaluation for calving ease in the Italian Holstein. F. Canavesi*[1], S. Biffani, and A. B. Samoré, [1]*ANAFI*.

The first genetic evaluation for calving ease was published around 1992. Data collected by milk recording agencies define calving difficulty based on 5 classes: A for easy calvings, B for calvings that required the assistance of one person, C for caesarean birth, D for difficult calving and E for embriotomy. These data were linear transformed on a scale from 0 to 100. Breeding Values were calculated using a sire model that included the environmental effects of herd-year and age-sex-month of calving. The new evaluation is based on the same data, edited for a higher standard of quality. The model used is a threshold model analysing three classes of difficulty: A, B and C and over. Environmental fixed effects in the model are: year-month, province-year, sex-parity-age. Herd year is an environmental random effect. Heterogeneity of variance is considered in the model for sex, province and year. Genetic random effects in the model are sire and maternal grand sire. Heritability estimates are 0.07 for direct sire effect and 0.027 for the maternal effect. Genetic correlations were 0.20 and -0.53 for sire-maternal grand sire and direct-maternal respectively. Correlation with breeding values computed using the old linear model were around 0.83 mainly due to data editing. The new model will be used for the official genetic evaluation before the end of year 2003.

Key Words: Genetic evaluation, Calving difficulty, Threshold model

519 Characteristics of genetic evaluations for daughter fertility in relation to other fitness traits. H. D. Norman*, J. R. Wright, P. M. VanRaden, and M. T. Kuhn, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD*.

Considerable attention is being focused on cow fertility because of the initiation of genetic evaluations for daughter pregnancy rate (DPR) in February 2003. In order for a new trait to be accepted, the industry needs to understand its characteristics. Properties of DPR evaluations were compared with those of evaluations for other fitness traits introduced during the last decade. For cows born during 1988, 1993, and 1998, predicted transmitting abilities (PTA) for DPR averaged 0.9, 0.5, and 0.4%, respectively, which reflected a negative genetic trend. Cow PTA for somatic cell score (SCS) also had a small unfavorable trend, but cow PTA for productive life (PL) has been improving. Mean reliability (REL) for cow PTA DPR is nearly as high as REL of PTA for PL and SCS even though based on a lower heritability (0.04 for DPR compared with 0.085 for PL and 0.10 for SCS), partly because of additional observations on fertility in later lactations or because of its lower repeatability. For 1988, 1993, and 1998 birth years, cow REL DPR was 32, 32, and 30%, respectively, compared with REL PL of 33, 32, and 31% and REL SCS of 32, 35, and 34%. For artificial-insemination (AI) bulls born during 1984 through 1988 (n = 6037), 1989 through 1993 (n = 7247), and 1994 through 1998 (n = 5425), PTA DPR averaged 0.1, 0.0, and −0.2%, respectively. Similar to cow PTA, bull PTA SCS showed a small unfavorable trend (3.11, 3.11, and 3.13), whereas PTA PL have been improving (−0.47, 0.01, and 0.14 mo). Mean bull REL DPR were 67, 67, and 59%, respectively; mean REL PL were 67, 67, and 61%, and mean REL SCS were 68, 73, and 69%. Effects of birth year and AI sampling organization on bull PTA DPR was examined. Birth year accounted for 2.6% of variation in DPR; AI sampling organization accounted for additional 0.3%. Those same effects accounted for 5.8 and 0.1%, respectively, of PL variation and for 1.1 and 0.4% of SCS variation. For bulls in active AI service, no differences were found between AI sampling organizations for DPR, although an effect was found for PL and SCS. Based on REL alone, reservations about using PTA DPR in selection programs because of its limited accuracy appear to be unwarranted.

Key Words: Daughter pregnancy rate, Productive life, Somatic cell score

520 Definition of traits and comparison of models for genetic evaluation of cow fertility. P. M. VanRaden* and M. E. Tooker, *Animal Improvement Programs Laboratory, Animal Research Service, USDA, Beltsville, MD*.

Cow fertility and longevity traits often have distributions similar to coin tosses that are repeated if tails are observed. Methods to evaluate repeated binomial observations were compared by simulation. Dependent variables included 21-d pregnancy rate, length of time to achieve pregnancy, and log of length of time. Pregnancy rate and average number of 21-d opportunities required to achieve pregnancy are reciprocals, but the product-moment (linear) correlation of true transmitting abilities was −0.987 rather than −1.00 because of curvature. An evaluation of pregnancy rate in which lactations received more weight if the cow required more cycles to become pregnant was preferred slightly to an unweighted evaluation but was not more accurate than evaluation of days open. Of the several models of analysis compared in simulation, none had an accuracy advantage of >1% over the others. With actual days-open data, heritability decreased from 4.1 to 3.0% when the upper limit on days open was increased from 150 to 305 d, probably because heritability of days to first breeding is higher (6.6%). The economic benefits of very early pregnancy are not as great as the costs of delayed pregnancy. Thus, breeding dates up to 250 d (rather than 150 d) are used routinely so that the more severe fertility problems are identified. As compared with days open or calving interval, pregnancy rate can be computed sooner, cows that do not become pregnant are included more easily, and larger rather than smaller values are desirable. Pregnancy rate can be obtained from days open using a nonlinear formula, pregnancy rate = 21/(days open – voluntary waiting period + 11), or by a linear approximation, pregnancy rate = 0.25(233 – days open), obtained from the derivative of the nonlinear formula evaluated at the mean. Voluntary waiting period is the initial phase of lactation during which no inseminations occur (assumed to be 60 d) and the factor of +11 adjusts to the middle day of the 21-d cycle. With either formula, 154 days open

converts to a pregnancy rate of 20% and 133 days open to a pregnancy rate of 25%.

Key Words: Genetic evaluation, Cow fertiltity, Pregnancy rate

521 Quality of data included in genetic evaluations for daughter pregnancy rate. P. M. VanRaden, M. E. Tooker*, A. H. Sanders, and G. R. Wiggans, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD*.

National genetic evaluations of daughter pregnancy rate are based on data from 40 million lactation records of 16 million cows that calved since 1960. Up to five lactations are included per cow. Date pregnant is determined from several data sources. The most accurate information is last insemination date verified by birth date of next calf within 15 d of expected birth date. For lactations with no reported inseminations, date pregnant is obtained by subtracting mean gestation length (280 d for Holsteins) from next calving date. For lactations without next calving date, date pregnant is assumed to be the last insemination date unless the cow was subsequently examined and verified not pregnant, or was still milking in the same lactation more than 295 d after the last insemination. Last reported breeding date is used if the next lactation is initiated by abortion. A final data source is an owner report that the cow was sold because of infertility. Such cows are assumed to be nonpregnant and the last insemination date is disregarded. Records for pregnancy rate are considered to be complete at 250 d in milk (DIM), and pregnancy status after 250 DIM is not used. Date pregnant is set equal to 50 DIM for cows that become pregnant before 50 DIM. Some early pregnancy dates calculated from next calving date are inaccurate because of short gestations or unreported abortions. Therefore, lower and upper limits of 50 and 250 DIM, respectively, were applied after adjusting days open for season effects; 5 and 14% of records were affected. For Holstein calvings during 1998 and 1999, 57% had breeding date verified by calving date; 6% had next calf born with no previously reported breeding date; 5% had breeding date inconsistent with birth date of next calf; and 5% had the cow reported as sold for reproductive reasons. Although 19% of reported final breeding dates could not be verified because the cow was sold for reasons other than fertility, comparisons with birth date indicate that most farms report accurate breeding dates.

Key Words: Genetic evaluation, Fertility, Pregnancy rate

522 Use of early lactation days open records for genetic evaluation of cow fertility. M. T. Kuhn* and P. M. VanRaden, *Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD*.

National genetic evaluation for female fertility was implemented in February 2003. The evaluations are reported as daughter pregnancy rate. Pregnancy rate is calculated from days open (**DO**) as (233 – DO)/4. Currently, records must have a minimum of 250 days in milk (**DIM**) to be included for genetic evaluation. Furthermore, DO is set to 250 for records that go beyond that upper limit. This research examined the possibility of using DO records prior to 250 DIM by predicting unknown records. The prediction model included the fixed effects of lactation and calving ease and linear regressions on age at calving, average of first three test day milk yields, previous DO, previous number of services, and days to first breeding. Quadratic effects of age and milk yield were also included. To assess the utility of the predictions, 10 DO groups were formed by defining the first group as 70 days or less and subsequent groups in 20 day increments. The final group was defined as $\geq$ 250-d. Each record was included in each group. Within group, y-hat was defined as actual DO if actual DO was $\leq$ the upper limit for that group or projected DO otherwise. Bias, standard deviation of prediction errors, and phenotypic correlations between y-hat and actual DO were calculated for each group. Genetic correlations were estimated for the groups with 90, 130, and 170 day upper limits. Bias ranged from 30 d (70-d group) to 0 d and was close to 0 d starting with the 110-d group. Standard deviation of prediction errors ranged from 49 d to 14 d. Phenotypic correlations increased from .41 (70-d) to .98 (250-d). Estimates of genetic correlations were 1 in all 3 groups examined. These results suggest that DO records can be utilized prior to the current 250-d requirement. Projected records require a weight less than one in genetic evaluation. Weights can be determined from correlations between actual and predicted records. Pregnancy confirmation code, now being collected, will also contribute to determination of weights.

Key Words: Genetic evaluation, Cow fertility, Prediction

Food Safety: On farm food safety: Assessment of costs, tools and management

523 Economic assessment of food safety in the dairy chain. N. Valeeva*, M. Meuwissen, and R. Huirne, *Wageningen University, Wageningen, the Netherlands*.

As a result of the increased demand for food safety, a number of quality assurance regulations have been introduced all over the world. However, little is known about the costs and efficiency of implementing such regulations, especially with regard to the entire chain. The objective of this research was to develop a mathematical programming model to identify measures for increasing the level of food safety in the dairy production chain in a cost-effective manner. The chain included compound feed production and its transport, the dairy farm itself, transport of raw milk, processing, delivery of (pasteurized) milk, and the retailer and catering sectors. The model focused on two main groups of hazards: microbial (*Salmonella, E. coli, M. paratuberculosis* and *S. aureus*) and chemical (antibiotics and dioxin). In collecting input data for the model, special attention was given to the costs of the various measures and the effectiveness of these measures in increasing the food safety level. Costs included implementation and maintenance of these measures (including interest and depreciation costs). Effectiveness was measured by adaptive conjoint analysis as the relative contribution of each measure to the food safety level. An electronic questionnaire was completed by 67 experts from industry, research, extension and farming who evaluated the measures in four steps. Linear regression analysis was then performed to determine the relative contribution (i.e. so-called utility level) of each measure. Respondents were consistent (R-squared $>$ 0.8) with respect to their individual responses. Relative contributions and cost estimates were used in the mathematical model to determine the optimal set of measures for various food safety levels. Results showed that the dairy farm (42%) and dairy processing (24%) stages are most important for reducing microbial hazards. In contrast, the compound feed (43%) and dairy farm (39%) stages are most important for reducing chemical hazards. Overall, an increase in the higher levels of food safety was associated with a steep non-linear increase in costs.

Key Words: Food safety, Dairy chain, Economics

524 Bactericidal efficacy of quaternary ammonium compounds against species of bacteria isolated from feces of dairy cattle. A. A. Sawant*, N. V. Hegde, S. C. Donaldson, K. B. Buck, and B. M. Jayarao, *Pennsylvania State University, University Park, PA*.

Quaternary ammonium compounds (QAC) are widely used as disinfectants in dairy, meat-packing, and food processing industry. QACs have been shown to be more effective against gram-positive than gram-negative bacteria. In a dairy setting, gram-negative organisms are the major microflora in the environment. There is very little information on the MIC_{90}values of gram-negative bacteria of dairy origin to QACs. A study was conducted to assess the susceptibility of gram-negative bacteria isolated from feces of lactating cattle to QACs. Gram-negative bacteria including *Escherichia coli* (n=186), *Citrobacter koseri* (n=14), *Enterobacter aerogenes* (n=3), *Klebsiella oxytoca* (n=3), and *Pseudomonas* spp. (n=6) were examined for their susceptibility to cetyltrimethylammonium bromide (CTAB), benzalkonium chloride (BKC), and benzyldimethylhexadecyl ammonium chloride (BDAC). The MIC_{90} modal values for *E. coli* were 60μg/ml for BKC (range 30 - $>$80), 60μg/ml for CTAB (range 50-700), and 400μg/ml for BDAC (range 100 - $>$800). *Pseudomonas* spp. showed high MIC_{90} values for BKC ($\geq$80μg/ml), CTAB ($\geq$700μg/ml), and BDAC ($\geq$700μg/ml). *Citrobacter koseri*, *E. aerogenes*, and *K. oxytoca* showed MIC_{90} $\geq$30μg/ml for BKC, $\geq$300μg/ml for CTAB, and $\geq$600μg/ml for BDAC, respectively. The presence of *qacE* gene in *E. coli* was detected in 80 of 186 (43%) of the *E. coli* isolates. The *qacE* gene was also detected in other species except *E. aerogenes*. Results of the study suggested that: (1)

there was no correlation between the high MIC_{90} values and the presence of the *qacE* gene, and (2) the MIC_{90} values varied considerably within and between species of gram-negative bacteria.

Key Words: Quaternary ammonium compounds, Gram negative bacteria, Dairy cattle

525 Antimicrobial effect of alpha-linolenic acid against *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *Salmonella* spp. in ground beef from finishing cattle fed flaxseed. M. A. Greenquist*, J. S. Drouillard, R. K. Phebus, L. J. Franken, B. E. Depenbusch, E. J. Good, C. M. Gordon, S. P. Montgomery, and J. J. Sindt, *Kansas State University, Manhattan, KS*.

The antimicrobial effect of long-chain fatty acids in culture medium is known to reduce some pathogenic microorganisms by inhibiting membrane transport systems. Feeding flaxseed to finishing cattle increases the alpha-linolenic acid (18:3n3) composition of adipose and muscle tissues. We conducted an experiment to determine if feeding flaxseed to enrich carcass tissues with alpha-linolenic acid could be used to inhibit growth of pathogenic organisms in ground beef. Individually fed steers (n=70; 338 kg initial BW) were fed steam-flaked corn-based diets containing (DM basis) 0, 5, 10, or 15% ground flaxseed with or without the addition of 220 IU/kg DM of vitamin E for 120 d. Three 10-g composites of 80% lean ground beef were obtained from each carcass and separately inoculated (3.0 log colony forming units/gram of meat) with a five-stain mixture of *Escherichia coli* O157:H7, *Listeria monocytogenes*, or *Salmonella* spp. Each pathogen was enumerated on d 0, 3, and 10. No interactions were detected among flax and vitamin E treatments ($P>0.75$). The addition of flaxseed to finishing diets did not affect the antimicrobial activity in ground beef against *E. coli* O157:H7 ($P=0.14$), *L. monocytogenes* ($P=0.24$), or *Salmonella* spp. ($P=0.63$). In addition, vitamin E did not affect antimicrobial activity in ground beef against *E. coli* O157:H7 ($P=0.36$), *L. monocytogenes* ($P=0.44$), or *Salmonella* spp. ($P=0.30$). Fatty acid enriched ground beef from cattle fed flaxseed does not elicit antimicrobial activity against *E. coli* O157:H7, *L. monocytogenes*, and *Salmonella* spp.

Key Words: Alpha-linolenic acid, Antimicrobial, Ground beef

526 Effects of diet and monensin on ruminal persistence and fecal shedding of *Escherichia coli* O157:H7 in cattle. M. J. VanBaale*[1], J. M. Sargeant[1], D. P. Gnad[1], B. M. Debey[1], K. F. Lechtenberg[2], and T. G. Nagaraja[1], [1]*Kansas State University, Manhattan, KS,* [2]*Midwest Veterinary Services, Oakland, NE*.

Twelve ruminally-cannulated cattle, adapted to high-forage (85% forage; HF) or high-grain diet (85% grain; HG) with or without monensin (1.32 mg/kg of diet), were used in a 2 x 2 factorial design, to investigate the effects of diet and monensin on level and duration of ruminal persistence and fecal shedding of *E. coli* O157:H7. Cattle were ruminally inoculated with a strain of *E. coli* O157:H7 (10^{10} CFU/animal) adapted to nalidixic acid (Nal^r). Ruminal and fecal samples were collected for 11 wk, and then cattle were euthanized, necropsied, and contents from different gut locations were collected. Samples were cultured for enumeration or detection of Nal^r *E. coli* O157:H7. Fecal and ruminal pH were recorded immediately after collection and an aliquot of ruminal sample was acidified and frozen for VFA analysis. Cattle fed the HF diet shed higher ($P<0.05$) concentrations of Nal^r *E. coli* O157:H7 in the feces and for a longer duration compared to cattle fed the HG diet. In HF fed cattle, the duration of shedding decreased for monensin compared to no monensin group. Generally, ruminal persistence of Nal^r *E. coli* O157:H7 was not affected by diet or monensin. Fecal pH was higher ($P<0.05$) in cattle fed HF diet compared to cattle fed HG diet. Monensin had no effect on fecal pH in cattle fed either of the two diets. Cattle fed HF diet had higher ruminal pH ($P<0.05$) and lower VFA concentrations than the cattle fed the HG diet. At necropsy, Nal^r *E. coli* O157:H7 was detected in hind gut (rumen and cecum) contents more often than from any other gut location, including the rumen. Our study suggests that cattle on a HF diet shed higher concentrations and for longer duration than cattle on a HG diet. Monensin supplementation decreased the duration of shedding with HF diet, and the hind gut, not the rumen, appears to be the site of persistence of *E. coli* O157:H7 in cattle.

Key Words: *Escherichia coli* O157, Monensin, Cattle

527 Bactericidal effect of 2-nitropropanol against selected foodborne pathogens *in vitro*. Y. S. Jung*, R. C. Anderson, T. R. Callaway, T. S. Edrington, K. J. Genovese, R. B. Harvey, T. L. Poole, and D. J. Nisbet, *USDA-ARS, Food and Feed Safety Research Unit, College Station, TX*.

The bactericidal effect of 2-nitropropanol (2NPOH), a nitroalkane, on several pathogenic bacteria including *Salmonella enterica* serovar Typhimurium, *Escherichia coli* O157:H7, *Listeria innocua*, and *Enterococcus faecalis* was determined *in vitro*. The test compound was added to tryptic soy broth (TSB) medium in amounts to give 0, 2.5, 5, and 10 mM final concentration. Specific growth rates (h^{-1}) (n=3) were calculated by measuring optical density (A_{600}). The growth of gram negative (Typhimurium and *E. coli* O157:H7) and positive (*L. innocua* and *E. faecalis*) was largely prohibited at $\geq$ 2.5 mM 2NPOH and was completely inhibited at 10 mM 2NPOH. To determine if pH affected the bactericidal activity of 2NPOH, approximately 10^5 to 10^6 CFU per ml of Typhimurium were inoculated into TSB medium containing 0, 2.5, and 10 mM of 2NPOH and adjusted to pH 5.6, 7.2, and 8.0. After 24 h incubation at 37°C, cell numbers were reduced approximately 3 log (from 10^5 to 10^2 CFU/ml) at 2.5 mM 2NPOH at pH 5.6 but not at pH 7.2 or 8.0. However, Typhimurium was completely inactivated (>5 log reductions) at 10 mM 2NPOH regardless of pH. To evaluate the bactericidal effect of 2NPOH against Typhimurium in buffered rumen and fecal fluid (pH 6.8), a novobiocin and nalidixic acid resistant Typhimurium strain was inoculated into these mixtures supplemented with 0, 2.5, 10 mM 2NPOH and incubated at 37°C under CO_2. The populations were monitored at different times (0, 3, 6, and 24 h). After 24 h, mean ± SD populations (log CFU/ml) of Typhimurium were reduced significantly ($P<0.05$) in both ruminal and fecal fluid containing 2NPOH at 10 mM concentration compared to controls (0.55 ± 0.64 vs 2.65 ± 0.06 and 0.1 ± 0.00 vs 2.80 ± 0.28, respectively). The results obtained in this study indicate that 2NPOH has bactericidal activity against *Salmonella*, *E. coli* O157:H7, *L. innocua*, and *E. faecalis*, and potentially could be developed as an antimicrobial supplement.

Key Words: 2-Nitropropanol, Bactericidal, Foodborne pathogens

528 Origanox as a natural ingredient to inhibit the growth of foodborne pathogens. S. A. Ibrahim*, *North Carolina A&T State University, Greensboro, NC*.

The Pathogen Reduction Program of the U.S. Department of Agriculture Food Safety and Inspection Service recommends that natural antimicrobial treatments such as herb extracts be included to reduce or inactivate food borne pathogens. Origanox (OX) is a common herb extract that has been used as a functional ingredient in foods, but has not been extensively examined as a possible antimicrobial agent. The objective of this study was to evaluate the effect of OX on the survival and growth of *Escherichia coli* O157:H7, *Salmonella typhimurium* (ATCC 14208) and *Salmonella agona* (H 6115 and F 5567). *E. coli* O157:H7 and *Salmonella* grown separately in Tryptic soy broth (TSB) at 37C for 24 h, were inoculated (final inoculum level of 2 log/ml) into TSB containing OX with different concentrations of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0%. Samples were then incubated at 37°C for eight h. Samples were withdrawn every two h during the incubation period and surface plated on EMB agar and XLD agar for conducting enumeration counts of *E. coli* and *Salmonella*, respectively. Results showed that the addition of 0.2% OX significantly inhibited the growth of pathogenic bacteria when compared to control samples. During the eight h storage period, populations of bacteria increased by 7.0 log CFU/ml in control samples while bacterial populations in samples with the addition of 0.1% OX increased by 2.2 log CFU/ml. When appropriate dilution of microbial suspension was surface plated on Tryptic soy agar supplemented with 0.1% OX, at least 2-log reduction in the microbial population was observed. These results indicated the potential applicability of OX as antimicrobial agent for increasing the biosafety of many consumable food products.

Key Words: Origanox, *Escherichia coli* O157:H7, *Salmonella typhimurium*

529 Experimental chlorate product treatment reduces *Salmonella* populations in swine during lairage. T. R. Callaway*[1], R. C. Anderson[1], T. S. Edrington[1], K. J. Genovese[1], C. H. Stahl[2], Y. S. Jung[1], K. M. Bischoff[1], T. L. Poole[1], R. B. Harvey[1], and D. J. Nisbet[1], [1]*USDA-ARS, Food and Feed Safety Research Unit, College Station, TX,* [2]*Iowa State University, Ames, IA.*

Each year more than 1.3 million human cases of salmonellosis are reported in the United States. Swine can be a reservoir of *Salmonella* that can be transmitted to human consumers of pork products. *Salmonella* have the ability to respire anaerobically by reducing nitrate to nitrite via the intracellular enzyme nitrate reductase (NR). However, NR does not differentiate between nitrate and its valence state analog chlorate, which can be converted within the bacterium to cytotoxic chlorite. When added to pure and mixed cultures of bacteria, chlorate killed both *E. coli* and *Salmonella* within 24 h. Preliminary in vivo studies indicated that chlorate supplementation reduced *E. coli* O157:H7, wild-type *E. coli* and *Salmonella* in cattle, sheep and swine, respectively. Therefore, an experimental chlorate-containing product (ECP) has been developed for use in food animals. The current study was undertaken to evaluate the effectiveness of ECP during the short-term lairage period immediately prior to harvest. Pig manure (10 kg) was inoculated with 10^3 CFU/g *Salmonella* Typhimurium and was spread throughout pens housing pigs (n=10) to simulate the introduction of swine to dirty lairage facilities. After 2 h, pigs were given ad libitum feed (controls) or feed supplemented with ECP for 4 h. Animals were humanely sacrificed and tonsils, ileocecal lymph nodes, cecal and rectal contents were collected. Fewer pigs treated with ECP had *Salmonella*-positive tonsils, but not unexpectedly due to the continuous exposure to *Salmonella*-contaminated feces this difference was not significant ($P>0.05$). No differences were noted in lymph node or intestinal content *Salmonella* status, likely due to the very short duration of ECP treatment. However, in a follow-up study using pigs (n=10) naturally colonized with *Salmonella*, ECP treatment ($P<0.05$) reduced natural cecal *Salmonella* colonization. Thus, these results indicate that ECP could be a viable pre-harvest intervention strategy to reduce *Salmonella* concentrations in swine, however further research is needed to optimize the effectiveness of ECP during lairage and transport to the slaughter facility.

Key Words: *Salmonella*, Swine, Lairage

530 Vermont Cattle Health Improvement Project. C.A. Rossiter-Burhans*[1], J.W. Barlow[2], and T.E. Johnson[3], [1]*Poulin Grain Inc., Newport, VT,* [2]*University of Vermont, Burlington, VT,* [3]*Vermont State Department of Agriculture, Montpelier, VT.*

Concerns about Johne's disease (JD) prevalence, economics, food safety, and public health risks have prompted industry, state and federal level initiatives recently. Vermont (VT) Department of Agriculture initiated a pilot program, Vermont Cattle Health Improvement Project (VTCHIP), in 2001 to develop a cooperative (state and industry) cattle health program requiring active participation by veterinarians and producers. Objectives included enhancing farm viability by promoting improved preventive herd health and disease control practices. VTCHIP broadly addressed herd health issues but focused on JD education, requiring comprehensive review of farm goals, herd health parameters, and management bottlenecks. Enrolled veterinarians (n=55) and producers (n=145) engaged in a systematic review process concluding with written management strategies addressing identified health concerns. A VTCHIP workbook guided a 4-step assessment process for: 1. farm goals and health parameters 2. estimating JD herd prevalence 3. farm management risk factors relative to the spread of JD, and 4. specific management plans to prevent or control JD and address other identified health concerns. VTCHIP funding supported the herd veterinarian's involvement in executing risk assessments and farm plans ($350/farm) and initial herd diagnostic testing ($300/farm). Funding was a one-time State appropriation supplemented by a USDA and a private grant. Future goals for VTCHIP include 1. securing support for an ongoing program 2. adopting the voluntary JD herd status program whereby VT herds can establish a national low-risk status and create a value added market for low risk animals, 3. expanding industry and state cooperation, and 4. addressing other economically significant health issues using the VTCHIP framework. Advantages of the VTCHIP approach include 1. cooperative implementation through herd veterinarians, 2. management focus, 3. systematic format, and 4. flexible application to multiple herd health issues. Advantages, successes, and challenges of the initiative will be presented.

Key Words: Johne's disease, Herd health

Growth & Development: Intestinal development - colostrum symposium

531 Over-expression of IGF-I effects on piglet intestinal growth. S. M. Donovan*, J. L. Hartke, M. H. Monaco, and M. B. Wheeler, *University of Illinois.*

Porcine milk contains hormones and growth factors that are thought to be responsible for the rapid postnatal intestinal growth and development of piglets. Work in our lab has shown that the addition of recombinant human IGF-I to sow milk replacer at 0.1 to 1.0 mg/L increased intestinal villus growth, lactase (LPH) activity and LPH mRNA expression in piglets. Further, stable isotope tracer studies suggest that IGF-I up-regulates LPH activity by suppressing proteolytic degradation of LPH and its precursor (proLPHh). Others have shown that oral IGF-I at 10 mg/L increased mucosal growth and sodium-dependent nutrient transport compared to piglets fed formula alone. However, the impact of IGF-I over-expression in sow milk on piglet intestinal development was unknown. To answer this question, transgenic sows that over-express IGF-I in milk under the direction of the regulatory elements of the bovine a-lactalbumin (a-LA) gene were developed. The a-LA/IGF-I gene construct was designed by inserting exon 4 of the human IGF-I gene, which contains the coding sequence for the mature peptide, into exon 1 of the bovine a-LA gene construct. IGF-I content in colostrum IGF-I transgenic sows ranged from 0.6 to 1.4 mg/L, compared to 0.15 mg/L in colostrum from non-transgenic full-sibling sows. The milk IGF-I content of transgenic sows is maintained at 0.6 mg/L or 60-fold higher than milk IGF-I of non-transgenic sows. Milk IGF binding protein (IGFBP) -2 and -5 are also higher in the milk of transgenic sows. To assess the impact of IGF-I over-expression on piglet intestinal development, piglets suckling IGF-I transgenic or non-transgenic sows were killed on days 3, 7, 14, and 21 of lactation. Consistent with our data from piglets fed formula with IGF-I, no effect on overal piglet body weight, or intestinal weight and length was observed. However, piglets suckling IGF-I transgenic sows had greater intestinal mucosal weight and disaccharidase activity than piglets suckling non-transgenic sows. (Funded by the USDA CSREES under project NRICGP 00-35206).

Key Words: Transgenic, IGF-I, Lactase

532 Intestinal growth and development in piglets suckling insulin-like growth factor-I (IGF-I) transgenic sows. J. L. Hartke*, M. H. Monaco, M. B. Wheeler, and S. D. Donovan, *University of Illinois, Urbana, IL.*

Our lab and others have shown that piglets fed formula containing IGF-I have increased villus growth, lactase activity, and nutrient transport, however, the impact of IGF-I over-expression in sow milk on piglet intestinal development was unknown. To answer this question, transgenic sows that over-express IGF-I in a mammary- and lactation-specific manner were created (IGF). IGF-I in colostrum of IGF transgenic swine (1.0 mg/L) is 5-fold higher than non-transgenic (CON) sows and milk IGF-I content (0.6 mg/L) is 60-fold higher than CON. Herein, the impact of ingestion of elevated milk IGF-I throughout lactation on piglet intestine was assessed. Piglets (n=160) were studied in 2 replicates. Farrowing was induced on d 113 of gestation and piglets were removed prior to ingestion of colostrum. Within 4 h, 10 piglets were randomly distributed to each sow, such that each litter contained piglets from all other sows within that replicate. On days 3, 7, 14, and 21 postpartum, one CON litter and one IGF litter were euthanized following a 12h fast. Serum IGF-I and IGF-I binding proteins were measured. Intestinal weight, length, protein and DNA content, disaccharidase activity and villus morphology were assessed. Piglets suckling CON sows were heavier than IGF-I only on d 7 ($p<0.02$). Intestinal weight and length were similar between treatment groups. Jejunal mucosa weight was greater at d3 in IGF piglets than CON ($p<0.01$) and ileal mucosal weight was increased in IGF piglets at d3, 7, and 21 vs. CON ($p<0.01$). Jejunal and ileal lactase and sucrase activities were greater ($P<0.05$) in IGF piglets than CON on d21. When data from all time points were combined, IGF

piglets had greater jejunal lactase and sucrase activity (P<0.0001) as well as increased ileal sucrase activity (P<0.0001) than CON. In summary, piglets suckling IGF had greater intestinal mucosal weight and disaccharidase activity than piglets suckling CON sows, however, body weight was not affected. (Funded by NRICGP 00-35206).

Key Words: IGF-I, Disaccharidase, Intestine

533 Intestinal development in neonatal calves: Effects of glucocorticoids and dependence on colostrum feeding.

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The neonatal development of the gastrointestinal tract around parturition in precocious mammals is greatly affected by endocrine factors like glucocorticoids as well as by nutritional factors. We have tested the hypothesis that glucocorticoids and colostrum (C) supply affect intestinal morphology, cell proliferation, digestive enzyme activities, and xylose absorption in neonatal calves. Calves (n=7 per group) of $GrFD^-$ and $GrFD^+$ were fed a milk-based formula (F), whereas calves of $GrCD^-$ and $GrCD^+$ were fed C. Dexamethasone (DEXA; 30 μg/[kg body weight × d]) was injected to calves of $GrFD^+$ and $GrCD^+$. Calves were fed C or F for the first 3 d, milk replacer on d 4, and were euthanized on d 5 of life. On d 3 d-xylose (0.5 g/kg BW) was fed and plasma xylose concentrations were measured. Villus size and crypt depth were measured by histomorphometry and cell proliferation was evaluated immunohistochemically by labeling mitotic cells with 5-bromo-2-deoxyuridine that was intravenously injected 1 h before euthanasia. Activities of lactase (EC 3.2.1.23), maltase (EC 3.2.1.20), aminopeptidases A and N (EC 3.4.11.7 and EC 3.4.11.2, respectively) and dipeptidyl peptidase IV (EC 3.4.14.5) were measured. C feeding increased ($P < 0.05$) villus sizes in small intestine, enhanced ($P < 0.05$) xylose absorption capacity and increased ($P < 0.05$) peptidase activities in ileum. DEXA-treatment increased ($P < 0.1$) villus size in duodenum, but reduced ($P < 0.1$) villus size and reduced ($P < 0.001$) sizes of Peyer's patches in ileum. Mainly in F-fed calves DEXA increased ($P < 0.05$) cell proliferation of crypt cells in ileum, decreased ($P < 0.05$) amino peptidase N activities in jejunum, but increased ($P < 0.05$) amino peptidase A activities in ileum. C feeding enhanced intestinal villus size, xylose absorption, and enzyme activities, whereas DEXA differently affected villus size, cell proliferation and enzyme activities dependent on intestinal segments and differences in feeding.

Key Words: Neonatal calf, Gut development, Dexamethasone

534 Effects of bioactive components of colostrum and milk on neonatal health, growth and intestinal development. .

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Colostrum and milk contain a wide variety of bioactive components that influence health and growth of the calf. Many of these components are highly enriched in colostrum and have well established effects on development, whereas the role of others remains to be defined. The objective of this paper is to review the mechanisms involved in mammary secretion of these factors and their subsequent effects on neonatal growth and development of the calf, with emphasis on factors concentrated in colostrum. Bioactive components of colostrum and milk include immunoglobulins, hormones, growth factors, cytokines, vitamins, minerals, other secretory proteins, and cellular components. The most widely recognized role of colostrum is to provide passive transfer of maternal immunoglobulins, primarily IgG1, to the calf, thereby reducing risk of calf disease. However, inadequate consumption of colostrum also results in low levels of beta-carotene and Vitamin A and alterations in plasma metabolites in the calf. Moreover, colostrum stimulates intestinal cell proliferation, perhaps through actions of its component growth factors. Cellular components of colostrum appear to enhance development of local immunity and active immunization of the neonatal intestine. Other proteins secreted in colostrum, including lactoferrin, transferrin, epidermal growth factor and immunoglobulins, are not only absorbed intact, but have been shown to be transported into the cerebrospinal fluid where they may play a role in neural development. Additional proteins, such as colostral trypsin inhibitor, may act to prevent proteolysis of bioactive immunoglobulins, cytokines and hormones, thereby protecting their functional activity. Clearly, the bioactive components of colostrum and milk interact to promote neonatal development. Thus, better understanding of these components and their functions may lead to new methods to manipulate their concentrations in mammary secretions and thereby improve calf health and growth.

535 Effects of dexamethasone on the somatotropic axis in neonatal calves and dependence on colostrum intake.

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Glucocorticoids and colostrum (C) feeding influence postnatal maturation of the somatotropic axis. We have tested the hypothesis that the somatotropic axis in neonatal calves is modulated by a high glucocorticoid status and by C feeding. Calves (n=7 per group) of $GrFD^-$ and $GrFD^+$ were fed a milk-based formula (F), whereas calves of $GrCD^-$ and $GrCD^+$ received C. Dexamethasone (DEXA; 30 μg/[kg body weight × d]) was injected to calves of $GrFD^+$ and $GrCD^+$. Calves were fed C or F for the first 3 d, milk replacer on d 4, and were euthanized on d 5 of life. On d 1, 2, 4, and 5 plasma concentrations of growth hormone (GH), insulin-like growth factor (IGF)-I and IGF bindings proteins (IGFBP)-2 and -3 were measured, and on d 5, mRNA concentrations of IGF-I, IGFBP-2 and -3, IGF type 1, IGF type 2, and insulin receptors (IGF1R, IGF2R, and IR, respectively) and GH receptor (GHR) were measured in liver. Concentrations of hepatic GH binding sites were measured by radioreceptorassay. Plasma GH concentrations on d 4 were lower ($P < 0.05$) in DEXA-treated groups than in non-treated groups. On d 4 and 5, DEXA increased ($P < 0.05$) plasma IGF-I concentrations. Plasma concentrations of IGFBP-2 on d 4 were lower ($P < 0.05$) in DEXA-treated than in non-treated calves and were lower ($P < 0.05$) in C-fed than in F-fed calves. Concentrations of IGF-I mRNA were higher ($P < 0.1$) in DEXA-treated than in non-treated calves and were higher ($P < 0.05$) in $GrFD^+$ than in $GrFD^-$ and in $GrCD^+$. IGFBP-2 and -3 mRNAs were higher ($P < 0.01$) in F-fed than in C-fed calves. GHR mRNA was higher ($P < 0.01$) in DEXA treated than in non-treated calves. IGF1R, IGF2R, and IR mRNAs were higher ($P < 0.05$) in F-fed than in C-fed calves and were higher ($P < 0.05$) in DEXA-treated than in non-treated calves. GH binding sites were higher ($P < 0.05$) in $GrCD^+$ than $GrCD^-$. DEXA affected the maturation of the somatotropic axis in neonatal calves and these effects were partly modified by C feeding.

Key Words: neonatal calf, somatotropic axis, dexamethasone

536 Effects of plasma IgG concentration and milk replacer feeding on hormone and growth responses in stressed calves.

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This study was conducted to determine if milk replacer (MR) feeding program or plasma IgG concentration on d 0 were related to hormone concentrations, growth, and health in young calves. Holstein bull calves (n = 120) were purchased from sale barns, transported to the research facility and fed 454 g/d of MR powder (20% CP, 20% fat) to 28 d (CON), or varying amounts of MR (28% CP, 16% fat; 454 to 908 g/d; total = 27.9 kg/calf) to 41 d (ACC), or ACC + Gammulin (APC, Inc.) at 30 to 60 g/d to 15 (GAM). Calf starter (CS) and water were available to 56 d. Calves were stressed by adding soiled bedding to each hutch prior to arrival. Calves were blocked by plasma IgG on d 0 (>10, 5-10, and <5 g/L). Blood was collected on d 7, 14, 28, 42 and 56 and samples were analyzed for IGF-1, TNF-α and growth hormone (GH) concentrations. Mean BW at 56 d, intake of MR, fecal scores, d scouring, d treated with antibiotics (AB) and plasma IGF-1 concentrations were lower in CON. Mortality was lowest in CON and tended to be lower in GAM. Intake of CS was higher in CON. Plasma GH was unaffected by treatment and declined from 7 to 56 d. Plasma IgG on d 0 had no effect on parameters measured, except TNF-α which was affected by a day by plasma IgG interaction. Calves with high IgG on d 0 had higher TNF-a from d 7 to 42. Calves fed increased amounts of MR grew faster, but experienced greater morbidity and mortality. Feeding GAM tended to reduce mortality in calves fed increased MR.

	Treatment				Contrast*	
Item	CON	ACC	GAM	SEM	1	2
BW, kg						
d 0	45.5	45.4	45.9	0.6	NS	NS
d 56	72.3	79.5	79.0	1.9	0.003	NS
DM intake, g/d						
MR	218	473	475	1	0.001	NS
CS	929	748	702	42	0.001	NS
Total	1148	1221	1188	45	NS	NS
TNF-α, ng/ml	0.137	0.133	0.136	0.003	NS	NS
GH, ng/ml	3.918	3.626	3.468	0.199	NS	NS
IGF-1, ng/ml	145.8	170.5	161.4	6.4	0.01	NS
Mortality, %	2.8	22.1	10.1	5.2	0.05	0.10
Fecal score**	1.37	1.59	1.53	0.04	0.002	NS
Scours, d	1.61	2.62	2.51	0.33	0.02	NS
AB, d	1.79	2.97	3.19	0.51	0.05	NS

*Contrasts: 1 = CON vs. (ACC+GAM/2); 2 = ACC vs. GAM; NS = P > 0.10.
**Fecal score: 1 = normal consistency to 4 = severe scours.

Key Words: Calves, Milk replacer, Health

537 Effects of intestinal development on calf growth. R. L. Baldwin, VI*[1], J. Klotz[2], R. N. Heitmann[2], and K. R. McLeod[3], [1]*USDA, ARS,* [2]*Univ. of Tennesse,* [3]*Univ of Kentucky.*

The role of intestinal development and the process of transitioning calves from their neonatal reliance on nutrients supplied by milk to nutrients supplied from grain are of substantial economic importance to the producer. Improvements to the calf nutritional regime can decrease mortality and disease susceptibility, increase post-weaning rate of gain, and ultimately, enhance the rate of herd genetic improvement (due to increased capacity for voluntary culling). Current feeding practices result in weaning from milk by 3 to 4 weeks of age by daily encouragement to eat grain diets. Although the mechanisms are not yet completely understood, development of a viable fermentation within the rumen is required to initiate the maturation of the rumen epithelia. The metabolic ramifications of this transition to calf growth rate are great, as tissues must convert from reliance on glucose supplied from milk to the metabolism of volatile fatty acids as primary energy substrates. This transition is the result of differential expression of numerous genes regulating both physical and metabolic characteristics of the tissue. While the most dramatic physical changes occurring during development are associated with the rumen epithelium, changes in intestinal mass and metabolism are also realized in response to dietary changes. Amino acid use by the intestinal tissues is high and may affect amino acid availability in support of growth. Moreover, because the metabolic and protein synthetic activities of the digestive tract are high, accounting for up to 30% of both whole animal energy use and whole animal protein synthesis, understanding their regulation is vital to the continued improvement in calf management. Specific nutrient-gene interactions have been identified across the digestive tract which serve to increase visceral organ mass and directly change nutrient metabolism by the epithelia. Similarly, humoral factors have been identified as having regulatory function over gastrointestinal tissue mass and metabolism. These and continuing efforts to better understand the factors affecting intestinal development will improve weaning strategies and foster better post weaning calf growth performance.

538 Influence of dietary nucleotides on calf health. C. E. Oliver*, M. L. Bauer, C. M. De Jesus Arias, W. L. Keller, and C. S. Park, *North Dakota State University, Fargo, North Dakota.*

To determine the effect of dietary nucleotides on calf health, performance, and immune function, 20 newborn Holstein bull calves (41.9 ±1.1 kg initial body weight [BW]) were assigned to either standard milk replacer or milk replacer supplemented with purified nucleotides in the proportion found in cow milk, but at 5 times the level (AMP = 0.04 μmol/kg BW per d, CMP = 1.14 μmol/kg BW per d, GMP = 0.48 μmol/kg BW per d, IMP = 0.64 μmol/kg BW per d, and UMP = 10.3 μmol/kg BW per d). Calves were fed milk replacer by dry powder weight at 1.4 % of BW/d divided into two equal portions and fed by bucket in 1.9 L water at h 0630 and 1600. No other feed was offered during the trial. Calves were housed indoors in individual pens on an expanded metal floor with a vinyl coating. Rectal temperature and fecal score (1 = normal, 4 = watery) were recorded daily in the morning, and calves were weighed and blood was drawn weekly and analyzed for glucose, insulin, non-esterified fatty acids (NEFA), and immunoglobulin G (IgG) and M (IgM). Calves were challenged with lipopolysaccharide (LPS) or saline at 3 to 4 wk of age; rectal temperature and blood were taken at h -24, 0, 1, 2, 3, 4, 6, 8, 12, and 24. Nucleotide supplementation did not affect weight, fecal score, rectal temperature, or serum glucose, insulin, NEFA, or IgM over the course of the trial. Nucleotide-fed calves tended to have higher mean IgG levels ($P = 0.16$) than controls (859.6 ± 98.9 vs 670.5 ± 85.4 mg/dl). During the LPS challenge, there was a treatment by challenge interaction in IgG level ($P = 0.01$). Dietary nucleotides do not affect metabolic status, but may enhance immunity in neonatal calves.

Key Words: Nucleotide, Immune, Calf

539 Effect of various levels of crude fiber and form of diet on rumen development in calves. J.A. Booth*[1], H.D. Tyler[1], and J.D. Quigley III[2], [1]*Iowa State University,* [2]*APC Company, Inc.*.

Consumption of solid feed is essential for making the transition from a preruminant animal to a functioning ruminant. The optimal amount of roughage for inclusion in the diet of young calves is still unclear. The objective of this study was to determine the effect of form of diet (coarse vs. ground) and the inclusion of various levels of hay on rumen development in calves. Holstein bull calves (n = 50) were randomly assigned to one of four treatments. Diets consisted of commercial coarse starter (C), a ground starter (G), coarse starter with 7.5% grass hay of consistent particle size (H1), and coarse starter with 15% hay (H2). All diets were formulated to be isocaloric and isonitrogenous. Total ADF in diets were 6.39, 6.44, 6.47, and 7.43%, respectively. Intake was held constant across treatments until weaning when feed was given ad libitum. Jugular blood samples were obtained weekly and analyzed for BHBA. Body weight and rumen fluid samples were also obtained weekly. Daily scour scores and days receiving antibiotics and electrolytes did not differ with treatment. Calves receiving the H1 and H2 diets tended ($P<0.07$) to be heavier prior to weaning and were heavier postweaning ($P<0.01$) than the calves receiving C. Calves receiving the H1 and H2 diets also had higher BW gain (ADG) and feed efficiency (GF) postweaning than calves fed C. Calves fed H1 diet tended to have higher ADG and GF postweaning than the calves fed H2 ($P<0.07$ and $P< 0.12$ respectively). There were no differences in intake. Total VFA concentrations were higher for calves fed G diet versus C diet ($P<0.01$) and tended to be higher for calves fed H1 versus H2 ($P<0.10$). Calves fed H2 had greater acetate to propionate ratio ($P<0.03$) than calves consuming the H1 diet. Calves receiving the G diet had lower proportions of acetate ($P<0.06$) than calves fed C. Addition of hay to diets of young calves appears to favorably alter the rumen environment causing more efficient gain of body weight.

Key Words: Dairy calves, Rumen development, Forage

540 Influence of ratio of dietary fat to protein on body composition of Jersey bull calves. S. Bascom*[1], R. James[1], E. Hovingh[1], M. VanAmburgh[2], and M. McGilliard[1], [1]*Virginia Tech,* [2]*Cornell University.*

Calves were fed either milk or milk replacer (MR) at one of three ratios of CP:fat to determine effect on growth, feed efficiency, and body composition. Week-old calves (n=39) were assigned to one of four diets. Six calves were randomly selected and sacrificed to establish baseline body composition. Nine calves were fed a 28.5% CP, 16.4% fat MR (29/16). Eight calves were fed a 27.3% CP, 33.4% fat MR (27/33), and eight calves were fed a 20.6% CP, 20.6% fat MR (21/21). Calves fed 27/33, 29/16, and milk received 180 g/d CP, whereas calves fed 21/21 received 90 g/d CP. Weight, hip height, wither height, heart girth, and body length, were measured weekly for 4 wk. Weekly plasma samples were analyzed for PUN, NEFA, and glucose. A subset of calves [29/16 (n=7), 27/33 (n=6), 21/21 (n=6), and milk (n=5)] was sacrificed for body composition analysis. Feed efficiency and ADG were largest for calves fed milk and least for calves fed 21/21. Calves fed 27/33 or milk had the largest body fat percentage (>7.0%) in the empty body. Calves fed 29/16 or 21/21 had similar fat percentage (4.9, 3.7%) in EB as baseline (2.9%), whereas calves fed milk and 27/33 had the largest fat percentage (6.8, 8.2%) in the EB and gains of fat (169, 238g/d). Calves fed 27/33 had a trend toward higher NEFA in wk 1 and 2. Overall, ADG of calves fed 27/33 and 29/16 was similar except that calves fed 29/16 were

leaner than calves fed 27/33. Feeding 180g of CP in the MR improved calf performance when compared to 90 g/d in the 21/21 diet.

Key Words: Jersey calves, Milk replacer, Body composition

Meat Science & Muscle Biology: Genetics and management of meat quality

541 Effect of sire line and slaughter weight on pork quality. M. A. Latorre[1], M. D. García-Cachín[2], A. Fuentetaja[3], R. Lazaro*[1], and G. G. Mateos[1], [1]*Universidad Politécnica de Madrid. Spain,* [2]*Estación Tecnológica de la Carne. Salamanca, Spain,* [3]*Copese S.A. Segovia, Spain.*

A trial was conducted to study the influence of sex (barrows; gilts), sire line (Danish Duroc, DD; Dutch Duroc x Large White, DHxLW; Pietrain x Large White, PxLW), and slaughter weight (120 kg; 135 kg) on meat quality. Dam line was Landrace x Large White in all cases. Each treatment was replicated four times and the experimental unit was formed by five samples of muscle *longissimus* (150 ± 15 g), obtained at the last rib level from five pigs penned together during the growth period. Carcasses were obtained from pigs that had a common feeding program with free access to diets based on corn and soybean meal. Meat from castrates had more intramuscular fat (2.8 vs 2.5%) and higher a* value (4.63 vs 4.34) than meat from gilts ($P < 0.05$), but gender did not modify tenderness or cooking or thawing losses. Loins from DD had less protein (23.8 vs 24.0% and 24.1%; $P < 0.01$) and more intramuscular fat (3.0 vs 2.4%, and 2.5%; $P < 0.001$) than loins from DHxLW or PxLW. Also, meat from DD crossbreds had less moisture than meat from DHxLW crossbreds, with meat from PxLW crossbreds in an intermediate position (73.5, 73.9, and 73.7%; $P < 0.01$). The PxLW sired-pigs had higher b* value than DD or DHxLW sired-pigs (9.89 vs 9.46 and 9.19; $P < 0.01$). No influence of boar line on resistance to cutting or water holding capacity was observed. An increase in slaughter weight increased intramuscular fat (2.8 vs 2.5%; $P < 0.01$) and tended to decrease moisture content of the meat (73.6 vs 73.8%; $P < 0.10$). Loins from heavier pigs were redder (4.75 vs 4.21; $P < 0.001$) and had more intense color (10.7 vs 10.3; $P < 0.01$) and less thawing losses (6.4 vs 8.7%; $P < 0.001$) than loins from lighter pigs. We conclude that DD is an atractive sire line that can be used as an alternative to DHxLW or PxLW for production of dry-cured products from heavy pigs. Also, an increase of slaughter weight improved some aspects of meat quality that might be of benefit for quality of dry-cured products.

Key Words: Sire line, Slaughter weight, Pork quality

542 The effect of lorry on meat quality. Cs. Abrahám*, J. Seenger, and E. Szûcs, *Szent István University, Gödöllo-Hungary.*

The aim of this research was to establish effects of two different lorry types on meat quality traits. In addition, the objective was to establish relationships between meat quality parameters. A further question was whether there are differences in various parts of the same muscle in terms of meat quality traits measured at the cut surface of the medial and lateral sides of M. longissimus dorsi (LD). For transport of pigs two different lorry types were compared: (A) single-decker lorry and (B) double-decker one. Pigs (n=100) were transported from the pig farm to the abattoir (130 km distance). The animals were slaughtered according to commercial procedure. After slaughter and/or chilling for 24 h meat quality traits were recorded as follows: pH_{45} and temperature in LD, as well as pH_u. Meat color was measured using MINOLTA CR 300 Chromameter (Minolta GmbH, Germany) at two anatomical (medial and lateral) parts of the LD cut surfaces. Data were processed and analyzed using software of SPSS 10.0 statistical program package. Significant differences were found between distributions of meat quality traits, which were assigned to PSE, normal and DFD categories. Lorry type A proved to be superior to lorry B showing a lower amount of PSE (18 vs. 34 %). The reason for the adverse phenomenon might be due to loading and unloading which was rather complicated with lorry B, and in this case frequent use of different tools for driving of animals was needed. It resulted in higher level of stress. Comparing the medial and lateral sides of the LD revealed significant differences for L∗ and a∗. Coefficients of correlation between meat quality traits reveal close, negative relationship of L∗ with pH_u (r = -0.76). No association was established between L∗ and LD temperature and surface reflectance. A relatively low coefficient of correlation was calculated for the relationship of LD temperature with surface reflectance (r=0.36).

Key Words: Pigs, Animal transport, Meat quality

543 Effects of available dietary carbohydrate and pre-slaughter stress on glycolytic potential and quality traits of pig muscles. G. Bee*, *Swiss Federal Research Station for Animal Production, Posieux Switzerland.*

The objective of the study was to evaluate the effects of pre-slaughter stress and dietary treatments known to affect post mortem muscle metabolism on the glycolytic potential (GP) and quality traits of the longissimus (LM) and semitendinosus muscles (light: STL; dark: STD portion). A total of 48 Swiss Large White pigs (24 gilts, 24 barrows) were selected at 88 kg and individually fed 2.6 kg of a diet either high (H) or low (L) in available carbohydrate up to 107 kg. In order to simulate pre-slaughter stress, 6 gilts and 6 barrows from each dietary treatment were subjected to a transporting stress for 3 h prior to slaughter. The remaining pigs were walked from the pen to the abattoir avoiding all unnecessary stress. In the samples collected 24 h post mortem of the LM, STL and STD the GP was determined. Measurements of the pH were carried out in the LM 30 min and 24 h post mortem and in the STD and STL 24 post mortem. Minolta L*, a*, b* values were assessed the day after dissection. In addition, muscles aged for 1 d and stored at -20C were thawed overnight at 4C (thawing loss) and then cooked to an internal temperature of 69C (cooking loss). Compared to the H-pigs, muscles of L-pigs had a lower GP (LM: 144 vs. 154 μmol/g; STL: 116 vs. 104 μmol/g; STD: 101 vs. 88 μmol/g; $P < 0.02$ for each). Regardless of the diet, pre-slaughter stress reduced the GP in the STD (90 vs. 99 μmol/g; $P < 0.05$), but not in the LM and STL. Neither diets nor pre-slaughter stress affected pH, but stress decreased meat temperature in the LM 30 min post-mortem (39.6 vs. 40.4C: $P < 0.01$). In the STL, L* (51.6 vs. 54.1) and b* values (3.4 vs. 4.2) were lower in pigs fed diet L ($P < 0.03$). Unexpectedly, pres-slaughter stress further accentuated the differences within diets ($P < 0.01$). Diet L reduced cooking losses of the STD (14.5 vs. 16.0%) and STL (12.8 vs. 13.6%; $P < 0.04$). Pre-slaughter stress increased thawing (7.5 vs. 6.4%) and cooking losses (13.6 vs. 12.8%; $P < 0.02$ for each) only in the STL. The present data revealed that the diet induced decrease of the GP positively affected meat colour and reduced thawing and cooking losses, whereas pre-slaughter stress accentuated the negative effects only in the STL.

Key Words: Feeding, Pre-slaughter stress, Pork quality

544 Growth parameters and carcass merit of market hogs supplemented creatine monohydrate in conjunction with ractopamine hydrochloride (Paylean) and a high glycemic carbohydrate. C. A. Stahl*[1], M. S. Carlson[1], D. L. McNamara[1], T. B. Schmidt[1], D. J. Newman[1], C. M. Schultz Kaster[2], and E. P. Berg[1], [1]*University of Missouri, Columbia, MO,* [2]*Premium Standard Farms, Milan, MO.*

Crossbred barrows (n=128; 85kg) were blocked by weight and allotted to one of 16 pens (eight pigs/pen; four reps/treatment) using a completely randomized design. Treatments consisted of diets A (pelletted corn-soybean base formulated to meet or exceed all NRC requirements), B (diet A supplemented with 0.92% creatine monohydrate (CMH) and 2.75% dextrose), C (Diet B supplemented with 4.5 g/ton Paylean) and D (diet A supplemented with 4.5 g/ton Paylean). Animal weight and feed disappearance was recorded at 9d intervals throughout the 27d testing duration to determine ADG and feed efficiency. In addition, real-time ultrasound was used to establish 10th rib fat depth (FD) and loin muscle area (LMA) on d1 and 27. No treatment differences were noted when comparing ADG (P=0.66) and cold carcass weight (P=0.51). Over the 27d test, diets C and D expressed the greatest improvement in LMA growth (A: 6.84; B: 7.61; C: 9.35; D: 9.03 +/-0.58cm^2, P<0.01). Additionally, diet affected d27 FD (A: 2.21; B: 1.90; C: 1.93; D: 1.85 +/- 0.08cm, P<0.05) and total fat accumulation (A: 0.69; B: 0.48; C: 0.46; D: 0.36 +/- 0.05cm, P<0.001). Moreover, boneless loin chops of animals

fed diet C possessed a greater percentage of intramuscular fat than animals supplemented diet D (A: 2.43; B: 2.3; C: 2.45; D: 2.17 +/- 0.08%; P<0.07). Dietary treatment did not significantly affect the ultimate pH, Japanese color score or CIE L* and b*-values of the loin; however, the CIE a*-value of loins from animals fed diets B and D differed (A: 5.86; B: 6.49; C: 5.81; D: 5.20 +/- 0.23, P=0.0026) from those fed diets A and C. In conclusion, the addition of CMH and dextrose to diets containing 4.5 g/ton Paylean does not significantly improve growth performance; however, the data provide evidence that this dietary addition allows for the repartitioning of nutrients without significantly altering intramuscular fat deposition.

Key Words: Paylean, Creatine, Pigs

545 Fresh pork quality of Rendement Napole and/or Halothane carriers supplemented with magnesium through drinking water. B. R. Frederick*, E. van Heugten, and M. T. See, *North Carolina State University, Raleigh, NC.*

Sixty-four pigs (117±0.7 kg BW) representing 1) non-carriers (NN/rn^+rn^+), 2) Rendement Napole carriers (NN/RN^-rn^+), 3) Halothane carriers (Nn/rn^+rn^+), and 4) carriers of both mutations (Nn/RN^-rn^+) in a factorial arrangement were individually penned and provided ad libitum access to feed (0.12% Mg) and water. Pigs were randomly allotted to receive 900 mg of Mg/L of drinking water from $MgSO_4$ for 0 or 2 d prior to harvest. Longissimus dorsi (LD) and Semimembranosus (SM) chops were placed on trays, wrapped, and stored at 4°C to simulate display storage for 8 d. Magnesium had no effect on quality characteristics reported. The RN carriers, regardless of the Halothane gene ($N\_/RN^-rn^+$), had lower (P<0.05) LD color scores (2.2 vs 2.9±0.2), LD pH at 24 h post-mortem (5.59 vs 5.81±0.02), SM pH at 24 h post-mortem (5.68 vs 6.00±0.03), and higher (P<0.05) initial LD Minolta L* (59.3 vs 54.5±0.7), final LD Minolta L* (61.7 vs 57.8±0.07), LD surface exudate (121 vs 98±5 mg), and display fluid loss of LD after 8 d (10.8 vs 7.6±0.4%) than normal rn^+ pigs ($N\_/rn^+rn^+$). Halothane carriers, regardless of the RN gene ($Nn/rn^+\_$), had higher (P<0.05) initial LD Minolta L* (58.7 vs 55.1±0.7), final LD Minolta L* (61.4 vs 58.1±0.7), display fluid loss of LD after 8 d (9.8 vs. 8.6±0.4%) and lower (P<0.05) LD color scores (2.2 vs 2.9±0.2) than Halothane normal pigs ($NN/rn^+\_$). Interactions between genotypes were present for pH of the LD at 60 min post-mortem (5.89, 6.02, 5.84, and 5.78±0.03), surface exudate of the SM (72, 88, 72, and 112±7 mg), display fluid loss of LD after 4 d (5.7, 7.7, 5.9, and 9.6±0.5%), display fluid loss of SM after 4 d (4.5, 6.8, 4.1, and 8.7±0.6%), and display fluid loss of SM after 8 d (6.7, 9.3, 5.9, and 11.4±0.4%) for genotypes 1, 2, 3, and 4, respectively. Although magnesium did not affect pork quality, the RN and Halothane mutations negatively affected color and fluid loss and effects were much more pronounced in the presence of both mutations.

Key Words: Rendement Napole, Halothane, Magnesium

546 Carcass cutability, belly firmness, and fatty acid composition of Ractopamine supplemented pigs sorted into backfat thickness classes. K. J. Mimbs*[1], T. D. Pringle[1], M. J. Azain[1], and T. A. Armstrong[2], [1]*The University of Georgia, Athens, GA,* [2]*Elanco Animal Health, Greenfield, IN.*

This study was conducted to determine the effect of Ractopamine (RA) feeding on carcass cutability, belly firmness, and fatty acid (FA) composition of pigs varying in prefinishing 10th rib backfat (BF). Crossbred barrows were assigned to a factorial arrangement with two BF classes (fat, F vs lean, L) and two levels of RA (0 vs 10 ppm). Pigs (80 kg) were selected, by ultrasound BF, into L and F pens (difference > .5 cm), and randomly assigned to RA treatment. After finishing (28 d, 18% CP diet, 1.1% lysine), the two average gaining pigs from a pen were harvested (n = 56). Fat samples were collected from subcutaneous (inner surface, SQF), loin i.m., and belly depots. Carcass fat percent (CF) and fat free lean (FFL) percent were calculated and belly thickness and firmness were measured. Data were analyzed using ANOVA for a replicated (n = 4), 2 x 2 factorial arrangement with the main effects of RA and BF and their interactions. Replicate and replicate interactions were included to remove variation. The interaction of RA x BF affected CF (P = .03) with the L-RA, F-RA, and L-C being leaner than the F-C. Weight of FFL was greater in RA vs C (P <.05); however, FFL% was not affected (P >.10) by RA or BF. Belly firmness and FA composition were not affected by RA or BF (P >.10). Linoleic (18.7 vs 17.3%) and linolenic (.80 vs .76%) acid contents from SQF were higher (P <.01) in L vs F pigs, and RA pigs tended to have higher linoleic acid levels than C pigs (18.5 vs 17.6%, P =.07). Palmitic acid from SQF tended to be higher in F vs L and in C vs RA (P = .08). Overall, SQF was more saturated in C vs RA (36.5 vs 35.1%, P = .02). PUFA was higher (P <.01) in L vs F (19.5 vs 18.0%) and tended to be higher in RA vs C pigs (P = .07). Loin i.m. fat had higher oleic acid (45.2 vs 43.4%, P = .05), lower linoleic acid (11.6 vs 13.2%, P = .04), and higher monounsaturated FA (MUFA) content in RA vs C (48.6 vs 46.6%, P = .05). Belly firmness and FA composition were not affected by RA or BF. Furthermore, RA and BF had greater effects on carcass fat content and fatty acid composition than on FFL percent.

Key Words: Pork, Ractopamine, Fatty acids

547 Effects of supplemental corn oil or rumen-protected conjugated linoleic acid on lipid deposition of finished beef cattle. K. R. Smith*, S. K. Duckett, M. H. Gillis, and C. E. Realini, *The University of Georgia.*

Thirty-six Angus-crossed heifers (366 kg) were used to determine the effects of dietary lipid sources on carcass quality, adipose cell diameter and lipid deposition of feedlot cattle. After an initial 56 d feeding period, heifers were allotted to one of three dietary treatments: 1) basal ration containing 88% concentrate and 12% grass hay (CON), 2) basal ration plus 4% corn oil (OIL), or 3) basal ration plus 2% rumen-protected CLA salt (SALT), containing 31% CLA-60. Six heifers per treatment (n=18) were harvested subsequent to a feeding period of either 32d or 60 d. At harvest, SQ and IM adipose tissue samples were collected for cell size determination. At 24 h postmortem, carcass data was obtained and one steak was removed for lipid content and fatty acid composition analysis by GLC. Data were analyzed with treatment, time on treatment, adipose depot and all interactions in the model. OIL fed heifers tended (P = 0.07) to have higher marbling scores than SALT and CON fed heifers. Quality grade and total lipid content of the longissimus did not differ (P > 0.05) by treatment or time. SALT supplemented heifers had 22% greater (P < 0.05) total CLA content than CON or OIL treatments. Corn oil supplementation increased (P < 0.05) linoleic acid concentration in adipose tissue, but did not alter (P > 0.05) level of CLA isomers. SQ depots had a greater (P < 0.05) percentage of cells in the smallest diameter range of 20 to 40 um and the largest diameter range of 160 to 270 um. IM depots had a greater percentage of cells in the mid-diameter range of 60 to 150. CON had a greater (P < 0.05) percentage of cells than SALT in the diameter range of 70 to 90 um; CON tended (P = 0.09) to have a greater percentage than OIL of cells 70 to 80 um and OIL tended (P = 0.10) to have a greater percentage than SALT of cells 80 to 90 um. Lipid supplementation to feedlot diets altered lipid deposition, increased CLA content and altered cellular diameter.

Key Words: Conjugated linoleic acid, Lipid, Beef cattle

548 Comparison of cooking and measuring methods as well as anatomical location on tenderness in M. longissimus dorsi in beef. J. Seenger*[1], Cs. Abrahám[1], G. Holló[2], K. Ender[3], and E. Szücs[1], [1]*Szent István University, Gödöllo-Hungary,* [2]*University of Kaposvár, Kaposvár-Hungary,* [3]*Research Institute for the Biology of Farm Animals, Dummerstorf-Germany.*

The objective of this study was to compare cooking, measuring and sample location effects on tenderness and cooking traits in beef samples taken from M. longissimus dorsi (LD). 27 Holstein-Friesian (HF), 4 German Simmental (GS) and 2 Charolais × Holstein-Friesian (CH × HF) carcasses were chilled for 24 h at 6°C. LD samples were taken between the 9-11th rib. Cuts were removed and cut into six slices (5 × 2.5 cm;1 × 4 cm), vacuum packed, aged (6°C) for 14d and frozen (-25°C). Beginning at the posterior end LD slices were numbered 1 through 6. Slices 1-5 were 2.5 cm, slice 6 was 4 cm thick. Three cooking and measuring methods were applied, as follows: Method I. After thawing, slices 1, 3, and 5 were cooked in water bath to 70 °C internal temperature. Five 1.27 cm-diameter cylindrical cores were removed parallel to the muscle fiber orientation. The Warner-Bratzler (WB) shear force (SF) was determined with Texture Analyzer TA.XT2 instrument using WB attachment. Cores were sheared once with a V shaped 1.2 mm thick blade. Method II. Slices 2 and 4 were grilled to 70 °C internal temperature. The coring and shearing method was the same as in Method I. Method III. Slice 6 was stewed in exsiccator on 160°C for 85 min. One to three, 2.54 cm-diameter cylindrical cores were removed from each slice parallel to the muscle fiber orientation. SF was determined with a Texture Analyzer TA.XT2 instrument. Cores were sheared once with a V shaped 3 mm thick blade. Data were processed by ANOVA and

LSDs. No statistical differences between mean SF value of LD samples treated with Method I (7.32±2.91 kg) or Method II (6.98±2.93 kg) were shown. Method III resulted in higher SF values (15.20±6.22 kg). Cooking, grilling and stewing losses were different. The average of stewing loss was the highest (43.57 %), the average of grilling loss was less (26.95%), and the average of cooking loss was the least (22.r%). Slices from Methods I and II were used to determine the effect of sample location was studied within a slice. The location within a slice seemed to affect SF. As well, the effect of longitudinal location was studied within LD using slices from Methods I and II. A tendency showed that SF is decreased from caudal end to cranial end.

Key Words: Shear force, M. longissimus dorsi, Measuring methods

Nonruminant Nutrition: Energy and amino acids

549 Evaluation of the true ileal digestible (TID) lysine requirement for 7 to 14 kg pigs. A. M. Gaines*[1], D. C. Kendall[1], G. L. Allee[1], M. D. Tokach[2], S. S. Dritz[2], and J. L Usry[3], [1]*University of Missouri-Columbia, Columbia,* [2]*Kansas State University, Manhattan,* [3]*Ajinomoto Heartland Inc., Chicago.*

A series of experiments were conducted at three different commercial research sites in order to evaluate the true ileal digestible (TID) lysine requirement for 7 to 14 kg pigs. In Exp.1, a total of 840 pigs (PIC 337 × C22; 7.6 ± 0.13 kg) were used in a completely randomized design with 7 replicate pens/treatment and 24 pigs/pen. In Exp. 2, a total of 1,260 pigs (PIC 337 × C22; 8.5 ± 0.14 kg) were used in a completely randomized design with 6 replicate feeders/treatment and 42 pigs/feeder. In Exp. 3, a total of 770 pigs (TR-4 × C22; 7.4 ± 0.07 kg) were used in a randomized complete block design with 7 replicate pens/treatment and 22 pigs/pen. Pigs used in all three experiments were allotted to one of five dietary treatments containing 1.22, 1.32, 1.42, 1.52, and 1.62% TID lysine, respectively. Diets used in the above experiments were formulated to be isocaloric and contained the same inclusion of soybean meal (30%), fat (3%), fish meal, and blood cells. The dietary lysine content was increased by adding L-lysineHCl with additional synthetic amino acids supplied as necessary to meet the minimum amino acid profile. For Exp.1, increasing dietary lysine increased (linear, $P < 0.01$; quadratic, $P = 0.01$) ADG (409, 422, 463, 449, and 440 g/d) and improved (linear, $P < 0.001$; quadratic, $P = 0.001$) G/F (0.756, 0.803, 0.832, 0.793, and 0.823). For Exp. 2, increasing dietary lysine increased (linear, $P = 0.001$; quadratic, $P = 0.02$) ADG (350, 386, 400, 409, and 413 g/d) and improved (linear, $P < 0.001$; quadratic, $P < 0.01$) G/F (0.673, 0.737, 0.753, 0.765, and 0.775). For Exp. 3, increasing dietary lysine increased (quadratic, $P = 0.05$) ADG (409, 427, 427, 422, and 409 g/d) and improved (linear, $P < 0.001$; quadratic, $P < 0.01$) G/F (0.752, 0.790, 0.809, 0.837, and 0.826). Results from these experiments indicate that the TID lysine requirement for 7 to 14 kg pigs may be as high as 1.42%.

Key Words: Lysine, Pigs, Growth

550 Effects of lysine source on growth performance of 11 to 25 kg pigs. D. C. Kendall*[1], G. L. Allee[1], G. Gourley[2], D. R. Cook[3], and J. L. Usry[4], [1]*University of Missouri-Columbia,* [2]*Swine Graphics Enterprises,* [3]*North American Nutrition Companies, Inc.,* [4]*Ajinimoto Heartland Inc.*.

Two experiments were conducted to determine effects of high synthetic amino acid inclusion on growth performance of 11 to 25 kg pigs. Upon placement into the nursery, pigs were allotted by sex in a completely randomized design with three replicate pens per sex and housed at 25 pigs/pen (n=750, Exp. 1) or four replicate pens per sex and housed at 22 pigs/pen (n=880, Exp. 2). Exp. 1 was from 11 to 29 kg and lasted 28 d while Exp. 2 was a 21 d experiment from 11 to 22 kg. The two experiments were conducted at different commercial nurseries with pigs fed nutritionally adequate diets prior to reaching a target weight of 11 kg. Both experiments utilized 5 dietary treatments differing in the inclusion of Lys-HCl (0, 0.12, 0.24, 0.36, and 0.48% Lys-HCl) with all diets containing the same level of lysine (1.32% true ileal digestible [TID] Lys) and energy (3.42 Mcal ME/kg). Dietary lysine content was maintained by adding soybean meal (45, 41.25, 37.5, 33.75, and 30.0%). The 1.32% TID Lys level was determined as the lysine requirement in both facilities from previous experimental results. Additional synthetic amino acids were supplied as necessary to meet minimum amino acid ratio requirements. In Exp. 1, no differences existed for ADG (620, 660, 651, 623, and 640 g/d, respectively), ADFI, or G:F (0.714, 0.727, 0.720, 0.730, and 0.725, respectively) between the dietary treatments. Likewise, in Exp. 2, no differences were detected for ADG (495, 485, 507, 497, and 502 g/d, respectively), ADFI, or G:F (0.783, 0.776, 0.773, 0.784, and 0.777, respectively). These experiments demonstrate that at least 0.48% L-Lysine HCl can be supplemented in diets for 11 to 25 kg pigs, as long as minimum ideal amino acid ratios are maintained.

Key Words: Pigs, Lysine, Nursery

551 Estimation of the ideal ratio of sulfur amino acids:lysine in diets for nursery pigs weighing 11-22 kg. A. M. Gaines*[1], D. C. Kendall[1], R. W. Fent[1], J. W. Frank[1], G. F. Yi[1], B. W. Ratliff[1], G. L. Allee[1], and C. D. Knight[2], [1]*University of Missouri-Columbia,* [2]*Novus International, St. Louis, MO.*

Two experiments were conducted to evaluate the ideal ratio of sulfur amino acids:lysine (SAA:LYS) for late nursery pigs using two sources of supplemental methionine (DL-methionine vs. Alimet®). For Exp.1, a total of 330 nursery pigs (TR4 × C22; 11.4 ± 0.10 kg) were allotted to one of nine dietary treatments in a randomized complete block design with six replicate pens per treatment. The control diet (Diet 1) was formulated to contain 1.15% true ileal digestible lysine (TID) with no supplemental Alimet® or DL-methionine (49% SAA:LYS). Diets 2-9 consisted of the control diet supplemented with four levels of DL-methionine or Alimet® that corresponded to SAA:LYS ratios of 54, 59, 64, and 69%, respectively. For Exp. 2, a total of 341 nursery pigs (Genetiporc; 12.8 ± 0.56 kg) were allotted to one of six dietary treatments in a randomized complete block design with six replicate pens per treatment. The control diet (Diet 1) was formulated to contain 1.05% TID lysine with no supplemental DL-methionine (49% SAA:LYS). Diets 2-5 consisted of the control diet supplemented with four levels of DL-methionine that corresponded to SAA:LYS ratios of 54, 59, 64, and 69%, respectively. To evaluate the effect of methionine source on growth performance, a 59% SAA:LYS diet was also formulated using Alimet®. In Exp.1, increasing the SAA:LYS ratio increased (quadratic, $P = 0.09$) ADG (472, 500, 509, 500, and 495 g/d) and improved (quadratic, $P = 0.02$) G/F (0.627, 0.650, 0.669, 0.677, and 0.663). There was no effect of methionine source ($P > 0.34$) and (or) methionine source × SAA:LYS interactions ($P > 0.89$) for ADG, ADFI, or G/F (Diets 2-9). In Exp. 2, increasing the SAA:LYS ratio increased (quadratic, $P = 0.05$) ADG (605, 642, 631, 636, and 619 g/d) and improved (linear, $P = 0.01$; quadratic, $P = 0.03$) G/F (0.598, 0.617, 0.613, 0.620, and 0.616). There was no effect of methionine source on ADG ($P = 0.16$) or G/F ($P = 0.28$). Results from these two studies indicate that the ideal ratio of SAA:LYS is as high as 59.0%, regardless of methionine source.

Key Words: Sulfur amino acids, Pigs, Growth

552 Determination of the TID tryptophan:lysine ratio for 90 kg barrows. D. C. Kendall*[1], B. J. Kerr[2], R. D. Boyd[3], J. W. Frank[1], A. M. Gaines[1], B. Ratliff[1], R. W. Fent[1], and G. L. Allee[1], [1]*University of Missouri-Columbia,* [2]*USDA-ARS-MWA-SOMMRU, Ames, IA,* [3]*The Hanor Company, Spring Green, WS.*

A 29 d experiment was conducted to determine the TID tryptophan:lysine (Trp:Lys) ratio for 91 to 124 kg barrows (n=210, TR4 x PIC C-22). Pigs were allotted in a completely randomized design and fed one of five dietary treatments with six replicates of seven pigs per pen. A four point titration curve was constructed with a basal diet (0.55% TID lys, 3.47 Mcal ME/kg, 9.3% CP) formulated to contain 0.072% TID Trp (0.130 Trp:Lys). Additional amino acids were supplied from synthetic sources to meet minimum ratios. L-Trp was added at the expense of corn, creating the three other Trp:Lys treatments (0.165, 0.200, and 0.235 Trp:Lys). A control corn-soybean meal diet was formulated to contain 0.55% TID lys, 3.47 Mcal ME/kg, 11.7% CP, and 0.110% TID Trp (0.200 Trp:Lys). Blood samples were collected from four pigs/pen at d 0 and d 29 for determination of blood urea nitrogen (BUN). A linear increase in ADG (0.986, 1.11, 1.12, and 1.16 kg/day, respectively; $P < 0.001$) and ADFI ($P < 0.01$) was observed with increasing Trp:Lys for the 29 d trial. There were quadratic improvements in d 29 BW ($P < 0.06$) and G:F (0.304, 0.327, 0.327, and 0.330, respectively;

P< 0.05) with increasing Trp:Lys. The change in BUN level from d 0 to d 29 decreased quadratically (P< .09) with increasing Trp:Lys. Pigs fed the 0.165 Trp:Lys diet had greater d 29 BW, ADG, G:F, and lower BUN levels than pigs fed the basal diet (P< 0.05). However, the 0.165 Trp:Lys diet did not differ from the 0.200 and 0.235 Trp:Lys diets for any criterion measured. Pigs fed the control diet had similar ADG and G:F (0.335 vs. 0.327) compared to pigs fed the 0.200 Trp:Lys diet, but d 29 BUN was greater (P< 0.001). This experiment demonstrates that a TID tryptophan:lysine ratio of .165 appears adequate in maintaining performance for pigs from 91 to 124 kg.

Key Words: Pigs, Tryptophan, Growth

553 A meta-analysis to estimate the optimum threonine to lysine ratio in growing pigs. J. van Milgen*[1] and L. Le Bellego[2], [1]*INRA-UMRVP, St-Gilles, France,* [2]*Ajinomoto Eurolysine, Paris, France.*

A meta-analysis was performed using data from widely different origin in order to estimate the optimum threonine (thr) to lysine (lys) ratio in growing pigs. Data from 22 different studies were used including those for piglets, growing and finishing pigs. All studies concerned growth trials in which different levels of thr were used. The thr to lys ratio was expressed on a standardized ileal digestibility basis. If this information was not reported, it was calculated from the reported feed ingredients using table values (AmiPig). The experimental unit used in the meta-analysis was the average response criterion (i.e., average daily gain (ADG) or gain to feed (G/F) ratio) for each treatment within a study. A total of 99 responses were obtained. Data were analyzed through non-linear regression of the response criterion on the thr to lys ratio using a generic response model and a fixed study-effect (Y_i) indicative of the maximum performance within each study (i.e., $Y = Y_i \times$ (generic model)). The generic model was either a linear-plateau (LP) or a curvilinear-plateau (CLP) model parameterized to have a maximum value of 1. Data were analyzed using the NLIN-procedure of SAS. Maximum ADG within a study ranged from 320 to 1000 g/d and maximum G/F within a study ranged from 290 to 690 g/kg. The thr to lys ratio that maximized the response criterion (i.e., ADG or G/F) averaged 61% for the LP model and 70% for the CLP model. However, the interpretation of these values is different. The breakpoint for the LP model corresponds to a minimum thr to lys ratio; a 1%-point reduction of the thr to lys ratio below the breakpoint reduced ADG by .94%. In contrast, the optimum thr to lys ratio for the CLP model corresponds to a safe ratio as a small deviation from the optimum only marginally affects performance. In a subsequent analysis, the optimum thr to lys ratio was allowed to vary linearly with body weight. Using the LP model, the optimum thr to lys ratio increased from 58% at 15 kg BW to 65% at 110 kg BW. For the CLP model, these values were 66 and 73%, respectively. For most of the studies concerned, lys may not have been limiting protein deposition throughout the experiment. Consequently, 65% appears to be the minimum standardized ileal thr to lys ratio in growing pigs.

Key Words: Pigs, Threonine, Requirements

554 Prediction of the energy value of corn from the dietary composition in piglets. J. Noblet*[1] and M. Champion[2], [1]*INRA, UMRVP, Saint Gilles, France,* [2]*Limagrain Genetics, Chappes, France.*

The energy value of ingredients for swine depends mainly on their chemical composition. Dietary fibre (DF) contributes to reduction of energy concentration whereas fat increases energy content. For corn, both constituents can vary largely and, from a prospective point of view, it is important to predict the energy value of any future type of corn. The objective of the trial was then to propose equations predicting the energy content of corn from its chemical composition. For this purpose, the energy digestibility and the DE content of 11 different corns were measured in piglets according to the difference method. The inclusion rate of the corns was 35% and the basal diet contained wheat, barley, corn, soybean meal and fish meal. All diets were pelleted and fed for 16 days; excreta were collected over the last 9 days. Mean BW of the piglets was 17 kg. On average, the 11 corns contained (% of DM) 1.6% ash, 11.9% CP, 5.2% fat, 66.9% starch (ST), 2.5% sugars (SU), 3.0% ADF and 11.8% DF (DM - (ash + CP + fat + ST + SU)); the corresponding values ranged between 1.4 and 2.1%, 7.8 and 17.9%, 3.5 and 8.5%, 45.6 and 74.0%, 1.8 and 3.3%, 2.1 to 7.5%, and 9.0 and 27.6%, respectively. The gross energy content averaged 19.07 MJ/kg DM (range: 18.41 to 19.74 MJ/kg DM). The energy digestibility and the DE content of the 11 corns averaged 88.0% (range: 79.4 to 90.3%) and 16.78 MJ/kg DM (range: 15.52 to 17.52 MJ/kg DM). According to a multiple regression model (without intercept) accounting for the total OM in corn, the calculated gross energy content of CP, fat, ST+SU and DF were 24.0, 39.8, 17.3, and 18.0 kJ/g, respectively (RSD of the model: 0.09 MJ/kg DM). The corresponding values for DE content were 18.9, 30.0, 17.2, and 8.6 kJ/g, respectively (RSD of the model: 0.26 kJ/kg DM). The average digestibilities of energy of CP, fat, ST+SU and DF in corn were then 79%, 75%, 99%, and 47%, respectively. A more simple but less precise prediction equation of corn DE would be: DE (MJ/kg DM) = 16.82 + 14.76 x Fat (g/g) + 26.76 x ADF(g/g) (RSD: 0.31 MJ/kg DM). In conclusion, this study allows estimating variation in DE content of corn according to changes in fat or DF content when fed, as pellets, to piglets. Results can be extrapolated to growing pigs.

Key Words: Pig, Corn, Energy value

555 Effect of pelleting and body weight on digestibility of energy and fat of two corns in pigs. J. Noblet*[1] and M. Champion[2], [1]*INRA, UMRVP, Saint Gilles, France,* [2]*Limagrain Genetics, Chappes, France.*

The energy value of ingredients for swine depends mainly on their chemical composition, the applied technological treatment and the BW of animals. The objective of trial 1 was to estimate the nutrients and energy digestibilities in growing pigs of two samples of corn (corn 1 and corn 2) according to two preparation technologies. For this purpose, a corn-soybean meal basal diet and two diets containing 65% of the basal diet and 35% of either corn 1 or corn 2 were fed for 3 wk to pigs weighing initially 55 kg (4/treatment), either as mash feed or as pellets. Excreta were collected for the last 10 d; average BW was then 61 kg. The energy and nutrients digestibilities of the corn samples were calculated according to the difference method. Corn 1 had a conventional composition (% of DM): 1.5% ash, 7.8% CP, 4.3% fat and 73.4% starch. The corresponding values for corn 2 were 1.6%, 9.5%, 8.2% and 67.3%, respectively. In combination with its higher fat content, the gross energy content of corn 2 was higher (19.57 vs 18.79 kJ/g DM for corn 1). Pelleting of diets improved (P<.01) fecal digestibility of fat (77 vs 61%) and energy (90.3 vs 88.4%) and the mean DE content of the three diets was 2% higher after pelleting. The energy digestibility of the corn samples was also improved by pelleting: 90.0 vs 88.0% for corn 1, 90.5 vs 88.0% for corn 2. The corresponding DE values were 16.91 vs 16.53 MJ/kg DM and 17.70 vs 17.21 MJ/kg DM. The increased energy value of corn after pelleting was mainly due to the improved digestibility of the fat fraction: 75 vs 54% for corn 1, 84 vs 65% for corn 2. In trial 2, a basal diet containing wheat, barley, corn, fish meal and soybean meal and two diets with 65% of the basal diet and 35% of either corn 1 or corn 2 were fed as pellets to piglets (4/treatment) for 16 d and their feces were collected for nine days at a mean BW of 18 kg. The energy digestibility was 90.3 and 89.5% for corn 1 and corn 2, respectively; the corresponding DE values were 16.96 and 17.52 MJ/kg DM. Fat digestibility averaged 77% for both corns. In conclusion, the DE content of corn depends mainly on its fat content and is equivalent in piglets and growing pigs, at least as pellets. Pelleting improves fat digestibility and the subsequent energy values of corn.

Key Words: Pig, Corn, Energy Value

556 Effect of high ambient temperature and feeding level on fatty acid deposition in growing pigs. M. Kloareg, L. Le Bellego, J. Mourot, J. Noblet, and J. van Milgen*, *INRA-UMRVP, St-Gilles, France.*

Predicting aspects of pork quality becomes increasingly important from both a nutritional and technological point of view. However, little information is available concerning the quantitative relation between nutrient intake and fatty acid deposition at the whole animal level. Eight blocks of five littermate barrows were used in a comparative slaughter trial to determine the effect of feeding level and ambient temperature on fatty acid (FA) deposition. At 24 kg BW, one pig from each litter was slaughtered to determine the initial FA composition. The other littermates were assigned to one of four feeding levels (100%, 90%, 80%, and 70% of ad libitum intake) and were given a diet based on wheat, corn, and soybean meal containing 3.1% lipid and 1.9% FA (of which 16% palmitic acid (C16:0), 2% stearic acid (C18:0), 21% oleic acid (C18:1), 58% linoleic acid (C18:2), and 3% linolenic acid (C18:3)). Pigs were housed individually and the temperature for each block was maintained at either 23 or 30C. At 65 kg, pigs were slaughtered and the lipid and FA

composition in the empty body was determined. Approximately 77% of the estimated digested C18:2 was deposited as-is versus 55% for C18:3. Although the complement can be oxidized or used for synthesis of other FA, 80% of the digested ω-6 FA and 55% of the ω-3 FA were deposited. For the non-essential FA, deposition exceeded intake of digestible FA nine to sixty-fold. Based on the assumption that 80% of the digestible non-essential dietary FA were deposited, the average composition of *de novo* synthesized FA corresponded to 1.7, 30.3, 2.4, 19.7 and 45.9% for myristic acid (C14:0), C16:0, palmitoleic acid (C16:1), C18:0 and C18:1, respectively. A data analysis model was developed based on the conversions between *de novo* synthesized FA. At 23C and for ad libitum feeding, 33% of C16:0 was deposited, 1.7% shortened to C14:0, 63% elongated to C18:0, and 2.8% unsaturated to C16:1. Twenty-eight percent of C18:0 (synthesized from C16:0) was deposited and 72% unsaturated to C18:1. At 30C, C18:0 desaturation was reduced by 3.5%-point. Feed intake and temperature independently affected elongation of C16:0. A reduction in feed intake increased the elongation rate whereas the increase in temperature reduced the elongation rate.

Key Words: Pigs, Fatty acids, Models

557 Partitioning of Metabolizable Energy for Maintenance and Growth by Growing Salmonids using a Factorial Approach: Species, Size/age and Diet Effects. P. A. Azevedo*[1], S. Leeson[1], C. Y. Cho[1], S. Birkett[1], H. Bayley[2], and D. P. Bureau[1], [1]*Department of Animal and Poultry Science, University of Guelph, Canada,* [2]*Department of Human Biology and Nutritional Sciences, University of Guelph, Canada.*

Efficiency of metabolizable energy (ME) utilization by juvenile lake trout (body weight, BW = 47 - 390 g) and Atlantic salmon (BW = 24 - 355 g) and post-juvenile rainbow trout (BW = 268 - 1547 g) and Atlantic salmon (BW = 456 - 1690 g) was investigated using a factorial approach. Four isoenergetic diets (estimated digestible energy, DE = 20 MJ/kg), with different digestible protein (DP)/DE ratios (18, 20, 22 and 24 g/MJ) were hand fed to near-satiety. Multiple fish carcass sampling over various time intervals was conducted to determine recovered energy (RE, kJ) and RE as protein (Pd, kJ) and RE as fat (Ld, kJ) over time. A digestibility trial (BW = 24 - 200 g) was conducted to estimate DE and ME for each diet and species. Maintenance energy requirements (MEm) and efficiency of ME utilization for growth (k_g) were estimated by linear regression. MEm was expressed as an allometric function of BW ($kg^{0.8}$). Covariance analysis was conducted on the residuals of the linear model to test for Diet, Species and Species x Diet interaction. The slope (k_g) of the linear regression of RE ($kJ/kg^{0.8}$ per day) *vs.* ME ($kJ/kg^{0.8}$ per day) was 0.66. This slope was not affected by dietary DP/DE ratio but it was significantly different among species/age combinations. The k_g was significantly higher for the juvenile lake trout (k_g = 0.67) and juvenile Atlantic salmon (k_g = 0.68) compared to the post- juvenile rainbow trout (k_g = 0.52). Underestimation of DE, and consequently ME, for post-juvenile Atlantic salmon is likely the reason for the surprisingly high k_g of 0.78. MEm was estimated for each treatment group by extrapolating the linear regression equation to zero RE. MEm were significantly different among species/age combinations but were not affected by diet. Furthermore the effect of Species x Diet interaction was not significant on either MEm or k_g. Multiple linear regression was used to estimate simultaneously the efficiency of ME utilization for protein deposition (k_p = 0.45, species effect, $P < 0.05$), and for fat deposition (k_f >1 and unrealistic), despite a Pd *vs.* Ld correlation of 0.67. Dietary DP/DE ratio had no effect on partitioning of ME utilization. However, partitioning of ME utilization was species specific and size/age dependent.

Key Words: Maintenance, Cost of growth, Salmonids

558 Effect of betaine on energy partitioning in growing pigs. J. van Milgen*, J. Noblet, and S. Dubois, *INRA-UMRVP, St-Gilles, France.*

Seven littermate barrows, initially weighing 50 kg, were used to test the effect of betaine on energy partitioning. Pigs received a corn - soybean diet supplemented with lysine, tryptophan and a vitamins and minerals mixture without choline. Each littermate received either this standard diet or the standard diet to which 1 g/kg of betaine was added. Pigs were adapted to the diet and housing conditions during two weeks prior to the start of the measurements. Both littermates received the same quantity of feed (distributed three times daily) at approximately 90% of ad libitum feed intake. Water was available ad libitum and temperature was maintained at 24C. The experiment lasted ten days (starting at approximately 60 kg) during which fecal digestibility (10 d), the nitrogen balance (10 d) and the energy balance (indirect calorimetry; 6 d) were measured. Energy retention was calculated as the difference between ME intake and heat production (HP). Lipid retention was estimated by difference from energy retention and energy retained as protein. Components of HP were estimated by regression of HP on estimators of physical activity and feed consumption. Fasting HP was measured for one day after the energy balance period. Data were analyzed through analysis of variance using litter and betaine as main factors. Weight gain and N balance during the collection period averaged 950 and 27.4 g/d, respectively, and were not affected by betaine. Digestive utilization of energy and nutrients was equivalent in both treatments. None of the response criteria for energy utilization was affected by the addition of betaine ($P > .10$). The ME intake averaged 2451 $kJ/(kg\ BW)^{.60}/d$. Heat production averaged 1266 $kJ/(kg\ BW)^{.60}/d$ and was repartitioned between fasting HP (745 $kJ/(kg\ BW)^{.60}/d$ or 59% of HP), thermic effect of feeding (27% of HP; 14% of ME intake) and HP due to physical activity (13% of HP; 7% of ME intake). On average, 1185 $kJ/(kg\ BW)^{.60}/d$ was retained, 28% of which as protein and 72% as lipid. The respiratory quotient averaged 1.12. Under these experimental conditions, the addition of betaine to the diet did not affect the partitioning of energy.

Key Words: Pigs, Betaine, Energy partitioning

559 Quantitative relationship between mitochondrial bioenergetics and efficiency of animal growth. T. R. Lutz* and T. S. Stahly, *Iowa State University, Ames.*

Variation in muscle mitochondria energy production among animals from a single strain, gender and rearing environment was quantified and the effects of these differences on the efficiency and rate of body growth were evaluated. Forty-three male Sprague Dawley rats, initially weighing 54 grams, were individually penned and allowed to consume a nutritionally adequate diet ad libitum for 21 $\pm$ 2 days. Body weight gains, feed intakes and feed wastage were quantified and mitochondria from the gastrocnemius muscle were isolated and mitochondrial protein content and State 4 (proton leak-dependent respiration) and State 3 (maximum rate of respiration) rates per unit of mitochondrial protein were determined. The mitochondrial RCR (ratio State3/State4), a measure of mitochondrial metabolic efficiency, also was calculated. Measures of mitochondrial energy production in the gastrocnemius muscle were correlated with the efficiency of whole body feed utilization. Specifically, lower rates of mitochondrial proton leak-dependent respiration ($r = .42$, $P < .01$) or improved mitochondrial metabolic efficiencies ($r = .33$, $P < .05$) were associated with improved BW gain/feed ratios. In addition, rats with a lower muscle mitochondrial protein content exhibited improved efficiencies of feed utilization ($r = .43$, $P < .01$) and improved rates of growth ($r = .31$, $P < .05$). Body growth rates were not associated with mitochondrial State 3 and State 4 oxygen consumption rates or RCR. Based on multiple regression analysis, differences among animals in mitochondria protein content (SD= 0.6) and proton leak-dependent respiration (SD= 4) equivalent to one SD from the population mean were associated ($r^2 = .33$, $P < .01$) with additive changes in body weight gain/feed (g/g) ratios of .024 and .024, respectively. These additive shifts in efficiency of feed utilization represent a 10% change among the two animal subpopulations. These data establish that the efficiency of mitochondrial energy production and mitochondrial protein content in skeletal muscle influence efficiency of animal growth.

Key Words: Mitochondria, Proton leak, Energetic efficiency

560 Effect of body weight and dietary protein level on heat production and energy utilization in growing pigs. J. Noblet*[1], P. Dimon[1], J. van Milgen[1], S. Dubois[1], L. Le Bellego[2], and M. Rademacher[3], [1]*INRA, UMRVP, Saint Gilles, France,* [2]*Ajinomoto Eurolysine, Paris, France,* [3]*Degussa AG, Hanau, Germany.*

A conventional (NP) or a low-protein diet (LP) were fed to growing pigs weighing 27 kg, 57 kg and 89 kg (stages 1, 2 and 3, respectively) to study the effect of a reduction in dietary CP level on heat production (HP) and energy gain according to stage of growth. The difference in dietary CP level between diets NP and LP was about 4.5 points but both diets provided equivalent levels of essential amino acids. The absolute levels of CP (21.9, 19.4 and 17.4% at stages 1, 2 and 3, respectively for the NP diets) and essential amino acids (1.05, 0.88 and 0.72 g digestible lysine/MJ NE) were adapted to each growth stage; ratios between essential amino acids corresponded to the ideal protein profile. Diets were

based on wheat, corn, and soybean meal and variation in CP content was achieved by substituting soybean protein isolate by corn starch and free amino acids (lysine, methionine, tryptophan, threonine, isoleucine and valine). Six blocks of two littermate barrows were used at each stage. Littermates received either the NP or the LP diet. Performance, nutrient digestibility, energy, protein and fat balance, and components of HP (indirect calorimetry) were measured for 10 d in pigs housed individually at 24C and fed four meals daily at about 90% of their ad libitum intake; feed intakes were similar within a litter. Performance was not affected (P>.05) by diet characteristics (915 g/d for ADG and 2.17 for FCR) and differed between stages. Nitrogen gain was lower (P<.05) at stage 1 (24.2 g/d) than at stages 2 and 3 (26.6 g/d) and lower for diet LP (24.5 g/d) than for diet NP (27.0 g/d). When adjusted for identical ME intake (2570 kJ/(kg BW)$^{.60}$/d) and physical activity, HP was higher (P<.01) for diet NP (1402 vs 1350 kJ/(kg BW)$^{.60}$/d for diet LP) and at stages 2 and 3 (1404 vs 1320 kJ/(kg BW)$^{.60}$/d at stage 1). The lower HP at stage 1 was due to a lower (P<.01) fasting HP (661 vs 766 kJ/(kg BW$^{.60}$/d at stages 2 and 3). The HP difference between diets was not affected by stage of growth and is equivalent to the difference in thermic effect of feed between diets (17.9 and 16.0% of ME for diets NP and LP, respectively). The activity related HP represented 8.1% of ME intake. These results confirm the interest of using a NE system as a basis for formulation of pig feeds.

Key Words: Pig, Crude protein, Heat production

Physiology: Uterus, gamete, embryo, and growth

561 Sheep oviductal secretory glycoprotein and mRNA expression in prepubertal ewe lambs, and mature ewes after natural or progestin-synchronized estrus. J. G. Berardinelli*[1] and D. Burgess[1], [1]*Montana State University, Bozeman.*

Expression of sheep oviductal secretory glycoprotein (sOSP) and mRNA in the ampulla (AMP) and isthmus (IST) were evaluated in prepubertal ewe lambs (PP; n = 5), mature ewes that exhibited natural estrus (MNE; n = 4), and mature ewes synchronized with progestin (MSE; n = 5). Salpingectomies were preformed aseptically 24 h after estrus for MNE and MSE ewes, and 18 h after feed and water removal for PP ewes. Utero-tubal, isthmic-ampullary, and ampullary-infundibular junctions of each oviduct were ligated to prevent fluid transfer among segments. Sections (4 mm) of mid-ampulla and mid-isthmus of one oviduct were frozen immediately in OCT for immunocytochemical analyses. Mucosa of the AMP and IST of the other oviduct was scraped with sterile mRNAase-free slides. Scrapings were placed into 1 mL of TRIzol® reagent and flash frozen in liquid N_2 for mRNA expression analysis. Sections (5 μm) of AMP and IST were treated with a primary rabbit antibody specific for sOSP, followed by a FITC donkey anti-rabbit second antibody, and visualized by fluorescence microscopy. Real-time RT-PCR, using forward and reverse primers for sOSP, was used to determine the presence of sOSP mRNA in each segment. Immunofluorescent staining showed that sOSP was present at the mucosa-lumen interface of the AMP and IST in 100% of PP, MNE, and MSE ewes. Relative fluorescent density (RFD; 0 = black; 3 = intense green) of AMP and IST sections did not differ (P < 0.05) among PP, MNE, or MSE ewes. RFD was greater (P < 0.05) in the AMP than in the IST. Sheep OSP mRNA was present in the AMP of every ewe (100%). There was no indication of mRNA expression for sOSP in the IST of any ewe (0%). We conclude that sOSP is present in the muscosa of the AMP and IST; however, sOSP mRNA is expressed only in cells of the AMP. Presence of sOSP in the AMP and IST, and mRNA for sOSP in the AMP was not affected by progestin synchronization or sexual development in sheep.

Key Words: Sheep oviduct secretory glycoprotein, Sexual development, Synchronization

562 Mifepristone treatment on d 2 of pregnancy decreases uterine capacity in swine. J. L. Vallet* and R. K. Christenson, *USDA, ARS, US Meat Animal Research Center.*

Progesterone treatment on d 2 and 3 of pregnancy accelerated conceptus development and uterine protein secretion and decreased uterine capacity. By contrast, treatment with mifepristone (RU486), a progesterone antagonist, on d 2 of pregnancy decreased uterine protein secretion and conceptus development. The objective of the following experiment was to determine the effect of RU486 on uterine capacity. Gilts were unilaterally ovariohysterectomized (UHO) at 160 d of age, observed for estrus starting at 200 d of age, and mated after at least one estrous cycle of normal length (17 to 23 d). Gilts then received either corn oil (CO, n = 47) or RU486 (400 mg in CO, n = 44) intramuscularly on d 2 of pregnancy. Gilts were slaughtered on d 105 and blood was collected from each fetus to measure fetal hematocrit. Each fetus, its associated placenta and each fetal heart, liver, and brain was weighed. The number of gilts remaining pregnant, mean fetal hematocrit and mean fetal heart and brain weight did not differ between treatments. Uterine capacity (litter size in UHO gilts) was significantly less (4.7 ± 0.4 and 7.3 ± 0.3, respectively; P< 0.01) in RU486-treated gilts than in CO gilts. Fetal weights (907 ± 18 and 859 ± 17, P = 0.05) and fetal liver weights (23.9 ± 0.8 and 21.5 ± 0.8, P < 0.05) were greater in fetuses of RU486-treated gilts compared to CO gilts. The number of fetuses weighing >900 g (2.5 ± 0.3 and 2.7 ± 0.3) and the number of placentas weighing >225 g (2.0 ± 0.3 and 2.2 ± 0.3, respectively) did not differ between treatments. In contrast, the number of fetuses weighing <900 g (2.2 ± 0.4 and 4.6 ± 0.4) and the number of placentas weighing <225 g (2.8 ± 0.4 and 5.0 ± 0.4, respectively) were less (P < 0.01) in RU486-treated gilts than in CO gilts. Thus, RU486 decreased uterine capacity, primarily by reducing the number of smaller conceptuses at d 105 of gestation. These results, combined with previous results, suggest that optimal uterine capacity is associated with an optimal progesterone concentration on d 2 and 3 of pregnancy.

Key Words: Progesterone, RU486, Fetus

563 Molecular cloning and endometrial expression of porcine high density lipoprotein receptor SR-BI during the estrous cycle and early pregnancy. J. G. Kim*, J. L. Vallet, and R. K. Christenson, [1]*USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

Rapid development of the placenta and fetus is associated with elevated levels of circulating high density lipoprotein (HDL) in humans. HDL receptor SR-BI (CD36L1) mediates selective cholesterol uptake and it is expressed in the human placenta. Endometrial expression of HDL receptor SR-BI mRNA has not been studied. We hypothesized that HDL receptor SR-BI may be expressed in porcine endometrium to take up maternal HDL cholesterol during early pregnancy to support endometrial development. The objectives of this study were to 1) clone and sequence the full coding region for HDL receptor SR-BI and 2) characterize SR-BI gene expression in the endometrium during the estrous cycle and early pregnancy in swine. By iterative screening of a porcine expressed sequence tag library, we obtained a clone (2601 bp, GenBank AF467889) containing the full coding region of HDL receptor SR-BI. Percent identities of porcine SR-BI amino acid sequence with bovine, human, mouse and rat SR-BI were 88, 87, 80 and 79%, respectively. Endometrial expression of SR-BI mRNA in White composite gilts (n=3 to 4) was determined by Northern blotting using total RNA from d 10, 13 and 15 cyclic and from d 10, 13, 15, 20, 30 and 40 pregnant gilts, followed by densitometry. There was an interaction (status x day) in SR-BI mRNA expression (P<0.01). In cyclic gilts, endometrial expression of SR-BI mRNA did not change between days 10 and 13, and increased (P<0.01) between d 13 (84.4±10.8 arbitrary units) and 15 (151.7±9.3). In pregnant gilts, endometrial expression of SR-BI mRNA increased (P<0.01) between d 10 (100.0±9.3) and 13 (140.5±9.3), remained elevated until d 30 (157.5±10.9), and decreased (P=0.015) on d 40 (113.4±10.8). These results show that endometrial SR-BI mRNA expression is temporally regulated during early pregnancy and the estrous cycle. This pattern of gene expression suggests that HDL receptor SR-BI plays a role in endometrial function during the estrous cycle and early pregnancy in swine.

Key Words: Endometrium, Early pregnancy, Cholesterol uptake

564 Timing of dinitrophenol treatment during in vitro culture of bovine embryos. J. F. De La Torre-Sanchez* and G. E. Seidel, Jr., *Colorado State University, Fort Collins, CO USA.*

Dinitrophenol (DNP) uncouples oxidative phosphorylation (OXP) and reduces glucose oxidation in in vitro-cultured embryos. Partial inhibition of OXP by DNP is beneficial for porcine and bovine embryos around the time of compaction. In this work we evaluated effects of timing

of DNP treatment on bovine embryo development in vitro. Slaughterhouse oocytes were matured and fertilized in vitro by standard procedures. Presumptive embryos were cultured in CDM (similar to SOF) plus nonessential amino acids and 10 μM EDTA for 2 d, and 8-16 cell embryos were randomly allocated to a 3 x 3 factorial design with factors dose: 90, 30, and 10 μM DNP, and time (Early= culture in DNP for 2.5 d, no DNP for 2.5 d; Late= culture in DNP only the last 2.5 d; and All= culture in DNP the whole 5-d period). Culture was in CDM plus nonessential and essential amino acids and 2 mM glucose (CDM-2). An additional well with no DNP for 5 d was included as a control. The experiment was replicated 3 times with semen from each of 3 bulls. After culture, embryos were evaluated for % of blastocysts, stage of development, morphological quality, and degree of lightness/darkness as a measure of lipid content. Data were analyzed by ANOVA, with factors time (3), DNP (3) and bulls (3). Time and DNP also were compared separately with the control. Early culture with DNP produced more advanced ($P<0.01$) and lighter ($P<0.05$) embryos than Late culture with All culture embryos showing intermediate values; embryos cultured in 90 μM DNP were less advanced ($P<0.01$) and tended to be darker ($P=0.07$) than embryos cultured in 30 or 10 μM DNP. When time and DNP were compared with controls, embryos in the Early group and in 30 μM DNP tended to produce more blastocysts than controls (Early 48% vs control 35% ($P=0.09$), 30 μM, 48% vs control, 35% ($P=0.06$). 30 μM DNP during precompaction culture (from 8-16 cell to compact morula stages) was beneficial for postcompaction embryo development.

Key Words: Dinitrophenol, Embryo, Bovine

565 Two-step vitrification and in-straw dilution of in vitro produced bovine embryos. L. F. Campos-Chillon*[1], J. F. de la Torre-Sanchez[2], and G. E. Seidel, Jr.[2], [1]*College of Veterinary Medicine and Biomedical Sciences, Colorado State University,* [2]*Animal Reproduction and Biotechnology Laboratory, Colorado State University.*

This study was aimed at developing a simple, two-step vitrification procedure that permits in-straw dilution so that embryos can be transferred directly. The factorial design included two embryological stages (morula and blastocyst), three equilibration times (1, 2 and 3 min) and two loading temperatures (4 and 24°C). A total of 775 grade 1 morulae and blastocysts sired by three bulls were obtained in six replicates. Briefly, oocytes were aspirated from 2-8 mm follicles from slaughterhouse ovaries, matured in vitro, and fertilized and cultured with standard procedures. We preloaded 0.25-ml straws with a 1 cm column of DHCDM (0.5 M galactose in a Hepes-buffered medium similar to SOF), then 0.5 cm air, and then 7 cm of DHCDM. Embryos were transferred to 1 ml of V1-CDM (3.5 M ethylene glycol in HCDM) for 1, 2 or 3 min at 24°C. Next, embryos were moved in 1 μl into a 10 μl droplet of V2-CDM (7 M ethylene glycol, 0.5 M galactose, 18% w/v Ficoll 70 in HCDM) at 24°C or at 4°C. In less than 1 min, the droplet containing embryos was loaded, followed by 0.5 cm air and 1 cm of DHCDM. The straw was sealed and plunged slowly into liquid nitrogen. Straws were thawed in air (24°C) for 10 sec and then in water at 20°C until ice disappeared. Straws were gently shaken to mix columns; then, embryos were placed in CDM + 5% FCS for 72 h. Data were arc sin transformed, analyzed by ANOVA, and means tested with Tukey's hsd. Room temperature was superior to 4°C for equilibrating embryos for vitrification. At 24°C (Table 1), 1 min equilibration was best for morulae, but 3 min equilibration was best for blastocysts.

Table 1. Expansion and hatching rates of vitrified embryos equilibrated at 24°C

	Morulae		Blastocysts	
Equilibration time (min)	% Expansion	% Hatching	% Expansion	% Hatching
1	57^{b}	23^{a}	55^{a}	29^{a}
2	37^{a}	12^{a}	65^{a}	41^{ab}
3	40^{ab}	14^{a}	82^{b}	60^{b}
Non-vitrified control	65^{b}	25^{a}	84^{b}	45^{b}

^{a,b} Values within columns without common superscripts differ ($P<0.05$).

Key Words: Embryo, Vitrification, In vitro

566 The size of the morula and the timing of blastocyst formation influence the resistance of bovine blastocysts to pro-oxidant agents. J. M. Feugang*, I. Donnay, F. Dessy, and A.-S. Lequarre, *Veterinary Unit, Catholic University of Louvain, 1348 Louvain-la-Neuve.*

In previous studies (Feugang et al., Theriogenology 55, 1, 2001), we showed that exposure of bovine embryos from the morula stage to pro-oxidants induced the degeneration of some blastocysts while the others remained unaffected. The degeneration process was only observed at day 7.5 post-insemination (pi) with no sign before. Here, the two populations of blastocyst (degenerated or resistant) were further characterized using time-lapse cinematography. In vitro produced zygotes were cultured under 5% O_2 in SOF medium with 5% FCS. At Day 5 pi (120 hpi), morulae were collected and cultured in a cinematography chamber in the same medium containing 0.01 mM 2,2#-azo amidinopropane (AAPH), an exogenous radical generator, or 0.4 mM buthionine sulfoximide (BSO), an inhibitor of glutathione synthesis. Frames were recorded every 4 min during 72 h. For each embryos developing to the blastocyst stage, the timings of cavitation and expansion as well as the diameter of the morula (including the zona pellucida) were recorded. The proportion of morulae reaching the blastocyst stage and of degenerated blastocysts on Day 8 pi (192 hpi) were similar with both pro-oxidants (84% and 50% for AAPH - 91% and 54% for BSO; Chi square $P\geq0.05$). Cinematographic analysis showed that, for both pro-oxidants, the population of resisting blastocysts derived from morulae with a larger mean diameter (Table 1). These resisting blastocysts also had started earlier their cavitation process and had a tendency to expanse more rapidly than degenerated ones ($P\geq0.05$). These results suggest that the capacity of a blastocyst to resist to oxidative stress depends on the morula size and the kinetics of blastocyst formation. Because the diameter of an embryo remains quite unchanged from the oocyte up to the morula stage, it is likely that blastocyst resistance can be correlated with the diameter of the oocyte from which it was derived. Further studies are needed to confirm this hypothesis and evaluate if a selection can be performed prospectively on those parameters.

Table1. Effects of pro-oxidants on the kinetic of bovine morula/blastocyst transition.

	AAPH-exposed Survived	embryos Degenerated	BSO-exposed Survived	embryos Degenerated
External diameter of morulae (μm)	161 ± 1^{a}	156 ± 1^{b}	161 ± 2^{a}	152 ± 1^{b}
Timing of cavitation (hpi)	134 ± 1^{a}	141 ± 2^{b}	136 ± 2^{a}	143 ± 2^{b}
Timing of expansion (hpi)	145 ± 2^{a}	152 ± 4^{a}	144 ± 2^{a}	149 ± 2^{a}

Data were analyzed by ANOVA 1 and expressed as meansem. ^{a,b} Values significantly different within the same pro-oxidant ($P\leq0.05$). Total of 3 replicates (45 emryos for each pro-oxidant).

Key Words: Bovine embryo, In vitro production, Oxidative stress

567 Physiology of pregnancy and calving characteristics of Holstein cows bred to Holstein or Gir (*Bos indicus*) sires. S. J. Schmidt*[1], B. S. Gandy[1], F. Hoholm[1], K. Graves[1], J. White[1], and S. T. Willard[1], [1]*Mississippi State University, Mississippi State, MS.*

The crossbreeding of Holstein dairy cows with Gir, which has a higher milk production potential than many other *Bos indicus* breeds, has not been evaluated extensively in the U. S., nor have the physiological characteristics of such crossbreeding efforts been documented completely. The objective of this study was to evaluate the physiology of pregnancy and calving characteristics of Holstein cows (n = 36) bred (AI) to Holstein (H) or Gir (G) sires. Blood serum samples were collected at 14-d intervals from 60 days of gestation to calving for evaluation of the effects of breed of sire on serum concentrations of progesterone (P4; quantified by RIA). Placentome measurements were also recorded at 14-d intervals during gestation using transrectal ultrasonography between 45 and 180 days of pregnancy. Following calving, placentas were collected (H: n = 5; G: n = 5) for analysis of cotyledon size, weight and number, and total placental weight. A calving difficulty score (1 = no difficulty, 5

= caesarian) and calf vigor score (1 = alert, 5 = dead) was assigned at calving, and calf birth weight and sex recorded. Overall (from week -32 to calving), serum concentrations of P4 were higher ($P < 0.05$) in Holstein cows bred to H sires (5.5 ± 0.16 ng/ml) than Holstein cows bred to G sires (4.8 ± 0.20 ng/ml), and did not differ ($P > 0.10$) relative to sex of calf. Placentome surface area increased ($P < 0.01$) during gestation ($r = 0.62$), but did not differ ($P > 0.10$) between H- and G-sired cows. Calf birth weights did not differ ($P > 0.10$) by sire breed (H vs. G), however G bull calves were heavier (48.1 ± 3.0 kg) than G heifer calves (37.3 ± 1.7 kg); H bulls and heifers did not differ ($P > 0.10$) in birth weight (46.0 ± 2.3 and 41.0 ± 2.3 kg, respectively). Gestation length (281.3 ± 1.4 vs. 284.0 ± 2.3 d), placental weight (4.5 ± 0.38 vs. 5.0 ± 0.51 kg), cotyledon surface area (91.8 ± 10.7 vs. 94.6 ± 7.9 cm^2) and weight (24.8 ± 1.8 vs. 24.6 ± 1.5 g), calf vigor score (1.6 ± 0.30 vs. 1.6 ± 0.24) and calving difficulty score (1.3 ± 0.14 vs. 1.4 ± 0.15) did not differ ($P > 0.10$) between H- and G- sired cows, respectively. In summary, while serum concentrations of P4 were slightly higher for H- than G- sired Holstein cows, all other gestational and calving parameters quantified were not affected by breed of sire.

Key Words: Holstein, Bos indicus, Pregnancy

568 Marked physical changes occur in yearling beef bulls during natural breeding. R. W. Ellis*[1], G. P. Rupp[1], P. J. Chenoweth[2], L. V. Cundiff[3], and D. D. Lunstra[3], [1]*Great Plains Veterinary Educational Center, University of Nebraska, Clay Center, NE,* [2]*Kansas State University, Manhattan, KS,* [3]*USDA, ARS, US Meat Animal Research Center, Clay Center, NE.*

To assess changes in body condition score (BCS), body weight (BW), scrotal circumference (SC), mating activity, and semen quality during natural breeding, 74 yearling (15 to 16 mo) beef bulls were evaluated biweekly before, during, and after a 63-d pasture breeding period (mid-June to August). Bulls used for breeding (UFB; n = 60) were compared to control bulls not used for breeding (NFB; n = 14). For multiple sire breeding, subgroups of 9 to 10 UFB bulls were exposed to cows at a bull/cow ratio of 1:20 in 80- to 160-acre pastures. At the start of observations, all bulls averaged 6.1 ± 0.1 BCS, 554 ± 5 kg BW, 36.3 ± 0.2 cm SC. In UFB bulls during the 63-d breeding period, BW decreased 73 ± 3 kg ($P < 0.001$; range = -25 to -103 kg), BCS declined 1.5 ± 0.1 units ($P < 0.01$; range = -1.0 to -2.5 units), and SC decreased 1.4 ± 0.2 cm ($P < 0.01$; range = -0.5 to - 4.0 cm), compared to values observed in NFB bulls. Percentage of normal spermatozoa decreased in both UFB and NFB bulls through the observation period. In general, mating proficiency increased and abortive mounting activity decreased as UFB bulls gained mating experience. In UFB bulls, 75% (n = 45) incurred musculoskeletal (n = 38) or reproductive (n = 7) injuries and 42% (n = 19) of the injuries were classified as major (> 4-d duration). Pregnancy palpation of cows from each breeding pasture at 65- to 87-d post-breeding indicated 91 to 95% pregnancy rates (paternal parentage will be determined after calves are born). We conclude that yearling beef bulls used for multiple-sire natural mating exhibit surprisingly high injury rates and large losses in body weight and testis size with declining semen quality during the breeding season. Additional emphasis on increased management and supplemental nutrition is needed in beef bulls used for multiple-sire breeding, and the impacts of injury rate and losses in BW and SC upon individual bull fertility remain to be elucidated.

Key Words: Beef bulls, Natural mating, Testes

569 Semen and libido characteristics in boars given repeated injections of Lutalyse. M. J. Estienne* and A. F. Harper, *Virginia Polytechnic Institute and State University, Blacksburg, VA.*

The objective was to determine the effects of repeated injections of Lutalyse (Pharmacia and Upjohn, Kalamazoo, MI) on semen and libido characteristics in terminal-line boars (1.5 yr of age). Semen was collected once weekly from wk 0 to 21. Gel-free semen volume and gel weight were determined gravimetrically, and sperm concentration, the percentage of motile sperm cells, and sperm velocity were determined using an integrated visual optical system (Hamilton Thorn Research, Beverly, MA). From wk 5 to 21, boars received an i.m. injection of 10 mg Lutalyse (n = 11) or 2 mL vehicle (n = 11) immediately prior to entering the collection room. Gel weight (36.5 ± 0.8 g), sperm concentration (0.33 ± 0.01 billion/mL), total sperm cells (66.2 ± 1.2 billion), motile sperm cells (69.5 ± 1.0 %), and sperm velocity (129.7 ± 1.2 um/sec), were affected by time ($P < 0.01$), but not by treatment or treatment x time ($P > 0.1$). The percentage of morphologically normal sperm cells, assessed at wk 21, was similar ($P > 0.1$) between groups (80.8 ± 1.0). Gel-free semen volume was similar ($P > 0.1$) between groups from wk 0 to 5 (191.3 ± 5.4 mL), but tended to be lower (by up to 23 %) in Lutalyse-treated boars from wk 5 to wk 21 (treatment x time, $P = 0.08$). Libido was evaluated from wk 5 to 21. There was an effect of treatment ($P = 0.04$), but no effect of time or treatment x time ($P > 0.1$) on the period from injection to the first attempt to mount the artificial sow (182.8 ± 30.9 s and 89.3 ± 30.9 s, for Lutalyse- and control boars, respectively). Duration of ejaculation was affected by treatment ($P < 0.01$; 472.0 ± 43.1 s and 280.4 ± 43.1 s, for Lutalyse- and control boars, respectively) and time ($P < 0.01$), but not by treatment x time. The period from injection to the start of ejaculation (225.6 ± 9.1 s) and false mounts (0.8 ± 0.1) were not affected by treatment, time or treatment x time ($P > 0.1$). Overall, there were no dramatic positive or negative effects of long-term treatment with Lutalyse on semen quality and libido in boars.

Key Words: Lutalyse, Semen, Boars

570 Breed effects on immune and endocrine profiles in growing pigs. M. A. Sutherland*, M. Ellis, and J. L. Salak-Johnson, *University of Illinois, Urbana-Champaign, IL.*

The objective of this study was to determine effects of breed and age on baseline immune and endocrine measures, Meishan (n=54), Landrace (n=36), Yorkshire (n=36), Berkshire (n=36) and Duroc (n=18) piglets were weaned at 17 to 21 d and kept in a common facility. Littermates were adjusted to the new environment ≥ 7 d prior to initial blood sample. Samples were obtained via venipuncture at 4, 8 and 12 wk of age to determine plasma cortisol (CORT), chemotaxis (CHTX), phagocytosis, natural killer cytotoxicity (NK), lymphocyte proliferation (LPA), total white blood cell (WBC) and leukocyte differentials. At 4, 8 and 12 wk baseline plasma CORT level was greater ($P < 0.0001$) in Meishan than Yorkshire, Landrace or Berkshire pigs. Durocs had higher ($P < 0.0001$) basal CORT level at 4 and 12 wk compared to Yorkshire, Landrace or Berkshire pigs. Berkshires had a higher ($P < 0.0001$) neutrophil count at 4 wk than any other breed, but there were no other breed or age effects on total WBC or lymphocyte cell counts. At 8 wk of age, Yorkshires had greater ($P < 0.05$) neutrophil phagocytosis than Landrace, Duroc or Meishan pigs. Neutrophil CHTX in response to human C5a was lower ($P < 0.05$) in Berkshires at 4 wk than in Duroc, Landrace or Meishan pigs. At an E:T ratio of 50:1, NK activity was higher ($P < 0.05$) in Yorkshires than in Landrace or Duroc pigs. There were breed and age effects ($P < 0.0001$) for leukocyte differentials. In addition, Meishans gained less ($P < 0.05$) weight after 8 and 12 wk than Duroc, Landrace or Yorkshire pigs. These results indicate that breed and age significantly affect both baseline immune and endocrine traits.

Key Words: Immune, Swine, Breeds

571 Assessments of velvet antler growth rates using digital infrared thermography in red deer stags. S. Bowers*[1], S. Gandy[1], D. Neuendorff[2], T. Dickerson[1], S. Mozisek[2], R. Randel[2], and S. Willard[1], [1]*Mississippi State University, Mississippi State, MS,* [2]*Texas A&M University - TAES, Overton, TX.*

Velvet antler (VA), a by-product of the deer farming industry, is usually harvested based on morphology, conformation and size. However, the use of Digital Infrared Thermal Imaging (DITI) to assess thermal gradients of the antler may permit the harvesting of VA at its peak in the growth phase. The objective of this study was to evaluate whether DITI would pattern VA growth. Antler growth rates, DITI measurements (main beam VA base, mid and tip temperatures), BW and scrotal circumference (SC) were obtained from red deer stags (n=31) every 14-d following eruption (d 0) through d 126. For analysis, antler growth patterns were split into three time points: early, mid and late, or were tested relative to day of eruption. Velvet antler growth rates increased ($P<0.001$) from 0.45 ± 0.03 cm/d in the early period to 0.52 ± 0.04 cm/d in the mid growth period, and decreased ($P<0.001$) to 0.16 ± 0.03 cm/d in the late growth period. Velvet antler DITI changed ($P<0.001$) over time for all stags and differed ($P<0.001$) between base, mid and tip. Base, mid and tip DITI were positively correlated ($R \geq 0.80$) with one another ($P<0.001$),and base, mid and tip DITI were positively correlated to VA growth (R=0.52, R=0.54, R=0.68 respectively, $P<0.001$). During the early growth period, VA temperatures increased ($P<0.05$) from 38.9 ± 0.2 °C at the base to 39.3 ± 0.2 °C at the tip of the antler. In addition, there was a tendency ($P<0.10$) during the

mid growth phase for the tip (38.4 ± 0.3 °C) to have a higher DITI than the base (37.9 ± 0.2 °C) of the antler. In contrast, during the late growth period, DITI was higher (P<0.001) at the base (36.8 ± 0.3 °C) than at the tip (35.7 ± 0.3 °C) of the antler. During the time of VA growth, SC was positively correlated with BW (R=0.70, P<0.001), and increased (P<0.001) from 15.9 ± 0.5 cm on d 0 to 20.5 ± 0.7 cm on d 112. In addition, BW increased (P<0.001) from 113.0 ± 5.4 kg on d 0 to 137.2 ± 6.9 kg on d 112. In conclusion, VA thermogenesis patterned VA growth with higher VA temperatures occurring during the early and mid growth periods, and lower VA temperatures occurring during the late growth period when VA growth began to cease. This suggests that DITI measurements may have value in determining the period of peak VA growth.

Key Words: Red Deer, Velvet antler, Digital infrared thermography

572 Relationship between placental characteristics, delivery parameters and placental retention. A. L. Riddle*[1], H. D. Tyler[1], and J. D. Quigley[2], [1]*Iowa State University, Ames, IA,* [2]*APC Company, Inc., Ames, IA.*

Retained placenta and dystocia are increasing problems within the dairy industry. Optimal delivery conditions can improve overall health status of the calf and dam, along with reducing the incidence of retained placenta. The objectives of this experiment were to determine placental factors that may be associated with dystocia and retained placenta. Calves (n=70) and placentae (n=44) were obtained from Holstein cattle following parturition. Delivery parameters include calving ease scores, duration of parturition, calf weight and parity. Placental characteristics evaluated after expulsion included color index (1-light to 5-dark) of cotyledons located at center and tips of placenta, cotyledon number, placental weight and length of umbilical stump. After delivery, calves were weighed, blood samples were collected to evaluate hematocrit, and the length and diameter of umbilical cords were measured. Multiple regression was used to identify explanatory variables associated with each response variable. Response variables included placental expulsion time, duration of calving, calf weight and calving ease scores (CES). The only factor that significantly affected placental expulsion time was umbilical cord break point (p<0.05). Factors that affected duration of calving included parity (p<0.01), diameter of umbilical stump (p<0.01), calf weight (p<0.0001), total length of umbilical cord (p<0.05) and calf umbilical cord efficiency (calf weight/diameter of umbilical stump) (p<0.0001). Factors affecting CES included color index in center of placenta (p<0.01), color index in tips of placenta (p<0.01), diameter of the umbilical stump (p<0.01), cotyledon number (p<0.05), and umbilical cord break point (p<0.01). Finally, the only factor that affected calf weight was weight of the placenta (p<0.05). The data strongly reflects the relationship between placental factors and delivery parameters.

Key Words: Retained placenta, Calf, Parturition

573 The effect of using of Ovsynch with supplemental GnRH on pregnancy rates of Holstein heifers in the tropics. R. W. Godfrey, R. E. Dodson*, A. J. Weis, and O. T. Isles, *University of the Virgin Islands, Agricultural Experiment Station, St. Croix.*

This study was conducted to evaluate the effect of GnRH given after artificial insemination (AI; day 0) on pregnancy rate (PR) of synchronized Holstein heifers at two times of the year. Heifers were synchronized using Ovsynch in April-May (Spring; n = 30; 16.4 ± 0.2 mo of age) or September-October (Fall; n = 20; 20.2 ± 0.3 mo of age) of 2002. Control heifers (n = 10 per season) received Ovsynch only. In the Spring 10 heifers received GnRH (750 iu, i.m.) on d 5. In the Fall and Spring 10 heifers received GnRH on d 5 and 11. Pregnancy was determined on d 45 by palpation. Rectal temperature (RT) of all heifers was measured for 10 d before and 30 d after AI. Ambient temperature, relative humidity (RH) and temperature humidity index (THI) were measured during this time using data loggers. Percentage of black hair coat (BHC) was determined using image analysis software (Sigma Scan 5.0). Heifers were categorized as dark (> 50% BHC) or light (< 50% BHC). Data were analyzed using GLM procedures of SAS. Ambient temperature and THI were lower (P < 0.05) in the Spring than in the Fall (26.9 ± 0.1 °C and 76.8 ± 0.1 vs 29.1 ± 0.1 °C and 80.1 0.1, respectively) but RH was not different (P > 0.10; 71.9 ± 0.4 vs 72.7 ± 0.4 %, respectively). There was no effect of GnRH treatment or season (P > 0.10) on PR. Heifers had higher RT (P < 0.0001) in the Fall than in the Spring (40.0 ± 0.05 vs 39.5 ± 0.05 °C, respectively). Dark heifers had a lower PR (P < 0.03) than light heifers (42.5 vs 80.0 %, respectively). In the Fall pregnant heifers had lower BHC (P < 0.02) than open heifers (58.8 ± 5.4 vs 77.6 ± 5.7 %, respectively) but there was no difference in the Spring. These results indicate that there is no beneficial effect of supplemental GnRH given post-AI on pregnancy rates of heifers synchronized using Ovsynch. Coat color of heifers had an effect on pregnancy with light colored heifers having a higher PR. Selecting of light colored dairy cattle may be a way of enhancing pregnancy rates under tropical conditions.

Key Words: Heifer, Coat color, Pregnancy

574 The effect of hair coat color on rectal and surface temperatures of Holstein heifers in the tropics. R. W. Godfrey, O. T. Isles*, A. J. Weis, and R. E. Dodson, *University of the Virgin Islands, Agricultural Experiment Station, St. Croix.*

This study was conducted to evaluate the impact of the environment and coat color on rectal and surface temperatures of Holstein heifers. Heifers were evaluated for 40 d during April-May (Spring; n = 30; 16.4 ± 0.2 mo of age) and September-October (Fall; n = 20; 20.2 ± 0.3 mo of age). Ambient temperature, relative humidity (RH) and temperature humidity index (THI) were measured at 10-min intervals using data loggers. Rectal temperature (RT) of heifers was measured every other day. Coat surface temperature (CST) of white and black coat of heifers was measured every other day only during the Fall using an infrared thermometer. Percentage of black hair coat (BHC) was determined using image analysis software (Sigma Scan 5.0). Heifers were categorized as dark (> 50% BHC) or light (< 50% BHC). Data were analyzed using GLM and correlation procedures of SAS. Ambient temperature and THI were lower (P < 0.05) in the Spring than in the Fall (26.9 ± 0.1 °C and 76.8 ± 0.1 vs 29.1 ± 0.1 °C and 80.1 ± 0.1, respectively) but RH was not different (P > 0.10) between Spring and Fall (71.9 ± 0.4 vs 72.7 ± 0.4 %, respectively). Mean and median BHC were 67.6 and 73.3 %, respectively. Heifers had higher (P < 0.0001) RT in the Fall than in the Spring (39.8 ± 0.06 vs 39.2 ± 0.03 °C, respectively). Dark heifers had higher RT (P < 0.0004) than light heifers (39.6 ± 0.03 vs 39.4 ± 0.06 °C, respectively). The CST of black coat was 4.1 ± 0.2 °C higher (P < 0.0001) than CST of white coat. The CST of black coat of dark heifers was higher (P = 0.05) than that of light heifers (43.5 ± 0.2 vs 42.4 ± 0.5 °C, respectively), but CST of white coat was not different (P = 0.08) between dark and light heifers (39.3 ± 0.2 vs 38.6 ± 0.3 °C, respectively). There was a low correlation (P < 0.01; r = 0.175) between RT and CST of white coat but not with CST of black coat (P > 0.10; r = 0.069). The higher RT of dark heifers suggests that selection for white coat color may be useful in mitigating effects of heat stress in dairy cattle in hot climates.

Key Words: Heifer, Coat color, Environment

Ruminant Nutrition: Fats and fatty acids

575 Conjugated linoleic acid (CLA) and milk production. M. A. McGuire*[1] and J. M. Griinari[2], [1]*University of Idaho, Moscow,* [2]*University of Helsinki, Finland.*

Dairy products are an important source of nutrients in the human diet. However, many scientists view dairy fat unfavorably due to the risk of coronary heart disease. A substantial body of literature now demonstrates that fatty acids in dairy fat possess important benefits to human health. Conjugated linoleic acid (CLA) and its precursor, trans-11 C18:1 or vaccenic acid, have been shown to be potent anticarcinogens in various cancer models, and dietary intake and plasma concentrations of these fatty acids are related to a reduced risk of breast cancer. Enhancing the concentrations of CLA in bovine milk would improve the healthful nature of milk fat as well as the perception by the consumer. Conjugated linoleic acid refers to a family of 18 carbon fatty acids with 2 double bonds separated by a single bond. Many isomers exist that arise from biohydrogenation of polyunsaturated fatty acids in the rumen. Desaturation of vaccenic acid within mammary tissue is the main source of cis-9, trans-11 CLA, the principal CLA in milk fat, shown to have anticarcinogenic effects. Another isomer is trans-10, cis-12 CLA produced

in the rumen under conditions that promote milk fat depression. The trans-10, cis-12 CLA potently inhibits lipogenesis as well as reduces tumor formation. Many studies have outlined potential nutritional methods, from altering forage to concentrate ratio to supplementation with various oils, to enrich milk fat with cis-9, trans-11 CLA. The feeding strategies that boost milk fat CLA also increase trans fatty acid content of milk. Although, the increase is attributable mostly to an increase in vaccenic acid, it is not clear how CLA-enriched milk products would be viewed by new food labeling rules. Additionally, feeding a rumen-protected CLA may soon be available. One could enrich milk fat with cis-9, trans-11 CLA to supply a healthy milk niche market, although other feeding methods may be more cost effective. Alternatively, one could provide trans-10, cis-12 CLA to cause milk fat depression. This strategic use may be a tool for management to control energy output or meet milk fat quotas. Vaccenic acid and CLA are minor fatty acids in milk fat important for human health.

Key Words: Milk fat, Conjugated linoleic acid, Vaccenic acid

576 The challenges of supplying omega fatty acids to body tissues of cattle to meet critical metabolic and physiologic functions. T. C. Jenkins* and A. AbuGhazaleh, *Clemson University, Clemson, SC 29634.*

The omega system of describing the double bond position in a fatty acid chain designates the number of carbons between the methyl end of the chain and the closest carbon having a double bond. Oleic acid (omega-9), linoleic acid (omega-6), and linolenic acid (omega-3) with one, two and three double bonds, respectively, are found in low concentrations (mg/g DM) in cereal grains and forages, but in high concentrations in vegetable oils. Fish oils contain high concentrations of two unique omega-3 fatty acids referred to as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) with five and six double bonds, respectively. Tissue desaturases can synthesize omega-9 fatty acids, but not all of the omega-3 or omega-6 acids. Because the omega-3 and omega-6 fatty acids are required for the synthesis of prostaglandins and other physiological regulators, but cannot be synthesized by body tissues, they must come from dietary sources and are considered essential. Even when omega fatty acids are fed to cattle in vegetable or fish oils, their intestinal absorption remains low because of biohydrogenation by ruminal microorganisms. Despite extensive biohydrogenation in the rumen, it is often accepted that cattle fed "normal" diets do not show signs of essential fatty acid deficiency. This assumption has been challenged in recent years based on results that show positive metabolic changes, such as improved reproductive performance, when cattle were fed fat sources high in omega-3 or omega-6 fatty acids. Aside from determining the type and amount of omega fatty acid needed for optimal tissue function, a major challenge is regulating ruminal biohydrogenation to deliver the desired quantity of omega fatty acid at the proper time. Information needed to meet this challenge includes describing in more detail the pathways of biohydrogenation including all intermediates and end products, how the pathways are influenced by environmental conditions in the rumen that accompany diet changes, determining how fatty acid structure can be altered chemically or physically to increase protection from biohydrogenation, and exploring the use of molecular techniques to establish microbial species with altered biohydrogenation activities.

Key Words: Omega fatty acids, Biohydrogenation, Ruminants

577 Increasing milk fat *cis*-9, *trans*-11 Conjugated Linoleic Acid content in pasture-fed cows. J. K. Kay*[1], J. R. Roche[1], N. A. Thomson[1], J. M. Griinari[2], and K. J. Shingfield[3], [1]*Dexcel, New Zealand,* [2]*University of Reading, UK,* [3]*University of Helsinki, Finland.*

More than 90% of *cis*-9, *trans*-11 conjugated linoleic acid (CLA) secreted in the milk of grazing cows is produced from endogenous conversion of *trans*-11 18:1 in the mammary gland. Attempts to manipulate milk fat CLA content in grazing cows have been relatively unsuccessful. This study examined the potential of feeding lipid supplements for 4 weeks to increase milk fat CLA content of cows at pasture. Twenty-eight multiparous Friesian cows in mid lactation were randomly allocated to 1 of 4 dietary treatments; pasture alone (P), or pasture supplemented with 150 g/d fish oil (FO), 350 g/d sunflower oil (SO) or 150 g/d fish oil and 350 g/d SO (FSO). Milk yield and milk protein output were not affected by lipid supplements. Milk protein and fat content and milk fat yield were decreased ($P<0.05$) by FO and SO supplements. Milk fat concentrations of *trans*-10 and -11 18:1 and *cis*-9, *trans*-11 CLA were all increased ($P<0.05$) in response to FO, SO and FSO treatments. The increase in *trans*-11 18:1 and decrease ($P<0.01$) in milk fat 18:0 content suggests that FO supplements inhibited the reduction of *trans* 18:1 fatty acids in the rumen. On the basis of milk fatty acids responses, it appears that *trans*-11 18:1 production in the rumen can be further enhanced when SO is used in combination with FO. In conclusion, fish oil alone or in combination with sunflower oil can be used as an effective supplement for increasing milk fat *cis*-9, *trans*-11 CLA content in grazing cows.

Treatment	P	FO	SO	FSO	SED	FO	SO	FOxSO
						———	*P*	———
Milk yield (kg/d)	26.2	27.3	27.6	27.8	0.81	0.10	0.27	0.47
Fat yield (kg/d)	1.13	1.09	0.99	0.87	0.043	<0.01	0.02	0.22
Protein yield (kg/d)	0.90	0.91	0.91	0.87	0.026	0.44	0.49	0.22
Fat %	4.35	3.95	3.63	3.15	0.149	<0.01	<0.01	0.71
Protein %	3.43	3.33	3.31	3.15	0.049	<0.01	<0.01	0.44
cis-9, *trans*-11 CLA[1]	1.34	3.28	1.55	4.66	0.170	<0.01	<0.01	<0.01
trans-11 18:1[1]	3.96	8.66	5.39	14.91	0.756	<0.01	<0.01	<0.01
trans-10 18:1[1]	0.21	0.54	0.47	1.78	0.275	0.02	0.01	0.10
18:0[1]	10.72	6.48	14.29	5.91	0.636	<0.01	0.04	<0.01

[1]g/100g total fatty acids

Key Words: Pasture, Fish oil, Conjugated linoleic acid

578 Dose response to supplementation with calcium salts of conjugated linoleic acid during the transition period and early lactation. E. Castaneda-Gutierrez*, T. R. Overton, and D. E. Bauman, *Cornell University, Ithaca N.Y.*.

The objective of this study was to evaluate the production response of dairy cows to supplementation with two doses of calcium salts of conjugated linoleic acid (CLA) during the transition period and early lactation. Multiparous Holstein cows (n = 48) were divided into three groups, receiving one of the following treatments: 1) control (271 g/d of calcium salts of palm oil; EnerGII®, Bioproducts Inc.), 2) CLA low dose (CLA-L; 147 g/d of calcium salts of CLA plus 136 g/day of calcium salts of palm oil), and 3) CLA high dose (CLA-H; 295 g/d of calcium salts of CLA). The calcium salts of CLA contained 4.7% *cis*-9, *trans*-11; 4.6% *trans*-8, *cis*-10; 6.2% *trans*-10, *cis*-12; and 6.1% *cis*-11, *trans*-13. Each treatment provided 230 g/d of fat, and was top dressed each day from 2 wk prior to predicted calving until 9 wk postpartum. Milk production and feed intake were recorded daily, milk components determined weekly, and body weight and body condition score were recorded weekly. Over the 9 wk treatment, supplementation with calcium salts of CLA resulted in decreased milk fat percentage *($P<0.05$)* (3.88%, 3.48%, and 3.17% for control, CLA-L and CLA-H, respectively). However, milk fat percent was similar among treatments during the first 3 wk of lactation. Milk fat yield was progressively decreased, averaging 1.65, 1.49 and 1.31 kg/d for control, CLA-L and CLA-H, respectively. This represented a 21% decrease between control and CLA-H *($P<0.001$)*. Milk production did not differ among treatments averaging 43.4, 43.6 and 43.0 kg/day for control, CLA-L and CLA-H, respectively. Secretion of milk protein and milk lactose, feed intake, body weight and body condition score were also unaffected. The supplementation with both doses of calcium salts of CLA induced reduction of milk fat in early lactation, with effects being readily apparent after 3 wk postpartum.

Key Words: CLA, Early lactation, Milk fat depression

579 Comparison of the effect of different rumen protected forms of CLA on milk fat synthesis. M. J. de Veth*[1], J. W. McFadden[1], J. M. Griinari[2], S. K. Gulati[3], N. D. Luchini[4], and D. E. Bauman[1], [1]*Cornell University, Ithaca, NY,* [2]*Clanet Ltd, Espoo, Finland,* [3]*University of Sydney, Rumentek (Pty) Ltd, Australia,* [4]*Bioproducts Inc., Fairlawn, OH.*

Abomasal infusion studies have shown *trans*-10, *cis*-12 conjugated linoleic acid (CLA) decreases milk fat synthesis. However, a delivery that bypasses the rumen will be required for commercial application of

CLA. Rumen protection methods would reduce CLA metabolism in the rumen and increase its supply to the small intestine. Our objective was to compare the efficacy of two forms of rumen-protected CLA at inducing milk fat depression. Three mid-late lactation Holstein cows fitted with a rumen fistula were used in a 3 × 3 Latin square design. Treatments were 1) control, 2) Ca salts of CLA (Ca-CLA), 3) formaldehyde-protected CLA (FP-CLA). Both Ca-CLA and FP-CLA were derived from the same CLA mixture (Natural, Norway) that contained 28% *cis*-9, *trans*-11 and 27% *trans*-10, *cis*-12 CLA (as proportion of lipid). Treatments were designed to deliver 10 g/d *trans*-10, *cis*-12 CLA and infused intraruminally once per day. Treatment periods were 7 d with an 8 d interval between periods. Milk fat yield was reduced ($P < 0.01$) for CLA treatments compared to control, as was FP-CLA compared to Ca-CLA ($P = 0.01$). Milk fat content showed the same pattern of response as observed for milk fat yield. Relative to control (0.77 kg/d), milk fat yield of Ca-CLA decreased by 34% and FP-CLA decreased by 44%. CLA treatment had no effect ($P > 0.28$) on DMI and milk protein yield, but a small decline in milk yield (8%) occurred. The decrease in milk fat yield for CLA treatments was due to reductions in both *de novo* fatty acid synthesis and preformed fatty acids utilisation because yield of all fatty acids was reduced ($P < 0.01$). Likewise the lower milk fat yield for FP-CLA relative to Ca-CLA involved reductions in fatty acids of most chain lengths. *Trans*-10, *cis*-12 CLA levels in milk fat increased ($P < 0.01$) from < 0.01% in controls to 0.07% for Ca-CLA and 0.18% for FP-CLA. Efficiency of transfer of abomasally infused *trans*-10, *cis*-12 CLA into milk fat was 3.2% and 7.0% for Ca-CLA and FP-CLA, respectively. These values are much lower than transfer efficiencies reported for abomasally infused CLA, suggesting much of the two CLA forms were metabolized in the rumen. Overall, results indicate formaldehyde encapsulation of CLA provides greater protection from rumen metabolism than formation of Ca salts.

Key Words: Conjugated linoleic acid, Milk fat depression, Rumen protection

580 Lactational response of cows to different levels of ruminally protected conjugated linoleic acids. R. Gervais*[1], R. Spratt[2], and P. Y. Chouinard[1], [1]*Universite Laval,* [2]*Agribrands Purina Canada.*

Dietary CLA supplements have been shown to reduce milk fat synthesis in dairy cows. This technology may be useful as a tool to produce low fat milk where it is economically feasible. A rumen-protected source of CLA is required for commercial feed applications. The conversion of dietary lipids to a calcium salt (Ca-CLA) is proposed as a method to protect dietary lipids from ruminal biohydrogenation, because Ca-CLA is thought to be insoluble in the rumen. Our objective was to determine whether feeding Ca-CLA under commercial conditions would affect milk production, milk composition and blood metabolic profile. In this multi-site trial, 248 dairy cows from 8 farms were blocked according to the calving date, and randomly assigned to four treatments, which consisted of four doses of Ca-CLA, providing 0, 8, 16 and 32 g/d of CLA. The predominant CLA isomers were *trans*-8, *cis*-10 (5%), *cis*-9, *trans*-11 (34%), *trans*-10, *cis*-12 (37%), and *cis*-11, *trans*-13 (12%). Experimental period was 42-d in length. Milk production was recorded and milk was sampled on days 0, 7, 14, 28 and 42 of the feeding period. Blood samples were taken on day 42 from early lactating cows (<157 DIM) to determine the metabolic profile. Milk fat yield was decreased 11, 16 and 34%, and milk fat concentration was reduced linearly 16, 21 and 29% (linear; $P<0.01$) when cows received 8, 16 and 32 g/d of CLA, respectively. Milk yield and milk protein content and yield were not affected by treatments. The addition of Ca-CLA decreased the milk fat content of short- and medium-chain fatty acids, and increased the proportions of long-chain fatty acids (linear; $P<0.01$). The concentration of *trans*-10, *cis*-12 CLA increased in milk fat ($P<0.01$), and there was no change in *cis*-9, *trans*-11 CLA. Blood parameters (glucose, urea, total protein, albumin, globulin, Ca, P, Mg, creatinine, total bilirubin, aspartate amino transferase, creatine kinase, alkaline phosphatase, alanine transaminase) were not affected. Ca-CLA can be used as an effective tool to manipulate milk fat content on commercial dairy farms.

Key Words: Conjugated linoleic acid, Milk fat, Rumen protection

581 Synthesis of Trans fatty acids and isomers of Conjugated Linoleic Acid in the rumen of cows fed grass silage based diets supplemented with rapeseed, soybean and linseed oil. K. J. Shingfield*[1], S. Ahvenjärvi[2], V. Toivonen[2], P. Huhtanen[2], and J. M. Griinari[3], [1]*School of Food Biosciences, The University of Reading, UK,* [2]*Animal Production Research, MTT Agrifood Research Finland, Jokioinen, Finland,* [3]*Department of Animal Science, University of Helsinki, Finland.*

Based on in vitro incubations and measurements of fatty acids in digesta, it is increasing evident that biohydrogenation of unsaturated fatty acids in the rumen results in the formation of a wide range of trans C18:1 fatty acids and isomers of conjugated linoleic acid (CLA). This study attempted to identify the origin of biohydrogenation intermediates produced in the rumen using supplements of rapeseed (R), soybean (S) and linseed (L) oil as a source of cis-9 C18:1, C18:2 (n-6) and C18:3 (n-3), respectively. Four lactating cows fitted with rumen cannula were used in a 4 x 4 Latin square with 14 d experimental periods. Cows were offered 18 kg DM/d of a basal (B) diet consisting of grass silage and a cereal based-concentrate (60:40; forage:concentrate ratio, on a DM basis) alone or supplemented with 500 g of R, S or L. The flow of fatty acids leaving the rumen was assessed using the omasal sampling technique and a triple indigestible marker method. Oil supplements had no effect on DM intake, but shifted rumen fermentation towards propionate and butyrate at the expense of acetate, and increased the flow of C18:0 (280, 632, 634 and 581 g/d for B, R, S and L, respectively), trans C18:1 (42, 112, 133 and 151) and CLA (4.5, 5.7, 7.9, 7.4) entering the omasal canal. Quantitatively, trans-11 was the most important isomer accounting for proportionately 0.44, 0.33, 0.38 and 0.37 of total trans C18:1 flow, for B, R, S and L, respectively. Similarly, cis-9, trans-11 was the most abundant CLA isomer (0.66, 0.66, 0.73 and 0.47). Ruminal synthesis of trans-4, 5 and 6-8 C18:1 was increased by higher cis-9 and cis-11 C18:1 intakes. Formation of trans-10 and cis-12 C18:1, trans-10, trans-12; trans-9, trans-11; trans-8, trans-10; trans-10, cis-12 and cis-9, trans-11 CLA was increased in response to dietary C18:2 (n-6), while C18:3 (n-3) stimulated the formation of trans-13-14, -15 and -16 C18:1, trans-12, trans-14; trans-11, trans-13 and cis-12, trans-14 CLA biohydrogenation intermediates.

Key Words: Trans fatty acids, Conjugated linoleic acid, Biohydrogenation

582 WITHDRAWN. , .

583 Effect of alfalfa forage preservation method and particle length on performance of dairy cows fed corn silage-based diets and tallow. S. G. Onetti, S. M. Reynal, and R. R. Grummer*, *UW - Madison.*

A study was conducted to evaluate the effect of including alfalfa preserved either as silage or long-stem or chopped hay on DMI and milk fat production of dairy cows fed corn silage-based diets with supplemental tallow (T). Fifteen Holstein cows that averaged 117 DIM were used in a replicated 5 x 5 Latin square design with 21 d periods. Treatments (DM basis) were: 1) 50% corn silage: 50% concentrate without T (CS); 2) 50% corn silage: 50% concentrate with 2% T (CST); 3) 25% corn silage: 25% short alfalfa hay: 50% concentrate with 2% T (SAHT); 4) 25% corn silage: 25% long alfalfa hay: 50% concentrate with 2% T (LAHT); 5) 25% corn silage: 25% alfalfa silage: 50% concentrate with 2% T (AST). Diets averaged 16.4% CP and 30.3% NDF. Mean particle size of SAHT and AST was 3.4 and 3.6 mm, respectively. Including 2% T in diets with corn silage as the sole forage source decreased DMI and milk fat % and yield. Replacing part of corn silage with alfalfa in diets with 2% T increased milk fat % and yield. Milk fat of cows fed CST was higher in *trans*-10 C18:1 than that of cows fed diets with alfalfa. No effect of alfalfa preservation method or hay particle length was observed on DMI and milk production. Milk fat % and yield were lower, and proportion of *trans*-10 C18:1 in milk fat was higher for cows fed LAHT than for cows fed SAHT. Alfalfa preservation method had no effect on milk fat yield. Replacing corn silage with alfalfa increased rumen pH. Rumen pH was higher for cows fed LAHT than SAHT. Feeding alfalfa silage or chopped hay appears to be more beneficial than long hay in sustaining milk fat production when 2% T is fed with diets high in corn silage.

	CS	CST	Diet SAHT	LAHT	AST	Statistical contrast ($P <$) A	B	C	D
DMI, kg/d	27.3	26.1	26.7	26.6	26.5	0.08	NS	NS	NS
Rumen pH	6.23	6.26	6.32	6.40	6.31	NS	0.02	0.03	NS
Milk, kg/d	44.9	44.3	44.8	44.3	43.6	NS	NS	NS	NS
Fat, kg/d	1.4	1.2	1.4	1.3	1.5	0.01	0.01	0.10	NS
Fat, %	3.1	2.7	3.2	3.0	3.3	0.01	0.01	0.03	0.10
trans-10 C18:1, %	0.8	2.2	1.0	1.7	0.8	0.01	0.01	0.01	NS

[1]A = CS vs. CST; B = CST vs. SAHT + LAHT + AST; C = SAHT vs. LAHT; D = SAHT vs. AST.

Key Words: Tallow, Milk fat, Alfalfa and particle length

584 Effects of feeding raw, micronized and extruded flaxseed on rumen fermentation parameters and nutrient utilization by lactating dairy cows. C. Gonthier*[1], A. F. Mustafa[1], D. R. Ouellet[2], R. Berthiaume[2], and H. V. Petit[2], [1]*Macdonald Campus of McGill University,* [2]*Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada.*

Four ruminally and duodenally cannulated multiparous lactating Holstein cows (average BW 595 ± 70 kg, average DIM 225 ± 35) were used in a 4 x 4 Latin square experiment to investigate the effects of feeding unheated, micronized and extruded flaxseed on nutrient utilization and ruminal fermentation parameters of dairy cows. Four diets were formulated; a control diet with no flaxseed (NF), an unheated flaxseed diet (RF), a micronized flaxseed diet (MF) and an extruded flaxseed diet (EF). The flaxseed diets contained 6% fatty acids while NF contained 3% fatty acids (DM basis). All diets were formulated to be isonitrogenous. Results showed that feeding flaxseed had no effect on DMI, ruminal pH or NH_3-N concentration. Duodenal flow of DM was lower ($P < 0.05$) for cows fed EF compared with the other dietary treatments. Cows fed EF had a higher ($P < 0.05$) ruminal degradability of DM, OM and gross energy and a lower ($P < 0.05$) ruminal degradability of fatty acid compare with those fed MF. Ruminal CP degradability was higher ($P < 0.05$) for cows fed EF than for those fed the other dietary treatments. Intestinal digestibility of DM and CP were higher ($P < 0.05$) for cows fed MF than for cows fed NF or EF. Feeding RF also increased ($P < 0.05$) intestinal digestibility of CP relative to feeding NF or EF. Whole tract DM, OM, CP and NDF digestibilities were all higher ($P < 0.05$) for cows fed flaxseed diets than for cows fed NF. No differenced in whole tract nutrient digestibilities were found between cows fed EF and those fed MF. We concluded that inclusion of flaxseed in dairy cow diets up to 2 kg of the diet DM increased whole tract nutrient utilization by dairy cows with no negative effects of ruminal fermentation. Micronization can be used to increase ruminal undegraded protein content in flaxseed while extrusion can be used to increased nutrient availability in the rumen.

Key Words: Flaxseed, Heat treatment, Nutreint utilization

585 Effects of rumen-inert fat saturation on feed intake, milk production, and plasma metabolites in lactating dairy cows. K. J. Harvatine* and M. S. Allen, *Michigan State University, East Lansing.*

Saturated (SAT) and unsaturated (UNSAT) rumen-inert fat sources were evaluated for effects on feed intake, milk yield, and plasma metabolites. Eight ruminally and duodenally cannulated multiparous Holstein cows (77± 12 DIM) were used in a duplicated 4x4 Latin square design with 21 d periods. Treatments were control (CON) and a linear titration of 2.5% added rumen-inert fatty acids (FA) varying in unsaturation; SAT (prilled FA, Energy Booster 100®), 50:50 ratio of SAT and UNSAT (calcium soaps of long chain FA, Megalac R®), and UNSAT. Experimental diets were 40% forage and contained 27.5% NDF, 30% starch and 2.5% FA from supplemental vegetable fat (14% cottonseed). Fat treatments increased gross energy (GE) of the diet 8.2%. Increasing fat saturation increased milk yield 2.9 kg/d, however there were no treatment effects of concentration or type of fat on 3.5% FCM, SCM or energy corrected milk. Yield of milk components and milk composition were not affected by treatment. Negative effects of fat supplementation on DMI increased linearly as UNSAT increased (25.8, 24.5, 24.1, 23.0 kg/d for CON, SAT, 50:50, and UNSAT, respectively). Dry matter intake for SAT was not different from control while UNSAT decreased DMI relative to control ($P < 0.05$). UNSAT linearly decreased DMI up to 1.5 kg/d ($P < 0.05$) and tended to decrease GE intake up to 3.94 Mcal/d ($P <0.10$) compared to SAT. Wet weight of rumen contents tended to decrease 8.9% with rumen inert fat treatments compared to CON ($P < 0.1$) and decreased linearly by UNSAT compared to SAT ($P < 0.05$). Plasma NEFA, BHBA and glucose also were not affected by level or type of fat. UNSAT linearly increased empty body weight gain up to 0.84 kg/d ($P = 0.01$) and NE_L gain 3.9 Mcal/d calculated from empty body weight ($P = 0.02$) compared to SAT. Fat supplementation with rumen-inert fat sources had no effect on milk yield or composition but type of fat affected DMI and tissue energy gain.

Key Words: Rumen-inert fat, Saturation, Hypophagic effects

586 Interrelationships of hepatic palmitate and propionate metabolism, liver composition, blood metabolites, and cow performance. M. S. Piepenbrink* and T. R. Overton, *Cornell University, Ithaca, NY.*

Measurements (n=27) from 95 cows in previous experiments conducted in our laboratory were used to evaluate the potential relationships between liver triglyceride content (TG), liver metabolism, blood metabolites, and cow performance. Initially, data was subjected to Pearson correlation analysis. Those variables that were significantly ($P < 0.05$) correlated with TG on d1 and 21 postpartum were used to develop equations for predicting liver TG content. Variables were removed from multiple regression analysis in a stepwise, backward fashion until all variables had a probability of a greater $F < 0.05$. For TG on d1 postpartum, the TG 21d prepartum, the capacity of liver to store [1-^{14}C]palmitate intracellularly (SEP) 21d prepartum, the capacity of [1-^{14}C]propionate conversion to CO_2 (POx) on d1 postpartum, the area under the curve for concentration of NEFA in plasma from d7 prepartum to d21 postpartum (NAUC), and the area under the curve for βHBA from d7 prepartum to d21 postpartum (BAUC) remained significant resulting in the equation TG_1 ($r^2 = 0.61$). For TG on d21 postpartum, TG on d21 prepartum and d1 postpartum, capacity of liver to convert [1-^{14}C]propionate to glucose 21d postpartum (GNG), calving body condition score (BCS_c), and NAUC were significant resulting in the development of the equation TG_{21} ($r^2 = 0.51$). Other correlations suggested relationships between TG and GNG (r = -0.39 and #0.48 for d1 and d21), cumulative DMI from d-7 to +21 (r= -0.37 and #0.35 for d1 and d21), BCS_c (r = 0.29 and 0.36 for d1 and d21) and BW change from calving to 3 wk postpartum (r = -0.33 and #0.34 for d1 and d21). These findings reemphasize the importance for optimal BCS for cows at calving to reduce the severity of fatty liver and confirm the negative relationship between liver TG accumulation and gluconeogenic capacity.

$TG_1 = -8.6245 + (1.8047 \times \text{TG-21}) + (0.0284 \times \text{SEP}) - (0.0006 \times \text{POx}) + (0.0002 \times \text{NAUC}) + (0.0041 \times \text{BAUC})$

$TG_{21} = -26.4965 + (2.1958 \times \text{TG-21}) + (0.4472 \times \text{TG1}) + (0.0014 \times \text{GNG}) + (6.6574 \times BCS_c) + (0.0005 \times \text{NAUC})$

Key Words: Periparturient cow, Liver

Ruminant Nutrition: Additives, enzymes and feedstuff analysis

587 Effects of cinnamaldehyde, garlic and monensin on nitrogen metabolism and fermentation profile in continuous culture. M. Busquet[1], S. Calsamiglia*[1], A. Ferret[1], and C Kamel[2], [1]*Universidad Autonoma de Barcelona, Spain,* [2]*University of Leeds, UK.*

Eight 1.3-L dual flow continuous culture fermenters were used in three periods (10 d) to study the effects of natural plant extracts on N metabolism and fermentation profile. Fermenters were fed 95 g/d of a 50-50 forage-to-concentrate diet. Treatments were: no additive (Negative Control, NC), Monensin (4 or 40 mg/d per fermenter, M and M10), Cinnamaldehyde (100 or 1000 mg/d per fermenter, CI and CI10) and Garlic (100 or 1000 mg/d per fermenter, G and G10). Fermenters were maintained at constant temperature (39 C), pH (6.4) and solid (5%/h) and liquid (10%/h) dilution rates. Each day, a sample was taken 2 h after the morning feeding for the determination of peptide N (Pep-N), aminoacid N (AA-N), ammonia N (NH3-N) and volatile fatty acids (VFA). During the last 3 days, samples were taken at 0, 2, 4 and 6 h

after the morning feeding, and analyzed for Pep-N, AA-N and NH3-N concentrations. Data were analyzed using the PROC MIXED (SAS, 1996) and significance declared at $P < 0.05$. Total VFA (mM) was higher in M10 (128.7) compared with NC (119.0). Acetate proportion (mol/100mol) was lower for CI (58.6), G (59.6), G10 (48.3) and M10 (46.1) compared with NC (63.1). Propionate proportion (mol/100mol) was higher in CI (23.6), G10 (27.1) and M10 (45.3) compared with NC (19.8). Butyrate proportion (mol/100mol) was higher in G10 (18.3) and lower in M10 (4.1) compared with NC (10.3). The Pep-N concentration across all hours (mg/100ml) was similar in all treatments. The AA-N concentration across all hours (mg/100ml) was higher in G10 (4.6) and M10 (4.4) compared with NC (1.9). The NH3-N concentration across all hours (mg/100ml) was lower in M10 (13.0) compared with C (19.2). The CI and G10 modified propionate and acetate proportions in the same direction as M10. However, the higher proportion of butyrate observed in G10 compared with M10 suggests a different mechanism of action may be involved. The accumulation of AA-N, and the decrease in NH3-N in M10 suggests that deamination was inhibited.

Key Words: Rumen fermentation, Monensin, Cinnamaldehyde

588 Malate in concentrate improves growth performance and digestibility of intensively fattened lambs. C. Flores[1], G. Caja*[1], R. Romero[1], and J. Mesia[2], [1]*Universitat Autonoma de Barcelona,* [2]*Norel & Nature Nutrition, Spain.*

Malate (Rumalato®; Norel & Nature) as a feed additive was evaluated in a total of 76 Manchega and Lacaune lambs. After weaning (35 d of age), lambs were allotted in balanced groups and fed ad libitum with a pelletized concentrate (18.2% CP; 1.82 Mcal NE/kg, DM basis) and chopped barley straw. Four types of concentrate were prepared according to the inclusion of malate (0.2% in concentrate) and type of cereal (barley or corn). Treatments were: B (barley); BM (barley-malate); C (corn); and, CM (corn-malate). In Exp. 1, 64 lambs (16.4 kg BW) were kept in straw bedded pens and used in a 2×2 factorial design with two repetitions to evaluate growth performances and rumen traits at slaughtering (26 kg BW). In Exp. 2, the same diets were used in 12 male lambs (14.9 kg BW) to study the nutrient digestibility in a 4×4 Latin square design. Eight lambs (two per diet) were randomly assigned to each treatment and kept in metabolic crates for four periods of 21 d. The remaining lambs were maintained as a reserve group. Malate improved fattening performance, ruminal pH and mucosa traits in Exp. 1, but days at slaughtering (32 d) did not vary. In Exp. 2, digestibility of nutrients and energy also increased by effect of malate. Concentrate type had less effect than malate. Use of Rumalato® (0.2%) is recommended as a feed additive in intensively fed lambs. Results (LSM means) of both experiments were:

Item	Treatments				Effects (P<)	
	B	BM	C	CM	Malate	Concentrate
Exp. 1 (n=64)						
ADG, g/d	259^{b}	330^{a}	299^{ab}	307^{ab}	0.013	0.616
DMI, kg/d	0.948^{a}	0.923^{a}	0.913^{a}	0.844^{b}	0.007	0.047
Feed conversion rate	3.80^{a}	2.87^{b}	3.25^{b}	2.90^{b}	0.002	0.240
Ruminal pH	6.87^{b}	7.05^{ab}	6.93^{ab}	7.13^{a}	0.017	0.320
Exp. 2 (n=8)						
Digestibility, %						
DM	78.1^{b}	82.1^{a}	79.3^{b}	83.1^{a}	0.001	0.399
OM	81.0^{b}	84.5^{a}	82.2^{b}	85.6^{a}	0.001	0.288
CP	78.3^{b}	82.2^{a}	76.1^{b}	81.2^{a}	0.001	0.237
NDF	39.8^{b}	49.7^{a}	42.1^{b}	48.6^{a}	0.001	0.491
ADF	47.4^{b}	55.9^{a}	54.9^{a}	59.2^{a}	0.017	0.007
GE	80.6^{b}	83.4^{a}	81.4^{b}	84.5^{a}	0.003	0.344

^{a,b}: $P<0.05$

Key Words: Malate, Feed additives, Digestibility

589 Effects of fibrolytic enzyme supplementation on the performance of growing cattle fed bermudagrass hay and molasses-based liquid supplements. B. R. Austin*, D. O. Alkire, T. A. Thrift, and W. E. Kunkle, *University of Florida, Gainesville, FL.*

One hundred and sixty Angus x Brahman crossbred yearling steers and heifers (initial BW=285 kg) were utilized to study the effects of five commercially available fibrolytic enzymes (cellulase, xylanase, beta-gluconase) on weight gain in growing cattle. All calves received a basal diet of bermudagrass hay (ad libitum, average intake 6.22kg/d) and 2 kg DM/d sugar cane molasses supplement, containing urea, vitamins and minerals. Calves were randomly assigned by sex and breed type to 32 pastures (0.8 ha, four pastures/treatment) with five cattle per pasture. Treatments included the basal diet fed without (Control) or with the following enzyme supplements: 1.5 or 3 g/d of Cattle-ase HR (CAT), or 0.12 g/d of Biocellulase A20 (A20), or 0.12 g/d of Biocellulase A20 and 0.06 g/d of Biocellulase X20 (A20/X20), or 2 or 4 g/d of Promote N.E.T.™ (PRO), or 15 g/d of Fibrozyme® (FIB). Additionally, the effects of a methionine hydroxy-analog (Alimet®) were examined by splitting each treatment group in half (two pastures), with one half receiving 12.5g /d Alimet® in the molasses supplement and the other half not receiving Alimet®. Trial duration was 113 days (December 12, 2001-April 2, 2002). Data were analyzed using the PROC Mixed function of SAS. Supplementation with fibrolytic enzymes had no effect (P=0.62) on gains as compared to control (0.49 kg/d vs. 0.50 kg/d). Cattle weight gains did not express a treatment by Alimet® interaction (P=.91). Supplementation of cattle with Alimet® had no effect (P=.58) on weight gains as compared to unsupplemented cattle (.50 kg/d vs. 0.49 kg/d). Supplementation with A20 and A20/X20 tended to increase (P=.08) gains over cattle supplemented with CAT at 1.5 g/d and 3 g/d (.54 kg/d vs. .47 kg/d). Supplementation with A20 and A20/X20 increased (P=.05) gains over cattle supplemented with PRO at 2 g/d and 4 g/d (.54 kg/d vs. .46 kg/d). Supplementation with enzymes had no effect (P=.50) on change in height as compared to control (6.62 cm vs. 5.98 cm). Supplementation of growing cattle with fibrolytic enzymes had no effect on animal performance as compared to control.

Key Words: Beef Cattle, Enzymes, Supplementation

590 Effect of fibrolytic enzyme preparations containing esterase, cellulase, and endogalacturonase activity on the digestibility of mature, tropical grass hays. N. Krueger*, D. Dean, W. Krueger, C. Staples, and A. Adesogan, [1]*University of Florida, Gainesville, FL USA.*

This study examined the effect of applying an enzyme complex (Depol 670L, Biocatalyst, UK) containing high esterase (7 U/ml), cellulase (1200 U/g), and endogalacturonase (800 U/g) activities on the digestibility of three tropical grass hays. The enzyme was applied in liquid form at 0, 0.5, 1, 2, or 3 (g/100g DM) to hay produced from 12-wk regrowths of Common bahiagrass (B) (*Paspalum notatum*), Coastal bermudagrass (C) (*Cynodon dactylon*), and Tifton 85 bermudagrass (T)(*Cynodon dactylon*)24h before in vitro digestion. Substrates were incubated in triplicate for 6, 24, and 48 h in buffered, ruminal fluid within Ankom Daisy II incubators. Treatments were arranged in a 3 x 5 factorial design with each hour of incubation analyzed separately. The experiment was repeated three times and ruminal fluid used was collected from two cows fed bermudagrass hay supplemented with 0.4 kg/d of soybean meal. Increasing the enzyme application rate resulted in a quadratic increase (P = 0.005) in IVDMD of B (135, 155, 169, 188, and 177 g/kg), C (175, 195, 204, 205, and 224 g/kg), and T (103, 110, 121, 143, and 145) hays at 6 h and in a linear increase (P = 0.007) in IVDMD of B (493, 501, 513, 520, and 521 g/kg), C (479, 487, 495, 504, and 512 g/kg), and T (486, 478, 481, 508, and 506 g/kg) at 48 h. Increasing enzyme application rate also resulted in quadratic increases (P = 0.001) in NDF digestibility (IVNDFD) of B (15, 26, 53, 37, and 36 g/kg), C (46, 41, 51, 38, and 59 g/kg), and T (19, 17, 30, 41, and 33 g/kg) at 6 h. At 6 h, optimum IVNDFD for B was at the 1% application rate but that for the C and T hays was at the 3 and 2% rates respectively (B vs. (C + T) by quadratic interaction (P = 0.030) and C vs. T by quadratic interaction (P = 0.076)). The main effect of enzyme addition on IVNDFD at 24 and 48 h was not significant. This work demonstrates the potential of fibrolytic enzymes for enhancing the digestion of tropical grass hays.

Key Words: Tropical grass, Esterase, Cellulase

591 Effect of fibrolytic enzyme preparations containing high esterase activity on the digestibility of mature, tropical grass hays. N. Krueger*, D. Dean, W. Krueger, C. Staples, and A. Adesogan, *University of Florida. Gainesville, FL USA.*

This study examined the effect of applying an enzyme preparation (Depol 740, Biocatalyst, U.K.) containing high esterase (32 U/ml) activity

on the in vitro digestibility of three tropical grass hays. The enzyme was applied at 0, 0.5, 1, 2, and 3 (g/100g DM) on the in vitro digestion of hay produced from 12-wk regrowth of Common bahiagrass (B), Coastal bermudagrass (C), and Tifton 85 bermudagrass (T) 24 h before in vitro digestion. Forages were incubated in triplicate for 6, 24, and 48 h in buffered, ruminal fluid within Ankom Daisy II incubators. Treatments were arranged in a 3 x 5 factorial design with each hour of incubation analyzed separately. The experiment was repeated three times and ruminal fluid used was collected from two cows fed bermudagrass hay supplemented with 0.4 kg/d of soybean meal. The IVDMD of B (133, 159, 165, 156, and 182 g/kg), C (180, 185, 178, 207, and 212 g/kg) and T (99, 113, 97, 149, and 159 g/kg) at 6 h increased linearly (P = 0.001) as the enzyme application rate increased. The increase in IVDMD at the 2% application rate was greater for T compared to C (C vs. T by quadratic interaction, P = 0.018). Likewise, the IVDMD of C at 48 h tended to increase linearly as enzyme application increased (487, 484, 489, 506, and 510 g/kg) but that of T at 48 h was unaffected (485, 481, 478, 485, and 497 g/kg) (C vs. T by linear interaction, P = 0.069). The NDF digestibility (IVNDFD) of T at 6 h (41, 34, 29, 61, and 72 g/kg) increased linearly with increasing enzyme addition whereas that of C (56, 58, 41, 75, and 63 g/kg) did not increase (C vs. T by linear interaction, P = 0.011). The IVNDFD of B at 24 h (325, 310, 330, 270, and 373 g/kg) increased linearly whereas that of C (305, 280, 299, 300, and 284 g/kg) and T (310, 338, 304, 337, and 331 g/kg) were unaffected by increasing enzyme addition (B vs (C + T) by linear interaction (P = 0.036). In conclusion, the enzyme enhanced the digestion of the hays but the pattern and extent of the improvement was forage specific.

Key Words: Tropical grass, Esterase, Digestion

592 The potential for enhancing the digestion of C4 grass hays with proprietary fibrolytic enzymes. D. Dean*, N. Krueger, L. Sollemberger, and A. Adesogan, [1]*University of Florida, Gainesville, FL/USA*.

This trial examined the effect of applying four proprietary cellulase/hemicellulase enzymes on the digestibility of two tropical grasses. Promote (P), Biocellulase X-20 (X), Cattle-Ase (CA) and Biocellulase A-20 (A), were applied at: 0, 0.5x, 1x and 2x the recommended rates on hays produced from 12 week regrowths of Coastal bermudagrass (BE) (*Cynodon dactylon*) and Common bahiagrass (*Paspalum notatum*) (BA) and the hays were stored for three weeks. In vitro digestibility of dry matter (IVDMD) and neutral detergent fiber (IVNDFD) were calculated after digesting the hays in buffered rumen fluid for 6 or 48 h in two ANKOM^{II} Daisy Incubators. Separate randomized complete block designs were used to quantify the effects of enzyme application on each hay at each period. Increasing the enzyme application rate produced linear and quadratic increases (P<0.01) in 6h IVDMD in BE hays treated with X (72.1, 89.6, 98.5 and 93.4 g/kg) and A (72.1, 121.8, 137.5 and 119.5 g/kg), and linear increases (P<0.01) in BE hays treated with CA (72.1, 75.9, 88.2 and 91.6 g/kg) at 6h and X at 48 h (410.3, 501.7, 518.9 and 534.2 g/kg) respectively. As enzyme application increased, IVNDFD was increased (P<0.01) linearly in BE hays treated with P at 6 h (41.0, 47.8 56.9 and 70.2 g/kg) and 48 h (429.9, 460.9, 442.8 and 492.1 g/kg) but a linear decrease (P<0.05) occurred in BE hays treated with CA at 48 h. BA hays treated with CA (129.6, 122.2, 112.3 and 144.8 g/kg) had linear (P<0.05) increases in 6h IVDMD as enzyme application increased, but a cubic (P<0.05) response was observed in BA hays treated with A at 48 h. There was a quadratic (P<0.05) increase in 6h IVNDFD of BA hays treated with P, and a linear increase (P<0.05) in that of BA hays treated with A. There were also cubic (P<0.05) responses in the 48h IVNDFD of BA hays treated with P and A at 48 h. This work shows that some fibrolytic enzymes complexes can enhance digestion of C4 grasses. However, improvements vary with digestion stage and forage type.

Key Words: Enzymes, Digestibility, C4-grasses

593 Effects of dietary sodium bicarbonate and sodium chloride on ruminal pH and digesta characteristics in dairy cows. C. S. Mooney* and M. S. Allen, *Michigan State University, East Lansing*.

Six ruminally and duodenally cannulated, mid-lactation (176 ± 12 DIM, mean ± SD) Holstein cows were used in a duplicated 3 x 3 Latin square design to evaluate effects of sodium bicarbonate on ruminal characteristics. Periods were 28 d in length with the last 14 days for data and sample collection. Treatments were control, sodium bicarbonate at 1% of dietary DM, and an isomolar concentration of sodium chloride. Each diet contained a common base mix (95% of diet DM) to which treatment premixes (5% of diet DM) were added. The control premix was composed of 50% finely ground dry corn and 50% ground rice hulls on a DM basis. Sodium bicarbonate and sodium chloride were included in place of rice hulls in their respective premixes. Diets were formulated to 20% forage NDF and 17.5% CP. Ruminal pH was measured every 5 seconds for 5 days by indwelling pH probes. Mean ruminal pH was 6.2 and was not affected by treatment (P= 0.97), nor was any other measure of pH (minimum, maximum, range, standard deviation, or time or area under pH 5.5, 5.8, or 6.0; $P > 0.28$). Dry matter intake and 3.5% FCM were similar across treatments (23.8 and 35.7 kg/d, respectively). Mean milk fat concentration was 3.51% and was not affected by treatment. Both sodium treatments increased water intake compared to control (103.8 vs. 98.6 L/d, italicizeP = 0.05) but there was no difference between sodium treatments ($P = 0.83$). Volume of rumen contents was increased by sodium bicarbonate compared to control (102.8 vs. 90.3 L, $P = 0.02$) but not by sodium chloride ($P > 0.50$). Density of ruminal contents was greater for sodium chloride compared to sodium bicarbonate (0.87 vs. 0.81 kg/L, $P < 0.01$). Differences in effects of the two sodium treatments on ruminal digesta volume and density might be because of their osmotic effects on water and DM turnover in the rumen. Lack of effect of sodium bicarbonate on ruminal pH or milk fat concentration was probably because buffering capacity of bicarbonate was in excess for all treatments.

Key Words: Sodium bicarbonate, Sodium chloride, Ruminal characteristics

594 Feeding fibrolytic enzymes to enhance DM and nutrient digestion, and milk production by dairy cows. P. Mandebvu*[1], C. S. Ballard[1], M. P. Carter[1], K. W. Cotanch[1], C. J. Sniffen[1], T. Sato[2], K. Uchida[2], A. Teo[3], U. D. Nhan[3], and T. H. Meng[3], [1]*W. H. Miner Agricultural Research Institute, Chazy, NY,* [2]*ZENNOH National Federation of Agricultural Co-operative Associations, Tokyo, Japan,* [3]*Kemin Industries (Asia), Pte, Ltd, Singapore*.

Forty-two multiparous Holstein cows (60-180 days in milk) housed in a free-stall barn were blocked by parity and previous 305-d mature equivalent milk production, and randomly assigned to a control TMR or a TMR containing fibrolytic enzymes in a study with a crossover design with two 28-d periods. The enzymes contained primarily cellulase, xylanase and neutral protease activities, and were added as a dry powder to the concentrates prior to addition of forages in the mixer wagon. Enzymes were applied at the rate of 1g/kg of non-forage DM of the Enzyme TMR. TMR comprised of 47-48% forages and 52-53% concentrates, and contained 18% CP and 31-33% NDF. Cows were group-fed by treatment and DM intake for each pen was recorded. During the fourth week of each period, milk production was recorded from all cows, and total tract digestion measured from a subset of animals using chromic oxide as an external marker. Fibrolytic enzymes enhanced digestion of DM, OM, and nonfiber carbohydrates ($P < 0.05$), but had no effect on digestion of CP and fiber or milk yield and composition.

Item	Control	Enzyme	SE	P-value
DMI[1], kg/d	26.7	27.1	...	...
Total tract digestibility, %				
DM	66.6	69.4	0.70	0.027
OM	67.4	70.0	0.74	0.047
CP	62.1	63.3	0.95	0.412
ADF	42.5	42.5	1.39	0.987
NDF	44.1	43.8	1.18	0.904
Hemicellulose	41.1	43.8	2.70	0.511
Cellulose	49.4	48.2	2.03	0.689
Fat	83.1	84.3	0.64	0.228
NFC[2]	89.1	91.4	0.44	0.015
Lactational Performance				
Milk yield, kg/d	43.3	43.3	0.40	0.955
3.5% FCM yield, kg/d	43.6	43.2	0.60	0.641
Milk fat, %	3.57	3.51	0.062	0.550
Milk true protein, %	2.81	2.80	0.009	0.543
Milk lactose, %	4.84	4.84	0.012	0.676
Milk urea N, mg/dl	14.5	14.8	0.25	0.374
SCC[3] x 1000	132.1	99.4	21.20	0.282

[1]Average pen DM intake of group-fed animals. [2]Nonfiber carbohydrates = 100-(ash + NDF + CP + fat). [3]Somatic cell count.

Key Words: Dairy cow, Fibrolytic enzymes, Digestion and milk yield

595 Effect of pH and enzyme supplementation to a total mixed ration on microbial fermentation in continuous culture. D. Colombatto*[1,2], G. Hervas[3], W. Yang[1], and K. Beauchemin[1], [1]*Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada,* [2]*Facultad de Agronomia, Universidad de Buenos Aires, Argentina,* [3]*Estacion Agricola Experimental (CSIC), Leon, Spain.*

The effects of pH and enzyme addition were examined in continuous culture using a 4 x 4 Latin square design, with four 9-d periods consisting of 6 d for adaptation and 3 d for measurements. The buffer pH was adjusted to 100% (high) or 60% (low) of the normal concentration of artificial saliva. Fermenters were fed twice daily a diet consisting of 30% alfalfa hay, 30% corn silage, and 40% rolled corn (DM basis). The silage was milled fresh and the TMR was fed fresh to the fermenters (64% DM). The EM was a protease containing no other major activities, and was applied daily to the TMR, at least 12 h before feeding. Treated feed was stored at 4°C until fed. Ranges of pH were 6.0-6.6, and 5.4-6.0 for high and low, respectively. Degradability of OM, NDF, ADF, and cellulose were reduced ($P < 0.05$) by low pH, but hemicellulose and protein degradation were not affected. EM addition increased ($P < 0.01$) NDF degradability (by 43% and 25% at high and low pH, respectively), largely due to an increase in hemicellulose degradation (by 79% and 51%, respectively). Total volatile fatty acids (VFA) and its molar proportions were decreased ($P < 0.05$) by low pH, but were not affected by EM. Protein degradation was only numerically ($P = 0.17$) increased by EM. Total N flow tended ($P = 0.07$) to be reduced with EM, but neither bacterial nor dietary N flow was affected by the treatments. Microbial protein synthesis was not affected by either pH ($P = 0.29$) or EM ($P = 0.86$). Methane production, expressed as a proportion of total gases, was decreased ($P < 0.001$) at low pH, but was not affected by EM. It is concluded that it is possible to adapt the CC system to use fresh feeds instead of dried feeds. Overall, the results indicate that the EM used in this study has significant potential to increase fiber degradability without increasing methane production.

Key Words: Continuous culture, Digestion, Enzymes

596 Effect of the sequence of fat and antibiotic-ionophores on ruminal fermentation and microbial lipids. M. G. Daves* and V. Fellner, *North Carolina State University, Raleigh, NC.*

Rumen inoculum was obtained from a fistulated cow, filtered, and incubated in 8 dual-flow fermentors. The basal diet consisted of 100 % alfalfa pellets and was offered twice daily (14g DM/d). Cultures were allowed two days of adaptation and then used to test the sequence effects of fat, monensin, and bacitracin addition. On day 3, two fermentors received monensin, two received bacitracin, and the other four received fat. On day 6, fat was added to the cultures receiving monensin and bacitracin, and two of the four fermentors fed fat were offered monensin and the other two bacitracin for an additional three days. A total of four replications were conducted. Data were analyzed using the Mixed procedure of SAS for repeated measurements. Monensin reduced methane 15% and 23% when compared to fat and bacitracin, respectively. Adding monensin prior to fat lowered methane by 22% compared to the addition of fat prior to monensin. Monensin increased ($P < 0.01$) propionate compared to bacitracin but increased valerate ($P < 0.03$) and iso-valerate ($P < 0.0001$) compared to fat. Addition of monensin prior to fat increased ($P < 0.03$) valerate when compared to cultures that received fat prior to monensin. Fat increased ($P < 0.003$) isobutyrate compared to monensin. Isobutyrate was higher in cultures that received bacitracin prior to fat than those that received fat first. Monensin increased ($P < 0.01$) C16:0 compared to fat. Levels of C18:0 ranged between 23mg/g of total FA (monensin) to 30 mg/g of total FA (fat), but the difference was not significant. Cultures receiving monensin had lower concentrations of C18:0 than those receiving bacitracin, but the sequence of fat addition had no effect. The addition of additives and their sequences did not alter total or trans-C18:1 levels. Monensin increased ($P <0.05$) cis-C18:1 compared to bacitracin or fat. When monensin was added prior to fat cis-C18:1 was higher ($P <0.05$) than when fat was added prior to monensin. Monensin, either alone or when added prior to fat, was more effective in altering fermentation compared to bacitracin. Inclusion of fat prior to monensin or bacitracin altered the response to the ionophore-antibiotics.

Key Words: Ionophore-antibiotics, Fat, Continuous cultures

597 Comparison of different starch analysis methods for feedstuffs. K.-H. Suedekum*[1], M. B. Hall[2], and M. Paschke-Beese[1], [1]*University of Kiel, Germany,* [2]*University of Florida, Gainesville.*

The official EU method for starch analysis on feedstuffs is a polarimetric procedure utilizing the optical activity of dispersed starch. For pure starches and high-starch commodities, this method provides reliable and accurate results. When applied to feedstuffs low in starch and high in fiber or protein, reliability is considerably reduced and values often overestimate true starch values. The objective of this work was to compare the polarimetric method with different enzymatic procedures. All enzymatic procedures involved a preliminary digestion step with a heat-stable α-amylase (Termamyl 120 L), dissolved either in a Na-citrate buffer at pH 5.8 or in water, and release of glucose by action of amyloglucosidase in a Na-acetate buffer at pH 4.6. Glucose was quantified subsequently using either phosphorylation or oxidation to gluconic acid. Free glucose was determined in a separate assay to yield unbiased estimates of glucose from starch. Eleven test samples were utilized comprising low-starch (distillers' grains, soybean meal, citrus pulp, total mixed ration with 25% citrus pulp) and high-starch (corn starch, potato starch, hominy feed) commoditites. As a general observation, starch values determined polarimetrically (mean, 48.9% of dry matter) were higher ($P < 0.0001$) than those determined enzymatically (mean, 43.1% of dry matter). Comparisons among enzymatic procedures showed that Na-citrate buffer as an incubation medium for the α-amylase yielded higher starch values than water (44.4 versus 40.5% of dry matter; $P < 0.0001$). Type of quantification of glucose (phosphorylation versus oxidation to gluconic acid) gave the same average starch concentration (43.1% of dry matter; $P = 0.7846$). Results from this study indicate that Na-citrate buffer was better than water as an incubation medium for α-amylase, and that glucose released by α-amylase plus amyloglucosidase action can be quantified by phosphorylation or oxidation. Differences between polarimetric and enzymatic methods, and variation among enzymatic procedures require further investigation.

Key Words: Starch, Feed analysis, Methods

598 A novel technique to assess particle distribution of rations and forages using digital imaging. A. Bach*[1], A. Anglada[1], X. Puigvert[2], and L. Bosch[2], [1]*ICREA-IRTA Dairy Systems, Spain,* [2]*Universitat de Girona, Spain.*

The objective of this study was to develop a simple and efficient technique to determine particle size distribution of forages and total mixed rations (TMR) for dairy cattle using digital imaging. The particle size distribution of different rations from different dairy farms was evaluated using the Penn State Separator and the new digital image technique. The new technique is based on a digital picture from a small sample (about 500 g) of forage or TMR on a black surface. Afterwards, the picture is analyzed with software for digital measurements to determine the length and the area of most of the particles in the picture. Following the analysis, a distribution chart is constructed. The preliminary results indicate that both, the average area of the particles determined digitally and the average particle size determined with the Penn State Separator were correlated with milk fat percentage. However, the correlation was stronger when the particles were analyzed using digital measures ($R^2 = 0.26$; $P = 0.09$) than when using the Pen State Separator ($R^2 = 0.07$; $P = 0.43$). Therefore, digital imaging is a more precise method to estimate the consequences of particle size distributions of TMR on milk fat percentage. The advantage of using digital imaging vs the Penn State Separator is that the former provides reliable results even with wet TMR. In several occasions, the Penn State Separator failed with wet TMR because a fraction of the small particles remained attached to larger particles with greater water content. Therefore, to obtain reliable results with the Penn State Separator with high-silage TMR, the determination should be conducted on a dry sample. The use of digital imaging does not require drying the sample prior to particle evaluation. Also, digital imaging provides an entire distribution pattern of almost all the particles in the TMR, instead of only the three break points (1.18, 8, 19 mm) that the Penn State Separator yields. This technique

proved to be reliable, repeatable, and simple, and warrants future field application.

Key Words: Particle size, Forage, Total mixed ration

599 Comparison of three systems to estimate the fraction of non-fiber carbohydrate, and its ruminal digestibility, in common feedstuffs. A. Offner* and D. Sauvant, *INA P-G INRA, Paris, France*.

The objective of this study was to compare the prediction of the non-fiber carbohydrate content and ruminal digestibility by three systems for the estimation of feed values (CNCPS, NRC and INRA models). The comparison was based on twenty common feedstuffs. The fraction of non-fiber carbohydrate (**NFC**, % of DM) and the fraction of digestible NFC (**dNFC**, % of DM) were determined with the three systems. The NRC used an empirical approach to estimate dNFC: dNFC = 0.98 × PAF × (NFC + NDICP); with PAF, the processing adjustment factor, and NDICP, the neutral detergent insoluble protein. The CNCPS and INRA considered a more mechanistic approach of rumen digestion based on the "competition" between degradation and passage; the fractional passage rate was set at 6 % h^{-1}. The fractional degradation rates were from *in vitro* (CNCPS) and *in situ* studies (Offner et al., 2003). The results showed close correlations (r > 0.88) between the NFC fractions predicted by the three systems. However, the CA fraction defined in the CNCPS was not accurately linked to sugar (difference: +1.9, correlation: *NS*) or soluble NFC (-17.4, r = 0.62). In addition, the CB1 fraction was not accurately linked to starch (-2.6, r = 0.92) or degradable NFC (+15.9, r = 0.87). Results for the dNFC fraction outlined significant differences ranging from 1.5 to 31 % of DM among the three systems. The NRC significantly overestimated dNFC compared to CNCPS (+10.8, r = 0.88) and INRA (+12.0, r = 0.93). Moreover, the NRC and the CNCPS did not take into account all the variability observed in NFC digestibility when various processing treatments were applied. Differences among the three systems were surprising and indicated the need for a more consistent estimation of NFC and dNFC. This will perhaps be possible by integrating enough NFC sub-fractions, like those for starch, into the systems.

Key Words: Non-fiber carbohydrate, Rumen digestion, Feeding systems

600 Near infrared reflectance spectroscopy prediction of digestion rates for cereal grains. C. Lanzas* and A. N. Pell, *Cornell University, Ithaca, NY*.

Near infrared reflectance spectroscopy (NIRS) is used for commercial feed analysis because of its speed and precision. NIRS calibrations for digestion rates would be a step towards the field use of models that require digestion rates as inputs. Our objective was to assess the accuracy of NIRS in predicting digestion rates of dried cereal grains obtained by measurement of gas production. Eighteen barley, 99 corn, 23 sorghum, and 57 wheat samples were collected from 22 countries. Samples were ground to pass a 4-mm screen and fermented in vitro with rumen fluid for 48 hours. Gas production was measured with a computerized system and the data were fit to an exponential model to derive the fractional rates. The mean and SD of gas production rates were 0.24±0.029 h^{-1} for barley, 0.14±0.025 h^{-1} for corn, 0.06±0.015 h^{-1} for sorghum, and 0.26±0.038 h^{-1} for wheat. Samples were scanned from 1100 to 2498 nm with a visible/near-infrared scanning monochromator machine at 1 nm intervals. Modified partial least squares regressions were used to calibrate spectral data against gas production rates. Two calibration models were developed with the same data set. In the first model, 189 samples were used to develop the calibration model; the coefficient of determination was 0.89, and standard error of cross-validation (SECV) was 0.023 h^{-1}. In the second model, 98 samples were used to develop the calibration model, the remaining samples (n= 91) were used as a validation set. The coefficient of determination was 0.84, and standard error of validation (SEV) was 0.03 h^{-1}. For the validation set, SEV was partitioned into three orthogonal components: lack of correlation, bias, and non-unity slope. The error distribution was 88.8 % for lack of correlation, 11.2 % for the bias component and 0 % for the non-unity slope. The coefficients of determination of the models suggest that NIRS had the ability to predict digestion rates. However, the ratio between SD and SECV (2.8) indicated lower prediction ability of the equations compared with NIRS models for chemical fractions.

Key Words: Near infrared reflectance spectroscopy, Digestion rates, Gas production

Contemporary Issues Symposium: Designing animal experiments for power

601 Designing trials to test the bio-equivalency of treatments for animal performance. Ian McMillan*[1], [1]*University of Guelph, Animal and Poultry Science*.

When analyzing the results of a trial that has been conducted to compare treatments, it is usually the desire of the researcher to demonstrate a significance result for the contrasts of the group means that are of interest. This is certainly the case when an improved product is desired. However, in establishing the bio-equivalence of a test product to a standard, the objective is usually to conclude, with reasonable justification, that no difference has been detected. In making such determinations, the probabilities of accepting false hypotheses of equality, or those of rejecting correct hypotheses of difference must be taken into account. Prior to beginning the trial, the researcher should have a good estimate of the power that will be associated with the detection of a given maximum acceptable difference. The required sample size for achieving the desired power for these tests depends, among other things, upon the coefficient of variation (CV) in the data collected. The lower the CV, the smaller the detectable difference becomes. A reduced CV can be achieved, in some cases, by using an appropriate experimental design to account for elements such as variation in either moisture or fertility of the soil on which a crop is grown . A Latin Square design adds another dimension of control for bias and variance. Regardless of the design chosen, it is imperative to identify the proper experimental unit receiving the treatment. If animals are treated individually they may each represent a unique experimental unit. If they are exposed to the treatment as a group at the same time, for example animals housed together in a pen, such that they do not represent independent, random observations, the group may be the correct experimental unit to consider. There are many considerations to take into account when planning a bio-equivalence trial, or any other trial for comparing performance under different treatments. This talk will discuss some of these items that are often overlooked and will attempt to make suggestions on how they may be handled.

Key Words: Bio-equivalence, Power of test, Sample size

602 The power of tests for feed experiments with poultry. W. B. Roush*[1] and P. Tozer[2], [1]*USDA-ARS Mississippi State, MS*, [2]*Penn State University, University Park, PA*.

The power of tests can be used to determine the ability of an experimental design to detect treatment differences. The power of tests is rarely formally considered in poultry research. The definition of statistical power is the probability of rejecting the null hypothesis when it is, in fact, false and should be rejected. The complement of statistical power is the Type II error. That is, accepting the null hypothesis that there is no difference in treatments when, in fact, there is one. With power analysis, the sample size that is needed can be calculated to detect a given change. A priori power analysis can indicate the probability at which the sampling regime or experiment can actually detect an effect if a difference exists. Post hoc power analysis indicates either the sufficiency or the sample size needed for an experiment that has already been conducted. Because the sample size for a priori and post hoc power analyses can be larger than may be considered practical, a compromise power analysis can be conducted that calculates sample size based on a ratio of beta and alpha errors (Erdfelder, 1984). In the current study, examination was made of the power of tests for experiments published in the literature where significant and non-significant differences were reported between control birds and birds fed grains. Examination of the power of tests was conducted with G*Power, a readily available freeware program.

Key Words: Statistical power, Poultry, Experimental design

603 How many pigs? Statistical power considerations in swine nutrition experiments. D. K. Aaron* and V. W. Hays, *University of Kentucky, Lexington*.

Replication refers to the assignment of more than one experimental unit (EU) to the same treatment. Each replication of a treatment is an independent observation; thus, each replication involves a different EU. In swine nutrition research, the EU may be an individual animal, as in sow reproduction experiments, or a group of animals, as in growing-finishing pig experiments. In either case, calculation of the number of replicates needed to give an accurate and reliable outcome is an important step in a pre-experiment protocol. Although investigators often appear to choose replication arbitrarily on the basis of cost or availability of animals, convenience, or tradition, the question of "how many pigs" (i.e., how much replication is necessary) is a statistical one that has a statistical answer. A power analysis, performed while in the process of designing an experiment, will provide an investigator with the number of replicates needed for an experiment of known power and sensitivity. This *a priori* power analysis ensures that an investigator does not waste time and resources carrying out an experiment that has little chance of finding a significant effect, if one exists. It also makes sure resources are not wasted by including more EU than are necessary to detect an effect. A second type of power analysis may also be useful. If no significant effects are found in an experiment, the investigator can assess *post-hoc* the actual power of the experiment, or may determine the size of treatment effect that could have been detected using the standard deviation and number of replicates in the experiment. This *a posteriori* or retrospective power analysis can be very useful in explaining results. If the actual power to detect an effect of the size found in the experiment is high, it can be safely concluded the treatment has no effect. If the actual power is low, results will not be sufficient to say there is no effect. The objective of this paper is to discuss *a priori* and *a posteriori* power analyses as they relate to the kinds of experiments typically conducted in swine nutrition research.

Key Words: Power, Replication, Swine Nutrition

604 Experimental design in companion animal and equine nutrition: issues and insights. C. M. Grieshop* and E. A. Flickinger, *University of Illinois*.

Numerous challenges exist in designing experiments for companion animals and horses including the small number of animals available, subjective response criteria, and high variability in most responses of interest. One of the greatest challenges in companion animal research is the inability to use large numbers of animals due to lack of availability or prohibitive costs. Experimental designs such as the Latin square and crossover design can be used to maximize power for detecting differences while minimizing the number of animals required. These designs allow animals to serve as their own baseline or controls, thus reducing variation among treatments. Another challenge that exists in designing experiments for companion animals is the subjectivity for many response criteria. Responses such as longevity, quality of life, and palatability are difficult to assess in a quantifiable and objective manner. Various defined experimental protocols have been designed in an attempt to decrease subjective variability in these measurements, but often it remains difficult to detect and interpret statistical differences. A high level of variation exists naturally for most of the responses of interest. Sources of this variation can be both within and between herds or colonies. Significant differences in genetic backgrounds and in management practices exist that can result in large differences in many different response criteria. Due to the challenges outlined, designing experiments for companion animals is a complex task. Specialized statistical designs and defined experimental protocols are necessary to minimize variability and maximize the ability to detect statistical differences in biologically significant responses in companion animal and equine experiments.

Key Words: Experimental design, Equine, Companion animals

605 Design of experiments for bioequivalence testing of biotechnology derived crops as feeds for dairy cattle. R. J. Tempelman*[1] and M. A. Faust[2], [1]*Michigan State University,* [2]*Iowa State University*.

Experiments for dairy feed product testing have been primarily designed for the purpose of providing sufficient power of test to detect economically important differences in various performance measures, e.g. milk production. The emerging importance of biotechnology derived feed crops have led to their recent comparisons with conventional feedstuffs for their effects on dairy cattle performance. A current or future goal of these studies may be to assess bioequivalence of hybrids or feedstuffs. However, experimental designs that are appropriate for testing bioequivalence may be subtly different from designs for detecting mean differences. We discuss experimental designs that may be more suitable for the purpose of bioequivalence testing in dairy cattle nutrition studies, noting that the crossover design has been already widely advocated for bioequivalence testing in clinical research studies. We further discuss the design issues pertinent to dairy nutrition studies such as group-fed versus individually fed animals and multiple testing and data reduction concerns surrounding the collection of many different performance measures. Literature estimates of mean differences and variability are used to derive representative sample size requirements for dairy bioequivalence studies.

Key Words: Dairy nutrition, Bioequivalence testing, Biotechnology crops

680 Power of the test considerations for beef cattle experiments. C. R. Richardson*[1], G. A. Nunnery[1], D. B. Wester[1], N. A. Cole[2], and M. L. Galyean[1], [1]*Texas Tech University, Lubbock, TX,* [2]*USDA-ARS-CPRL, Bushland, TX*.

The inherent value of evaluating the power of a test procedure in beef cattle experiments is similar to that for other species; however, because of major differences in the methods and conditions involved compared with other species, considerations for the use of power test procedures are distinct and specific for beef cattle experiments. Some of these major differences include: 1) lack of similar research facilities, which leads to wide fluctuations in the number of animals used per experimental unit (pen) by researchers; 2) variation in types of pens (totally or partially enclosed indoor pens, open outdoor pens, enclosed fields, or open ranges); 3) use of individual animal data from Pinpointers, Calan gates, and metabolism studies; 4) seasonal effects by region on animals housed outside; and 5) variation in the performance of control groups among locations because of differences in diet composition and animal genetics. When power tests are used in the planning and experimental design phase of a research study, they provide critical information on sample sizes necessary to detect a treatment effect at a predetermined α level. In using power tests across different experimental designs, attention should be given to the consequences of both Type I and Type II errors. Lowering the Type I error rate increases the Type II error rate and vice versa. For several common statistical procedures and experimental designs, power tables are available; however, none specifically addresses beef research, and software is not readily available. Data will be reviewed from published beef cattle research in which comparisons can be made to determine the effects that experimental design, numbers of animals within the experimental unit, number of replications, type of housing, regional effects, feed composition, and genetics have on power tests. Estimation of power in beef cattle experiments is important.

Key Words: Beef cattle, Statistics, Power test

Lactation Biology Symposium: Altering the lactation cycle in dairy cows

606 Why re-evaluate length of dry period? R. R. Grummer* and R. R. Rastani, *University of Wisconsin, Madison*.

Possible advantages of reducing length of dry period include increased income from milk production, simplified dry cow management, and alleviation of over-crowded dry cow facilities. The traditional recommendation is a 60-d dry period. Physiologists describe the dry period as consisting of three phases: active involution, steady state involution or rest phase, and redevelopment of secretory tissue. The importance of a rest phase has never been established. There are abundant data in the literature to support a 6 to 8 week dry period. However, interpretation of the data is difficult. The great majority of data is from studies using farm records (e.g., DHI data). In these data sets, cows with less than 6 to 8 wk dry periods probably were not intended to have short dry periods and consequently were not managed for short dry periods.

Additionally, recommendations from observational data may be biased due to interactions between parameters such as milk yield or calving interval and length of dry period. Some experiments specifically designed to compare 30 and 60-d dry periods indicate that shorter dry periods are possible without sacrificing milk production the next lactation. Additional studies are needed to confirm these findings and determine the effects of shortened dry periods on body condition, incidence of health disorders, and reproductive performance. If 30-d dry periods can be achieved without negative effects the next lactation, the next logical question becomes: can the dry period be reduced further? To study the effects of no dry period, twins or quarters within a cow have been assigned to continuous milking or a traditional 60-d dry period. These results have indicated a 25 to 40% drop in milk yield the following lactation due to continuous milking. However, these and other studies have utilized low cow numbers and cows with extremely low milk production. As milk yield and persistency of lactation increases, either through genetic selection or administration of exogenous agents such as bST, the likelihood of successfully shortening or eliminating the dry period should increase.

Key Words: Dry period length, Continuous milking, Lactation

607 Effect of POSILAC® (bST) and dry period management strategy on milk yield. E. L. Annen*[1], M. A. McGuire[2], J. L. Vicini[3], and R. J. Collier[1], [1]*Univ. of Arizona, Tucson,* [2]*Univ. of Idaho, Moscow,* [3]*Monsanto Co., St. Louis, MO.*

A dry period of 40-60 d has been a routine practice in the dairy industry and was intended to provide a balance of maximum lifetime milk and profitability. A dry period less than 40 d reduces yield in the subsequent lactation by 5 to 15%. Omitting the dry period completely results in production losses of 20 to 40% in the subsequent lactation due to reduced functionality of mammary parenchyma rather than nutritional status or endocrine regulation. This study evaluated milk production effects of shortened or omitted dry periods on today's high-producing cows treated with bST (500 mg every 14 d). The study utilized 3 commercial dairy herds and included four treatment groups. Initially, five multiparous and five primiparous cows from each farm were assigned to each group. Treatments included: 1) control: 60-d dry period, bST per label (bST started at 57-70 DIM to end of lactation), 2) 30-d dry period, bST per label, 3) continuous milking, bST per label and 4) continuous milking with continuous bST. Average milk yield was reduced in primiparous cows during the first 17 wk postpartum for treatments 2, 3 and 4, compared with controls (40.1, 32.2, 34.6, vs. 43.1 kg/d; P<0.01, N=57). Milk production in multiparous cows was not affected by treatment (45.6, 42.0, 45.5 vs. 47.3 kg/d; N=38). We hypothesize that a shortened or omitted dry period impedes mammary growth in primiparous animals and may have minimal production effects in multiparous cows treated with bST. In addition, profitability in multiparous cows was improved through increased net milk income generated by omitting the dry period. In multiparous cows, treatment 4 improves net milk income over controls by $130/cow for the first 17 wk of the subsequent lactation. The partial budget included: last 60 d of gestation milk, 17 wk of subsequent lactation milk, extra feed and bST costs, and dry cow costs not acquired. Further research is required to examine the effects of continuous milking and bST on mammary involution and mammary proliferation.

Key Words: Continuous lactation, Shortened dry period

608 Effects of varying dry period length and prepartum diet on metabolic profiles and lactation of periparturient dairy cattle. R. R. Rastani*, R. R. Grummer, S. J. Bertics, A. Gümen, M. C. Wiltbank, D. G. Mashek, and M. C. Rich, *University of Wisconsin, Madison.*

Sixty-five Holstein cows were utilized in a randomized block design to evaluate different management schemes involving altered dry period lengths on subsequent milk production and metabolic variables. Cows began the experiment 90 d prior to expected calving date, were fed a common diet for 34 d, and were assigned to one of three treatments: traditional 56 d dry period (cows fed a low energy diet from -56 to -28 d and a moderate energy diet from -28 d to parturition; T), 28 d dry period (cows continuously fed a high energy diet; S), and 0 d dry period (cows continuously fed a high energy diet; Z). Contrasts were 56 vs. 28 d dry management scheme (T vs. S) and 28 vs. 0 d dry period (S vs. Z). Prepartum (PRE) DMI was 13.9, 16.8, and 18.1 kg/d for T, S, and Z, respectively (T vs. S, $P < 0.01$; S vs. Z, $P < 0.01$). There were no differences in concentrations of PRE non-esterified fatty acid (NEFA), glucose, liver triglyceride (TG), PRE and postpartum (POST) -hydroxybutyric acid, and POST DMI. Liver TG were greater for S compared with Z at 1 d POST (8.82 vs. 5.23, % DM; $P < 0.02$) and at 35 d POST (5.54 vs. 3.23, % DM; $P < 0.02$); liver TG were similar for T and S ($P > 0.15$). There were no differences in POST NEFA between T and S, but NEFA were greater for S compared with Z (394 vs. 235 Eq/L; $P < 0.01$). Postpartum glucose concentrations were lower for S compared with Z (55.0 vs. 59.3 mg/dl; $P < 0.01$) and there was a tendency towards lower glucose concentrations for T vs. S (52.5 vs. 55.0 mg/dl; $P < 0.12$). There was no difference in POST 4.0% FCM yield in cows on T vs. S (42.4 vs. 41.5 kg/d; $P > 0.15$). However, there was a tendency towards lower POST 4.0% FCM yield in cows on Z vs. S (36.1 vs. 41.5 kg/d; $P < 0.11$). In summary, T and S management schemes have similar response on FCM yield and metabolic variables in the subsequent lactation. Shortening the dry period length from 28 to 0 d may improve metabolic status, but decrease FCM yield.

Key Words: Dry period length, Transition period

609 Milk production from Holstein half-udders after concurrent 30 and 70d dry periods. M. S. Gulay*, K. C. Bachman, M. J. Hayen, and D. R. Bray, *University of Florida, Gainesville.*

The objective of this study was to determine whether the half of a bovine mammary gland that had been dry for 30d would produce as much milk, during the subsequent lactation, as the other half-udder that had been dry concurrently for 70d. Multiparous Holstein cows were assigned randomly to control (C, n=14) and treatment (T, n=26) groups. All mammary quarters of cows in C group were allowed to have a full 70d (67±10) dry period. At 80d before expected calving dates (ECD), milk production of left and right half-udders for cows in T group was measured for 10d. No difference was detected in the yield or distribution of milk produced by left (8.00 kg/d; 50.9%) and right (7.70 kg/d; 49.1%) half-udders. At random, within each cow of the T group, one half-udder was dried off at 70d before ECD while milk removal from the other half-udder continued twice daily until 30d before ECD. Average daily yields and distribution of milk produced from 80 to 70d before ECD for the half-udders (n = 12L, 14R) subsequently dry for 68±9 d (7.74 kg; 49.3%) did not differ from the values for the half-udders (n = 14L, 12R) subsequently dry for 27±7 d (7.96 kg; 50.7%). During the postpartum period, milk removed from the left half-udder was measured using a Tru-test® milk meter and total-udder milk production was obtained from the parlor meter. Right half-udder production was estimated by difference. Through 30 DIM, the two mammary quarters within the 30d dry half-udders produced less milk (P<0.01) than the two mammary quarters within the 70d dry half-udders (14.2 vs. 18.3 kg/d; 43.7 vs. 56.3%). C group, managed with the T group, produced more milk through 30 DIM (38.3 vs. 32.2 kg/d; P<0.01). Mean BW (kg) did not differ at calving (C=684.5 vs. T=671.9) or postpartum (C=648.9 vs. T=669.2). Although mean BCS did not differ at calving (C=3.54 vs. T=3.57), T group lost less body condition during the first 30 DIM (C=3.17 vs. T=3.33; P<0.1). Milk yield results from this within-cow experimental design suggest that a 30d dry period decreases subsequent milk production.

Key Words: Dry period, Milk yield, Days dry

610 Effect of delayed breeding and POSILAC® on milk production and reproduction of dairy cows during 2 lactations. M. McGrath*[1], S. Bettis[1], C. Bilby[1], R. Hintz[1], E. Plunkett[1], J. Vicini[1], D. Armstrong[2], J. Fetrow[3], D. Galton[4], J. Shearer[5], and J. Smith[6], [1]*Monsanto, St. Louis, MO,* [2]*Univ. of Arizona, Tucson,* [3]*Univ. of Minnesota, St. Paul,* [4]*Cornell Univ., Ithaca, NY,* [5]*Univ. of Florida, Gainesville,* [6]*Kansas State Univ., Manhattan, KS.*

Extended voluntary wait (VW) and POSILAC (POS) were evaluated in 26 US herds. Primiparous (Prim, N=2331) and multiparous (Mult, N=1384) Holstein cows were studied in one complete lactation (L1). Prim cows from L1 that followed treatment protocol were also examined in the subsequent lactation (L2). Cows were assigned to a: 1) 60-day VW with no POS (C60), 2) 60-day VW with POS (P60), or 3) 165-day VW with POS (P165). POS was administered per label (500 mg bST every 14 d from 57-70 DIM to end of lactation). A 135-day breeding period followed each VW. Testday milk (kg) was evaluated from 60 to 195 DIM (M1) or 196 to 315 DIM (M2). Persistency was evaluated

as the slope of declining production from 100 to 195 DIM (M3) and in M2. Total milk yield was greater in P60 and P165 vs. C60 for both parities (P<0.05) in M1 and M2 in both L1 and L2. Milk yield was greater in P165 vs. P60 (P<0.05) during M2 for both parities in L1 but no difference was detected in L2. P165 Prim and Mult cows were more persistent vs. P60 (P<0.05) in late lactation (M2) during L1. No significant difference in persistency was detected in L2. Milk production at dry-off (MPD) for Prim cows was greater in P60 vs. C60 or P165 (P<0.05). MPD was not affected by treatments for Mult cows. Days dry was shorter (P<0.05) for all P60 cows vs. P165 cows in both lactations. Days dry was not different for C60 vs. P60. Days to first insemination after the VW were less for P165 cows vs. C60 or P60 cows in both lactations and both parities (P<0.05). A greater percentage of P165 Prim cows became pregnant in the L1 breeding period vs. P60 Prim cows (P<0.01). There was no difference in percent pregnant between P165 vs. C60 Prim cows in L1 or among any of the Mult groups in L1 or L2. There was no effect of POS or delayed breeding on mastitis case rate.

Key Words: Delayed breeding, Milk production, Reproduction

611 Induced lactation: the need for enhanced mammary development and differentiation. B. A. Crooker*[1], R. J. Collier[2], J. L. Vicini[3], M. F. McGrath [3], and W. J. Weber[1], [1]*University of Minnesota, St. Paul,* [2]*University of Arizona, Tucson,* [3]*Monsanto Agricultural Group, St. Louis, MO.*

Induction of lactation has the potential to increase farm profitability through retention of healthy reproductive culls for one or more additional lactations. Of the approximately 1 million dairy cows culled in the US due to reproductive failure each year, about half are healthy and in appropriate condition for another lactation. These potential culls would be retained if they were profitable. Methods to induce lactation have been described for more than 50 years and most utilize twice daily subcutaneous injections of 17β-estradiol (0.05 mg/kg BW/injection) and progesterone (0.125 mg/kg BW/injection) for 7 d with a secondary treatment such as dexamethasone (0.05 mg/kg BW/d). However, these methods have been plagued by considerable variation in the proportion of treated cows that actually produce milk and their subsequent milk yield. Recent efforts to improve the technique have included administration of bST during the induced lactation and inclusion of bST in both the induction treatment phase and subsequent lactation. Although these efforts have increased milk yield, variation in response and in yield relative to previous production remain greater than desired. Clearly the pregnancy and parturition dependent processes of extensive ductal and lobuloalveolar development, proliferation of alveolar cells, and terminal differentiation of these secretory epithelial cells is not mimicked adequately by current methods to induce lactation. More recent efforts to induce lactation have attempted to enhance mammary development and/or differentiation by intramammary infusion of mammogenic compounds. Results from a half-udder model indicate intramammary infusion of prostaglandin E_2 either enhanced mammary development or differentiation which resulted in increased milk yield from cows induced to lactate. Continued refinement of this technology is warranted and required before it can be considered as a practical on-farm technology.

Key Words: Induced lactation, Mammary development, Differentiation

Nonruminant Nutrition Symposium: Energy density of pig diets

612 Energy density of pig diets: effect of energy evaluation system, technology and pig body weight. J. Noblet*[1] and J. van Milgen[1], [1]*INRA, UMRVP, Saint Gilles, France.*

The feed cost is the most important cost in pig production and energy represents the greatest proportion of this cost. Ad libitum energy intake depends on many animal and environmental factors in which feed energy density (or its chemical composition) play an important role. Under satisfactory protein supply, performance of animals depends directly on the energy supply. Finally, nutrient requirements must be expressed relative to energy intake in order, for instance, to take into account changes in the partitioning of energy gain between protein and lipid during growth. It is then important to express feed energy value on an appropriate basis. Both energy supply (a diet characteristic) and requirement (an animal characteristic) should be expressed using the same system. From that point of view, a NE system may be a good compromise. Energy density depends on the nutrient composition which differ markedly in GE content (23.0, 39.0, 17.4, and 18.4 kJ/g for CP, fat, starch (ST) and dietary fiber (DF), respectively). In addition, nutrient digestibility is variable so that the contribution of nutrients to DE supply in growing pigs ranges from 31.7 kJ/g for fat to 22.4 kJ/g for CP, 17.2 kJ/g for ST and only 3.2 kJ/g for DF. Nutrient composition also affects the metabolic utilization of ME: the ratio of NE to ME varies from 90% for fat to 82% for ST and 60% for CP. Consequently, the relative energy density of feeds for pigs depends on the energy system (DE, ME or NE). For instance, the energy values (relative to a conventional diet with corn, wheat, soybean meal and fat containing 14.2, 13.6 and 10.3 MJ/kg of DE, ME, and NE, respectively) 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 existing confusion about energy systems is partly due to the existence of different NE systems and care has to be taken when combining values obtained from different systems. The energy density of pig feeds can also be affected by technology. For instance, pelleting increases markedly the fat and energy digestibilities in corn or full fat rapeseed. Finally, digestion of DF becomes more efficient with increasing BW with subsequent differences in energy density of feeds according to pig BW.

Key Words: Pig, Feed, Energy value

Animal Behavior & Well Being: Production challenges

613 Is iodide responsible for the heat-relief effects of *Ascophyllum nodosum*? P. A. Eichen*[1], M. J. Leonard[1], M. A. Kozma[1], B. M. Kronk[1], L. E. McVicker[1], D. E. Spiers[1], and D. P. Colling[1], [1]*University of Missouri, Columbia, MO,* [2]*Acadian AgriTech, Kansas City, MO.*

Previous studies indicate that adding seaweed (*Ascophyllum nodosum*) extract (Tasco-EX®) to the diet results in decreased core body temperature (Tc) in rats experiencing heat stress and fescue toxicosis. A rat model was used to test Tasco-EX (Acadian Seaplants Limited, Nova Scotia) versus ethylenediamine dihydroiodide (EDDI, International Nutrition, Omaha), at an iodide level equal to Tasco-EX (1215 μg I/g). Experiment I was designed to observe changes during each phase of treatment/temperature exposure. Diets contained no additive, 1% Tasco-EX or EDDI. Male rats (n=72; 372 g av BW) were maintained at thermoneutrality (TN; 21°C) for 5 days before treatment to record baseline feed intake and BW. Treatment diets were fed for seven days at TN, followed by exposure to heat stress (HS; 31°C) for 14 days, with a final seven days at TN. Body weight and feed intake were recorded daily. Six rats from each treatment were sampled for organ weight, and blood T3 and T4 at the end of each phase (four sample weeks). Experiment II was designed to look at Tc response to treatment/temperature. Male rats (n = 24; 288 g av BW) were implanted with telemetric temperature transmitters (Mini Mitter, Bend, OR) to record Tc and activity under conditions similar to Experiment I. At the end of week four, all rats were euthanized for determination of organ weights and blood T3 and T4 levels. Feed intake and weight gain were not different for any of the treatments. There were no T3 differences by treatment or sampling time. In contrast, T4 was lower in all treatment groups at the end of week three (P<.004), and was higher in rats receiving either Tasco-EX or EDDI (P<.007) compared to controls. Rats fed Tasco-EX or EDDI tended to have lower average daily Tc compared to control animals during HS. Average daily maximum Tc of rats receiving Tasco-EX was decreased below control level during a period of HS. These results indicate that dietary iodide is associated with some, but not all, responses to Tasco-EX.

Key Words: Heat stress, Seaweed, Telemetry

614 Monitoring fescue toxicosis in a pasture environment and evaluating the effect of prior treatment with *Ascophyllum nodosum*. D. E. Spiers*[1], L. E. McVicker[1], J. E. Williams[1], P. A. Eichen[1], L. Thompson[1], G. Rottinghaus[1], and D. P. Colling[2], [1]*University of Missouri, Columbia, MO,* [2]*Acadian AgriTech, Kansas City, MO.*

Dietary administration of seaweed (*Ascophyllum nodosum*) extract (TascoEX^{TM}) to cattle produces a reduction in core body temperature (Tc) during heat stress. The present study was conducted to monitor Tc of Angus steers on endophyte-infected tall fescue pastures, and determine if previous treatment with Tasco14^{TM} meal could reduce the impact of fescue toxicosis. Cattle were implanted with telemetric temperature transmitters and fed daily either Tasco14 (1.0% DMI) or control diet for 48 days. They were then removed from the diets and, after 21 days, randomly assigned to either uninfected (E-) or infected pastures (E+; 187 ppb ergovaline average) for a total of 4 test groups (n = 6 per group). Hourly measurements included Tc and ambient conditions (air and black-globe temperatures, percent relative humidity) during onset of summer heat stress (61 days). An early period of heat stress occurred at 15-19 days followed by a second longer period at 35-55 days. Relationship between Tc and air temperature (Ta) for the entire period was a second-order polynomial equation, with a 2-hour delay in Tc behind Ta (R=0.84; P<0.001). Weight gain on pasture was highest for E- control group (33.1kg) and lowest for E+ control group (20.3kg). Both Tasco14 groups exhibited intermediate weight gain (25.4kg). The E+ group had higher Tc levels primarily during Ta increase (e.g., 15-19 days), with less evidence of a difference between E+ and E- groups over days of continuous heat stress. Evaluation of the first heat stress period showed that Tasco14 treatment reduced Tc response to Ta from E+ to E- level. Magnitude of the Tasco14-induced Tc reduction during this period was 0.3°C. Also, E+ control steers began to increase Tc at 12°C Ta, whereas E+ Tasco14 steers did not increase Tc until 17°C. These results suggest that pretreatment with Tasco14 meal treatment may produce a short-term reduction in Tc response to heat stress.

Key Words: Heat stress, Cattle, Fescue toxicosis

615 Effect of social regrouping and relocation on the hypothalamic-pituitary-adrenal axis and immune function of finishing beef steers. S. Gupta*[1,2], B. Earley[1], S. T. L. Ting[1,2], and M. A. Crowe[2], [1]*Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland,* [2]*Faculty of Veterinary Medicine, University College Dublin, Belfield,Dublin 4, Ireland.*

To investigate the effect of repeated regrouping and relocation (mixing) on the hypothalamic-pituitary-adrenal (HPA) axis and immune function, 72 Holstein-Friesian (14-mo-old; 441±7.2 kg) steers were randomly assigned to either control (n=30; C) or regrouped (n=42; R) treatments and housed 6 per pen in 12 pens. The R steers were exposed to 6 mixing events over 102 d. New pen cohorts were allowed to stabilize for 14 d and none of the R steers were allowed to share the same pen or pen-mates where or with whom they were previously housed. C steers were housed in the same pen with the same pen-mates. The HPA-axis function, haptoglobin and concanavalin A (Con A)-induced in vitro interferon (IFN)-γ production were assessed 2 h before treatment, and 2 h after the first, third and sixth mixing. Median area under the plasma cortisol curve (AUC) was higher (P<.05) in R than C steers after first mixing, with no differences among treatments after the third and sixth mixings. Over time, median values for cortisol AUC in R steers decreased (P=.0001) following the third and sixth mixing compared with the first. However, median values for cortisol AUC in response to exogenous adrenocorticotrophic hormone (1.98 IU/kg metabolic BW, following administration of 20 μg/kg BW of dexamethasone at -12 h) after the third mixing were not different among treatments. Similarly, there was no difference (P<.10) in the cortisol AUC in response to exogenous bovine corticotrophin-releasing hormone (0.3 μg/kg BW) in C versus R steers after the sixth mixing. There were no differences (P<.10) among treatments in haptoglobin and Con A-induced in vitro IFN-γ after the first, third and sixth mixing. In conclusion, social regrouping and relocation increased plasma cortisol immediately after the first mixing. The HPA-axis of steers repeatedly exposed to regrouping and relocation adapted with a reduction in cortisol secretion.

Key Words: HPA-axis, Social regrouping, Steers

616 Restaurant audits have maintained high standards of stunning and handling at beef slaughter plants. T. Grandin*, *Colorado State University, Fort Collins, CO USA.*

From 1999 until the present, restaurant companies such as McDonald/s Corporation, Wendy/s and Burger King have been auditing stunning and handling at beef slaughter plants for animal welfare. This has resulted in great improvements in stunning and handling. To pass the audit, a plant must comply with the American Meat Institute guidelines at an acceptable level of performance. On a 100 animal audit, 95% or more of the cattle must be stunned with one captive bolt shot, 100% rendered insensible on the bleed rail, 75% moved without an electric prod and only 3% of the cattle vocalize during handling and stunning. Data collected prior to the restaurant audits indicated the following percentages of plants at the acceptable level were stunning 30%, insensibility 90%, electric prod use 43% and vocalization 43%. Four years of restaurant audit data (1999 to 2001) indicate an improvement in the percentage of plants at the acceptable level. For stunning, the percentage of plants passing the audit were 90%, 90%, 91% and 94%. Insensibility was 97%, 98%, 93% and 95%. Vocalization was 71%, 80%, 86% and 91%. Electric prod use as 76%, 67%, 76% and 82%. The number of plants audited was 1999, N=41; 2000, N=49; 2001, N=44 and 2002, N=57. Data from 2002 indicated that 54 plants that were experienced with audits all passed the stunning audit and only one had a partially sensible animal. Three out of four new plants did not know what was expected and they performed poorly. Two of these plants stunned less than 90% of the cattle with one shot. Plants that have good internal auditing usually perform better than plants which do not have internal auditing. On the 2001 data, inter-observer agreement was compared on the percentage of plants scored acceptable on stunning by three different auditors. There was no significant difference between auditors (Chi Square .077 p < 0.75).

Key Words: Restaurant audit, Stunning and handling, Beef

617 The pharmacological effect of small doses of naloxone on sexual exhaustion in white New Zealand male rabbits. V. O. Fuentes*, C. Villagran, R. Orozco, and J. J. Alvarez, [1]*Centro universitario de los Altos, Universidad de Guadalajara.*

Rationale: Reproductive behaviour is modulated by endogenous opioids. The study of these neurohormones will give further information related to the control of reproduction. Objectives: To study the effect of small doses of naloxone in the sexually exhausted New Zealand white male rabbit. Methods: Six young rabbits (6 to 12 months old) and six mature (14 to 20 months old) male rabbits were used. Three days prior to the start of the experiment, naloxone was administered through a subcutaneous implant of 8 mg. With a previous three day rest, male rabbits were first studied to find out how many females they were capable of mounting and ejaculating before becoming sexually exhausted. For this purpose oestrous females were introduced to the male's cage and four minutes were given for mating to occur, when mated the female was replaced with a new oestrous female, this procedure continued until the male refused to mate with a new female. Results: It was observed that young rabbits mated 9 to 10 females and mature male rabbits mated 6 to 8 times to reach sexual exhaustion (p=0.002). After naloxone treatment young rabbits mated 11 to 12 females and mature rabbits mated 9 females to reach sexual exhaustion (p<0.001). I Conclusions: Naloxone treatment increased sexual activity in the male white New Zealand rabbits, giving further support to endogenous opioids as modulators of sexual behaviour.

Key Words: Rabbits, Sexual exhaustion, Naloxone

618 The pharmacological effect of implanted and injected naloxone on plasma testosterone levels in bucks during the breeding and non-breeding seasons. V. O. Fuentes*, J. G. Ruiz, P. I. Fuentes, and R. Sanchez-Gutierrez, [1]*Centro universitario de los Altos, Universidad de Guadalajara.*

The objective of this work was to study the effect of naloxone on plasma testosterone, when administered through a subcutaneous implant and by i.m. injection during the non-breeding and breeding seasons in bucks. For this purpose, during spring (March, April, May) and autumn (September, October, November). Fourteen bucks were selected and allocated at random in to three groups, 1 (n=5), 2 (n=5) and 3 (n=4). Group 1 was treated with 0.5 mg of naloxone by intramuscular injection at 12 hour intervals for 15 days. Group 2 was implanted with a

cristaline microcelulose pellet with 15 mg of naloxone. And, group 3 was injected with saline solution at the same intervals as group 1. Testosterone in plasma samples was determined by RIA at the beginning of the experiment and at 7, 15 and 21 days during treatment. During the non-breeding season testosterone levels in naloxone treated bucks was significantly increased from a control concentration of 0.5 ng/ml to a plasmatic concentration of 1.7 ng/ml, and 1.6 ng/ml of naloxone as compared with 0.5 ng/ml in the control group ($p<.01$). When bucks were treated during the breeding season (autumn) the administration of naloxone did not affect the concentration of plasma testosterone. It was concluded that naloxone antagonism was more effective when administered to bucks in the non-breeding season.

Key Words: Bucks, Testosterone, Naloxone

Animal Behavior & Well Being: Housing environments

620 Behavioral and physical variation among cloned litters of pigs. G. S. Archer*[1], T. H. Friend[1], J. Piedrahita[2], C. H. Nevill[1], and S. Walker[2], [1]*Department of Animal Science, Texas A&M University, College Station,* [2]*College of Veterinary Medicine, Texas A&M University, College Station.*

A series of tests were used to quantify the variation in food preference, temperament, and time budgets of two genetically identical cloned Duroc litters (n = 5,4) and their matched naturally bred controls (n = 4,4). Food preference was determined for all pigs using apples, bananas, crackers, and carrots. Each food type was offered ten times per trial for two trials. To assess variation in temperament a Towel Test, Back Test and Pick-up Test were used. The Towel Test consisted of recording the average time for each pig to remove a towel from its head ten times in each of three trials. The Back and Pick-up Tests were conducted only on the second set of matched litters at 7 weeks of age. They consisted of counting the number of vocalizations and escape attempts each pig made during one-minute of restraint when held on its back and picked up by a person. Time budgets of the pigs were determined for three consecutive 24 h periods at three different ages using time-lapse video. Time spent lying in bedding, lying on concrete, standing, feeding, and play/fighting was quantified. An F-test was used to determine if any differences in variation between litters existed. The cloned litters were found to be similar or more variable ($P < 0.05$) than the naturally bred controls: in their preference for the foods in thirteen of the sixteen comparisons; in five of the eight comparisons during the Towel Test; in all four comparisons in the Back and Pick-up Tests; and in all ten of the comparisons in the time budget analysis. Physical variation among the clones was also observed: one clone had curly hair while the rest had straight hair, one clone developed hyperkeratosis while the others did not, and one clone had 13 teats and the rest had 14. These results indicate that environmental and epigenetic phenomena have major effects on the behavior and physical development of cloned pigs and question the feasibility of using cloning by nuclear transfer to replicate animals with specific behavioral or physical characteristics.

Key Words: Clone pig, Variation, Behavior

621 Effect of stressors on serum concentration of acute phase proteins and performance in pigs. C. Pineiro*[1], E. Lorenzo[1], J. Morales[1], E. Gomez[2], and G. G. Mateos[3], [1]*PigCHAMP Pro Europa S.A., Spain,* [2]*CPP Hontalbilla, JCyL, Spain,* [3]*UPM, Spain.*

Two trials were conducted to assess the effect of stressors on serum concentration of acute phase proteins (APP), pig-MAP (MAP) and haptoglobin (HPT), and performance of pigs. In trial 1 we studied the effect of room temperature in young piglets. A total of 208 piglets were allotted at weaning (21 d) into two identical rooms with eight pens of 13 piglets each. Room temperatures were reduced from 32 C at 28 d to 28 C at 40 d in the control group (CON) and from 26 C at 28 d to 24 at 40 d in the cold room (COOL). From 40 to 60 d room temperature was identical for both groups. From 21 to 28 d of age COOL piglets grew less (73 vs 119 g/d; $P = 0.0003$) and had worse feed conversion (1.17 vs 2.05 g/g; $P = 0.0003$), than CON piglets, but the differences disappeared thereafter. From 21 to 28 d of age APP concentrations increased (0.74 vs 1.2 mg/ml for MAP and 0.22 vs 0.37 mg/ml for HPT at 21 and 28 d, respectively; $P < 0.05$). At 40 d of age APP concentrations decreased in CON group but not in COOL group (1.02 vs 0.75 mg/ml for MAP; $P = 0.12$ and 0.43 vs 0.10 mg/ml for HPT; $P = 0.006$ for COOL and CON groups respectively). In trial 2 we studied in growing pigs (74 to 116 d of life) the effects of feeding frequency on the same parameters. A total of 240 pigs were randomly distributed in 24 pens. The experimental treatments consisted of pigs fed ad libitum (AL) or disorderly (DIS). Total feed intake was kept constant in both groups. From 74 to 102 d of age, AL pigs grew more than DIS pigs (542 vs 482 g/d; $P < 0.05$) but no differences were observed at the end of the trial. Serum APP were higher for the DIS group than for the AL group ($P = 0.004$ for MAP and $P = 0.001$ for HPT). We conclude that stressors impair pig performance and that the impairment can be detected through measuring the variation in serum concentration of Pig-MAP and HPT. When the stressors disappears pigs compensate for the losses in performance and serum levels of APP return to basal levels.

Key Words: Stressors, Acute phase proteins, Pig performance

622 Effects of pre-natal stress on immunological response and weight gain during the grower finisher period. M. J. Toscano*[1], K. A. Scott[1], H. K. Smith[1], J. E. Cunnick[2], M. J. Daniels[3], and D. C. Lay, Jr.[1], [1]*USDA-ARS-MWA-LBRU,* [2]*Iowa State University,* [3]*University of Florida.*

Pre-natal stress, stress applied to the pregnant dam which potentially affects development of subsequent young, works through unclear mechanisms. In the current study, sows received one of two treatments once a week during d 42 to d 77 of gestation: injections of ACTH (i.v., 1 IU/kg BW) (ACTH, n=19), or forcefully moved up and down an alley and received 3 shocks from a standard electric prod over a 10-min-period (ROU, n=15). A third group served as a control and received no treatment (CONT, n=18). Subsequent progeny were separated into groups of 6 (2 pigs/trt/grp) upon weaning. To assess the affect of the treatments on immunological function, at 106 ± 0.51 d of age, a single pig from each litter received a 6-mm punch biopsy to assess healing and then regrouped with other test pigs maintaining groups of six. A base blood sample was taken before the procedure (d 0) and then d 2, 4, 7, 9, 11, 14, 21, 28, 35, 42. To provide a record of punch biopsy healing, digital pictures were taken of the wound at each sampling time until d 21. Collected blood provided an immunological cell profile and each wound picture was scored for severity by 3 observers blind to treatments. Average daily gain from farrowing to d 146 ± 1.0 of age was calculated. Granulocytes as a percentage of white blood cells was least in the ACTH group followed by CONT and ROU, respectively (51.5 ± .82 vs. 53.4 ± .94 vs. 56.08 ± .84 %; $p<.05$). Eosinophils tended to be least ($p>.08$) in the CONT, followed by ROU and ACTH, respectively (1.9 ± .13 vs. 2.01 ± .14 vs. 2.14 ± .34 5^{10} cells/L). A score given to biopsy healing progress was most improved in ROU, followed by CONT and ACTH, respectively (2.12 ± .06, 2.26 ± .06 , 2.34 ± .06; $p > .04$). Average daily gain was not affected by treatment (.65 ± .01 kg/d, $p>.45$). Our results suggest pre-natal stress is a factor in granulocyte production and the body/s ability to heal a small biopsy. Continued research is needed to develop a complete understanding of pre-natal stress/s effects.

Key Words: Pre-natal stress, Swine , Immune

623 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: productivity measures. J. McGlone*[1], J. Morrow[2], and J. Smith[1], [1]*Texas Tech University,* [2]*USDA-ARS.*

Eighty three Camborough-22 (PIC USA) gilts with known estrus dates were used to determine the effects of two penning systems (crates vs. pens of 5) and feeding system (drop fed vs. trickle fed) on reproductive performance. The four treatments were arranged in a 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop. Trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period. Gilts with a known estrus date and a predicted next estrus date were randomly selected and moved from their acclimation group pen to their assigned treatment. Estrus detection, maintenance of pregnancy and litter performance measures were collected. Measures of behavior and physiology will be reported elsewhere. Overall farrowing rate was not different among treatments. However, more gilts were not bred (not detected in estrus) among penned (4.9%) than crated gilts (0.0%). Fewer gilts recycled after mating when in TRICK-Pen (15%) than in TRICK-Crate (25%), DROP-Pen (29.2%), or DROP-Crate (24.2%) treatments.

Other measures (mean SEM) not significantly influenced by treatments included: gilt body weights at breeding (135.6 ± 2.7 kg), farrowing (205.0 ± 2.02 kg) or weaning (189.4 ± 2.82), backfat thickness (11.05 ± 0.57), and per litter measures of pigs born alive (10.9 ± 0.61), pigs born dead (1.13 ± 0.28), piglet birth weights (1.7 ± 0.04 kg), number weaned (8.8 ± 0.57), preweaning survival (87.0 ± 3.9%), piglet weaning weight (6.21 ± 0.14 kg) and shoulder lesions (scored 0-3 with 0 = no lesion; 0.53 ± 0.13). Overall reproductive rates and sow and litter productivity were similar for gilts in the four treatments. Differences in estrus detection and recycle rates after mating were probably due to ease of animal observation in the different systems. In conclusion, productivity of breeding and gestating gilts was similar in the four systems evaluated.

Key Words: Pig, Welfare, Housing

624 The effects of dietary sodium bicarbonate on abnormal behavior and heart rate in sows. J. N. Marchant-Forde*[1] and E. A. Pajor[2], [1]*USDA-ARS,* [2]*Purdue University*.

Many oro-nasal behaviors are considered to be stereotypic and abnormal and have been implicated as an indicator of poor welfare in swine. There is some evidence in other monogastric species to suggest that oral stereotypies serve a pH buffering function and reduce ulceration of the stomach resulting from restricted feeding practices. Stomach ulceration is prevalent in swine and a weak link between stereotypies and ulceration has been established. The objective of this study was to determine whether the incidence or types of oro-nasal behaviors were affected by dietary sodium bicarbonate. Sixteen sows housed in gestation crates were subjected to change in diet for 2 wk of a 6-wk experimental period, with each animal therefore acting as its own control. During wks 1 & 2 and wks 5 & 6, all sows were fed standard commercial ration. During wks 3 & 4, all sows were fed a diet containing 2% sodium bicarbonate but identical to normal diet in other ingredients and total energy content. Behavior and heart rate were recorded on the middle day of each week from 0.5h before feeding to 2h after feeding and analysed to determine incidence and durations of oro-nasal behaviors and heart rate responses to feeding. Sows spent 46.2% of the pre-feeding observation period engaged in oro-nasal behaviors, increasing to 55.23% of the post-feeding period (P<0.05). The main pre-feeding behaviors were nosing the crate (NC = 11.7%) and bar biting (BB = 11.6%). The main post-feeding behaviors were nosing the floor (NF = 22.3%) and sham chewing (SC = 10.2%). The post-feeding durations of BB and NF were both lower after the diet contained bicarbonate (BB wks 1&2 = 330s, wks 3&4 = 166s wks 5&6 = 175s, P<0.01, NF wks 1&2 = 2010s, wks 3&4 = 1412s, wks 5&6 = 1140s, P<0.05), but the post-feeding incidence of nosing the trough (NF) increased (wks 1&2 = 192s, wks 3&4 = 514s, wks 5&6 = 559s, P<0.001). The heart rate response to feeding was higher (p<0.01) in wk 4 (163bpm) than any of the other wks (151 bpm). The results suggest that the addition of dietary bicarbonate may affect both the performance of feeding-related stereotypic behaviors and the cardiac response to feeding. Further investigation is required to elucidate the mechanisms by which bicarbonate may be acting.

Key Words: Swine, Stereotypies, Well-being

625 Effect of housing systems on implantation in sows. L. Anil*, S. Baidoo, R. Walker, J. Deen, R. Morrison, and S. Anil, *University of Minnesota, Saint Paul, Minnesota*.

A study was conducted to evaluate the effect of housing systems during breeding and gestation in sows on subsequent reproductive performance in terms of piglets born alive, mummies and stillborn piglets. The 3 housing systems were; 1.Sows bred and reared for their entire gestation in stalls (TS, n = 87), 2. Sows bred and reared for their entire gestation in pens with electronic sow feeder (TP, n = 49) and 3. Sows bred and maintained in stalls for 28 days and then transferred to pens with electronic sow feeder for the rest of gestation (PS, n = 43). Analysis of variance was performed to compare the housing systems. The mean born alive varied significantly among the housing systems (TS 11.71 ± 0.27; TP 10.27 ± 0.41; PS 10.42 ± 0.39; $P< 0.01$). The difference between PS and TP housing systems was not significant. However, significant differences ($P< 0.01$) were found between the TS and TP and between TS and PS. Litter weight (kg) showed the same trend as that of born alive (18.33 ± 0.35, 16.77 ± 0.59 and 16.74 ± 0.58 for TS, TP and PS respectively with $P< 0.05$). There was no difference among the groups in terms of farrowing rate, mummies and stillborn. Sows housed in stalls and pens during gestation are equally susceptible to factors causing stillborn and mummies and therefore, there was no difference among sows with respect to mummies and stillborn. There was no difference in farrowing rate among sows, as farrowing success is independent of litter size. The higher live born numbers in stall-housed sows indicates the beneficial effect of stall housing in reducing stress during the implantation period.

Key Words: Gestation, Implantation, Housing

626 Swine Welfare Assurance Program. A. K. Johnson*, E. A. Lautner, and P. L. Sundberg, *National Pork Board*.

Recently in the US there has been intense marketing interest in animal welfare and on-farm production guidelines. Multiple communications with the marketing sector indicate that animal welfare assurances may be transferred back to the producer. The National Pork Board's (NPB) Animal Welfare Committee (AWC) has worked with an international panel of experts to develop a program by which pork producers can objectively assess pig welfare on the farm. The Gestating Sow Welfare Index was the first phase of this collaboration and concentrated on gestating sow welfare. The index was tested in early 2002 by animal and veterinary experts. Results were presented to the AWC who expanded the program to include the farrowing sow and the neonatal piglet, nursery and finisher pigs. It has been renamed the Swine Welfare Assurance Program (SWAP). Three sections of SWAP will assess swine welfare. The first is an evaluation of records, which assesses herd health and nutrition and caretaker training. The second is animal observations, which assesses regularity of animal observation, body condition score, euthanasia, and handling and movement. Third is an assessment of the facilities, which evaluates facility conditions emergency support and continuing assessment and education. SWAP was tested on farm in late 2002 and modifications and refinements to the program have been completed. SWAP Instructor Teams (SIT) will train Certified SWAP Educators (CSE) who will educate producers and provide assessments. SWAP will benefit producers by providing them with a voluntary, uniform, producer-developed tool to help maintain market availability or open up new marketing avenues if selling to a market that asks for information about animal welfare. SWAP can also help producers evaluate and track animal performance and welfare over time and identify weaknesses in management, nutrition or health programs before they become welfare and production problems. SWAP will also demonstrate the US pork producers' commitment to the welfare of their animals.

Key Words: Assessment, Swine, Welfare

627 Factors affecting cow preference for stalls with different freestall bases in pens with different stocking rates. W. K. Fulwider* and R. W. Palmer, *University of Wisconsin-Madison*.

Stall use was monitored using a closed circuit television system in a 4-row, 104-stall freestall barn. Stall status was recorded four times each day, 1400, 2000, 0400, and 0900h, for a 6-month period, 6/19/02 to 12/17/02. Two measures of cow preference, stall with cow lying or stall occupied (cow lying or standing in stall) were recorded. The objective was to compare percentages of cow preference measures for each factor affecting use of stalls with different freestall bases. Six factors were analyzed: freestall base, distance to closest water, stall location within a stall type section (End vs. NotEND), row of stalls (INTERIOR vs. EXTERIOR (wall side)), inside barn temperature (TEMP), and length of time animals exposed to freestall bases (XPOSR). One pen had a low stocking rate (LowSR, 65%), six different freestall bases, [cork-based mattresses-CMATR; foam-based mattresses, FMATR3, FMATR4; rubber-based mattresses RMATR2, waterbeds (WATR), and rubber mat (RMAT4)], and cows were milked with a robotic milker. The other pen had a 100% stocking rate (100%SR), seven different freestall bases [foam-based mattresses-FMATR1, FMATR2; rubber-based mattresses RMATR1, RMATR2; and rubber mats, RMAT1, RMAT2, and RMAT3], and cows were milked twice daily in a herringbone parlor. Each pen was analyzed separately because of different stocking rates. Freestall bases were grouped with 3 to 8 stalls/section and randomly placed in each row. Results show significant differences (P< .05) between a number of freestall bases for lying and occupied. Stall usage for the 100%SR side for lying was FMATR1 (62%), RMATR1 (59%), RMATR2 (57%), FMATR2 (52%), RMAT1 (51%), RMAT2 (43%), RMAT3 (42%), whereas, occupied was FMATR1 (91%), RMATR2 (85%), RMATR1 (84%), FMATR2 (81%), RMAT1 (73%), RMAT3 (65%), and RMAT2 (64%). Stall usage for the LowSR side for lying was FMATR3 (49%), FMATR4 (35%), RMATR2

(35%), WATR (32%), CMATR (18%), and RMAT4 (16%), whereas, occupied was FMATR3 (62%), FMATR4 (50%), RMATR2 (46%), WATR (40%), CMATR (25%), and RMAT4 (23%). Results show foam- and rubber-based mattresses to be superior to rubber mats.

Key Words: Freestall base, Cow preference, Stocking rate

Breeding & Genetics: Molecular genetics and analyses of microarray data

628 Analysis of gene expression patterns in the cattle digestive system. S. L. Rodriguez-Zas*[1], M. R. Band[2], R. E. Everts[1], B. R. Southey[1], Z. L. Liu[1], and H. A. Lewin[1,2], [1]*University of Illinois at Urbana-Champaign, Urbana, IL,* [2] *W. M. Keck Center for Comparative and Functional Genomics, University of Illinois, Urbana, IL.*

Scant information is available on the levels of gene expression in the digestive system of cattle. A study was conducted to characterize transcript profiles in rumen, large intestine, small intestine and reference samples. The absolute intensities obtained from cDNA microarrays that included 7653 cattle and control sequences were used as indicators of the transcript levels. The experimental design included dye-swaps totaling six arrays and sequences were duplicated within array. Data normalization included a LOWESS fit to remove dependencies between tissue effect and average expression level. The remaining variation was analyzed using a linear mixed effects model including the effects of array, dye, gene, and gene by tissue. A total of 218 sequences were significant at P< 10 to the -6 power, of which 28 were significant at P< 10 to the -9 power. The 99.9% bootstrap confidence interval limits of tissue contrasts indicated that 625 genes were expressed at different levels between large and small intestines, 448 were different between the large intestine and rumen, and 401 were different between the small intestine and rumen. Multiple sequences associated with fatty acid metabolism were over expressed in the rumen with respect to the small and large intestines. This result is consistent with the high fatty acid absorbance that occurs in the wall of the rumen. In agreement with the high cell turnover rate of the intestinal epithelium, some Caspase genes were significantly under-expressed in the rumen, when compared to small and large intestines. These results augment the understanding of the gastrointestinal tract development, differentiation, and function and can be used in nutritional programs to optimize feed efficiency and metabolism.

Key Words: Cattle, Digestive system, Microarray

629 Analysis of microarray data: are you better off by replicating genes or arrays? R. Rekaya*, *The University of Georgia.*

Maximizing information content of gene expression experiments is essential for successful application of the technology. The way data is collected (design) and analyzed determines the information content of a study and the power of detection of true changes. Gene expression technology is still very expensive especially for animal agriculture applications. As a result, most expression experiments have less than a dozen chips. Given the noisy data we are dealing with, such small number of arrays will have little power for detecting genuine changes. One way of increasing power is to increase the number of arrays. However, this option is not the most cost effective way. An alternative approach is to replicate genes within array without increasing the number of arrays. This approach allows the control of within-chip variation. To demonstrate the importance and benefits of modeling on-chip variation and compared with the simple approach of increasing the number of arrays, a simulation study was carried out. A mixed linear model including the fixed effect of treatment, a random affect for on-array variation at each gene with variance ${\sigma^2}_g$ and the residual term (between arrays variation) with variance ${\sigma^2}_e$ was fit to the normalized expression level. Three cases of within array replication where each gene was replicated 2, 4 and 8 times were considered. Also, we varied the ratio of variances $R={\sigma^2}_g/{\sigma^2}_e$ from 0.01 to 1. For each combination of number of on-chip replication and variance ratio, 50 datasets with 10 arrays and 200 genes were simulated. For small variance ratio (0.2), the power of the design with on-chip replication was 2.5, 3.6 and 3.9 fold greater than the design without gene replication. The difference in power decreases with the increase of the ratio of variances. However, it remains significantly greater for the design with on-chip replication. In fact, at a ratio of 1, the within chip replicate design remains twice more powerful. Similar power was obtained using 4 arrays with 4 on-chip replication and 10 arrays without gene replication. Results indicate that on-chip replication is a cost effective way to increase power.

Key Words: Microarray, Power, Replicate

630 Normalization, replication, and significance tests in cDNA microarray experiments. G. J. M. Rosa*, R. J. Tempelman, S. Suchyta, S. A. Madsen, J. L. Burton, and P. M. Coussens, *Michigan State University, East Lansing, MI.*

Spotted cDNA microarray experiments are being increasingly used in animal science to compare gene expression of tissues under different biological states, such as different environmental stress conditions or a time course. These experiments generate large, complex, and noisy data sets, which must be appropriately analyzed for satisfactory mining of important biological information. Several procedures have been proposed for normalizing the data regarding different kinds of biases and sources of systematic variation, e.g. intensity- or spatially-dependent dye biases. Also, a variety of statistical approaches have been suggested for the determination of significant differences between mean expression signals. We apply and contrast some of these methodologies, using robust local regression technique, ANOVA models and mixed model approaches. Four microarray experiments are used to illustrate these methods and to discuss their advantages and drawbacks. The experiments were conducted at the Center for Animal Functional Genomics at Michigan State University, using a bovine-specific cDNA microarray system containing 3,888 total spots representing 709 bovine EST clone inserts, 345 amplicons of known genes derived from bovine sequence, and numerous blank and control gene spots. The first dataset derives from a self-self hybridization trial where the same tissue sample was arrayed with two fluorescent dyes, in a reverse labeling experiment. A second loop design experiment was used to monitor gene expression profile changes in blood neutrophils collected from cows multiple times as they proceeded through parturition. The other two experiments compare gene expression profiles of peripheral blood cells from control and Johne's disease positive cows. Special attention in the statistical analyses is given to spatial variability, the use of control genes for data normalization, biological replication, multiple testing and the false positive rate. Some suggestions for further research on the statistical treatment of microarray data are outlined, including the use of mixtures and thick-tailed processes, and different alternatives for modeling heterogeneity of variances across genes and slides.

Key Words: Microarray, Normalization, Significance test

631 Accounting for genotyping errors in QTL analyses. G. J. M. Rosa*, *Michigan State University, East Lansing, MI.*

Construction of genetic maps and the identification of QTL should involve genetic data of high fidelity. However, the rate of mistyping is considerable in most genotypic data, substantially reducing statistical power on detection of linkage between loci and associations between markers and phenotypic traits. Checks for genotyping errors are then crucially important prior to gene mapping analysis based on traditional statistical methods. Common strategies include comparison of duplicate samples, independent calling of alleles, and Mendelian-inheritance error checking. These strategies, however, are not able to detect all errors. A statistical approach that simultaneously infers upon genotyping error rates and allows for the possibility of miscoded genotypes in QTL analyses is presented. The methodology treats observed marker genotypes as phenotypes with a penetrance function that links these variables (which include errors) to the actual (unknown) genotypes. The model includes an additional parameter, which describes the probability of genotype miscoding. A Bayesian approach based on Markov chain Monte Carlo methods is adopted. Backcross data sets with 150 or 300 individuals, genotyped for 5 loci (including some missing data), and with recombination rates between adjacent loci ranging from 0.01 to 0.15 were simulated. Miscoding probabilities were 0, 1, 3 and 5%. Analyses were conducted ignoring or contemplating miscoding in the model.

Results indicate that our methodology provides more precise inferences, especially regarding QTL locations. An analysis of *Brassica napus* is presented to illustrate how the procedure works in practice.

Key Words: QTL analysis, Genotyping error, Bayesian inference

632 Power to detect loci linked to common diseases of dairy cattle using identical-by-descent based methods of half-sib pair linkage analysis. R. L. Vallejo*, *Department of Dairy and Animal Science, Penn State University*.

The utility of sib pairs for quantitative trait locus (QTL) mapping is well established and is based on the use of identical-by-descent (IBD) relationships among genotypes. These model-free methods of sib-pair linkage analysis have proven robust for the analysis of complex diseases in human pedigrees. In contrast, sib pair methods of linkage analysis are not widely used in outbreed farm animals. In dairy cattle, daughter and granddaughter designs are the most commonly used in the detection of marker-QTL linkage, and the statistic most used to demonstrate that a marker is linked to a QTL is the marker contrast between alternative sire alleles. The US dairy population has a number of elite dairy sires each with tens of thousands of daughters which facilitates the development of large half-sib (HS) families. In this study, a simulation method based on sib pair linkage analysis was used to estimate the prospects of detecting loci linked to common diseases as a function of marker and disease allele frequency, the recombination rate, sampling scheme and pedigree structure. The data was simulated under these assumptions: a sex-limited trait that is expressed only in females (e.g., mastitis), disease binary trait; disease status for dams were simulated according to genetic model used; marker genotypes were simulated for all family members; three marker-disease loci recombination rates 0.0, 0.05, and 0.10; autosomal dominant trait with incomplete penetrance (0.80); biallelic marker and disease trait loci with allele frequencies of 0.1, 0.3 and 0.5. The power to detect linkage was estimated using 1000 simulations. This study shows that (1) HS families that include both affected and unaffected daughters are the most informative for the linkage analysis of common diseases; (2) higher power is achieved if the marker allele frequency is at least as large as the disease allele frequency; (3) the more common the disease allele it becomes harder to detect (i.e., power decreases); and (4) HS pair linkage analysis is powerful for the mapping of genes underlying common diseases of dairy cattle.

Key Words: QTL mapping, Sib pair linkage analysis, Common diseases

633 Combining breed and family information to detect QTL in crosses of outbred populations. S. K. Musani* and G. B. Jansen, *University of Guelph, Guelph, ON Canada*.

Crosses of outbred populations pose a unique challenge to QTL mapping due to the existence of linkage disequilibrium between breeds and within families. The present study uses simulation to examine a combined model that uses both sources of information. Two backcross populations (BC1 and BC2) were obtained by backcrossing F1 A×B dams to sires of breed A and F1 B×A dams to sires of breed B. Eight sires and 256 dams each of breed A and B and vice versa were used in the matings, leading to a total of 512 backcross progeny. Each backcross consisted of a set of eight half-sib families with 32 progeny per sire. A finite locus model was simulated with eleven independently segregating QTLs, ten small and one large. The large QTL had three alleles with non-additive effects and explained 24 percent of the total genetic variance of a trait with narrow and broad sense heritabilities of 33 and 45 percent, respectively. Thirteen markers were simulated at 10 cM intervals surrounding the large QTL. Single marker regression analysis was applied. Progeny phenotype was regressed on the probability that the maternal allele came from breed A, in the BC analyses, or the probability that the progeny inherited the first sire allele, in the HS analyses. Statistical power was computed separately for BC1 and BC2, and then as a double BC (BC1+BC2). Similar analysis was done for the HS design. For a marker positioned at 0.1 cM from the QTL, theoretical power was 0.21 and 0.37 for single and double BC analyses, and 0.29 and 0.44 for single and double HS analyses, respectively. Double BC and double HS were combined into one design by multiple regression. When choosing the single marker, out of 13, with the largest test statistic, power of QTL detection was determined empirically. Empirical estimates of power for double BC and double HS analyses were 0.20 and 0.33, respectively, and increased to 0.42 for the combined analysis. These results support the use of a combined approach for the detection of QTL in designed experiments of crosses between outbred populations.

Key Words: QTL detection, Outbred populations

634 Positional candidate genes for reproductive traits in a Meishan-White Composite resource population on pig chromosome 10. D. Nonneman* and G.A. Rohrer, *USDA-ARS, U.S. Meat Animal Research Center, Clay Center, Nebraska*.

Sufficient variation in production traits exists in commercial populations of livestock to exploit allelic variation of superior animals to increase production efficiency and improve the quality of livestock products. Identification of predictive markers by constructing dense comparative maps with human and mouse genomes will allow identification of genomic regions that impact production traits in swine. Several quantitative trait loci (QTL) for important reproductive traits (age of puberty, AP; ovulation rate, OR; nipple number, NN; and plasma FSH, FSH) have been identified on the long arm of porcine chromosome 10, which by bi-directional chromosome painting has been shown to be homologous to human chromosome 10p. Because few anchored markers have been placed on SSC10, we wanted to increase the density of known genes that map to this region of the porcine genome. A total of 20 genes on human chromosome 10p were mapped to pig chromosome 10q and 7 genes from human 10q mapped to pig chromosome 14. Genes from human 10p represent 36 megabases (Mb) that correspond to 53 centimorgans (cM) of pig chromosome 10q with an average marker distance of 2.9 cM (2 Mb of human DNA). Gene order was highly conserved within these markers from centromere to telomere of porcine chromosome 10q, as compared to human chromosome 10p, with 1 large rearrangement along the center of pig 10q. The largest gap in the pig map was 16 cM (104-120 cM on the pig map) corresponding to human 10p14 (8-11 Mb), a region which is very gene-poor in the human. The breakpoint for pig chromosomes 10 and 14 was at the centromere of human chromosome 10. Positional candidate genes were identified for AP (aldo-keto reductase, AKR1C), OR (cAMP regulatory element modulator, CREM), FSH (mannose receptor C1, MRC1) and NN (enhancer of polycomb, EPC1). Nucleotide variation in AKR1C, MRC1 and EPC1 is currently being evaluated in the multi-generation reciprocal backcross resource population as markers for quantitative traits.

Key Words: Genetic markers, Quantitative trait loci, Mapping

635 QTL mapping in extended halfsib families. N. Vukasinovic*[1] and M. L. Martinez[2], [1]*Monsanto Animal Genomics,* [2]*Embrapa - CNPGL*.

QTL mapping in dairy species is usually conducted in presumably unrelated halfsib families, often resulting in imprecise estimates of QTL parameters. Including relationships among sires can improve precision of QTL mapping. In this study we compare a standard halfsib analysis that assumes unrelated sire families with a general pedigree approach that extends halfsib families by considering relationships among sires. Two base individuals were simulated and mated to produce 3 sons. The sons were randomly mated to 4 dams each to produce one male offspring per mating. These 12 sires were then mated to 25 dams each to produce one daughter per mating. The terminal generation included 300 individuals in 12 halfsib families. A 60cM chromosomal segment with 5 equally distributed polymorphic markers was simulated. A 5-allelic QTL was simulated at 20cM or 40cM. The QTL heritability was 0.25. Only marker genotypes on all sires and daughters and phenotypes on daughters were assumed available for analysis. QTL mapping was performed using the random model approach in which phenotypic (co)variances between related individuals are functions of the proportion of alleles identical-by-descent (IBD) shared at a putative QTL. The IBD proportions within families in the standard halfsib analysis were inferred from genotypes at flanking markers. In the general pedigree analysis, the IBD proportions within and between families were obtained by a recursive deterministic method using the closest informative marker bracket. Maximum likelihood techniques were used to estimate QTL parameters. In the halfsib analysis, the 95% confidence intervals for QTL position were 14.6 to 41.4cM and 27.9 to 58.7cM for QTL located at 20cM and 40cM, respectively. In the general pedigree analysis, the corresponding 95% confidence intervals were 16.9 to 25.1cM and 41.6 to 48.4cM. The halfsib analysis in most cases resulted in likelihood ratio profiles showing ghost peaks and bumps, whereas the general pedigree analysis produced profiles with a clearly defined peak. The estimates of QTL heritability

were 0.29 and 0.55 from the general pedigree and halfsib analyses, respectively. Considering relationships among sires is an efficient way to improve results of QTL mapping without considerable cost increase.

Key Words: QTL mapping, Pedigree, Simulation

636 Comparison of statistical methods used to analyze marker data from daughter design with selective genotyping. Y. Pan[1,2], N. Caron[1], G. B. Jansen[3], E. B. Burnside[1,2], and J. P. Chesnais[1,2], [1]*The Semex Alliance, Saint-Hyacinthe, Quebec, Canada,* [2]*L'Alliance Boviteq, Saint-Hyacinthe, Quebec, Canada,* [3]*University of Guelph, Guelph, Ontario, Canada.*

A daughter design (**DD**) was used to identify linkage between markers and QTLs. Selective genotyping can considerably reduce the cost of genotyping for a DD; however, it can result in biased estimates of allele substitution effects when simple regression methods are used. A simulation was carried out to compare three methods. They were maximum likelihood (**ML**: Lander and Botstein, 1989), mean difference between two marker genotypes (**MD**: Darvasi and Soller, 1992) and logistic regression (**LR**: Henshall and Goddard, 1999). Phenotypic measures were simulated for a typical trait in dairy cattle ($h^2 = 0.36$, $\sigma_p = 41.6$ kg). Ten marker loci (3 to 10 alleles at each locus) and a QTL (2 alleles) located on one chromosome were simulated. The allele substitution effect was 0.0, 0.2, or 0.5 σ_p. Selective genotyping with equal and unequal proportions of daughters from each tail was used in a DD. Equal selection proportions were 0.50, 0.25 and 0.05 from each tail and unequal selection proportions were 0.30 (top) vs. 0.20 (bottom) and 0.06 (top) vs. 0.04 (bottom). The accuracy of estimation of allele substitution effects was evaluated as the deviation between estimated and true values. All three statistical methods (ML, MD and LR) provided similar means and standard errors of allele substitution effects when equal proportions were selected from each tail. Estimation errors ranged from 0.002 to 0.017 σ_p in all cases. However, ML and LR methods performed slightly better than MD when unequal proportions of animals were selected. Compared with LR using a SAS standard procedure, ML required much more computing resources. All three methods were suitable for analysis of marker data from selective genotyping in a DD.

Key Words: Statistical methods, Selective genotyping, Daughter design

637 Superiority of QTL-Assisted Selection in Dairy Cattle Populations with Nucleus Herds. G. A. Abdel-Azim*[1] and A. E. Freeman[1], [1]*Iowa State University.*

Two-stage selection of dairy sires, the conventional method currently in use, was applied to the simulated data as the reference or base-line scheme. As reported by several simulation studies, QTL-Assisted Selection (QAS) has been most useful in nucleus herds. However, stochastic simulation studies that investigated the superiority of QAS in nucleus herds often simulated small closed nucleus herds with simple selection and mating plans. In the current study, a juvenile hybrid nucleus herd scheme with a hierarchical mating design was simulated. The nucleus herd partially contributed to the group of young bulls tested in the population every year. Twenty years of selection were simulated with overlapping generations and with population and model parameters proportional to the U.S. Holsteins. A moderately heritable quantitative trait (h2 = 0.3) affected by 40 bi-allelic loci and one QTL with a major effect was simulated. The favorable QTL allele started at a frequency of 0.1. A general trend across all pathways was observed: low superiority in early years of selection that increased to a plateau in later years and then decreased. Superiority at plateau for selection pathways are listed in the table below. In addition to the percentage of superiority, response to selection attributed to each of the QTL and the polygenes was addressed. Further, the effect of the rate at which the favorable allele approached fixation and the accuracy of predicting breeding values on the percentage of superiority were studied. Two major conclusions can be drawn from the study. The contribution of nucleus herds to QAS was positive, and superiority trends in schemes with nucleus herds were more developed relative to the base-line scheme.

	Two -Stage	Nucleus Herds
Active Sires	7.0	7.0
Young Bulls	8.1	9.0
Bull Dams	13.1	13.3
Donor Females	-	19.0
First-Lactation Cows	2.7	3.3

QAS Superiority at plateau computed as percentage difference from QTL-Free Selection.

Key Words: QTL-assisted selection, Nucleus herd, Dairy cattle

638 Detection of QTL affecting milk production and conformation traits on six chromosomes in Holstein cattle. J.A.B. Robinson*[1], G. Vander Voort[1], G. B. Jansen[1], J. C. Byatt[2], L. A. Messer[2], F. X. Du[2], and M. M. Lohuis[2], [1]*Centre for Genetic Improvement of Livestock,* [2]*Monsanto Company.*

The multiple chromosome genome scan approach to detecting QTL for production and conformation traits in dairy cattle has been gaining popularity as the number of documented microsatellite markers increases. This study reports on the use of microsatellite markers covering six chromosomes in a granddaughter design to detect QTL for production and conformation traits in 25 Holstein sire families. A total of 1,835 sons of 25 sires were genotyped for 54 microsatellite markers distributed across chromosomes BTA1 (12 markers), BTA3 (10), BTA9 (9), BTA10 (8), BTA14 (8) and BTA20 (7). The performance data for this study were the USDA production genetic evaluations (PTA) and the Holstein USA conformation genetic evaluations (STA) released in February 2002. Weighted least squares interval mapping was performed across and within sire families using a modified version of the software developed by S. Knott and C. Haley. Analyses were performed at one cM intervals separately for each trait. Permutation testing and false discovery rate were used to control type I error. The information content of the markers genotyped in this study ranged from 0.57 to 0.89 with most between 0.75 and 0.85. Six significant QTL effects were evident from the multiple sire analyses for production traits. Evidence for a QTL for both PTA milk and PTA fat% was found on BTA14 (0 cM) and a QTL at 81 cM for PTA protein%. On BTA3 and BTA 20, there was evidence for QTL associated with PTA protein% at 26 and 41 cM respectively. Three significant QTL effects were evident from the multiple sire analyses for conformation traits. All three QTL were found on BTA10; a QTL associated with STA Strength was located at 43 cM, a QTL associated with STA Body Depth was located at 45 cM and a QTL associated with STA Dairy Form was located at 49 cM.

Key Words: QTL, Production, Conformation

639 Putative quantitative trait loci affecting perinatal survival in eleven Holstein families. P. J. Berger*[1], J. Koltes[1], M. H. Healey[1], M. S. Ashwell[2], R. D. Shanks[3], H. Schlesser[3], and H. A. Lewin[3], [1]*Iowa State University, Ames, IA,* [2]*USDA-ARS-GEML, Beltsville, MD,* [3]*University of Illinois, Urbana, IL.*

Perinatal survival (PS) is a categorical trait expressed as the proportion of calves alive 48 hr after birth. Recent estimates of predicted transmitting ability (PTA) for PS for elite Holstein sire families were used to identify putative quantitative trait loci (QTL) for PS. From 55 sire families with 50+ sons, 17 families were shown to have a bimodal distribution for PTA-PS; 11 of the 17 families had genotypic data. Full genome-wide scans were available for two of the 11 families. A total of 56 markers were from the USDA linkage map; 18 markers on BTA 6 and 16 markers on BTA 27. Data were analyzed using ANOVA in the granddaughter design, to identify significant marker-PS associations. Number of informative sons ranged from 38 to 285. Mean number of informative sons across all markers was 131; 115 for BTA 6 and 151 for BTA 27. Six markers, three each on BTA 6 and 27, had significant ($P < 0.02$) associations with PS. Suggestive of a major genetic component for PS, estimates of effects ranged from -0.45 to 0.28 % PS. Markers on BTA 9, 12, 14, 17, and 18 also exhibited significant associations with PS ($P < 0.02$), although this data was limited to two families. Estimates of effects for these markers ranged from -0.31 to 0.56 % PS. Distribution of the number of sons with alleles for significant markers was similar to the original bimodal distribution of PTA-PS. Evidence presented implies the existence of QTL linked to major genes affecting PS. Upon validation and fine-mapping, sires can be selected for PS based on the existence of specific marker information.

Key Words: Perinatal survival, Quantitative trait loci, Holstein dairy cattle

640 Genome scan of BTA1 for QTL affecting weaning weight, yearling weight and postweaning growth in Japanese Black cattle. A. E. O. Malau-Aduli*[1], T. Niibayashi[1], T. Kojima[1], K. Oshima[1], Y. Mizoguchi[2], Y. Sugimoto[2], and M. Komatsu[1], [1]*Dept of Livestock & Grassland Science, National Agric Res Center for W/Region, Oda, Shimane, Japan.,* [2]*Shirakawa Institute of Animal Genetics, Fukushima, Japan.*

A genome scan for chromosomal regions of bovine chromosome one (BTA1) influencing weaning weight (WT6), yearling weight (WT12) and postweaning average daily gain (PWADG) was performed using 112 half-sib progeny of 4 Japanese Black (Wagyu) sires and 98 microsatellite DNA markers. Identity-By-Descent (IBD) probabilities at specific chromosomal locations from multiple marker data were determined and a linear model containing the fixed effects of sex, parity and season of birth as well as age as a covariate, was fitted to the IBD coefficients and phenotypic data. Data were analysed by generating an F-statistic by the regression of phenotype on the IBD probabilities of inheriting an allele from the sire. Permutation tests at chromosome-wide significance thresholds were carried out over 1, 000 iterations at 1cM intervals while the boostrap with resampling procedure was followed to estimate confidence intervals and average QTL locations. All these procedures were implemented in the QTL Express Computer programme with a web-based user interface (available at: http://qtl.cap.ed.ac.uk/). A significant QTL (P chromosome-wise threshold = 0.05) for PWADG was identified in Sires 2 and 3 located at 27cM and 29cM (95% confidence intervals of the QTL locations being 0-132cM and 0-125cM) respectively. Another QTL for WT12 was identified at 113cM in Sire 2. No significant effect on WT6 was detected in any of the sires. Selection indices that include QTL with accurately estimated effects on carcass characteristics could reduce the amount of lengthy and costly data collection by providing a means of genetic evaluation early in the life cycle. Since PWADG is positively correlated with WT6 and WT12 in beef cattle, the identification of these QTL in Japanese Black Cattle holds a high prospect for the implementation of marker-assisted selection for the early attainment of slaughter weight in this breed .

Key Words: QTL, Japanese Black, Growth

641 Different images of putative quantitative trait loci on BTA6 for correlated milk traits. G. Freyer*[1], P. Sorensen[2], C. Kuehn[1], and R. Weikard[1], [1]*Research Institute for the Biology of Farm Animals,* [2]*Danish Institute for Agricultural Science.*

A number of publications based on various studies strongly suggest the existence of several putative quantitative trait loci (QTL) on the bovine chromosome 6 (BTA6) for the milk traits (Bovenhuis and Schrooten 2002). Further, they partly suggest equal QTL locations for different traits (e.g. Ron et al. 2001). The aim of our study was to investigate, whether previous findings of similar QTL positions for correlated milk traits are due to trait specific QTL or due to QTL with pleiotropic effects on several traits. For this reason, we applied a multitrait (co)variance component based QTL mapping method (Sorensen et al. 2003) to a data set involving five granddaughter families with 298 genotyped sons from the German Holstein cattle population. The marker map contained 16 microsatellite markers (according to Khn et al. 1999, extended), distributed across BTA6. The trait values (DYD and EBV) were provided by the VIT Verden. The multitrait- QTL approach (MTMQTL) is part of the DMU package, developed by the Danish Institue of Agricultural Sciences (DIAS) and allows analysing several traits multivariately, and specifying five different genetic submodels. A chromosome-wise significance threshold was used, because BTA6 is known to harbor QTL for several milk traits. We received significant QTL findings for milk yield (between markers BM1329 and FBN12), for yields of protein and fat (FBN9 ... FBN13), and QTL for contents of fat and protein (BM1329 ... FBN12). The multivariate analysis resulted in a significant pleiotropic QTL finding for fat yield and protein yield. The estimates of variance contribution due to the QTL were 20 % and 25 %, respectively. For fat yield and fat content, a pleiotropic QTL seems to be likely, between FBN12 and TGLA37, but these results were not fully significant. Negatively correlated milk traits are likely affected by trait specific closely linked QTL on BTA6, e.g. 24 cM apart for protein yield and fat content, according to significant results. The confidence interval CI (95%) was computed as suggested by Darvasi and Soller (1997) and ranged from 8 to 13 cM, depending on the model, in significant cases.

Key Words: Milk traits, Multivariate QTL analysis, Pleiotropic QTL

Extension Education: Extension education and evaluation programs

642 Using the internet for exchange of dairy genetic evaluations and research information for the dairy industry. A. H. Sanders*, F. A. Ross, and H. D. Norman, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA.*

The mission of the USDA Animal Improvements Program Laboratory (AIPL) is to foster genetic improvement in dairy cattle. Practical improvement in production and profitability is achieved through the distribution of genetic evaluations used by the dairy industry to guide breeding decisions. Since 1997, evaluations have been distributed via the internet through the AIPL website (http://aipl.arsusda.gov) and FTP site (ftp://aipl.arsusda.gov). Data used to calculate evaluations is received via the FTP site from dairy record processing centers (DRPC), breed associations, and other industry cooperators. Between quarterly evaluations, 11.2 million individual animal updates, and 150,000 pedigree updates come from DRPC and breed organizations, respectively. Over 80 interactive tools assist cooperators and AIPL staff with data quality control, and access is customized by user group. Genetic evaluations are also available to the public via the website through 22 interactive queries. More than 20 quarterly or yearly reports are also available. Complete documentation of evaluation procedures is stored in the AIPL website. The user-accessible directory includes 377 Mb of data and information in 12,000 files. A full function search engine assists with site navigation. File metadata also facilitates indexing by outside engines. In 1997, the National Agricultural Statistics Service reported that 20% of all farms with over $100,000 annual sales had internet access. In 2001 that figure was up to 58%. In the second half of 2002, over 170,000 requests for bull evaluations and 67,000 requests for cow evaluations were submitted to the AIPL website. Evaluation access quadruples during the week following evaluation release. Links accessed within the AIPL website account for 74% of all website requests. Outside requests are from links on other sites 12% of the time, others coming from bookmarks or user entry. About 25% of all requests are from the top 1% of requesters. Recent website enhancements include Spanish language availability and improved indexing. Planned improvements include more-dynamic database query tools, and user account control for industry cooperators.

Key Words: Internet, Information technology, Dairy genetics

643 Effectiveness of presenting a national beef breeding management educational program via the internet. K. D. Bullock*[1], D. R. Strohbehn[2], E. J. Pollak[3], B. L. Golden[4], J. K. Bertrand[5], and D. E. Wilson[2], [1]*University of Kentucky, Lexington, Kentucky,* [2]*Iowa State University, Aimes, Iowa,* [3]*Cornell University, Ithica, New York,* [4]*Colorado State University, Fort Collins, Colorado,* [5]*University of Georgia, Athens, Georgia.*

There is a great demand for beef cattle breeding and genetics information from cattle producers and animal sciences students, however, with shrinking budgets at many Universities there is often a void in expertise. A national educational program was developed to provide resource materials and train Extension beef cattle specialists, other Extension personnel, beef science instructors, graduate students, breed association representatives and beef stud company representatives in all phases of beef cattle breeding management. Seven one-hour sessions were developed that covered the following topics: basic genetic principles; using Expected Progeny Differences (EPD); future EPD; multi-breed evaluations; economically relevant traits; incorporating genomics in genetic evaluations; and applying the technologies available. Each session was developed and presented by experts in the respective fields. A web-based system was used to deliver the program. The presenter and recipient participated from their remote location. After each session the presentation and audio files were available for downloading and a CD of all sessions was distributed to participants. Additionally, at the completion of the series a survey was administered to evaluate the content, method of delivery and impact. Participants in 33 states enrolled and 31% of the enrolled participants returned a completed survey. This represented 42% faculty, 6% graduate students, 36% county/area Extension agents, and

17% other. Forty-one percent planned to use the presentations to deliver educational programs to producers, 74% planned to develop their own slides from the material for producer educational programs, 32% planned to use the material to teach undergraduate courses and 68% planned to use the information for consulting clientele. On a one to five scale from "Horrible" to "Excellent" the delivery method was rated 3.9 and the content was rated 4.1. Sixty-six percent thought the level of the content was "About Right". The estimated impact was 6808 contacts, which does not reflect the 69% that did not complete the survey or those that plan to utilize the CD. In conclusion, this genetic management series delivered via a web-based system was effective in educating a large national audience at a minimal cost.

Key Words: Beef cattle, Education, Breeding

644 Use of a dairy whole farm nutrient balance education tool (Dairy WFNBET) to teach dairy producers and their advisers about nutrient management concepts at the whole-farm level. J. H. Harrison*[1], T. Nennich[1], J. Gillies[2], and C. A. Rotz[3], [1]*Washington State University,* [2]*NRCS,* [3]*USDA/ARS, University Park, PA.*

All dairies in the state of Washington were required by law to have an approved nutrient management plan by July 2002. By December 2003, these nutrient management plans must be certified that the planned practices and structures have been implemented. In early 2003, we conducted a series of nutrient management workshops to assist dairy producers and their advisers better understand the factors affecting the whole farm balance of nitrogen. The goal was to encourage active use of their nutrient management plans as a part of their overall farm management. A spreadsheet based education tool was developed in Excel® to demonstrate whole farm concepts related to nutrient balance with a focus on nitrogen. The goals in developing the tool were: 1) to have it viewed on a single page (worksheet), 2) to require inputs readily available on most dairy farms, and 3) to be consistent with a planning program developed by NRCS to write nutrient management plans for dairies in Washington. The inputs required to simulate a farm were: herd milk production, number of milking cows, dry cows, and heifers, DMI of lactating cows, CP content of lactating cow rations, fertilizer import, land in forage crops, yield and CP content of forage crops, soil organic matter content, estimated losses of manure nitrogen based on storage system and manure application method, and nitrogen loss due to denitrification. Output of the analysis included the manure nitrogen available to crops and the whole farm balance of nitrogen. Specific management strategies were demonstrated with the education tool, which included diet reduction of CP, level of milk production, custom raising of heifers, crop yield, and manure application method.

Key Words: Environment, Nutrient management, Extension education

645 Development of an educational program to promote the performance of dairy farms in North-East of Iran. A. Naserian and T. Vafa*, *Ferdowsi University of Mashhad, Khorasan, Iran.*

Khorasan state is second top of milk production in Iran, which produce more than one million ton milk annually. Holestein is the dominant breed which is kept. Extension Department of Agriculture Ministry, in order to promotion of performance of dairy farms strongly recommended to herd owners employee dairy graduated person. The short course was developed in response to the desire of dairy owners to increase the skills of their employees. Extension personnel consulted with dairy producers during meetings to identify training needs. Dairy specialist from university trained these skills. The objective of present study was to evaluate the effect of dairy graduated student manager and short course training in performance of dairy herds in Khorasan. Data were collected from different farms with different sizes, between 1996-2002. Dairy farms were divided between two main class a) Farms with dairy graduated students managers (T1=DGSM), b) without dairy graduated students managers (T2=WDGSM). Each class was consisted of four herd sizes (40-60, 60-80, 90-110, 120-160). Data were analyzed using General Linear Models procedures of SAS v6.12 for ANOVA to evaluate differences among experimental groups. The design was completely randomized (unequal replicates) in a 2×4 factorial experiment. The results showed that herd owners employed DGSM had more milk and fat than other herds ($P \leq 0.0001$). According to the following table, presence of graduated student manager has significant effect on milk production and fat percentage in all herd sizes ($p \leq 0.0001$). Interactions were not significant.

Item	T1	T2	SEM
Milk (kg)	26.75^a	23.77^b	2.73
Fat %	3.13^a	3.01^b	0.10

	40-60	60-80	90-110	120-160
Milk (kg)				
T1	26.73^b	27^b	26.43^b	26.84^b
T2	23.68^a	24.25^a	22.9^a	24.24^a
SEM	11.41	8.4	8.4	5.75
Fat %				
T1	3.25^b	3.15^b	3.11	2.98^b
T2	3.08^a	3^a	3.09	3.11^a
SEM	0.15	0.16	0.59	0.13

Key Words: Educational program, Management, Dairy cattle

646 The south Texas "Cow Camp" program. R. L. Stanko*[1], J. Ford[2], F. Escobedo[2], R. Mercado[2], B. Wymore[2], J. McManus[2], J. Lopez[2], R. Garza[2], H. Buehring[2], and J. C. Paschal[3], [1]*Texas A&M University-Kingsville, Kingsville, TX,* [2]*Texas A&M University CEA, South Texas,* [3]*Texas A&M University Cooperative Extension Service.*

Building leadership for the future in the beef industry was the idea behind Cow Camp, a program developed and initiated in 1997 as a collaborative effort by south Texas Extension agents and Texas A&M University - Kingsville. The objectives of Cow Camp are to educate and build leadership skills of high school age youth interested in the beef cattle industry. Cow Camp was designed to provide an integrated, multifaceted three-day beef cattle program which included university experience. The camp consists of classroom, live animal laboratory, range and wildlife habitat evaluation, computer interactive, and tour sessions. Sessions provide knowledge, background, and experience in the cow-calf, feedlot, packing, marketing, breeding and selection, reproductive management, and herd health segments of the beef cattle industry. Camp instructors include faculty, Extension agents and specialists, industry professionals, and regional beef cattle producers. Campers (n=94) were selected through an application process which has resulted in 19 ± 3 students selected per yr during the past six yr. Youth have ranged in age from 14 to 18 yr (mean = 16 yr) and have originated from 44 Texas counties. A variety of race, experience, and geographical region has enhanced the experiential learning at Cow Camp. Most campers (98%) have owned cattle themselves as a result of other beef production youth activities (4-H or FFA). The remainder of campers and their parents (2%) owned no cattle. The majority (97%) of campers planned on attending college and 90% planned on majoring in an agriculture field. Success indicators include: 1) number of program participants, 2) continued support of the sponsors and donors, and 3) enhanced ($P > .05$) comprehension of beef cattle management and the beef cattle industry as determined by pre- and post-camp exams. This program has been successful for six consecutive years and could serve as a model for other youth livestock programs.

Key Words: Beef cattle, Youth, Extension

647 A Spanish language milker's school for Idaho dairy employees. K. S. Jensen*, J. C. Dalton, W. Cook, D. Falk, and R. Norell, *University of Idaho Cooperative Extension, Caldwell, ID.*

A Spanish language milker's school for Idaho dairy employees was developed in response to the request of dairy producers for educational opportunities for their employees. University of Idaho Cooperative Extension personnel consulted a dairy advisory board, consisting of producers and members of allied industry, to identify critical topic areas. The program consisted of 4.5 h of classroom teaching, and was held in Caldwell, Twin Falls, Preston, and Blackfoot, Idaho. Topics included udder anatomy, cow preparation and sanitation, milk letdown, milk removal and milking unit handling, mastitis, prevention of antibiotic residues in bulk tank milk, milking systems, and the role of the dairy industry in Idaho's economy. All material was presented in Spanish. A 30-question test (true or false, fill in the blank, and multiple choice) covering various aspects of milking management was given to participants at the beginning and conclusion of the program. Fifty-six students completed the pre- and

post-test. The overall mean test score for the pre-test was 57.3%, while the mean for the post-test was 80.6%. A certificate of completion was awarded to all participants at the conclusion of the program. Additional Spanish language educational opportunities are planned due to the high level of interest among dairy producers and their employees.

Key Words: Spanish, Milker, Dairy

648 A novel method to aid in determining focus of 4-H youth programming. J. A. Nadeau*[1], E. A. McCabe-Alger[2], K. Chameroy[1], and T. Hoagland[1], [1]*University of Connecticut, Dept. of Animal Science,* [2]*University of Connecticut, Dept. of Extension.*

General knowledge exams have been conducted as a part of the activities at the Eastern States New England 4-H Horse Show, the conclusion of a year of work for most New England 4-Hers. Until now, the exams were graded and ribbons awarded based on score. In 2002, an extension specialist and an extension educator wanted to develop an exam that may determine strengths and weaknesses of the youth from states participating in an event. They planned to use these results to enhance program planning statewide. One hundred multiple-choice questions were placed into 10 categories with 10 questions in each category. Questions were randomized so that each category was dispersed throughout the exam. The test was administered to approximately 100 4-Hers. Exams were photocopied and the copies scored immediately at the show. The original exams were scored by Scan-Tron and data were evaluated. Information on name, birth date, number of years attending the event, discipline (hunt seat, saddle seat, western, or junior leaders), and state was gathered. An average score for each category was calculated. The final result for each category calculated as percentage correct revealed how the strength or weakness of the state was in that area of the exam. This information was distributed to each state leader with the recommendation that the information be dispersed throughout the state. It was hoped that these results could then be used to help determine topics to include when developing statewide events, such as a state workshop day. The use of a randomized, categorized exam should be considered when feedback on strengths and weaknesses is desired. This system may also offer a way to determine a 4-Her's progress over time. This method, due to its simplicity and potential benefit to coaches, extension educators, extension specialists and 4-H youth, might also have potential for inclusion in hippology contests.

Key Words: Exam, Youth, Program planning

649 Arkansas 4-H dairy and meat goat conferences. J. A. Pennington*, *University of Arkansas Cooperative Extension Service, Little Rock.*

The Arkansas 4-H Dairy Goat Conference was initiated in 1994 at the request of dairy goat producers in the State. Topics included primarily management practices related to fitting and showing dairy goats which were presented at a county fairgrounds on Saturday in the spring. The next year, the conference moved to the Arkansas 4-H Center and topics were related to routine feeding and management in the morning and fitting and showing in the afternoon. In 1998, topics concerning meat goats were added, and the conference evolved into the Arkansas 4-H Goat Conference. In 2000 the conferences were split, and both dairy and meat goat conferences were conducted with the locations alternating yearly between northwest Arkansas and the 4-H Center in central Arkansas. Present topics include feeding, health, facilities, parasites, marketing and routine management plus fitting and showing. Youth are usually separated from adults for some sessions. Speakers are primarily Extension agents, industry personnel, and a scientist from Langston University. Participants in the conferences vary each year but are approximately 1/3 youth, 1/2 adults from industry and parents of youth, plus educators and speakers. Each year, a planning committee composed of goat breeders reviews comments from the previous year as they plan the program. Evaluations averaged 4.6 on a 5.0 scale last year and comments were positive, indicating that the conferences were well received by attendees.

Key Words: Dairy goat, Meat goat, Youth

650 Reducing catastrophic injury through helmet safety awareness. J. A. Nadeau[1], E. A. McCabe-Alger*[2], and A. Bialczak[2], [1]*University of Connecticut, Dept. of Animal Science,* [2]*University of Connecticut, Dept. of Extension.*

The Connecticut Helmet Safety Program was developed to increase awareness of helmet safety throughout New England, especially Connecticut. This program was funded by USDA Farm Safety funds. According to recent medical examiner reports, 60% or more of horse related deaths result from head injuries. Helmets can reduce this risk by 70-80%. The program began with development of a peer-reviewed brochure and a web site. The brochure highlighted important facts about helmet safety and was distributed at various horse-related events throughout the year. A web site was developed that features information on helmet safety, proper fitting and care of helmets, types of helmets available, and links to other horse related sites such as the University of Connecticut Animal Science department and horse specialist web pages. Additionally, age appropriate techniques of promoting helmet safety awareness were developed. The program developers also attended various equine events throughout the year, presenting information about helmet safety through distribution of brochures, showing the video "Every Time, Every Ride," and sponsoring a drawing for helmets, "Every Time, Every Ride" videos and other prizes. In the future, a "train the trainer" curriculum will be developed in which interested volunteers will be educated about helmet safety and speak to interested groups. This will be accomplished through a training course and distribution of a pre-developed presentation on compact disc (CD). In the future the program will target equine groups who have historically failed to adopt helmets as a necessary safety feature. The Connecticut Helmet Safety Program offers many ideas on how to promote helmet safety awareness to all horse owners. This program can be used as a model for use in other states. Training others to effectively disseminate information on behalf of program developers such as extension specialists and extension educators can enhance the scope and impact of important programs.

Key Words: Helmet, Safety, Program planning

651 Fish farmer certification: In-depth classes for producers of catfish or freshwater prawns. G. J. Burtle*, *University of Georgia, Tifton, GA/USA.*

Interest in alternatives to conventional farm crops is creating a demand for detailed instruction in fish farm management. Catfish culture and freshwater prawn culture are the most popular aquacultural enterprises in Georgia. Instructional programs were developed to teach catfish culture over five days and freshwater prawn culture over three days in order to provide information in-depth and allow for hands-on learning during each session. A certificate of completion was offered for successful completion of each course. Letters describing course content were provided as material for business plan documentation. The catfish course consisted of five Saturday sessions from January to June. The freshwater prawn course began on a Thursday in October, in order to demonstrate harvesting, and included Saturdays in November and December. The first session was devoted to economics of production and processing, harvesting and marketing topics. Lectures in subsequent sessions covered facility design and construction, nutrition, water quality, animal health, hatchery, and nursery topics. Laboratory activities included economic spreadsheet use, water analysis, fish processing, disease recognition, and hatchery techniques. These sessions were fee-based to limit participation to those in earnest and extension personnel were given substantially discounted rates. Enrollment was allowed on a session-by-session basis. The courses drew 14 students for catfish training and 17 students for prawn training. Students have utilized their training to start processing operations, develop investment proposals, construct fish farms, or determine that they were not prepared to enter the business. Extension personnel comprised 25.8% of the students and were willing to invest the time to learn more about aquacultural enterprises.

Key Words: Aquaculture, Catfish, Freshwater prawn

652 Comparison of IgG concentrations and total protein concentration in the blood plasma of newborn dairy calves. D. T. Vines*, R. Rodgers, A. B. Bodine, and W. C. Bridges, *Clemson University, Clemson, SC, USA.*

Previous studies at other laboratories suggest a relatively high regression coefficient for plasma IgG and protein when measured by a hand held refractometer. Jugular blood samples were collected from 2-4 day

post-partum Holstein and Jersey calves at the Clemson University Dairy. Plasma was collected following centrifugation and stored at -20°C until assayed. Protein values were determined by placing one drop (50°μl) on a refractometer window (Model RHC-200 ATC clinical refractometer, Westover Scientific) and reading value at g/100mL. IgG values were determined by a sandwich ELISA procedure using a monoclonal antibody against bovine IgG (Sigma Chem). Plasma samples were diluted at 1:20,000 with PBS containg 0.2% ovalbumin. The data obtained were analyzed by regression procedure for correlation and by regression analysis. Mean values (n=148) for IgG was 1947 mg/100mL (S.E.=±47). Mean value (n=148) for protein was 6.13g/100mL (S.E.=±0.07). Mean IgG values (n=97) for Holsteins was 1889 (S.E.=±55.8) and for Jersey (n=51) was 2059 (S.E = ±86.2). Mean protein values (n=97) for Holsteins was 6.06 (S.E.=±0.09) and for Jerseys (n=51), 6.20 (S.E.=±0.13). Data analysis by the above statistical procedures revealed an r value of 0.26 with extensive skewness at 2000 mg/100mL IgG. Within an assay there appeared to be a good positive correlation; increased protein similarly increased IgG. However, assay to assay variation was too great to result in an overall significant correlation between protein and IgG. In addition, comparison of refractometer protein readings to a standard protein analysis procedure could possibly suggest an insensitivity of the refractometer to major protein changes in plasma.

Key Words: IgG, Dairy calves, Refractometer

Growth & Development

681 Effects of conjugated linoleic acid (CLA) and trans- $C_{18:1}$ fatty acids (TFA) on energetic metabolites and subcutaneous adipose tissue fatty acid composition. L. H. Baumgard*[1], S. R. Sanders[1], C. Davis[1], B. A. Corl[2], J. W. Perfield, II[2], D. E. Bauman[2], and G. C. Duff[1], [1] *The University of Arizona, Tucson,* [2] *Cornell University, Ithaca NY.*

Finishing beef cattle (n=30, 359 60 kg BW), which were studied in an immune trial were also utilized in this experiment. Cattle were fed isoenergetic diets (steam-flaked sorghum based) supplemented (top dressed) with rumen protected (RP) palm oil (559 g/d; EnerGII®[EII]; control), RP TFA (594 g/d) or RP CLA (609 g/d) for 35d. Each treatment provided 475 g lipid/d and RP TFA consisted of 17.2% italicizetrans-6-8, 8.7% *trans*-9, 8.8% italicizetrans-10, 5.8% *trans*-11 and 7.3% italicizetrans-12 $C_{18:1}$ and the RP CLA contained 6.5% *cis*-9, *trans*-11, 5.4 % c/t-8, c/t-10, 8.25% c/t-11, c/t-13 and 7.9% italicizetrans-10, *cis*-12 CLA. All bull calves were weighed and blood collected on d 0, 7, 13, 21, 28 and 35. Subcutaneous adipose biopsies were taken from the tail head on d 35. Overall, CLA supplementation decreased DMI (P = 0.04; 7.6, 7.4 and 6.1 kg/d for EII, TFA and CLA, respectively) and did not effect G:F or ADG. CLA supplementation tended (P = 0.10) to increase NEFA concentrations (196^a, 213^{ab} and 258^b μmole/L, for EII, TFA and CLA, respectively) and this was not dependent upon time. Supplementing CLA reduced (P=0.04) plasma glucose levels (5.4%) compared to EII and there was no trt x time interaction. Compared to EII cattle fed TFA had increased (P<0.01) concentrations of *trans*-6-8 (120%), *trans*-9 (113%), italicizetrans-11 (30%) and *trans*-12 (62%) $C_{18:1}$ fatty acids, but did not change italicizetrans-10 $C_{18:1}$ (64 mg/g fat) and also increased *cis*-9, *trans*-11 CLA (10 %). Irrespective of treatment the content of italicizetrans-10 was 3.8 fold more than italicizetrans-11 $C_{18:1}$. CLA supplementation did not alter the trans-C18:1 profile but increased italicizecis-9, *trans*-11 and *trans*- 10, *cis*-12 CLA content by 8 and 50% respectively. There was no treatment effect on total unsaturated fatty acid content (54%) or on the $Delta^9$-desaturase index (42.5) nor any of the specific Δ^9-desaturase ratios. These data indicate the Δ^9-desaturase system contributes to the *cis*-9, *trans*-11 CLA content in beef adipose tissue.

Key Words: CLA, Δ^9-desaturase

682 Effect of conjugated linoleic acid on DNA fragmentation in cultured adipocytes. K. M. Hargrave* and J. L. Miner, *University of Nebraska.*

Dietary conjugated linoleic acid (CLA) causes body fat loss and DNA fragmentation in adipose tissue of mice. DNA fragmentation is an indication that CLA may cause apoptosis, either in preadipocytes or adipocytes. We recently reported that CLA promoted DNA fragmentation in cultured preadipocytes. The present study was designed to determine if mature 3T3-L1 adipocytes are susceptible to this effect of CLA. 3T3-L1 preadipocytes were seeded into 12-well plates with DMEM plus 10% calf serum, grown to confluence, and stimulated to differentiate with dexamethasone, IBMX, insulin, and fetal bovine serum. Differentiated cells were maintained in DMEM plus 10% fetal bovine serum for 7 to 9 d and then 0, 50, 100, or 200 μM linoleic acid (LA) or trans-10, cis-12 CLA, complexed to albumin (6.6:1), or 50, 500, or 1 nM staurosporine. Media were changed every 2 d. Cells were collected on d 2, 4, and 6 of treatment. Attached and detached cell number, DNA fragmentation, cellular triglyceride content, and glycerol content of media were determined. CLA did not increase DNA fragmentation compared to either the control or LA on any day. CLA, at the 50 and 100 μM doses, reduced ($P < 0.01$) cell number on d 2 but not on d 4 or 6. LA and CLA did not alter cellular triglyceride content on any day. CLA also had no effect on glycerol content of the media. However, 200 μM LA increased ($P < 0.05$) glycerol in the media on d 2 (790 vs 1370 μg for control vs 200 μM LA, respectively). Staurosporine reduced ($P < 0.05$) total DNA on each day by 20 to 90% and appeared to increase DNA fragmentation on d 2. Additionally, 50 and 500 nM staurosporine reduced ($P < 0.05$) cellular triglyceride content on d 2 by 42 and 65%, respectively, and increased the glycerol content of the media on each day, compared to the control. In conclusion, CLA did not cause an increase in DNA fragmentation in mature 3T3-L1 adipocytes. This indicates that the DNA fragmentation observed in fat pads of mice fed CLA may be attributed to preadipocytes and not to adipocytes.

Key Words: Conjugated linoleic acid, Adipocytes, DNA Fragmentation

683 IGF-I infusion alters gene expression profile of prepubertal bovine mammary parenchyma. B. E. Etchebarne*, L.F.P. Silva, G.J.M. Rosa, P. M. Coussens, M. S. Weber Nielsen, and M. J. VandeHaar, *Michigan State University.*

Insulin-like growth factor-I (IGF-I) stimulates proliferation of bovine mammary epithelial cells in vitro and in vivo. Our objective was to identify key genes that mediate the IGF-I mitogenic response in prepubertal mammary parenchyma. IGF-I was infused via the streak canal into two quarters of six prepubertal Holstein heifers at 10 μg/quarter per d; other quarters received saline plus BSA. After 7 d, heifers were killed and mammary parenchymal tissue was collected. IGF-I increased the percentage of epithelial cells in the S-phase by 30%, as reported in a separate abstract. To date, gene expression profiles of total parenchymal mRNA from each quarter of 2 animals have been examined using a bovine-specific cDNA microarray system containing 796 unique expressed sequence tags and 539 amplicons representing known genes. A loop design was used with cDNA from each quarter of each cow labeled with Cy3 or Cy5 dyes prior to microarray hybridization. Gene expression data were normalized for dye intensity using control genes. Significance levels of differential gene expression among treatments were assessed using a mixed model approach with the procedures LOESS and MIXED of SAS. IGF-I increased expression of several genes. Of particular interest, IGF-I upregulated nuclear receptor coactivator 6 interacting protein, an activator of the STAT3 pathway; beta-1,4-N- acetylglucosaminyltransferase IV, which influences cell cycle progression and susceptibility to apoptotic stimuli; MHC Ovar-DR-alpha, which interacts with the STAT1 pathway; and nickel-specific induction protein (Cap43), a marker for rapidly proliferating breast cancer cells. Expression of these 4 genes was increased 70 to 100% (P < 0.008). We are currently evaluating the other 4 animals in the study, verifying changes with real-time PCR, and employing laser capture microdissection to measure expression profiles of epithelial and stromal cell types separately. We conclude that IGF-I infusion into prepubertal bovine mammary glands induces changes in expression of genes affecting STAT signaling, mammary cell apoptosis, and cell cycling.

Key Words: IGF-I, Microarray, Mammary development

684 Leptin intramammary infusion alters the gene expression profile of prepubertal bovine mammary parenchyma. B. E. Etchebarne*, L.F.P. Silva, G.J.M. Rosa, P. M. Coussens, M. S. Weber Nielsen, and M. J. VandeHaar, *Michigan State University*.

Increased body fatness in prepubertal heifers is associated with impaired mammogenesis. Leptin, a hormone produced by adipocytes, reduces proliferation of bovine mammary epithelial cells in vitro and in vivo. Our objective was to identify key genes mediating this inhibition. Leptin was infused via the streak canal into 2 quarters of 6 prepubertal Holstein heifers at 100 μg/quarter per d; control quarters received saline plus BSA or saline plus IGF-I. After 7 d, heifers were killed and mammary parenchymal tissue was collected. Leptin decreased the percentage of epithelial cells in the S-phase by 48% in IGF-I-treated and 19% in saline-treated quarters, as reported in a separate abstract. To date, the gene expression profile of total parenchymal mRNA from each quarter of 2 animals has been examined using a bovine-specific cDNA microarray containing 796 unique expressed sequence tags and 539 amplicons representing known genes. A loop design was used with cDNA from each quarter of each cow labeled with Cy3 or Cy5 dyes prior to microarray hybridization. Gene expression data were normalized for dye intensity biases using control genes. Significance levels of differential gene expression among treatments were assessed using a mixed model approach with the procedures LOESS and MIXED of SAS. Leptin upregulated 50 genes at $P < 0.01$; at least 30 of these had clear links to pathways mediating cell proliferation. The upregulated genes included 3 promoters of apoptosis: dynamin 2, CCAAT/enhancer-binding beta protein, and ribosomal protein S3A; 3 cell cycle regulators: nucleoporin p62, ubiquitin-like protein NEDD, and protein kinase CDK9; several transcription factor regulators; and several cellular reorganization proteins, all with fold changes from 1.5 to 4.5 ($P < 0.008$). We are currently evaluating the other 4 animals in the study, verifying changes with real-time PCR, and employing laser capture microdissection to measure expression profiles of epithelial and stromal cell types separately. We conclude that leptin infusion into prepubertal bovine mammary parenchyma induces changes in expression of genes regulating apoptosis, cell cycling and transcriptional machinery. These molecular changes might help explain the impaired mammogenesis of fat heifers.

Key Words: Leptin, Mammary development, Microarray

685 Intramammary infusion of leptin decreases proliferation of mammary epithelial cells in prepubertal heifers. L.F.P. Silva*[1], J. S. Liesman[1], M. S. Weber Nielsen[1], and M. J. VandeHaar[1], [1]*Michigan State University*.

Excessive body fatness is associated with impaired mammogenesis in prepubertal heifers. Leptin, a hormone produced by adipocytes, reduces IGF-I-stimulated proliferation of bovine mammary epithelial cells in vitro. Our objective was to determine if leptin also reduces proliferation of mammary epithelial cells in vivo before puberty. Recombinant ovine leptin (>98% purity) was infused via the streak canal into two quarters of six prepubertal Holstein heifers at 100 ug/quarter per d with or without rhIGF-I at 10 mg/quarter per d. The N-terminus of roLeptin was homologous to native oLeptin. Contralateral quarters were used as controls and received saline plus BSA with or without IGF-I. After 7 d of treatment, bromodeoxyuridine (BrdU) was infused intravenously at 5 mg/kg BW, and heifers were killed 2 h later. Samples from three parenchymal regions (proximal, intermediate, and distal to the teat) were collected, fixed, sliced, and incubated with BrdU monoclonal antibody to identify cells in the S-phase of the cell cycle. Total number of epithelial cells and BrdU-labeled cells were quantified in three microscopic fields from each slide section so that 2700 cells were counted in each quarter. Leptin infusion decreased BrdU-labeling 48% in IGF-I-treated quarters (4.1 vs. 7.9%, $P < 0.01$), and 19% (5.0 vs. 6.2%, $P = 0.01$) in saline-treated quarters. Treatment effects were likely not associated with an immune response as we used sterile technique, mammary tissue was visually normal, and endotoxin was not detected in the infusates using a commercial kit sensitive to 0.006 ng/ml. We conclude that intramammary infusion of leptin inhibits proliferation of mammary epithelial cells in prepubertal heifers and completely blocks the stimulatory effect of IGF-I on mammary epithelial cells. These results suggest that leptin may mediate the inhibitory effects of high-energy intake on mammary gland development in heifers. If so, perhaps we can prevent nutritional impairment of mammogenesis by simply managing body condition of young heifers.

Key Words: Heifer, Mammary development, Leptin

686 Compensatory growth during late gestation and its effects on metabolic status and health of transition heifers. M. S. Laubach*, D. B. Carlson, W. L. Keller, and C. S. Park, *North Dakota State University, Fargo ND/USA*.

Ten pregnant Holstein heifers averaging 499 kg of body weight and 60 d of gestation were divided into two treatments to determine if a one stair-step gestational nutrition regimen affects metabolic status and lactation potential during the transition period. The control group was fed a diet containing 14.0% crude protein and 22.4 Mcal of ME per d for the entire 210 d of the trial. During the restriction period, the treatment group was fed a diet containing 18.5% crude protein and 14.5 Mcal of ME per d until d 180 of gestation; the diet was changed to 14.0% crude protein and 29.0 Mcal of ME per d for the realimentation period. Control heifers were restricted-fed to obtain an ADG of 0.68 kg per d, while treatment heifers were restricted to less then 0.1 kg per d of gain during the restriction period. During realimentation, treatment heifers were allowed to gain 0.91 to 2.26 kg per d. Heifers were weighed for three consecutive days at the start, at 180 d of gestation, and within one wk before calving; BW was not different at initiation, at 180 d of gestation, or one week before parturition. Blood was drawn on d 14, 11, 9, 7, 5, 4, 3, 2, and 1 before parturition; within 3 h of calving; and on d 1, 2, 3, 4, 5, 7, 9, 11, and 14 after parturition to monitor glucose, insulin, triglycerides, NEFA, and the immune status. Glucose, insulin, triglycerides, and NEFA were not different between groups before or after parturition. Total leukocytes were significantly higher ($P = 0.05$) in the treatment group before parturition; however, after parturition there was no difference between groups. Milk production was not different (control, 8,571 kg; treatment, 8,453 kg). Milk fat percentage was increased in the treatment group (4.2% vs 4.1%, $P = 0.05$); however, milk protein percentage was the same in both groups (2.9%). The results suggest that compensatory growth during the last trimester of gestation does not affect the metabolic status of prepartum heifers or subsequent milk production.

Key Words: Heifer, Transition, Blood metabolites

Production, Management, & the Environment

653 A system to characterize feeding behavior of dairy cows and feeding behavior of periparturient and mid-lactation cows. M. A. DeGroot* and P. D. French, *Oregon State University, Corvallis*.

The objectives of the following research were to develop a system to describe feeding behavior of group housed dairy cows and characterize feeding behavior of periparturient and mid-lactation cows. In experiment 1, 8 periparturient Holstein and Jersey cows were used to determine feeding behavior for the three weeks before and after parturition. Cows were group housed and fed individually via Calan® doors. Behind each door was a feed tub that rested on a digital scale, equipped with a RS232 bi-directional interface. Scales were connected to a computer and a software program collected date, time, and weight events. Variables measured were meals/day, total meal duration/day, individual meal duration, daily DMI, DMI/meal, and meal efficiency (kg DM/min). Data were analyzed using the MIXED procedure of SAS. From 21 to 1 d prepartum, total meal duration decreased linearly ($P<0.01$) from 284 to 136 min/d, individual meal duration decreased linearly ($P<0.07$) from 32 to 17 min/d, DMI decreased linearly from 11.5 to 7.3 kg/d, and meal DMI decreased linearly ($P<0.01$) 1.4 to 0.9 kg. From 1 to 21 d postpartum, total meal duration and individual meal duration increased linearly ($P<0.05$) from 100 to 278 min/d and 12 to 26 min/meal, respectively. Total meal duration was positively correlated with prepartum DMI (r=0.62) and postpartum DMI (r=0.80). Meals (10.2 meals/d) and efficiency (0.06 kg DM/min) were similar for the prepartum and postpartum periods. In experiment 2, 8 Holstein and Jersey cows were used to characterize feeding behavior of mid-lactation cows (17334 days in milk). Overall, cows consumed 8.5 meals/d, total meal duration was 250 min/d, and efficiency was 0.09 kg DM/min. Daily DMI, DMI/meal,

and efficiency were greater ($P<0.01$) for Holsteins compared to Jerseys. Jerseys consumed more ($P<0.05$) meals/day than Holsteins. Results indicate that periparturient DMI is affected by the amount of time spent at the feed bunk. Therefore, strategies that increase individual meal duration may increase DMI during this critical period.

Key Words: Periparturient, Feeding behavior, Meals

654 Effect of supplementing intensely grazed late gestation and early lactation dairy cows with chromium-L-methionine. M. A. Bryan[1], M. T. Socha*[2], and D. J. Tomlinson[2], [1]*Central Southland Veterinary Services Limited, Winton, Southland, New Zealand,* [2]*Zinpro Corporation, Eden Prairie, Minnesota, USA.*

Two hundred and thirty-two cows were assigned to a study to determine the effect of feeding 0 or 6.25 mg chromium/d from MiCroPlex® chromium-L-methionine (Zinpro Corporation, Eden Prairie, MN) on lactation and reproductive performance. Cows received treatments from 6 weeks precalving through 21 weeks postpartum. Precalving, treatments were incorporated into a pelleted grain mixture and group-fed. Postcalving, cows received treatments via an individual oral drench once a day. Grazed herbage was the primary diet constituent for lactating cattle. Trial evaluators were blinded to treatment assignment until collection and analysis of data was completed. Blood was collected from a predetermined group of cows prior to and immediately after calving. Approximately every 6 weeks during the treatment period and at two timepoints following the treatment period, milk yield was recorded and samples collected for determination of composition. Chromium supplementation tended to reduce ($P\leq0.15$) yield of 3.5% fat-corrected milk (FCM) and milk solids during the treatment period and tended to reduce 3.5% FCM yield over the entire lactation ($P\leq0.15$). There was no effect of treatment on milk solids yield over the entire lactation. Chromium supplementation reduced plasma non-esterified fatty acid (NEFA) concentration ($P\leq0.05$). There was no effect of treatment ($P\geq0.15$) on plasma β-hydroxybutyrate or glucose concentrations. Chromium supplementation tended to reduce ($P\leq0.15$) percentage of cows open 48 days after the planned start of mating and days from calving to conception. Results indicate that chromium-L-methionine supplementation of intensely grazed, late gestation and early lactation dairy cattle tended to reduce lactation performance, reduced plasma NEFA concentrations and tended to improve fertility.

Key Words: Chromium, Lactating dairy cattle, Reproduction

655 The buffering activity of a potassium clinoptilolite zeolite in steers fed a high concentrate steam flaked grain- corn silage diets. K. S. Eng*[1], R. Bectel[2], and D. P. Hutcheson[3], [1]*Eng, Inc., San Antonio, Texas, USA,* [2]*Advance Agricultural Testing, Baden, Ont. Canada,* [3]*Animal-Agricultural Consulting, Inc., Amarillo, Texas, USA.*

Subclincial acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Previous studies have indicated potassium clinoptilolite zeolite (CZ) may have buffering capabilities in feedlot diets. In 4 separate feedlot finishing trials, the rumen pH of steers on a control ration containing Rumensin and Tylan or a similar ration containing 1.2% CZ in place of an equal amount of grain were compared. The diets in each study were composed of approximately 87% steam flaked corn and wheat, 6% corn silage and 7% premix (DMB). The experimental cattle were yearling steers of English- Continental cross breeding. There were 8 animals/rep and 8 to 11 reps/treatment in each of the four trials. Approximately 90 days after the cattle were placed on full feed, one animal from each rep or total of approximately 40 animals for the four separate experiments were sampled for rumen pH. Rumen samples were obtained using a Geishauser Probe and pH was measured immediately thereafter. The rumen pH for the control verses the treatment steers are shown in Table 1. In each of the four trials and on an overall basis, CZ increased rumen pH. The overall average difference was statistically significant ($P\leq .08$).

Effect CZ on rumen pH

Trial	Control	1.2%CZ
1	6.02	6.33
2	6.30	6.62
3	6.51	6.79
4	6.51	6.71
Mean	6.34	6.61

Key Words: Potassium clinoptilolite zeolite, Rumen buffering, Steam flaked corn

656 Effect of prepartum dietary cation-anion difference on subsequent milk production and plasma metabolites in dairy cattle. S. B. Puntenney, K. N. Higgs, M. A. DeGroot, and P. D. French, *Oregon State University, Corvallis.*

The objectives of this research were to determine the effect of an anionic supplement (Animate®) on prepartum feed intake, periparturient plasma metabolites, and subsequent milk yield. Twenty eight Holsteins and 20 Jerseys were blocked by expected calving date and assigned at random to one of two treatments beginning 28 days prior to expected calving date. Main effects were breed (Holstein or Jersey) and dietary cation-anion difference (DCAD; -13 or +23 meq/100 g DM). Negative DCAD was achieved through the addition of Animate® (-712 meq/100 g DM) to the prepartum diet. Cows were individually fed a TMR once daily beginning 21 days prepartum and received a common TMR from parturition to 21 days postpartum. Data were analyzed as repeated measures using the MIXED procedure of SAS®. Prepartum and postpartum body weight and body condition score was similar for DCAD level. Three Jerseys receiving the positive DCAD diet were treated for milk fever after parturition. Urine pH was lower for cows receiving negative DCAD (6.2 vs 8.2; $P < 0.05$). Prepartum DMI was similar for DCAD level and postpartum DMI was greater for cows that received negative DCAD (16.0 vs 14.9 kg/d; $P < 0.05$). Holsteins that consumed negative DCAD produced more energy correct milk (46.0 vs 41.7 kg/d; $P < 0.05$) compared to Holsteins that consumed positive DCAD. Prepartum DCAD did not affect energy correct milk yield of Jersey cows. Plasma Ca was greater for cows receiving negative DCAD (7.7 vs 6.7 mg/dL; $P < 0.05$). Prepartum DCAD did not affect plasma β-hydroxybutyrate, glucose, or free fatty acids. In conclusion, negative prepartum DCAD increased postpartum DMI and energy corrected milk yield of Holstein cows through improved Ca balance after parturition.

Key Words: Cation-anion difference, Prepartum diet, Milk fever

657 Effect of grazing growth rate on subsequent feedlot and carcass traits in cattle. J. J. Cleere*[1], A. D. Herring[2], J. W. Holloway[3], C. R. Long[1], H. Lippke[3], M. F. Miller[4], W. E. Pinchak[5], F. M. Rouquette[1], and B. G. Warrington[3], [1]*Texas Agricultural Experiment Station, Overton,* [2]*Texas A&M University, College Station,* [3]*Texas Agricultural Experiment Station, Uvalde,* [4]*Texas Tech University, Lubbock,* [5]*Texas Agricultural Experiment Station, Vernon.*

Braunvieh cross steers (n = 91) were assigned to various stocking rates at the Texas Agricultural Experiment Stations at Uvalde (UVL), Overton (OVT), and Vernon (VRN) to create different growth rates. Steers were stocked on TAM 90 annual ryegrass (RG) at UVL, Maton rye and RG at OVT, or TAM 202 wheat at VRN from January to May 2002. Cattle were placed on feed at the Texas Tech University Alltech research feedlot at termination of the grazing period to determine the influence of grazing growth rate (GGR) on feedlot and carcass traits. Steers were assigned to pens within location, stocking rate, and weight with 4 to 6 animals per pen. Animals were classified as very low (VL), low (LO), moderate (MD), moderately high (MH), and high (HI) GGR groups based on ADG. Grazing period ADG was different between the VL, LO, MD, MH, and HI GGR groups (-0.01, 0.55, 0.77, 0.90, and 1.02 kg/d, respectively; $P < 0.0001$). The statistical model included GGR and location with initial grazing weight as a covariate. Initial feedlot weights were different between VL, LO, MD, MH, and HI steers (316, 366, 383, 397, and 406 kg, respectively; $P < 0.01$). Feedlot ADG was similar among the GGR groups with the exception of a difference ($P = 0.02$) between the LO and MD steers (VL = 1.73, LO = 1.81, MD = 1.65, MH = 1.72, HI = 1.68 kg/d). The VL steers had lighter hot carcass weights (HCW) than LO, MD, MH, and HI steers (302 vs. 338, 340, 354, 351 kg, respectively; $P < 0.0001$). The LO steers had lighter HCW than MH

and HI steers ($P < 0.05$) and MD steers had lighter HCW than MH and HI steers ($P < 0.05$). The VL steers were on feed longer than LO, MD, MH, and HI steers (113 vs. 111 d; $P < 0.05$). Adjusted fat thickness, kidney pelvic heart fat, marbling scores, and yield grades were similar among the GGR groups. The VL steers had smaller ribeye areas than the LO, MD, MH, and HI steers (79.9 vs. 89.1, 88.8, 88.1, and 90.0 cm^2, respectively; $P < 0.01$). Lower GGR steers had lighter HCW due to failure to compensate for differences in initial feedlot weight and GGR had a slight effect on carcass quality.

Key Words: Feedlot performance, Carcass, Beef cattle

658 Use of FEB-200™ to increase productivity of cattle grazing fescue pasture. D. G. Ely*[1], D. K. Aaron[1], J. Wyles[1], and V. Akay[2], [1]*University of Kentucky, Lexington, KY,* [2]*Alltech, Inc., Nicholasville, KY.*

Ninety-two Angus and Angus x Beefmaster cow/calf pairs were randomly allotted to nine, 10.5-ha KY 31 tall fescue endophyte-infected (> 90%) pastures on May 1 in two consecutive years to evaluate the potential of FEB-200™ (modified glucomannan, Alltech, Inc., Nicholasville, KY) to increase productivity. Three replicate pastures were randomly assigned each year to three treatments: CONT (control, no supplement); CS (corn supplement, 0.45 $kg \cdot hd^{-1} \cdot d^{-1}$ ground shelled corn); FEB [0.45 $kg \cdot hd^{-1} \cdot d^{-1}$ supplement (96.6% ground shelled corn + 4.4% FEB-200™)]. Initial cow and calf weights were taken on two consecutive days (May 1, 2). Cows averaged 5.2 yr, 511 kg, and 6.0 body condition score (BCS) when the experimental period began each year. Initially, calves were 68 d of age and weighed 101 kg. Interim weights, BCS, and rectal temperatures of cows and weights of calves were taken at 35-d intervals until weaning on September 17 (consecutive day weights, September 17, 18). Cow weight changes from May 1 to July 12 were not different. Cows consuming FEB gained more ($P < 0.05$) from July 12 to September 17 than CONT and CS cows (5.5 vs. -4.5 and -1.8 kg/hd). Changes in BCS were not different from May 1 to July 12. Cows in the FEB treatment maintained higher ($P < 0.05$) BCS than CONT and CS cows from July 12 to September 17. No differences in rectal temperatures were found. Overall (139 d), calf ADG (kg) were higher ($P < 0.05$) for FEB (0.95) than CONT (0.90) and CS (0.88). Greater cow gains, maintenance of higher cow BCS, and faster calf gains indicate consumption of FEB-200™ has the potential to alleviate some of the endophyte toxicosis associated with this forage during July, August, and September.

Key Words: Fescue, Cows, Calves

659 Cow tympanic temperature response to supplementation with FEB-200™. D. K. Aaron*[1], D. G. Ely[1], J. Wyles[1], and V. Akay[2], [1]*University of Kentucky, Lexington, KY,* [2]*Alltech, Inc., Nicholasville, KY.*

Fifty-four mature Angus and Angus x Beefmaster cows, grazing endophyte-infected KY 31 tall fescue, were used in a 2-yr study to evaluate the potential of a modified glucomannan (FEB-200™, Alltech, Inc., Nicholasville, KY) for reducing deep body temperature effects associated with fescue toxicity. Each year three cows were randomly selected from each of nine pastures previously allotted (May 1) to three treatments: CONT (control, no supplement); CS (corn supplement, 0.45 $kg \cdot hd^{-1} \cdot d^{-1}$ ground shelled corn); FEB [0.45 $kg \cdot hd^{-1} \cdot d^{-1}$ supplement (96.6% ground shelled corn + 4.4% FEB-200™)]. Tympanic temperatures were continuously measured at 30-min intervals during a 72-h period in mid-June, July, and August each year. Each cow's maximum, minimum, and average tympanic temperatures were found for each day of each period. Daily diurnal ranges and daily differences between maximum and average tympanic temperatures (partial differences) were calculated. Average maximum and minimum ambient temperatures were 30.6 and 19.2, 30.5 and 19.7, and 28.1 and 16.1 °C for the June, July, and August periods in 2001. Corresponding values for 2002 were 29.3 and 15.1, 31.4 and 19.5, and 32.7 and 25.3 °C. No significant year x treatment interaction was found. Maximum tympanic temperatures (°C) were lower ($P < 0.05$) for FEB than CONT cows in all months (June: 39.3 vs. 39.5; July: 39.2 vs. 39.4; August: 39.1 vs. 39.4). Daily diurnal ranges and partial differences (°C) were lower for FEB than CONT cows in June (1.29 and 0.72 vs. 1.46 and 0.88; $P < 0.10$), July (1.24 and 0.67 vs. 1.37 and 0.82; $P < 0.10$), and August (1.23 and 0.63 vs. 1.47 and .82; $P < 0.01$). Although not statistically significant, temperature differences between FEB and CS cows also tended to support FEB-200™ supplementation as a potential means of alleviating the problem of elevated body temperature associated with fescue toxicosis.

Key Words: Fescue, Temperature, Cows

660 Corn silage and haylage variability within bunker silos. W. C. Stone*, L. E. Chase, and T. L. Batchelder, *Cornell University. Ithaca, NY.*

Eleven corn silage and nine haylage bunker silos from nine dairies located in New York state were evaluated to estimate the degree of variability occurring within bunker silos. Samples were collected on six dairies with a backhoe, on two dairies with a loader bucket, and on one dairy with a face remover. Sample collection was designed to reflect the feed that would be obtained if a feeder obtained a loader bucket of feed from a region (upper, middle, or lower) of the silo as compared to a bucket obtained from the entire height of the silo face. Silos above (n = 15) approximately four meters in height were split into thirds for sampling, while those less (n = 4) than approximately four meters were split into halves. Experimental feed within each section was thoroughly mixed and sampled for subsequent analyses. Within each silo, deviations from the minimum analytical result for DM, ADF, NDF, CP, and VFA were determined.

Haylage varied more than corn silage, although there were examples of extreme variation in DM in both crops. In some situations a feeder could be delivering an entirely different ration from one load of feed to the next if care is not taken in forage obtainment from the silo. Dairy feed personnel need to be aware of this variation, and of the difference it can make to the final ration delivered to the cow. Techniques to minimize forage variation, such as obtaining each bucket of feed from the height of the silo face or the premixing of forages obtained from across the entire face of the silo, should be part of feeding standard operating procedures on dairies.

Haylage results	DM	CP	ADF	NDF	NEL	Lactate	Acetate	Total VFA
Minimum deviation, %	5.2	3.3	1.1	5.4	1.6	5.2	25	7
Maximum deviation, %	44.7	52.1	20.0	24.8	20.0	646	163	287
Average deviation, %	21.0	17.6	10.7	14.7	9.9	112	72	69
Median deviation, %	19.4	9.5	9.9	14.4	9.3	57	50	38
Corn silage results								
Minimum deviation, %	1.3	2.5	2.3	.5	1.4	3.8	11.2	.1
Maximum deviation, %	55.0	29.5	18.3	18.6	5.6	48.7	131	41.3
Average deviation, %	12.3	11.0	8.4	8.6	3.1	25.6	53.7	20.5
Median deviation, %	8.3	10.0	8.6	8.4	2.8	26.0	29.9	21.4

Key Words: Forage variability, Bunker silos

661 Performance of market cows consuming hay and various levels of rice bran. D. W. Sanson*[1], S. M. DeRouen[2], and D. H. Foster[3], [1]*LSU Ag. Center, Rosepine Reserch Station, Rosepine,* [2]*LSU Ag. Center, Hill Farm Reseach Station, Homer,* [3]*U.S. Market News Service, Baton Rouge.*

Ninety thin cows were purchased from area sale barns each of two years to evaluate the effects of different levels of rice bran in the diet. Cows were purchased during 3 to 4 weeks in late October and early November each year. After purchase, cows were transported to the Rosepine Research Station where they were weighed and scored for condition, treated for internal parasites, and identified with an ear tag. In Year 1, cows were fed one of four rice bran based supplements. Cows were fed 1.1, 2.3, 3.4, or 4.5 kg of rice bran daily in addition to hay free-choice. Supplements were formulated with cottonseed meal so that the supplements provided equal levels of protein. There were 2 replicates of each of the four treatments and the trial lasted 110 d. In Year 2, cows were fed rice bran at either 2.3 kg, 3.4 kg, or free-choice in addition to hay free-choice. There were 2 replicates of each of the three treatments and the trial lasted for 105 d. Cows were weighed on two consecutive days and scored for condition at the beginning and end of each trial.

On the last day of each trial, cows were transported to a local auction barn and sold. In Trial 1, cows that received the 3.4 or 4.5 kg of rice bran plus cottonseed meal gained ($P < .05$) more weight than cows that received 1.1 or 2.3 kg of rice bran plus cottonseed meal. Body condition score also tended to be higher for cows that received the higher levels of rice bran. There was no difference ($P > .05$) between weight gain of cows that received 3.4 kg of rice bran and those that received 4.5 kg of rice bran. There was no difference ($P > .05$) among treatments in the purchase price or the sale price. Average purchase price of the cows was \$34.98 ± .4 per cwt and average sale price was \$49.93 ± .9 per cwt. There was no effect ($P > .05$) of level of rice bran supplementation on weight gain or condition score change in Trial 2. Cows fed rice bran free choice had an average consumption of 5.2 kg of rice bran per head per day. Neither purchase price nor sell price was affected ($P > .05$) by supplemental treatment in Trial 2. The average purchase price was \$35.80 ± .9 per cwt and the average sell price was \$47.33 ± 1.5.

Key Words: Beef cow, Rice bran, Supplementation

662 Effects of calving date and weaning age on cow and calf production in the Northern Great Plains. E. E. Grings*, R. E. Short, and R. K. Heitschmidt, *USDA-ARS, Fort Keogh LARRL, Miles City, MT.*

A 3-year study evaluated late winter (**Feb**), early spring (**Apr**), and late spring (**Jun**) calving systems (**CS**) on beef cow and calf performance. Crossbred cows were randomly assigned to 1 of 3 CS (avg n · CS^{-1} · $year^{-1}$ = 148) and 1 of 2 weaning times (Wean 1, 2) within each CS. Feb and Apr calves were weaned at 6- and 8-mo of age; Jun calves were weaned at 4- and 6-mo of age. Breeding by natural service occurred in a 32-d period that included estrus synchronization. Early weaned steers were housed in feedlots while half of the early weaned heifers grazed improved pastures and half were housed in feedlots. Early weaned calves were weighed on approximately the same day as late weaning. Weaning weight of calves adjusted to a constant date (October 19) was decreased ($P < 0.01$) as calving time became later (273, 229, and 181 kg for Feb, Apr, and Jun calves, respectively). Jun calves (203 kg) were lighter ($P < 0.01$) than Feb (224 kg) and Apr (221 kg) calves at 190 d of age. A CS x Wean interaction ($P < 0.01$) occurred for calf gains between Wean 1 and 2. Gains for early weaned calves averaged 0.71, 0.56, and 0.56 and for late weaned calves averaged 0.75, 0.47, and 0.56 kg · d^{-1} for Feb, Apr, and Jun, respectively. Between weanings, suckled cows gained less (Feb: Wean 1, 23.0 kg vs Wean 2, 6.0 kg) or lost more than non-suckled cows in all herds ($P < 0.01$). Cow weight change between Oct (Wean 1) and Dec (Wean 2) did not differ for Apr and Jun (-1.7 kg) non-suckled cows, but loss was greater for suckled Jun (-35.0 kg) than Apr (-15.4 kg) cows (CS x Wean interaction, $P < 0.01$). Time of weaning did not affect ($P > 0.10$) subsequent year's cow or calf performance at weaning. Pregnancy rates (87.9%) were not affected ($P > 0.10$) by CS. Season of calving and weaning age have significant impacts on outputs from rangeland-based beef cattle operations.

Key Words: Beef cattle, Calving season, Rangelands

663 The effect of early calf weaning on performance and measures of stress during the feedlot receiving period. J. D. Arthington*[1] and J. W. Spears[2], [1]*University of Florida - IFAS, Ona,* [2]*North Carolina State University.*

Forty crossbred steers (Brahman x English) were weaned at two ages, 1) early weaned (EW; n = 20), and 2) normal weaned (NW; n = 20). Calves averaged 89 and 300 d of age at the time of EW and NW, respectively. Early weaned calves were kept on-site and grazed on annual and perennial pastures until the time of normal weaning. During this time, EW calves were provided a commercial feed (16% CP) at 1.0% of BW daily. Upon NW, all calves were loaded onto a commercial livestock trailer and transported to the North Carolina State University Research Feedlot, Butner (1200 km). Upon arrival, calves were randomly allotted to 4 pens per weaning age treatment, such that each weaning treatment had two pens of light and two pens of heavy calves. Individual calf BW and blood samples were collected at weaning, upon arrival to feedlot (d 1; 24-h following weaning), and d 3, 7, 14, 21, and 28 of the receiving period. Calves were offered a complete, corn silage-based receiving ration at rates to ensure ad libitum consumption. During the first 3 d, all calves were provided access to long stem grass hay. Feed intake by pen was measured daily. As an estimate of stress, plasma was harvested from blood samples and analyzed for ceruloplasmin and haptoglobin concentrations. Early weaned calves were lighter (P = 0.03) at normal weaning than NW calves (223 vs 277 kg). By d 28, BW did not differ (244 vs 280 kg for EW and NW calves, respectively; P = 0.11). Overall, EW calves gained an average of 0.59 kg/d more (P = 0.02) than NW calves. Intake was similar (P = 0.36) between weaning ages (ADFI = 5.3 and 4.9 kg DM for EW and NW, respectively). Feed efficiency was higher ($P < 0.02$) for EW than NW calves (F:G = 6.4 vs 13.0). Ceruloplasmin concentrations increased in NW, but not EW calves, peaking on d 7 (27.6 and 34.2 mg/100 mL for EW and NW calves, respectively; $P < 0.05$). Haptoglobin concentrations increased in both groups and were highest ($P < 0.05$) in NW calves on d 3 (7.63 vs 14.86 HpB/100 mL). These data suggest that early-weaned calves that are maintained on-site prior to shipping, are more stress-tolerant and productive during an initial 28-d feedlot receiving period.

Key Words: Calves, Weaning, Stress

664 Fertility and greenhouse gas emissions in dairy cows. P.C. Garnsworthy*, *University of Nottingham, Loughborough, UK.*

Dairy cows are estimated to account for 20% of methane and ammonia emissions worldwide. The aim of this study was to quantify the effects of fertility on gas emissions. Improved fertility increases mean annual milk yield per cow because a greater proportion of milk is produced in early lactation and the proportion of cows in their first lactation is smaller. Increased milk yield means higher feed intakes and gas production per cow. On the other hand, improving fertility means fewer replacements are needed, thereby reducing emissions. A model was constructed to calculate combined emissions from cows and their replacements. Heat detection (HD) and conception rate (CR) were used in a decision tree to calculate pregnancy probabilities for a Markov chain that determined calving intervals, herd structure and replacement rate. NRC equations were used to calculate nutrient intakes, which determined methane and ammonia emissions. Annual milk yield was set at 10,000 liters for a cow in second lactation, with a 15% reduction for first lactation and a 10% increase for third and subsequent lactations; days to first service was set at 75 and TMR feeding was used for all cows and heifers. Using values of HD 40% and CR 30%, methane and ammonia emissions per 100 cows (plus replacements) were 19.3 and 5.1 t/yr respectively, equivalent to 20.6 and 5.4 g/l milk. A modest improvement in fertility (HD 50%; CR 50%) decreased emissions to 17.4 and 4.5 t/yr (17.0 and 4.4 g/l). Good fertility levels (HD 70%; CR 60%) gave emissions of 16.8 and 4.3 t/yr (15.5 and 4.0 g/l). At the low level of fertility (HD 40%; CR 30%), replacements accounted for 30% of herd emissions; at good fertility levels (HD 70%; CR 60%), replacements accounted for 10% of herd emissions. These results demonstrate the impact of fertility on greenhouse gas emissions from dairy herds. Moving from low to high fertility status can reduce herd methane and ammonia emissions by 13 and 16% respectively, which equates to a 25% reduction per liter of milk.

Key Words: Dairy cows, Fertility, Environmental emissions

665 Early detection of a change in pregnancy rate with control charts. A. de Vries*, *University of Florida.*

The objective of this study was to estimate the average time to detection of a true change in pregnancy rate monitored with statistical process control charts. Pregnancy rate is an important measure of the success of a reproductive program. An unexpected true change needs to be detected soon, but the rate of false alarms should be kept at an acceptable level. The performance of control charts, measured as the average time to signal (ATS), is the time between false alarms when only normal variation is present (ATS_0) or the time to first detection of a true change in pregnancy rate (ATS_1). A stochastic dynamic simulation model was used to simulate daily performance of cows over time. Default estrous detection efficiency (EDE) was 65% and default conception rate (CR) was about 0.40. Pregnancy checks resolved all inseminations 42 days after breeding. Five scenarios were simulated (n=400 runs): no change (scenario A), decrease in EDE to 55% (B), decrease in EDE to 35% (C), 25% decrease in CR (D), and both a 25% decrease in CR and decrease in EDE to 45% (E). Period lengths were 1, 3, 7, and 21 d. Herd sizes were 100 and 1000 cows. Control charts used were a Shewhart chart, a binomial cusum chart, and a non-parametric cusum chart. Control limits were set such that the ATS_0 were near 365 or 730 d. Additionally, traditional 3-sigma limits were used for the Shewhart chart. Three-sigma limit Shewhart charts with 21 day periods failed to signal changes in pregnancy rate in the 100-cow herd in all cases. For the 1000-cow herd, ATS_1 were 5818 (A), 3154 (B), 90 (C), 1106 (D), and 94 (E) d. Smaller

period lengths decreased ATS_0 significantly, but not ATS_1. Binomial cusum charts with period lengths of 3 days detected true changes in pregnancy rate in general earlier than any other design or chart. For the 100-cow herd, ATS_1 (ATS_0 365 d) were 273 (B), 104 (C), 212 (D), and 106 (E) d. ATS_1 (ATS_0 730 d) were 422 (B), 127 (C), 332 (D), and 127 (E) d. For the 1000-cow herd, ATS_1 (ATS_0 365 d) were 130 (B), 53 (C), 78 (D), and 53 (E) d. ATS_1 (ATS_0 730 d) were 172 (B), 57 (C), 93 (D), and 57 (E) d. Binomial cusum charts should be considered when early detection of a true change in pregnancy rate is important.

Key Words: Statistical process control, Monitoring, Pregnancy rate

666 Weaning at the onset of the breeding season fails to improve hind performance traits in Red Deer. R. D. Randel*, S. A. Mozisek, D. A. Neuendorff, and A. W. Lewis, *Texas A&M University Agricultural Research & Extension Center, Overton, Texas USA*.

Suckling stimulus suppresses rebreeding performance in beef cows. This experiment was designed to determine if performance of Red Deer females was similarly altered. Twenty two lactating Red Deer hinds were randomly assigned to be weaned (W; n=11) or suckled (S; n=11) from September 25 (time of introduction of the breeding male) through November 20 (end of breeding season) with half of each group in one of two breeding pastures. Body weight, body condition score and a blood sample for progesterone analysis by RIA were collected at weekly intervals from September 4 through November 20. Body weights of the fawns were collected from September 25 (1st weaning date) through November 20 (2nd weaning date). All hinds were maintained on Coastal bermudagrass pastures and supplemented with .91 kg/hind/d of 2:1 ground corn:soybean meal and Coastal bermudagrass hay as needed. Weaned fawns grazed Coastal bermudagrass pastures overseeded with ryegrass and were supplemented with .45 kg/fawn/d of 2:1 corn:soybean meal. The fertile males were equipped with marking harnesses and the females were examined daily for estrus activity. Pregnancy was determined by ultrasonography 45 d after ending the breeding season. Weaning of the fawns on September 25 failed to improve ADG (W= -.11±.02 kg/d; S= -.12±.02 kg/d) or body condition (W =.02±.24; S = -.18±.24 units) of the hinds during the breeding season (P>.10). Pregnancy rates were identical (100%) in W and S hinds. Days from beginning stag exposure to conception were 15.4±3.5 d in W compared with 21.6±3.5 d in S (P=.23). Fawn ADG during the 56 d period of the breeding season was not different between W (.072±.012 kg/d) and S (.074±.011 kg/d) groups with all fawns gaining at similar rates. Early weaning failed to improve performance in the Red Deer female with 100% of each group conceiving during the 56 d breeding season. This may be related to the strong seasonality and possible male effect from the stag.

Key Words: Red Deer, Suckling, Reproduction

Ruminant Nutrition: Metabolism - modeling

667 Evaluation of empirical equations to predict microbial efficiency. A. M. Mueller*, L. M. Lake, M. R. Ellersieck, and M. S. Kerley, *University of Missouri-Columbia*.

The maximum efficiency of microbial growth in the rumen is a function of dilution rate (DR). The Beef NRC calculates microbial efficiency (MOEFF) based on the maintenance rate of the bacteria, the digestion rate of a feedstuff, and the theoretic maximum yield of the bacteria. The purpose of this study was to compare the experimentally determined MOEFF to the Beef NRC model prediction and a prediction calculated using particulate passage rate (PPR). Four ruminally fistulated and duodenally cannulated crossbred beef steers (591 ± 39 kg) were used in a 4x4 Latin square design. Treatment diets were pelleted, contained 77 % ground corn, 15 % cottonseed hulls, 0.4 % urea, and differed in source of supplimental protein. The diets contained 1) 7.4 % soybean meal (SBM); 2) 5.4 % fishmeal (FM); 3) 3.8 % bloodmeal (BM); or 4) 5.6 % corn gluten meal (CGM). Treatments were formulated to be isonitrogenous and isocaloric. Treatments had no affact ($P > 0.05$) on dry matter (DMI) or nitrogen (NI) intake, apparent total track dry matter digestability (DMD), true DMD, PPR, MOEFF (expressed as g bacterial N / kg organic matter truely fermented), ammonia-N, or VFA concentrations. The experimentally determined PPR was used to calculate MOEFF, which was not significantly ($P > 0.05$) different from the measured MOEFF. The Beef NRC predicted MOEFF was greater ($P < 0.07$) than the measured MOEFF. Using PPR to predict MOEFF more accurately estimated MOEFF than did the Beef NRC model.

Key Words: Microbial efficiency, Dilution rate, Beef NRC

668 Effect of RDP and roughage level on microbial efficiency in continuous culture. C. A. Willis* and M. S. Kerley, *Univeristy of Missouri-Columbia*.

Feeding strategies can manipulate the rumen environment to control volatile fatty acid (VFA) production and potentially alleviate the need for roughage in the diet. Six diets were evaluated using a continuous culture system to determine the effects of high or low rumen degradable protein (RDP) level with or without roughage on VFA production, digestibility, and microbial efficiency. All diets were corn-based, either cracked (CC) or ground (GC) corn. The RDP level was controlled by the addition of soybean meal (SBM). Low RDP diets contained no SBM and yielded an RDP of 4%. SBM was added to achieve a 14% RDP level, which coincides with the NRC guidelines for feedlot diets. Diets consisted of: 1) 4% RDP with CC and 15% hay, 2) 14% RDP with CC and 15% hay, 3) 4% RDP with CC, 4) 14% RDP with CC, 5) 4% RDP with GC, and 6) 14% RDP with GC. Cultures were acclimated to their diet for ten days and then followed by three days of sample collection. Concentrations of VFA and ammonia were determined and microbial efficiency calculated. The high RDP treatments resulted in higher VFA concentrations as compared to their low RDP counterparts ($P < 0.01$). Microbial efficiencies were greater for high RDP treatments versus low RDP treatments ($P < 0.01$). Diets that did not contain the 15% hay had significantly improved microbial efficiencies ($P < 0.01$). RDP level can be used to control organic acid production which could potentially reduce problems associated with feeding a 0% roughage diet. Removing roughage from the diet unexpectedly improved microbial efficiency.

Key Words: Microbial efficiency, RDP, No-roughage

669 Measuring ruminal pool size and duodenal flow of protozoal N using real-time PCR. J. T. Sylvester*[1], S. K. R. Karnati[1], M. L. M. Lima[2], J. L. Firkins[1], Z. Yu, and M. Morrison[1], [1] *The Ohio State University, Columbus, OH, USA,* [2] *Universidade Federal de Goiás, Goiânia, GO, Brasil*.

Studies evaluating the effects of protozoal ecology on ruminal N recycling and microbial N flow have been limited by availability of a protozoal marker. Current procedures have been either too laborious, not specific to protozoa, or have needed by-difference calculations using multiple markers with their own potential errors. The current objectives are 1) to evaluate a molecular-based assay using the 18S rRNA gene as a protozoal specific marker and 2) to report rumen N pool measurements and protozoal N flow predictions from two cows fed low (LF; 16%) or high (HF; 21%) forage NDF. Rumen pool size was determined from the average of two evacuations; duodenal DM flow, by INDF; and liquid dilution rate (LDR), from a pulsed dose of Li Co-EDTA. Rumen and duodenal samples were composited over 4 d. Rumen samples were quantitatively fractionated for protozoal enumeration and for enrichment of protozoa followed by DNA extraction. Ciliate protozoal specific PCR primers were used to amplify a 1.5-kb fragment of the 18S rRNA gene by conventional PCR for each sample and quantified for use as a standard. A second set of internal primers was used to amplify an approximate 300-bp fragment using real-time PCR to quantify the rDNA copies (i.e., amplicons) present in each ml of sample. Rumen protozoal N pool predictions were determined gravimetrically (i.e., protozoa/ml x ruminal fluid volume) and by multiplying the pool size or duodenal flow of rDNA copies x N/copies ratio of enriched protozoa. The bacterial N pool size and duodenal flow were determined by subtracting protozoal purines from the total purines [protozoal N x (purine/N in enriched protozoa)]. More replications are needed for further verification of the molecular method.

	Rumen	N, g			Duodenal N	flow, g/d
	Protozoa		Bacteria		Protozoa	Bacteria
	Molecular	Gravimetric	Molecular	Gravimetric	Molecular	Molecular
LF	7.2	15.3	143.0	135.8	20.8	337.2
HF	27.4	23.8	189.8	192.8	49.9	366.9
SE	4.0	0.8	27.7	35.9	1.9	16.9
P value	0.07	0.08	0.35	0.46	0.06	0.43

Key Words: Rumen N pool, Protozoal N flow, Real-time PCR

670 Ruminal urease activity and fermentation traits as affected by urease-containing feed sources.

Q. X. Meng*[1] and X. M. Min[1], *China Agricultural University*.

Two in vitro experiments (Expt. 1 and Expt. 2) were conducted to determine the effect of urease-containing feed sources on ruminal urease activity and fermentation traits. In Expt 1, the traditional titration and the spectrophotometric assays were prepared in assessing urease activity of different origin of soybean products. The result showed that mean variations of urease activity for high activity samples were similar between two assays, whereas the variation for low activity samples was smaller (P<0.05) with spectrophotometric assay than titration assay. Using the latter assay, some feeds and rumen fluid samples available in the laboratory were ranged according to their urease activities: dehulled soybean> whole soybean> rumen fluid> soyhulls> alfalfa hay. In Expt 2, the effects of addition of urease-containing feed source on ruminal urease activity and ruminal fermentation traits were investigated using an in vitro gas production experiment. Raw soybean seeds meal and deactivated soybean seeds meal were mixed at ratio of 0%, 33%, 67% and 100%, and used as substrates of rumen fermentation. The incubation was lasted for 12 h. During incubation, urease activity for 0% raw soybean maintained smooth levels, while the activities for 33%, 67% and 100% raw soybean samples decreased with progressed incubation time. During the first 8 h inoculation, urease activities at all time points were significantly different among four treatments (P<0.006), suggesting a linear (P = 0.001) decrease in ruminal urease activity with incremental levels of raw soybean seeds. However, when incubation lasted up to 10 h, ruminal urease activities were almost kept equal levels for four treatments (P = 0.29). As raw soybean inclusion level increased, theoretically maximum gas production decreased (linear; P = 0.004) and gas producing rate increased (linear; P = 0.001). The inclusion of raw soybean seeds had no effect on digestibility of DM, pH values, NH_3-N concentrations and individual VFA profile (P>0.06).

Key Words: Urease activity, Rumen fermentation, Raw soybean seeds

671 Nutritional improvement of rice husks.

J. Vadiveloo, *MARA University of Technology*.

The objective of the study was to ascertain if the nutritional value of rice husks could be improved by chemical or biological means for feeding to ruminants.
Ground and whole husks were treated with 4% urea or 4% NaOH solution for 21 days at room temperature. Samples were dried to constant weight at 60°C and analysed for total ash (TA), neutral detergent fibre (NDF), ash insoluble in neutral detergent solution (IA), crude protein (CP) and in vitro dry matter digestibility (IVD). Untreated husks served as a control.
Ground and whole husks were fermented by the edible fungus, *Pleurotussajor-caju* without a nitrogen supplement (U), with palm kernel cake (PKC) or rice bran (RB) at 200g supplement/kg substrate or urea (UR) at 100g supplement/kg substrate. Standard mineral solution was added to achieve a moisture content of 70%. After incubation for 10 or 25 days at 25°C in the dark, the spent waste was dried analysed as above. Husks not inoculated with the fungus served as a control.
Untreated and urea-treated ground husks did not differ significantly in TA (13%), NDF (80%), IA (6%) or IVD (16%) but NaOH treatment reduced NDF (61%) and IA (3%) and improved IVD (49%). Urea treatment increased CP from 3% to 5% but NaOH treatment reduced CP to 2%. Differences between ground and whole husks were small.
Pleurotus grew only on the U, PKC and RB treatments, grew better on ground husks than whole husks and better after 25 days than 10 days. The TA, NDF, IA, IVD and CP of the U treatment of ground husks was respectively 15%, 81%, 9%, 17% and 3% at 0 days and 14%, 75%, 6%, 26% and 6% at 25 days. Between 0 and 25 days, the PKC treatment reduced NDF from 84% to 73%, IA from 7% to 5%, increased IVD from 16% to 29% but did not improve CP (5%). The RB treatment reduced NDF from 73% to 68%, IA from 6% to 5%, increased IVD from 23% to 34% and CP from 4% to 7%.
Pre-treatment with NaOH may not be practical because of cost and difficulties in handling. Solid-state fermentation retained organic matter and improved digestibility and protein content (U and RB treatments) or digestibility only (PKC treatment). Refinements in fermentation conditions may elicit further improvements in nutritional value.

Key Words: Rice husks, fermentation

672 Does level of dietary protein inclusion influence the ruminal degradability of the protein.

L. R. Legleiter* and M. S. Kerley, *Department of Animal Science, University of Missouri, Columbia*.

This experiment was designed to test the effect of undegradable protein (RUP) inclusion rate on ruminal degradability of the protein. Five ruminally and duodenally cannulated steers were used to measure site and extent of digestion. The five diets were basal (B) with no supplemental protein, basal + 2.4 % blood meal (BM-L), basal + 4.8 % blood meal (BM-H), basal + 4.3 % soybean meal (SBM-L) and basal + 8.6 % soybean meal (SBM-H). The BM-L and SBM-L diets were formulated to be isonitrogenous; likewise, BM-H and SBM-H were isonitrogenous. The experiment consisted of five, 10-d experimental periods, including a 7-d acclimation period followed by 3-d of sampling for each period. Steers were weighed at the beginning of each period and fed 1.9 % of BW per day to minimize orts. Chromium oxide, ytterbium-labeled cracked corn and cobalt-EDTA markers were used to determine digestibility, solids dilution rate and liquid dilution rate, respectively. Ruminal and duodenal samples were taken every 6-h with sampling times advanced 2-h each day so that every 2-h were represented over a 24-h period. Ruminal ammonia concentration was higher (P < 0.05) for SBM-H due to increased degradable protein. Treatment did not affect microbial efficiency (g of N/ kg OM truly digested) with averages of 15.4, 16.8, 15.4 and 22.1 for BM-L, BM-H, SBM-L and SBM-H, respectively. Proteolytic activity, VFA production, and digestibility were not affected (P > 0.05) by treatment. Solids dilution rate was not affected (P > 0.05) by level of protein, however, liquid dilution rate was lowest for BM-H. The % RUP of BM-L was not different (P > 0.05) from the % RUP of BM-H with values of 61.7 % and 54.8 % respectively. Likewise, the % RUP was not different (P > 0.05) for SBM-L at 47.7 % than SBM-H at 45.9 %Ẇe concluded that increasing dietary inclusion rate of RUP would not influence the RUP value of the protein source.

Key Words: Bloodmeal, Rumen undegradable protein, Digestibility

673 Dry matter and protein digestibility of alfalfa hay or silage in the rumen and intestine of steer measured by mobile nylon bag technique.

E. Khafipour, M. D. Mesgaran*, and F. E. Shahroudi, *Ferdowsi University of Mashhad,Mashhad,IRAN*.

The present study was carried out to evaluate DM and CP digestibility of alfalfa hay and alfalfa silage (treated with urea and/or sulfuric acid). Second cut alfalfa (about 27% DM) was harvested, left on the ground for 8 h before ensiling or 2 days for drying. The chopped alfalfa was ensiled with urea (0.0 and 1%,DM) and/or sulfuric acid (0.0 and 1.5%,DM) in a complete randomized design (T_1: alfalfa silage, T_2:T_1+ 1.5% acid, T_3: T_1+ 1% urea, T_4:T_1+ 1% urea+ 1.5% acid,T_5: alfalfa hay). The ruminal and post ruminal disappearances of DM and CP were determined using the mobile nylon bag technique in four Holstein steers (40015,kg) fitted with rumen fistula and T- shaped cannnula. For each treatment, ten bags (3×6 cm, 1.2 g DM of each sample) incubated in the rumen for 12 h. Then,the bags were removed and washed in running cold water. The bags containing intact samples (10 bags for each treatment) were inserted into small intestine, via the cannnula (one bag every 30 min), then removed from the voided feces, washed in cold running water. Finally, the bags were dried in a forced air oven (58°C, for 24 h) and weighed to determine DM disappearance. The Ruminal and intestinal disappearance results are shown in the Table. Both ruminal DM and protein digestibility of afalfa were significantly influencd by the teatments (P< 0.05). It seems that urea and sulfhuric acid may influence the digestible parameters of alfalfa silage in both rumen and intestine. So, it has been concluded that they might be used as good preservatives in alfalfa silage.

Items	T_1	T_2	T_3	T_4	T_5	SEM	P
Disappearance in Rumen							
DM	444	456	479	451	531	38	*
Protein	858	839	738	815	703	69	*
Disappearance in Intestine							
DM	426	435	382	427	441	37	ns
Protein	917	909	922	930	902	42	ns

* $P<0.05$

Key Words: Alfalfa silage, Additives, Digestibility

674 Rumen degradation and intestinal digestibility of crude protein and amino acids from tropical forages. L. Miranda*[1], N. Rodriguez[2], R. Sainz[3], E. Pereria[4], M. Gontijo Netto[5], C. Veloso[6], A. Queiroz[7], and P. Fernandes[8], [1]*FEAD-Minas, Brazil,* [2]*Universidade Federal Minas Gerais, Brazil,* [3]*University of California-Davis, USA,* [4]*Universidade Estadual Oeste Parana, Brazil,* [5]*EMBRAPA Gado de Corte, Brazil.*

Ruminal degradation and intestinal digestibility of rumen undegradable protein (RUDP) and individual amino acids (AA) were determined in leaves of perennial soybean (PS) (Neonotonia wightii) and leucaena (L) (Leucaena leucocephala). In situ ruminal degradation was determined at 6, 18 and 48 hours incubation times and intestinal digestibility of the RUDP was determined on the 18 h residue by a three-stage procedure. All samples were analyzed by HPLC after acid hydrolysis or peroxidation followed by acid hydrolysis. L showed the largest amount of RUDP consequently, lower degradation of the AA among the forages. PS was the forage that showed a high intestinal digestibility of CP and total and individual AA. Therefore, one of the reasons for the low intestinal digestibility of the residues of rumen incubation could be due to the high ruminal degradation of the forages. The forage that supplied the largest content of RUDPD (percentage CP or g/kg DM) was the leucaena, due to the ruminal escape, and to the intestinal digestibility (23.56 percentage). In PS the intestinal digestibility of total amino acids was larger than that of the protein, however in L they were similar (24.04 and 23.56, respectively). Histidine and Cystine were the amino acids that showed the largest intestinal digestibility in L (48.79 percentage) and PS, respectively. Results demonstrate that the intestinal digestibility of the CP does not always predict with accuracy the intestinal digestibility of individual AA. The perennial soybean presented the highest intestinal digestibility for histidine (76.40 percentage of CP). Results showed that protein and AA non-degraded in the rumen have variable intestinal digestibilities.

Key Words: Amino acid, Tropical forage, ADIP amino acid profile

675 A model of net removal of amino acids from blood and absorptive supplies by portal drained viscera in the cow. M. D. Hanigan*[1], C. K. Reynolds[2], F. E. Standaert[1], and J. D. Sutton[2], [1]*Purina Mills, LLC, St. Louis, MO,* [2]*The University of Reading, Reading, UK.*

A more complete understanding of amino acid (AA) metabolism by the various tissues of the body is required to improve upon current prediction systems. Models of rumen, liver, and mammary AA metabolism have been constructed. The objective of this work was to construct and parameterize a model of net AA absorption and utilization by the portal-drained viscera (PDV). Six catheterized, late lactation cows fed grass silage, grass pellets, and concentrate (20:20:60, DM basis, 15.4% CP) were infused abomasally (via a rumen cannula) with 0, 200, 400, or 600 g of casein for 10 d in a 6 X 4 Latin Square design with 3 wk periods. Net PDV flux of amino acids was measured hourly (n=6) on the last day of each infusion. A net uptake model was derived from that described by Hanigan et al. (1998): $C_P = (C_A F_A + DC_D C_D F_D + DC_I C_I F_I) / (K + F_A)$, where C, F, and DC represented concentration, flow, and digestion coefficient, respectively. K represented the rate parameter for net removal by PDV, and the subscripts A, D, I, and P represented arterial, duodenal, infusate, and portal, respectively. F_D was predicted using the model of Clark et al. (1992) and C_D was derived from the literature. K was derived for each AA by fitting to observed portal AA concentrations where C_A, F_A, C_I, and F_I were measured inputs. Milk yield (14.8 kg/d: $P<0.04$) and milk protein (41.4 g/kg; $P<0.07$) responded quadratically to infusion amount. Arterial concentrations of a number of essential AA increased linearly ($P<0.10$) with respect to infusion amount. When assuming $DC_I=0.95$, the minimum value for DC_D was found to be 0.8. PDV removal of AA was linearly related to supply ($P<0.01$), and extraction percentages ranged from 0.5 to 7.25% for essential AA. Prediction errors for CP ranged from 4 to 9%. When setting $DC_D=0.8$, net removal of AA by PDV was adequate to support endogenous losses at the terminal ileum that were 21% of total ileal protein flow if 100% of the total net losses to the PDV appeared at the ileum.

Key Words: Portal-drained viscera, Amino acid, Model

676 A concordance coefficient to compare model predictions to observed data. N. R. St-Pierre*[1], *The Ohio State University, Columbus.*

Mathematical models are frequently used to quantify complex systems. The validation of such models is done by comparing model predictions to observed data. Various statistical methods have been used to assess a model's validity: the Pearson correlation coefficient, the paired t-test, the least-square analysis of slope (=1) and intercept (=0), and the coefficient of variation or the intraclass correlation coefficient. None of these can completely assess the desired reproducibility characteristics. The Pearson correlation coefficient only measures precision of a linear relationship, not accuracy. Both the paired t-test and least squares analysis can falsely reject (accept) the hypothesis of high agreement when the residual error is small (large). The coefficient of variation and the intraclass correlation coefficient assume a dependent and an independent variable. More importantly, they fail to recognize the duality (interchangeability) of predictions with observations. Both are transforms of measurements. Both have random errors from measurements and parameter estimates. And both have structural errors due to the simplification of the complex real world. The relevant question is not whether a model predicts observed data but whether the model and the observation method measure the same thing. This requires a joint assessment of precision and accuracy. A single scaled statistic called concordance correlation coefficient (CCC) is suggested. Let Y_1 be the observed values and Y_2 be the predictions. The concordance correlation coefficient $\rho^c = 1 \# \{E(Y_1\text{-}Y_2)^2 / E[(Y_1 - Y_2) — Y_1, Y_2 \text{ are uncorrelated}]\} = 2 \sigma_{12} / [\sigma^2{}_1 + \sigma^2{}_2 + (\mu_1 - \mu_2)^2] = \rho_{12} \chi_{12}$, where $\mu_1 = E(Y_1)$, $\mu_2 = E(Y_2)$, $\sigma^2{}_1 = Var(Y_1)$, $\sigma^2{}_2 = Var(Y_2)$, and $\sigma_{12} = Cov(Y_1, Y_2) = \sigma_1 \sigma_2 \rho_{12}$. The CCC is a product of two components: precision (ρ_{12}) and accuracy (χ_{12}), where $\chi_{12} = 2 \sigma_1 \sigma_2 / [\sigma^2{}_1 + \sigma^2{}_2 + (\mu_1 - \mu_2)^2] = [(\nu_{12} + 1/\nu_{12} + u^2{}_{12}) / 2]^{-1}$, with $\nu_{12} = \sigma_1 / \sigma_2$ representing scale shift, and $u_{12} = (\mu_1 - \mu_2) / (\sigma_1 \sigma_2)^{1/2}$ representing location shift relative to the scale. Application to the NRC(2001) dataset of measured and predicted microbial N flow to the duodenum shows that measurements and predictions are concordant but lack precision.

Key Words: Concordance coefficient, Model validation

ABSTRACTS
ADSA Student Affiliate Division

*** Author Presenting Paper**

Original Research/Independent Study
Undergraduate Paper Presentations

687 Performance of Holstein and Holstein-Jersey crossbred heifer calves when using an intensive feeding program from birth to 84 days of age. . E. E. Hammell*, M. L. Raeth-Knight, E. Ballinger, J. G. Linn, A. J. Seykora, and L. B. Hansen, *University of Minnesota, St. Paul, MN, USA*.

Fifteen Holstein and twenty-five Holstein-Jersey crossbred heifer calves were utilized to evaluate differences in calf performance and health when feeding milk replacer and starter in an intensive feeding program. Calves were born from October 2002 to January 2003. Colostrum was fed twice daily the first two days following birth. Milk replacer, containing 28% crude protein and 20% fat, was mixed with hot water to achieve a 17.6% solids solution. From day 3 to day 7, calves were offered 2 quarts of milk replacer solution twice daily. After day 7, milk replacer was increased and calves were offered 3 quarts of milk replacer twice daily until day 42. Day 43 milk replacer was decreased and calves were offered 3 quarts of milk replacer once daily until weaning at day 49. Starter (22% CP) was offered ad libitum from day 3 to 84. Intakes and fecal scores were recorded day 3 to day 56. Body weights were recorded at birth and every two weeks following birth, with additional body weights recorded at day 49 and 84. Hip height, heart girth and body length measurements were recorded at day 3, 49 and 84. Calves were housed individually in calf hutches from day 3 to 56 and then group housed (8 calves/group) from day 57 to 84. Holstein calves weighed significantly (P ¡ .01) more at birth compared to crossbred calves (41.8 kg vs. 35.7 kg). Average hip height at birth for Holstein calves was 79.8 cm compared to 76.5 cm for crossbred calves (P ¡ .01). All calves are healthy and performing well.

Key Words: Crossbreeding, Calf, Growth

688 Effect of Prepartum Dietary Carbohydrate Source and Monensin on Postpartum Immuune Function. H. R. Springer*[1], G. A. Varga[1], M. M. Pickett[1], J. P. Goff[2], J. R. Stabel[2], and T. W. Cassidy[1], [1] *The Pennsylvania State University, University Park, PA,* [2] *USDA-ARS, National Animal Disease Center, Ames, IA*.

Thirty two multiparous Holstein cows were used in a complete randomized block design to evaluate the effects of carbohydrate source and prepartum monensin supplementation on postpartum immune function. Immune function was assessed by *in vitro* antibody production and phenotyping using flow cytometry for CD3, CD4, CD8, B cells, monocytes, $\gamma\delta$ T cell receptor (gdTCR), MHC-II, and IL-2 receptor. Two diets with (+) or without (-) supplemental monensin (0 or 330 mg/d) were evaluated in a 2 X 2 factorial arrangement. The prepartum CONV diet contained 70% forage and the NFFS diet contained nonforage fiber sources such that 28% of the forage was replaced with cottonseed hulls and soyhulls. Treatments were designated CONV-, CONV+, NFFS-, and NFFS+. The prepartum diets were formulated to contain 1.55 Mcal/kg NE_L, 40% NDF, and 14% CP. Dietary treatments began at dry off and continued until parturition. Monensin was top dressed daily starting 28 d prior to expected calving date. Jugular blood samples for immune function were collected on day 1, 14, and 42 postpartum. *In vitro* antibody production was lower for cows supplemented with monensin compared to cows not receiving monensin ($P \leq 0.05$; 1732.3, 2625.5 $\pm$ 279.0). Antibody production increased from d 1 to 42 ($P \leq 0.05$; 831.5, 2463.4, 2820.9 $\pm$ 818.0). Percentage of cells positive for CD3, CD4, CD8, B-cells, gdTCR and IL-2 were not different across treatments ($P \geq 0.15$). There was a treatment by day effect such that monensin treatment resulted in lower monocyte populations on d 1 ($P \leq 0.05$; 6.2 vs. 2.9 $\pm$ 0.99). Day was significant for MHC-II populations which were higher for d 1 and 14 compared to d 42 ($P \leq 0.05$; 31.7, 33.4, 23.3 $\pm$ 4.8). Based on this study if the prepartum ration is properly balanced, postpartum immune function should not be affected. Monensin supplementation may effect monocyte populations and antibody production postpartum.

Key Words: Immune function, Monensin, Transition Cow

689 Growth and incidence of scouring in Holstien calves fed high fat (28%) milk replacer (MR) compared to those fed lower fat (20%) milk replacer. H. E. Carpenter*, J. S. Birney, and K. A. Koudele, *Andrews University*.

The replacement heifer calves at the Andrews University Dairy were switched from a diet of whole waste milk (3.06% protein, 3.35% fat) to MR (22% protein, 20% fat, or 2.8% protein, 2.5% fat on as-fed basis) due to concerns about the spread of Johne/s disease and other pathogens. There was concern following the switch that the calves were not growing as well on the MR since it was not equivalent to whole milk in protein

and fat. But there were also concerns that a higher-fat MR would increase the incidence of scouring especially in warm weather, and also reduce pre-weaning grain consumption. During the late summer and fall of 2002 forty-eight heifer calves were paired by birth weight and fed either the regular MR, or a high-fat (17% protein, 28% fat or 2.1% protein, 3.6% fat on as-fed basis) MR. The calves were housed outside in individual hutches and fed 2L MR twice a day until weaning at 7 weeks of age, when they were weighed again. They received free-choice water, grain and hay. Grain intake was tracked weekly and environmental temperatures were monitored daily. The frequency and duration of scouring and treatments were recorded daily. The weight gained from birth to weaning was significantly higher in the high-fat MR group (43.55 kg vs. 31.76 kg; p≤ .001). The % of birth weight gained by the high-fat MR group was also significantly higher (105% vs. 75%; p≤ .001). There were no significant differences in grain intake by either group (2.26 kg/d). The cost of feed intake was less in the high-fat MR group by $.02 per calf per day. Although the environmental temperature ranged from 37.1°C to -7°C during the trial period, there were no significant differences in the incidence or duration of scouring (8 cases/group, treated for 3 d). The data from this pilot study suggests that high-fat MR can be cost-effective to feed to calves even during warmer months resulting in higher weight gains with no reduction in grain consumption, and with no increased incidence of scours.

Key Words: Calf raising, High fat milk replacer, Weight gain

690 Evaluation of intensified liquid feeding programs for dairy calves. B. C. Pollard*, H. M. Dann, and J. K. Drackley, *University of Illinois, Urbana, IL*.

Our objective was to compare growth between two intensified liquid feeding programs (E) and a conventional early weaning (C) program. At 3 d of age, female Holstein calves in individual hutches were assigned to C (milk replacer [MR; 22% CP, 20% fat] plus starter [18% CP], as fed) or E (MR [28% CP, 20% fat] plus starter [22% CP], as fed). Trial 1 used 12 calves on C (C1) and 11 calves on E (E1). For E1, calves were fed MR at 2% of body weight (BW) during wk 1 and 2.5% of BW during wk 2-5 (adjusted weekly). During wk 6, calves were fed half the amount offered during wk 5 and were weaned at the end of wk 6. In trial 2, 21 calves received each diet (C2 and E2). For E2, calves were fed MR powder at 2% of BW during wk 1 and 2.5% of wk 2 BW during wk 2-5. During wk 6, calves were fed half the daily amount offered during wk 2-5 and were weaned at the end of wk 6. In both trials, C calves were fed a constant amount of MR (1.25% of birth weight as powder) through wk 4, one-half of that amount during wk 5, and were weaned at the end of wk 5. All calves had ad libitum access to water and starter. Total MR consumed was greater (P¡0.01) for E (16.4, 38.9, 16.3, and 40.0 kg DM for C1, E1, C2, and E2, respectively). Total starter intakes through wk 8 were lower (P¡0.01) for E (49.8, 22.4, 54.1, and 25.3 kg). In trial 1, BW (57.0 vs 47.0 kg) and heart girth (HG) were greater (P¡0.01) for E1 at wk 4; at wk 8 body length (BL) was greater (P¡0.01), and wither height (WH) and HG tended (P¡0.10) to be greater, for E1. In trial 2, BW (63.5 vs 51.1 kg), BL, and HG were greater (P¡0.01) for E2 at wk 4 and tended (P¡0.10) to remain greater at wk 8. Average daily gain (ADG) was greater (P¡0.01) for E in both trials through wk 4 (0.303, 0.709, 0.360, and 0.714 kg/d for C1, E1, C2, and E2, respectively) and through weaning (0.519, 0.747, 0.562, and 0.671 kg/d). The ADG through wk 8 was greater for E1 than for C1 (0.690 vs. 0.560 kg/d, P¡0.01) and tended (P¡0.08) to be greater for E2 than for C2 (0.671 vs. 0.591 kg/d). Intensified liquid feeding programs resulted in greater early gains of BW and frame.

Key Words: Calves, Growth, Milk replacer

691 The effect of cobalt supplementation in free choice salt on fiber digestion by cattle. L. J. Odens*, C. L. Steigert, J. J. Michal, K. A. Johnson, and R. L. Kincaid, [1]*Washington State University, Pullman, WA*.

The objective of this study was to determine the intake of cobalt (Co) that optimizes fiber digestion in a ruminant. Four ruminally fistulated cows were fed a diet of approximately 50(BGS). Treatments were arranged according to a Latin square design in which each cow was fed a trace element salt that contained 0, .5, 4 , or 10 ppm of added Co. Squares were randomized to avoid a carry-over effect when the next concentration was applied. The Co concentrations were achieved by adding cobalt glucoheptonate to a basal mineralized salt. Cows were adapted to each treatment for 7 d, ruminal fluid was collected (approximately 4 h after feeding) and transported to the laboratory to be used as an inoculant for the Daisy Incubator (ANKOM Technology). To examine dry matter and fiber digestion, the forage used in the diet was collected, dried at 60 C, ground through a 1 mm screen, weighed into small bags and placed into the incubator. Ground alfalfa hay (AA) was used as a reference standard. After 48 h, the incubation was ended; the bags were washed and dried at 100 C for 4 h to determine dry matter disappearance (DMD). Duplicate incubations from each cow at each Co level were conducted. The content of neutral detergent fiber (NDF) in the dry residue was determined. The impact of cobalt level on in vitro ruminal digestion of DM and NDF was evaluated using the SAS statistical package for a Latin square. Salt was fed free choice and intakes varied dramatically by cow. Preliminary evidence suggests Co intake had no effect on DMD or NDF disappearance (NDFD). Mean DMD was 58BGS and 5238fiber digestion.

Key Words: Cobalt, Fiber digestion, In vitro

692 The costs and returns associated with select Wood Model lactation lengths. E. A. Vaaler* and G. L. Hadley, [1]*University of Wisconsin-River Falls*.

The objective of this study is to determine the costs (returns) associated with extended days open and longer lactation lengths using curves developed by the Wood Model. Production profitability is at the heart of dairy farms. Therefore, the importance of this study is enabling the producer to select the lactation length that captures the highest return. Curves were developed for five calving intervals (40, 44, 48, 52, 56 weeks) for each of the three lactations (1, 2, 3). Costs include breeding, housing, labor, and feeding, as well as, other costs associated with the lactation. Cost, revenue, and profit were determined on a per day basis. They were also determined using the University of Wisconsin-Extension and Center for Dairy Profitability Agricultural Financial Advisor (AgFA) farm financial records database. The Net Present Value (NPV) associated with each series of lactation was calculated. To account for the different time frames, each lactation series was replicated to infinity by converting the NPV to an equivalent annuity. By applying a profit function to a Wood Model of various lactation lengths, we found that the cost of an average day open increases as lactation length increases. The return to the farm decreases as lactation length increases. Therefore, if a farm's lactation curve is similar to those generated by the Wood Model, these results mean that a farm should decrease lactation length (calving interval) to increase return.

Dairy Production Undergraduate Paper Presentations

693 Effects of seasonality on the incidents of double ovulation in lactating Holstein cows. K. L. Genho*, R. W. Silcox, and D. L. Eggett, *Brigham Young University*.

Twinning has a dramatic negative effect on subsequent health and reproductive performance of dairy cattle. Double ovulation is the primary cause of twinning. A study was conducted to evaluate the effect of seasonality on the incidence of double ovulation in lactating dairy cows. The study, designed to evaluate the effect of season (summer versus winter) on the incidence of double ovulation, utilized 590 non-pregnant, high producing (¿42 kg/day) Holstein dairy cows located at two different farms under similar management practices owned by a single entity. Observations took place in July-August (summer) and January (winter). There were 315 cows observed in summer and 275 cows observed in winter. The ovaries of each cow were examined once using a Corometrics 500V ultrasound machine to determine the number of corpora lutea present. Overall ovulation rate was not affected by location or lactation number (P¿.05), so data were pooled. Incidence of double ovulation was affected by days in milk (P=.0382) and by rate of milk production (P=.0061). In addition, season was found to have an effect (P=.0113) on the incidence of double ovulation (22.2%) in this experiment. How-

ever, in this study the number of double ovulations was higher in the winter months (25.7%) versus the summer months (18.2%).

Key Words: Dairy cattle, Double ovulation, Seasonality

694 Are Dogs "Man's Best Friend" or "Cattle's Worst Enemy?". Jessica Carrey*, *Louisiana State University*.

Abortions in dairy cattle represent a significant loss of potential income and present a frustrating challenge to dairy producers and veterinarians. Abortion in dairy cattle is defined as a loss of the fetus between 42 and 260 days of gestation. It has been estimated that each abortion costs dairy producers $500 to $900 depending on factors such as value of replacement heifers, feed and milk prices, and the stage of gestation when the abortion occurs. Genetic abnormalities, heat stress, and toxic agents such as mycotoxins have been implicated as factors which may cause abortion. The most frequent causes of abortions in dairy cattle are bacterial and viral infections. However, Neosporosis is a parasitic disease that can trigger spontaneous abortions in many species, including dairy cattle. This infection is caused by the coccidian protozoan parasite *Neospora caninum*. This organism is transmitted by dogs that ingest infected tissues from aborted fetuses and shed the parasite eggs, or *Neospora* oocysts, in their feces. Dairy cattle are exposed to this organism when they ingest feed contaminated with the dog feces. *Neospora caninum* was not identified until 1988, but its economic impact has already become extensive throughout the United States and the world. Although there is no treatment for Neosporosis, a vaccine has recently become available. Good management practices, including pest management, removal of aborted fetuses and placentas, and vaccination protocols, may prove to be beneficial in the prevention of this costly problem in the dairy industry.

Key Words: Neosporosis, Dog, Dairy cattle

695 Crossbreeding in the dairy industry: A new era in dairy production. L. B. Core*, *University of Kentucky*.

Crossbreeding is as controversial today as it was in the 1930's when the first studies were conducted. Although, Holstein generally have a higher lactational performance, crossbreeding tend to offer other benefits to the producer. Lifetime yields, growth, health and reproductive traits are positively impacted by crossbreeding. An Illinois crossbreeding study reported that crossbred dairy cows had a 14.9% higher per cow income and 11.4% higher per cow per year income. A Canadian study reported equivalent lifetime milk yields, milk value and net returns for Crossbred and Holstein cows. Additionally, heterosis of 15 to 20% for lifetime traits was observed. Many studies indicate that a two breed rotational crossbreeding system is the most profitable. A three breed system has been examined , however evidence for its profitability is yet to be determined. The information cited does not prove the profitability of crossbreeding. More research is needed which includes current U.S. genetics, current market values, and multi-generation economic comparison. Many researchers agree that straight breeding eliminates the ability to utilize the positive attributes of all dairy breeds. Cross breeding may be the answer for dairy producers to maximize economic merit.

Key Words: Crossbreeding

696 Organic dairy production: Past present and future. W. T. Wencl* and S. C. Kelm, *University of Wisconsin -River Falls*.

Organic agriculture has emerged as a developing market for dairy farmers. Both supply and demand for "certified organic" food products have risen dramatically over the past 20 years. Hundreds of certifying agencies emerged across the United States to verify the authenticity of the many products farmers and ranchers were producing. Cooperatives also formed as producers realized the importance of marketing products to consumers, the most important part of the equation. As the markets continued to develop producers and consumers realized that change was needed to better define the term "organic". The many different certifying agencies that developed all had slight variations in their certification requirements; European standards were also different. Such differences caused problems with trade and general consumer confidence in the label, causing confusion as to what the term organic means. A solution to this problem was to develop a national organic standard and this project was assigned to the USDA as part of the 1990 Farm Bill containing the Organic Food Production Act. National Standards were presented on December 20, 2000 and were implemented in October 2002. These standards will greatly affect this industry as it grows in the future.

Key Words: Organic, Standards

697 Effects of photoperiodic manipulation of dairy cattle. G. Brauning, III*, *Virginia Tech, Blacksburg, Virginia*.

The modern dairy producer has multiple management techniques that can be used to stimulate milk production. Changing milking frequency from 2X to 3X, supplementation with bST, and now photoperiod manipulation, are examples of tools that can be used to stimulate production. A natural photoperiod consists of 13 or fewer hours of light/day. A long day photoperiod (LDPP) is 18 hours of light/day, followed by 6 hours of dark. LDPP has been shown to increase milk production by up to 3.3 kg/day. In most studies, milk composition has not been altered, but minor decreases in fat concentration in milk have been documented with LDPP. Continual lighting is not recommended, as a dark period is required to maintain the ability of the animal to track day length and consequently regulate bodily functions. In order to observe milk yield increases, a footcandle illumination of 20 footcandle illumination per 50 feet of barn length is suggested. While the mechanism behind the increased milk yield with LDPP is not clear, LDPP affects the melatonin concentrations in the blood. Melatonin regulates plasma IGF-1 and serum prolactin concentrations. Research points to IGF-1 as the most probable cause of increased production with LDPP. Producers can combine bST supplementation and LDPP for an additional production increase. Additional fat corrected milk production increases from 1.9 kg/day with LDPP, to 5.7 kg/day over control when LDPP is combined with bST. Photoperiodic manipulation has the potential to be an important tool for dairy producers. While there are fixed costs to implement LDPP, and power usage increases, most producers find LDPP to be a profitable management tool. No additional effort is required on a daily basis to gain the effects of LDPP, no injections need to be administered, and there is no additional labor involved.

Key Words: Photoperiod

698 Crossbreeding in the dairy industry: why now? J. D. Hushon* and D. R. Olver, *Pennsylvania State University*.

Researchers and companies have spent extensive time and investment looking at how changes in environmental factors impact milk production in dairy cows. However, it must be noted that milk production is the result of both genetics and environment. With that in mind, producers are exploring new ways that genetics can impact the dairy industry that is seeing a decline in herdlife. This decline is being partially blamed on the growing problem of a gradually more and more inbred national dairy population. One possible solution is crossbreeding. Crossbreeding has been used for hundreds of years in other areas of agriculture. In the dairy industry, only recently have studies begun to look again at this using crossbreeding. In fact, a recent study by the USDA on Holstein sires crossed with Ayrshires, Brown Swiss, Guernseys, and Jerseys, showed heterosis effects to vary between 2.47.5led to the renewed interest in this age-old technique. These factors include a shift from volume based milk pricing to component based milk pricing, and increased concerns about inbreeding, efficiency and fertility. It will also examine uses of crossbreeding internationally and explore how dairy producers in the United States, especially large commercial producers, can utilize those results.

Key Words: Crossbreeding, Genetics

699 Utilizing milk forward contracting as a risk management tool. V. Ahlem*, *California Polytechnic State University, San Luis Obispo*.

As the dairy industry enters the years ahead, producer will be faced with numerous challenges, such as tightening of environmental standards, rising fees for waste management programs, loss of land to urban sprawl, and an uncertain milk price. As we move forward and face these challenges, budgets will tighten and profit margins can begin to slip if not managed correctly. One-way to help manage this cycle is to use milk forward contracting options to mitigate drastic price swings. By doing so a producer can lock in a price that he/she will be able to turn a profit on. Many details must be evaluated before even considering forward contracting as an option, such factors as current cost of producing

a hundredweight of milk, knowledge of where the market has been and where it might be headed, and most importantly, a willingness to live with the decisions once they have been made. Forward contracting of milk has long been an untapped resource, due to the fact that we operate in a capitalistic society, and the complex steps that must first be taken to understand the full financial implications as they are related cost of production. The time has come for the dairy industry to start taking advantage of such tools as forward contracting to minimize risk and become more efficient.

Key Words: Forward contracting, Milk pricing, Risk management tool

Dairy Foods Undergraduate Paper Presentations

700 Dairy case wars: "got milk?" vs. "not milk?". J.H. Krall*[1] and D.R. Olver[1], [1]*Pennsylvania State University*.

Many supermarkets currently display both soy "milk" and dairy products on the same shelves. However, is soy beverage actually milk? Obviously it is not produced by a lactating mammal. For this reason, the National Milk Producers Federation (NMPF) filed a trade complaint with the Food and Drug Administration to prevent the labeling of soy beverage as milk. According to federal guidelines, some requirements for a beverage in its final packaged form to be labeled as milk include lacteal secretion from healthy cows, pasteurization, and contents of at least 8.25fat. Since the ingredient soy protein is not listed in this regulation, the NMPF argues that soy products cannot be labeled as milk. Soy industry officials respond that milk is a generic term attached to many products. According to a California research firm, sales of refrigerated soy milk in traditional supermarkets increased by 57October 31, 2001. Some speculate that a portion of this increase is due to consumers erroneously associating dairy's wholesome image and health benefits with soy because of the soy "milk" label. The resolution of this issue by FDA will be seen in supermarket dairy cases nationwide.

Key Words: Soy milk, Dairy products

701 Phage peptide inhibition of phage infection in cheese fermentation. J. Woodcock*, *University of Kentucky*.

Bacteriophages (phage) are viruses that infect bacteria by injecting their genetic material into the bacteria cell. Phage are commonly found in milk products and can affect manufacturing by destroying culture bacteria necessary for the formation of cheese and other fermented products. Phages lock onto a bacterial cell membrane by attaching a protein to a receptor site on the prokaryote. In particular, the c2 phage adsorption protein binds with the bacteria Lactococcus lactis ssp. lactic c2, creating an irreversible lock. By utilizing competitive inhibition, in which the receptor sites on the host bacteria are blocked by c2 phage peptides, the rate of phage proliferation is reduced.. With this reduction, cheese production and efficiency can increase. Considering the simplicity of introducing a phage to a cheese plant by clothing, cheese whey, and even mist, phage peptide inhibition could allow sufficient time for cheese fermentation without risk of phage infection.

Key Words: Phage Peptide, Bacteriophage, Cheese Fermentation

702 Will the "Real" Milk Please Stand Up? L. Ward, *Louisiana State University*.

In October, 1999, the FDA stated that "it recognizes the health benefits of daily consumption of soy protein. Specifically, consuming 25 grams of soy protein daily can help reduce the risk of heart disease." This announcement paved the way for the soy product market. One product that has been gaining in popularity is soy milk. Soy milk is high in protein, rich in vitamins and minerals, low in fat, and cholesterol free. It contains no lactose, which makes it a safe and nutritious alternative for lactose intolerant individuals. Research has shown that soy foods may help to prevent heart disease and some forms of cancer. This beneficial effect is possibly due to isoflavones, a phytoestrogen found in soybeans. While soy milk has numerous potential health benefits, it is not "nature's most nearly perfect food." Soy milk has been reported to be unpalatable. Sensory experts have reported off flavors, bitter taste, chalky mouth feel, and a bad aftertaste. With milk consumption declining and the soy milk market getting larger, the dairy industry must work harder to promote the health benefits of milk. Milk and dairy products have numerous health benefits because of their high concentrations of calcium, protein, vitamins, and minerals. The dairy case also has a full line of products for lactose intolerant individuals. In choosing their milk, consumers must be the judge. They can select a bad tasting product with health claims, or they can opt for "real" milk with its great taste and many nutritional benefits.

Key Words: Milk, Soy, Health benefits

703 Wazzu's famous variety. J. DeVoe*, *Washington State University*.

Cougar Gold is a unique cheese made only by Washington State University Creamery in Pullman, WA. This cheese was developed in the 1930's with a unique bacterial strain giving it its own particular taste. To this day the same strain is cultured every three days, derived from the same clone that was selected over seventy years ago. Cougar Gold is a sharp, white cheddar with a taste that resembles Swiss or Gouda and it is aged for at least one year. This cheese is packaged in a can, because of research in the 1930's for a more ideal packing medium. Cougar Gold is the only known cheese in the USA that is canned, therefore making it Washington State's own unique cheese. The scarcity of Cougar Gold also adds to its uniqueness. The only way to get this cheese is either to make a trip to Pullman or to have it mail ordered. It is not shipped in mass quantity and anyone ordering it can only order twenty cans at a time. Therefore, not only is this cheese unique, but it's supply is restricted. The WSU Creamery makes this cheese year round and produces a little less than 150,000 cans of Cougar Gold a year. To add to its singleness, Cougar Gold helps to support student employment in the WSU Creamery. Furthermore, the facility provides opportunities for students to work with and learn about cheese. For example, the Food Science Human Nutrition club works with the cheese for a fund-raiser, students from the food science department hold classes and graduate and undergraduate students hold research studies at the Creamery. Therefore, a can of Cougar Gold is not just a plain old can of cheese; it is unique and represents many years of support, education and quality.

Key Words: Cougar Gold, Cheese

704 On-farm dairy processing: Opportunity for diversification of small farms. E. Moss*, *Virginia Polytechnic Institute and State University*.

To better compete in the changing dairy industry, many small dairy producers are considering diversification. One diversification strategy that is growing in popularity is on-farm processing of fluid milk, cheeses, and other dairy products. There are currently 13 registered on-farm creameries in the state of Virginia. Many of these farms are family run and owned. These operations produce their own milk from small milking herds and turn the raw product into a "cow to consumer" product. The start up cost for the typical Virginia on-farm processing operation varies from $1 million to $1.5 million. Examples of products manufactured at these creameries include several flavors of milk with varying fat content, specialty cheeses, yogurts, and chip dips. On-farm processed dairy products are often, but not always, produced organically, and are promoted as being of excellent quality and freshness. On-farm processing of dairy products offers a new technological twist on the old-fashioned concept of diversified farming. Homestead Creamery and Shenville Creamery in Virginia are two examples of small dairies that are competing by processing their own fluid milk. Both of these creameries use Pladot^{TM} Mini-Dairy, an Israeli-made milk processing system that includes a cream separator and cheese-curding tank. These systems are made especially for small-scale operations with from 30 to 300 cows. Homestead and Shenville use traditional glass bottles, offers home delivery, and charge a premium for their product. A half-gallon of Homestead Creamery whole milk retails for $4.19 at grocery stores including $1.50 deposit that is refunded upon return of the glass bottle. This compares to $2.99 for a gallon of milk in a regular plastic jug.

705 Innovative applications of membrane filtration.

C. Machado*, *Califonia Polytechnic State University, San Luis Obispo*.

Membrane filtration research is currently aimed at the standardization of milk, enhancing functional properties of milk proteins, fractionating whey proteins, and improving milk quality. Membrane filtration requires little energy and does not destroy any product during treatment. The pore size of the filter determines the type and size of the molecules to be retained by the filter. Alteration of the pore size yields a customized permeate and retentate. With the use of membrane filtration there could be an improvement in the quality of existing dairy foods, a creation of new and innovative products, and progress could be made in processing efficiency and profitability. Permeates gathered from filtration could be used as a value-added ingredient, fortifying foods, from sports drinks to infant formulas. The permeate could add a boost to the existing nutritional identity of fluid milk or create an entirely new product using milk's functional or nutritional components. Filtration could become a key element in the production of cheese. It could extract valuable proteins prior to making cheese, greatly decreasing the amount of protein lost to acid whey during cheesemaking. Milk could be considered a collection of individual components with different nutritional values, such as protein, fat, casein, lactose, vitamins, and minerals. Federal standards have not been implemented to support this technology to date, but membrane filtration allows for promising economic benefits compared to the more traditional methods of concentrating, fractionating, and separating milk components.

Key Words: Membrane filtration, Milk components, Dairy processing

ABSTRACTS
POSTERS, Monday, June 23, 2003

*** Author Presenting Paper**

Physiology: Control of the estrous cycle and pregnancy

M1 Induced twinning by artificial insemination and embryo transfer fails to increase pregnancy rates but increases total fetus numbers in beef cows. G. C. Lamb*[1], R. C. Wasson[1], D. R. Brown[1], and C. R. Dahlen[2], [1]*North Central Research and Outreach Center, University of Minnesota, Grand Rapids 55744,* [2]*North West Research and Outreach Center, University of Minnesota, Crookston, 56716.*

We determined whether induced twinning would increase fertility and twinning rates, and to elucidate factors responsible for altering twinning rates in suckled beef cows. Two hundre ninety-seven suckled beef cows were estrous synchronized with 7-11 Synch (i.e., melengestrol acetate [0.5 mg/head/d] from d -18 to d -11, $PGF_{2\alpha}$ on d -11, GnRH on d -7, and $PGF_{2\alpha}$ on d 0). Forty-eight hours later (d +2) all cows received a second 100 μg injection of GnRH and were assigned randomly to one of three treatments: 1) Fixed-time artificial insemination on day +2, (AI; n = 99); 2) a direct transfer embryo placed in the uterine horn ipsilateral to the ovary containing a corpus luteum (CL) on d +9, (ET; n =99); and, 3) a fixed-time AI on d +2 and an embryo on d +9 (TWIN; n =99). Blood samples were collected on d -29, -18, 0, +2, +7 to determine concentrations of progesterone. Ultrasonography was used to monitor follicle diameter on d +2, CL diameter on d +9 and to determine the presence of embryos on d 35. Only 34% of all cows were cycling by d -18, pregnancy rates were greater ($P < 0.05$) for TWIN (48%) and AI (46%) than for ET (33%) treated cows. Of the 48 pregnant cows in the TWIN treatment 19 were twin pregnancies (40%), whereas there was one twin pregnancy in the AI treatment and 0 twin pregnancies in the ET treatment. As a result, TWIN cows had more fetuses ($P = 0.01$) as a percentage of all treated cows (68%) than AI (47%) or ET (33%) treated cows. On d -18, A greater percentage of primiparous cows (57%) were cycling than multiparous cows (26%), resulting in greater ($P < 0.05$) overall pregnancy rates in primiparous (54%) than multiparous (40%) cows. Days postpartum on d 0 were greater ($P < 0.01$) for primiparous (79 2 d) than multiparous (68 1 d) cows. In the TWIN treatment, the correlation coefficient between concentrations of progesterone on d -7 and CL volume was 0.499 ($P < 0.001$), whereas the correlation coefficient between CL volume and the incidence of twins was 0.299 ($P < 0.01$). Embryo grade or stage of development failed to affect twinning rates. We concluded that transferring an embryo into a cow after timed-AI increased twinning rates, but failed to increase overall pregnancy rates compared to a fixed timed-AI.

Key Words: Twinning, Beef cows, Artificial insemination

M2 Effect of administration of GnRH on day 5 or day 5 and 11 post-insemination on pregnancy rates and serum progesterone concentrations in dairy cows during different seasons. A. E. Sweetman*, L. I. Nordbladh, and C. S. Whisnant, *North Carolina State University, Raleigh, NC.*

Heat stress has been shown to reduce reproductive performance in lactating dairy cows. One effect of heat stress is to decrease serum progesterone (P4) concentrations. Lower serum P4 may be associated with decreased pregnancy rate. Previous research suggested that administration of hCG on day 5 post-insemination or use of GnRH at day 11 post-insemination could increase serum P4 and improve pregnancy rates in cattle. The objective of the current experiments was to compare the response to supplemental GnRH in heat stress and cool environments. Lactating Holstein cows were bred at a timed AI after use of the Ovsynch protocol in either summer (heat stress) or winter. Controls (CON n = 35) received no further treatment. GnRH (100 ug, Fertagyl, Intervet) was administered either on day 5 (D5 n = 42) or day 5 and 11 (D5+11 n = 39) post-insemination and blood samples were collected and rectal temperatures were measured every other day beginning 3 days after AI. Concentrations of P4 were compared between treatments using the GLM procedure of SAS for repeated measures. Pregnancy rates were compared using Chi square. The results from summer follow. Summer THI (70.2) indicated mild heat stress. Serum P4 levels were higher in D5 cows ($P< 0.01$) on days 9, 11, and 13 and were higher than P4 concentrations in CON cows ($P< 0.01$) on days 17 and 19 in D5+11 cows. Rectal temperatures did not differ between groups. Pregnancy rates as assessed using ultrasonography on day 30 post AI were higher ($P< 0.05$) in D5 ($35.2 \pm 2.4\%$) compared with CON ($18.5 \pm 1.3\%$) and D5+11 ($20 \pm 1.7\%$). In experiment 2, a similar protocol was performed except during winter when heat stress conditions did not exist (THI = 44.8). Serum P4 concentrations were higher in GnRH treated cows than in CON as in summer. However pregnancy rates did not differ between groups (CON $37.2 \pm 2.7\%$; D5 $39.3 \pm 2.9\%$; D5+11 $34.4 \pm 2.2\%$;) unlike the results in summer. These results suggest that administration

of GnRH can increase serum P4 concentrations in lactating dairy cows during both heat stress and cooler conditions but that pregnancy rates were increased only during heat stress.

Key Words: Heat stress, GnRH, Progesterone

M3 Effect of treatment with hCG or GnRH on day 5 after AI on conception rates in lactating dairy cows during the summer.

M. P. Beltran, J.L.M. Vasconcelos*, R. M. Santos, D.G.B. Demetrio, F. S. Wechsler, and A. B. Teixeira, *FMVZ - UNESP - Botucatu*.

This study evaluated the effect of GnRH or hCG injection on day 5 after AI on conception rates in lactating dairy cows during the summer. Lactating Holstein cows, 158, producing 26±9 kg milk/d and 213±112 DIM, were randomly assigned to one of 3 treatment groups: G1 (N=52), control; G2 (N=55), 100 mcg i.m. of gonadorelin (Cystorelin®); and G3 (N=51), 2500 UI hCG i.m. (Vetecor®). Experiment was conducted during the summer in Brazil. Rectal temperature was checked at the moment of AI, and blood samples were collected on days 5, 7 and 12 after AI to evaluate serum progesterone (P4) concentrations. Pregnancy was determined between 42 and 49 d after AI. Data were analyzed by the MIXED procedure of SAS, and were included in the model the effects of treatment, parity, milk production, rectal temperature at the moment of AI and interactions. Treatment with GnRH and hCG increased serum P4 (P<.01). Serum P4 concentrations (ng/ml) for G1, G2, and G3 were, respectively, on day 5, 2.71, 2.45, and 3.23, on day 7, 4.79, 4.15, and 5.75, and on day 12 after AI, 5.21, 6.91, and 8.50. Due to the proportional increases in serum P4 concentrations from d 5 to 7 after AI, it is likely that treatments did not have luteotropic effects on the existing CL, but due to the higher increase in serum P4 on day 12, probably induced formation of a new CL. The average rectal temperature of cows at the time of AI was 39.7°C. Treatment with GnRH and hCG increased conception rates in cows with rectal temperature below 39.7°C (10.1, N=26; 36.8, N=27; and 32.8%, N=21; P<.01), but had no effect on conception in cows with temperature above 39.7°C (15.2, N=26; 17.8, N=28; and 24.4%, N=30; P>.15). These data suggest that GnRH and hCG increase conception rates in lactating cows by increasing serum P4 concentrations. The positive effects of treatments were not detected in cows with high rectal temperature probably because of the deleterious effects of thermal stress on fertilization and early embryo development.

Key Words: hCG, GnRH, Conception

M4 The effects of supplemental GnRH administration following Ovsynch on pregnancy rates of lactating dairy cattle during the summer and fall seasons.

T. Dickerson*, K. Graves, J. White, S. Bowers, L. Evans, B. Gandy, S. Schmidt, and S. Willard, *Mississippi State University*.

High environmental temperatures are negatively correlated with reproductive efficiency in dairy cattle, as evidenced by lower conception rates. Studies were conducted in the summer and fall seasons respectively to evaluate the efficacy of supplemental GnRH injections post-breeding on pregnancy rates in lactating dairy cattle. Lactating dairy cows in Study 1-Summer (n=43) and Study 2-Fall (n=79)were synchronized using the Ovsynch protocol, bred (TAI) and assigned to one of three post-TAI GnRH treatment groups: Control (CON), D 5 & 11 (GnRH-5/11), and D 11 (GnRH-11). Blood samples were collected throughout the trials for evaluation of serum progesterone (P4) in relation to GnRH treatment. CL area and numbers were determined by ultrasonagraphy on D 5, 11, and 17 post-TAI for all cows in Study 1-Summer, and a subset of cows in Study 2-Fall (n=12/treatment). Rectal temperatures (RT) were collected throughout both studies, and ambient temperature-humidity index (THI) recorded daily. Study 1: Overall THI (24-h) was 74 (mild heat stress), with no differences (P>0.10) in RT between treatment groups. On D11 post-TAI, GnRH-5/11 cows had higher (P<0.05) serum P4 than CON cows, but did not differ (P>0.10) from GnRH-11 cows. On D17 post-TAI, GnRH-5/11 cows had higher (P<0.05) serum P4 than either the CON or GnRH-11 cows. Overall CL area did not differ (P>0.10) among treatment groups, yet GnRH-5/11 cows had higher (P<0.05) CL numbers on D 11 and 17 post-TAI than either the CON or GnRH-11 cows. Pregnancy rates did not differ (P>0.10) with respect to treatment. Study 2: Overall THI (24-h) was 50 (no heat stress), with no differences (P>0.10) in RT between treatment groups. On D11 post-TAI, GnRH-5/11 cows had higher (P<0.05) serum P4 than CON cows, but did not differ (P>0.10) from GnRH-11 cows. On D17 post-TAI, serum P4 did not differ (P>0.10) among treatment groups. Overall CL area did not differ (P>0.10) among treatment groups, yet GnRH-5/11 cows had higher (P<0.05) CL numbers on D 17 post-TAI than either the CON or GnRH-11 cows. Pregnancy rates did not differ (P>0.10) with respect to treatment. In summary for both trials, supplemental GnRH post-TAI increased serum P4 and CL numbers but did not increase pregnancy rate.

Key Words: Dairy cattle, GnRH, Progesterone

M5 Effect of bovine somatotropin and breed of recipient on pregnancy rates following timed embryo transfer with in vitro produced embryos.

J. Block*[1], R. L. Monson[2], J. J. Rutledge[2], R. M. Rivera[1], F. F. Paula-Lopes[1], O. M. Ocon[1], H. Rosson[1], Y. M. Al-Katanani[1], and P. J. Hansen[1], [1]*University of Florida, Gainesville, FL*, [2]*University of Wisconsin-Madision, Madision, WI*.

Administration of bovine somatotropin (bST) improves pregnancy rates following timed artificial insemination in lactating dairy cows. Two experiments tested whether bST administration to non-lactating recipients improves pregnancy rates following transfer of in vitro produced (IVP) embryos. In exp. 1, Braford cows were synchronized using the OvSynch protocol. On d -1 (d 0 = anticipated ovulation), recipients were treated with bST or not. Embryos were transferred to all recipients having a palpable corpus luteum on d 7. Pregnancy was diagnosed on d 30 and 90. In exp. 2, recipients of 3 breed types [Angus (A), Holstein (H), and Brahman or Brahman crossbreds (B)] were given bST or not on d 0. Pregnancy was diagnosed between d 42 and 49. Other procedures were as for exp. 1. There was no difference in pregnancy rates between control and bST recipients in exp. 1 (d 30, 4/14 = 28.6% vs. 2/13 = 15.4%; d 90, 3/15 = 20.0% vs. 1/14 = 7.1%) or 2 (7/36 = 19.4% vs. 5/24 = 20.8%). In neither experiment did bST affect body condition, ovulation synchronization rate (determined by plasma progesterone (P_4) concentrations on d 0 and 7), or plasma P_4 on the day of transfer. In exp. 2, synchronization rate and plasma P_4 concentrations were similar across breeds, but pregnancy rates were lower (p<0.05) for B (0/15 = 0.0%) than for H (8/35 = 22.9%) and A (4/10 = 40.0%) recipients. In both experiments, there was a non-significant trend for recipients with ≤ 2.5 ng/ml plasma P_4 on d 7 to have lower pregnancy rates than those with plasma P_4 > 2.5 ng/ml. Results indicate that breed of recipient but not bST administration affects pregnancy rates in non-lactating recipients following timed embryo transfer with IVP embryos. (Support: USDA IFAFS #2001-52101-11318, USDA TSTAR 2001-34135-11150, and the Babcock Inst. for International Dairy Res. & Dev., UW-Madison).

Key Words: Bovine somatotropin, IVP embryos, Timed embryo transfer

M6 Synchronization protocols in lactating crossbred Holstein-Gir cows.

W. R. Garcia*, J.L.M. Vasconcelos, M. Meneghetti, E.P.B.C. Silva, A. H. Souza, and F. S. Wechsler, *FMVZ - UNESP*.

This trial was designed to compare synchronization protocols in lactating crossbred cows in a grazing based dairy system. This study was conducted between December (2001) and February (2002) in Brazil. Cows producing 13.8 ±4.0 kg milk/d and 99.8 ±73.6 DIM, were randomly assigned to one of the four groups: G1) Control (N=51), which consisted of AI 12h after heat detection (HD); G2) CIDR in (Eazi-Breed CIDR®) + GnRH (Cystorelin®, 50mcg, i.m.) - 6d # CIDR out + PGF2α (Lutalyse®, 25mg, i.m.) # IA - 12h after HD (N=50); G3) CIDR in + GnRH - 6d #CIDR out + PGF2α - 24h - ECP (ECP®, 1mg, i.m.) - 48h # AI (N=52); G4) CIDR in + GnRH - 6d # CIDR out + PGF2α - 36h # GnRH - 12h - AI (N=53). Cycling status was determined by two ultrasound examinations at days #10 and 0 (first GnRH). Data were analyzed by CATMOD procedure of SAS and were included in the model groups, parity, milk production, BCS at day of first GnRH, DIM and interactions. Interaction between parity and group was detected (P<.05) for the TAI protocols. Pregnancy rate (PR) in TAI for primiparous (PC) and multiparous cows (MC) were 25.0% (7/28) and 50.0% (12/24) for G3 compared to 37.9% (11/29) and 16.7% (4/24) for G4, respectively. Conception rate (CR) to first service for PC and MC (P=.34), were 62.5% (10/16) and 47.3% (9/19) in G1 compared to 43.7% (7/16) and 52.6% (10/19) for G2, respectively. In G3 and G4 the CR in cows effectively synchronized, for PC and MC (P<.01) were

36.8% (7/19) and 63.1% (12/19); 52.4% (11/21) and 21.1% (4/19), respectively. Interaction between parity and group (P<.05) was detected for the cumulative pregnancy rate at Day 48 (CPR). For PC and MC, CPR and number days to be confirmed pregnancy in pregnant cows were 35.7% (10/28), 30.3 ±2.4d and 56.5% (13/23), 33.5 ±3.2d; 26.9% (7/26), 9.7 ±.1d and 58.3% (14/24), 28.7 ±3.1d; 39.3% (11/28), 23.9 ±1.7d and 66.7% (16/24), 24.6 ±4.0d; 51.7% (15/29), 22.9 ±2.5d and 37.5% (9/24), 38.0 ±3.4d; for groups 1, 2, 3 and 4, respectively. In summary, protocols increased differently the PR, with ECP should replace the second GnRH in MC.

Key Words: Synchronization, ECP, GnRH

M7 Effect of incorporation of a low dose of estradiol cypionate (ECP) into a timed artificial insemination protocol on estrous behavior and conception rates in beef cattle. A. Ahmadzadeh*[1], D. G. Falk [1], R. Manzo[1], C. B. Sellars[1], and J. C. Dalton[2], [1]*University of Idaho, Moscow,* [2]*Southwest Research and Extension Center, Caldwell, ID.*

Timed artificial insemination (Ovsynch; OVS) is a convenient method to facilitate artificial insemination, however GnRH administered during the follicular phase, as occurs in Ovsynch, causes a premature decline in estradiol secretion. It was hypothesized that administration of estradiol cypionate (ECP) coupled with the second GnRH injection would improve conception rate. The objective was to determine the effect of low dose ECP incorporation into OVS on expression of estrus and conception rates in beef cattle. One hundred eighty-two British cross-bred beef cows (55-60 d postpartum) received (i.m.) injection of 25 mg PGF (d -14). Fourteen days later 100 ug GnRH was administered (i.m.;d 0) followed by 25 mg PGF on d 7. On d 9 cows were assigned randomly to receive either GnRH + 0.25 mg ECP (OVS-ECP; n=90) or GnRH + vehicle (OVS; n=92). All cows were artificially inseminated 12 to 15 h post-treatment. Estrus activity was monitored 2 times daily after second PGF administration, blood samples were collected on d 0, 7, and 9, and pregnancy determined by ultrasonography 40 and 70 d post-insemination. More cows (P < 0.05) were detected in estrus in the OVS-ECP group (43.5%) compared to the OVS group (25%). Mean serum progesterone concentrations did not differ between treatment groups on any day. Conception rate from AI was 68% and 57.5% for OVS-ECP and OVS, respectively and was not different (P = 0.14) for either d 40 or d 70 post-insemination. These results suggest that incorporation of a low dose of ECP into conventional OVS increased estrous behavior and may improve conception rate.

Key Words: Timed AI, Estradiol cypionate, Conception rate

M8 Comparison of synchronization protocols for beef heifers using melegesterol acetate, prostaglandin, GNRH, and timed artificial insemination. K. E. Miller*, W. S. Mackay, J. C. Whittier, R. M. Enns, and R. K. Peel, *Colorado State University Department of Animal Sciences*.

The objective of the study was to compare the effectiveness of MGA Select synchronization protocol to 19-d MGA-PG protocol when using timed artificial insemination (TAI) with the MGA Select protocol. Crossbred beef heifers (n = 131) were randomly assigned to one of three treatments, control, MGA Select, and MGA Select with timed artificial insemination (MSTAI). Treatment 1, control group, (n = 43) was fed melengestrol acetate (MGA) for 14 days (0.5 mg hd-1 d-1) and injected (i.m.) with PG (25 mg of Lutalyse) 19 days after the last day of MGA feeding. Treatment 2, MGA Select, (n = 44) group was fed MGA for 14 days (0.5 mg hd-1 d-1), injected (i.m.) with GnRH (100 g of Fertagyl) 12 days after the last day of MGA feeding and injected (i.m.) with PG (25 mg of Lutalyse) 19 days after the last day of MGA feeding. Treatment 3, MSTAI, (n = 44) was treated the same as MGA Select group except TAI occurred 60 hours post PG injection. Estrus detection via "Heat watch" began the day of PG and continued through 84 h for control and MGA Select groups. The estrus response was similar (P > 0.05) for the control, and treatment 2. Peak estrus period for both groups was observed to be between 48 and 60 h after PG, 53% of control and 64% of treatment 2 groups exhibited estrus (P > 0.05). Control and treatment 2 number of non-responders, those not exhibiting estrus, did not differ (P > 0.05). Comparison of conception rates for control and treatment 2 did not differ (P > 0.05). Additionally, comparison of first service pregnancy rates for treatment 2 to treatment 3 did not differ at (P > 0.05). This research suggests the use of MGA Select can be equally effective in synchronizing estrus in beef heifers as the 19-d MGA-PG protocol. Use of TAI can be used for beef heifers in conjunction with the MGA Select protocol to achieve similar first service pregnancy rates as MGA Select when used in conjunction with estrus detection.

Key Words: Timed AI, MGA select, heifer

M9 Melengestrol acetate (MGA) pretreatment or estradiol cypionate (ECP) in short duration synchronization systems to improve synchrony of estrus and ovulation in yearling beef heifers. S. K. Johnson* and J. S. Stevenson, *Kansas State University*.

The objective of this experiment was to determine if MGA pretreatment or ECP after $PGF_{2\alpha}$ would improve synchrony of estrus, ovulation, and AI pregnancy rates in heifers. Yearling Angus and Angus crossbred heifers at a commercial heifer-development facility were assigned randomly to four treatments: 1) two injections of $PGF_{2\alpha}$, 14 d apart (2XPGF, n=97), AI 6-12 h after observed estrus (EAI); 2) same as 2XPGF plus 0.5 mg of ECP 24 h after the 2nd $PGF_{2\alpha}$ injection (d 0; PECP; n=98), EAI through 72 h after $PGF_{2\alpha}$ then timed AI (TAI) and GnRH to all non-detected heifers at 74 h; 3), GnRH on d -7 and $PGF_{2\alpha}$ on d 0 and EAI (SS; n=97); 4) 0.5 mg of MGA from d -17 through d -11, $PGF_{2\alpha}$ on d -11, GnRH on d -7 and $PGF_{2\alpha}$ on d 0, EAI through 72 h after $PGF_{2\alpha}$ on d 0 then TAI and GnRH to all non-detected heifers at 74 h (7-11Synch, n=189). Doses administered were i.m.: 100 μg of GnRH and 25 mg of $PGF_{2\alpha}$. Pregnancy was diagnosed by ultrasound 30 to 34 d after AI. From 0 to 72 h after $PGF_{2\alpha}$, average interval to estrus was greater (P<0.01) for 2XPGF than PECP but did not differ for SS or 7-11Synch, 56.4 ± 1.7, 49.6 ± 1.3, 47.6 ± 2.2, 49.0 ± 0.9 h, respectively. Proportion of heifers in estrus between 48 and 72 h was greater (P<0.01) for 7-11Synch (67%) than SS (49%) and tended to be greater (P<0.06) for PECP (70%) than 2xPGF (58%). Conception rate from 48 to 72 h was lower (P<0.01) for PECP than 2XPGF but similar for SS and 7-11Synch: 48%, 71%, 75%, and 73% respectively. Conception rate of TAI heifers in PECP and 7-11Synch treatments was 5.9% (1/17) and 9.8% (4/41), respectively. Pregnancy rate (d 0 to 5) was greater (P<0.01) for EAI treatments than TAI treatments: 60%, 55%, 54%, and 41%, for 2XPGF, SS, 7-11Synch, and PECP, respectively. MGA pretreatment and ECP after $PGF_{2\alpha}$ improved synchrony of estrus, but ECP reduced conception rates. Pregnancy rate after 3 d of AI in 7-11Synch heifers was similar to 5 d of AI in SS heifers.

Key Words: Ovulation synchronization, Progestin, Estrogen

M10 Synchronization protocol using CIDR/ECP/ PGF2α/GnRH increase conception in lactating dairy cows. J.L.M. Vasconcelos*, W. R. Garcia, R. M. Santos, T.G.R. Amaral, and V. C. Bolzani, *FMVZ - UNESP*.

The objective of this study was to evaluate the efficiency of synchronization protocols to improve pregnancy rate by improve in conception. Lactating Holstein cows (n=195), producing 30.4±1.3 kg milk/d with 90±23 DIM at the time of synchronized AI, were randomly assigned to one of 5 treatment groups: G1 (N=37), CIDR in (Eazi-Breed CIDR®) # 7d # CIDR out + PGF2α (Lutalyse®, 25mg, i.m.)# 24h - ECP (ECP®,1mg, i.m.) # 2.5d # CIDR in # 6d # CIDR out + PGF2α - 24h - ECP # 44h - AI ; G2 (N = 36), CIDR in # 7d # CIDR out + PGF2α # 24h - ECP # 2.5d # CIDR in # 6d # CIDR out + PGF2α - 48h - GnRH (Cystorelin®, 100mcg, i.m.) # 12h # AI; G3 (N = 37), CIDR in # 7 d # CIDR out + PGF2α # 48h - GnRH # 24h # CIDR in # 6d # CIDR out + PGF2α - 24h - ECP # 44h # AI; G4 (N = 35), CIDR in # 7 d # CIDR out + PGF2α # 48h - GnRH # 24h # CIDR in# 6d # CIDR out + PGF2α - 48h - GnRH # 12h # AI and G5 (N = 50), control, injection of PGF2α 14 days apart and AI after estrous detection. Data were analyzed by CATMOD procedure of SAS, and were included in the model effects of treatment, parity, ciclicity, milk production, DIM and interactions. No effects of treatment were detected on synchronization (81, 89, 89, vs. 94%) or pregnancy rates (35, 50, 32, vs. 40%) in the synchronized groups G1,G2, G3, and G4, respectively. When data of the cows effectively synchronized (CL regression and synchronized ovulation) were analyzed separately with data of G5, no differences in conception were detected between the control group (N=50; 32%) and the synchronized groups G1 (N = 30; 43%), G3 (N = 33; 36%) and G4 (N = 32; 44%), but G2 (N = 31; 58%) had higher (P =.053) conception than the control group. The conception on the second AI were not affected by treatments (P=.49), G1 (N=23; 26%); G2

(N=16; 25%); G3 (N=20; 30%); G4 (N=19; 5%); and G5 (N=25; 24%). This study suggests that the G2 protocol could improve the pregnancy rate due to increase in the conception.

Key Words: Synchronization, ECP, GnRH

M11 Concentration of estradiol-17β (E2) in milk of dairy cows; effect of injection of E2 cypionate. D. M. Henricks*, J. J. Owenby, and S. L. Gray, *Clemson University, Clemson, SC/USA*.

The objective was to measure concentration of E2 in milk samples (E2 conc; pg/2gm) taken at specified times from dairy cows treated (T) with ECP® Sterile Solution (ECP; 2mgE2 cypionate/mL) compared to E2 conc in samples taken contemporaneously from control(C) cows. Unless specified, four-quarter composite (am+pm) samples were taken from each cow on consecutive days. Cows were randomly selected/assigned to one of five groups(gp): (1) late lactation cows sampled for 5d (LL;n=15); (2) fresh cows C sampled for 7d (FC-C; 3-5d post partum[PP]; n=15); (3) fresh cows T with 2mL ECP i.m., sampled for 7d (FC-T; n=15); (4) breeding cows C (BC-C; 40-60d PP; n=16); and (5) breeding cows T with 0.5mL ECP i.m.(BC-T; n=17). To obtain BC for gp 4 and 5, cows were T with 5 mL Lutalyse® Sterile Solution, and then sampled for 4d (am and pm, not composited). Cows in estrus by the 8th milking were assigned randomly to the BC-C and BC-T gp, and sampled post-T for 3d (am and pm, not composited). A total of 75 LL, 240 FC and 506 BC samples were assayed for E2 conc using a validated RIA. Data were analyzed using ANOVA. For the LL gp, milk E2 conc (pg/2gm) varied between 27.7 and 35.4 for the 5d period. Mean E2 conc of the FC-C (8.7) and FC-T (19.5) were less (P<0.01) than E2 conc in the LL gp. Similarly, mean E2 conc of the BC-C (6.3) and BC-T (8.0) were less (P<0.01) than E2 conc in the LL gp. E2 conc was not different(P>0.01) between BC-C and BC-T. E2 conc in the FC-T gp was greater (P<0.01) than E2 conc in FC-C gp. E2 conc did not vary greatly by d of milking within the LL or BC gp. In the FC-C gp, E2 ranged from 4.8 to 16.0 and for the FC-T gp from 10.6 to 28.5 over the 8d period. In the BC gp, E2 conc was not different (P>0.05) pre- and post-ECP T. These findings indicate E2 conc in FC controls were 25% of E2 conc during LL. By 1-2 mo into lactation, E2 conc had decreased to 15-20% of E2 conc in LL. A 2 mL, but not a 0.5 mL injection of ECP gave a transient increase in E2 conc. The E2 conc in milk following ECP injection was lower than E2 conc observed in LL cows.

Key Words: Estradiol, Milk, Comparisons

M12 Timed AI (TAI) with estradiol cypionate (ECP) or insemination at detected estrus in lactating dairy cows. R.L.A. Cerri*, K. N. Galvao, S. O. Juchem, R. C. Chebel, and J.E.P. Santos, [1] *University of California Davis*.

Holstein cows, 799, from 3 dairies were blocked according to parity, BCS, and milk yield and randomly assigned to one of two treatments consisting of either TAI (Heatsynch) or insemination at estrus detection (ED). Cows received two injections of PGF2a (Lutalyse, Pharmacia Animal Health) at 37+/-3 and 51 DIM. At 65 DIM, cows received an injection of GnRH (Cystorelin, Merial Ltda), followed 7 d later by PGF2a. Cows in the ED group were inseminated after observed in estrus during the 7 d after the last PGF2a. Cows in the Heatsynch received an injection of 1 mg of ECP (Pharmacia Animal Health) 24 h after the last PGF2a and were inseminated if observed in estrus in the first 24 h or TAI 48 h after ECP. Pregnancy was diagnosed by ultrasound at 30 d after AI and reconfirmed 14 and 28 d later. Progesterone in plasma was measured at the second PGF2a, GnRH, third PGF2a, and at 48 h after the third PGF2a injections. Lactation performance was followed for the first 165 DIM. Continuous and binomial data were analyzed using the MIXED and the LOGISTIC procedures of SAS (2001), respectively. Milk yield during the first 4 months after treatment (41.5 kg/d) was similar for Heatsynch and ED (P=0.64), but cows in the Heatsynch had lower production in the month of ECP treatment (43.1 vs 44.8 kg/d; P<0.01). Conception rate was higher for cows in the Heatsynch than ED on d 30 (43.0 vs 35.6%; P=0.03) and 58 (37.5 vs 31.0; P=0.03) after AI. Heatsynch cows displaying estrus 24 and 48 h after ECP treatment had higher conception at d 30 after AI than those not displaying estrus at the moment of TAI (48.5 vs 23.6% P<0.01). Pregnancy rates were higher for cows in the Heatsynch than ED on d 30 (43.0 vs 22.6%; P<0.01) and 58 (37.5 vs 19.6%; P<0.01) after AI. Pregnancy loss between 30 and 58 d after AI was similar for Heatsynch and ED (11.0 and 12.4%; P=0.88). Conception rate in the second AI was not affected by treatment (P=0.14) and it averaged 26.7%. Timed AI with the Heatsynch protocol compared to AI following ED improved conception and pregnancy rates at first AI, and had no effect on pregnancy loss in lactating dairy cows.

Key Words: Timed AI, ECP, Dairy cows

M13 Use of CIDR devices in a synchronization of ovulation protocol using GnRH and $PGF_{2\alpha}$ for first AI service and for resynchronizing return to estrus for second AI service in Holstein dairy heifers. H. Rivera*, H. Lopez, and P.M. Fricke, *University of Wisconsin - Madison*.

Holstein dairy heifers (n=190) 13 to 14 mo of age were subjected to a 42 d AI breeding period in which heifers received AI after once daily evaluation of removed tail chalk. At AI breeding period onset (d 0), heifers were randomly assigned to receive synchronization of ovulation (100 μg GnRH, d 0; 25 mg $PGF_{2\alpha}$, d 6; 100 μg GnRH+TAI, d 8; GPG; n=96), or synchronization of ovulation as per GPG heifers but with a CIDR device inserted from d 0 to 6 (CIDR; n=94). The proportion of heifers receiving AI before d 8 was greater (p<0.01) for GPG (23.9%, 23/96) than for CIDR (0.0%, 0/94) heifers, and conception rate at 30 d post-AI did not differ between GPG (29.1%, 28/96) and CIDR (31.9%, 30/94) treatments. No treatment x AI technician interaction was detected (p=0.68); however, AI technician affected (p<0.01) conception rate (Tech 1=10.6%, 5/47; Tech 2=4.2%, 2/48; Tech 3=53.7%, 51/95). Overall pregnancy loss from 30 to 75 d post-TAI was 6.9%, (4/58) and did not differ between treatments. To synchronize second AI service, heifers (n=167) receiving TAI to first service were randomly assigned to receive either no further treatment (Control; n=85) or CIDR device insertion from d 14 to 20 after TAI (Resynch; n=82). All heifers received second AI service after removed tail chalk. Conception rate at d 42 post-AI was greater (p<0.05) for Resynch (46.9%, 23/49) than for Control (26.0%, 13/50) heifers. Proportion of heifers receiving AI from d 14 to 20 was 0.0% (0/43) for Resynch vs. 32.7% (17/52) for Control, whereas proportion of heifers receiving AI within 72h after CIDR removal was 90.7% (39/43) for Resynch vs 58.49% (31/52) for Control heifers. Inclusion of a CIDR device prevented heifers from receiving AI during the TAI protocol with no detrimental effect on conception rate, and resynchronization of estrus using a CIDR device resulted in tighter synchrony of return to estrus for second AI service. *Supported by Hatch project WIS04431 to PMF*

Key Words: Dairy heifers, Synchronization of ovulation, Timed artificial insemination

M14 Administration of estradiol cypionate (ECP) or GnRH after the end of a CIDR-based fixed-time AI program in dairy heifers. A. Garcia*, I. D. Peeler, O. A. Peralta, and R. L. Nebel, *Virginia Polytechnic Institute and State University, Blacksburg*.

An experiment was conducted to investigate the effects of estradiol cypionate (ECP) administered at the time of a CIDR device insertion on synchronization of follicular wave emergence and to compare the effects of ECP or GnRH administered 24 or 48 h after CIDR removal respectively on ovulation rate, time of ovulation, diameter of the ovulatory follicle and pregnancy rate after fixed-time AI in dairy heifers. Holstein and Jersey heifers (n = 30) 14 to 16 mo of age received a CIDR intravaginal insert (Eazi-Breed; Pharmacia Upjohn Animal Health) and 1 mg ECP (Pharmacia Upjohn Animal Health) i.m. on d 0. On d 7, CIDR devices were removed and 25 mg dinoprost (Lutalyse; Pharmacia Upjohn Animal Health) i.m. was administered concurrently. After CIDR removal, heifers were randomly allocated to receive either a 0.5 mg ECP i.m. (ECP group; n = 15) 24 h later or 100 μg GnRH (Cystorelin, Merial Limited) i.m. (GnRH group; n = 15) 48 h later. Timed AI was performed 48 to 72 h after CIDR removal using frozen/thawed semen from sires of proven fertility. Ovarian ultrasonographic examinations were performed once a day from d 0 to 7 and twice daily from d 8 to ovulation. Categorical data was compared using chi-square analysis, and quantitative data by ANOVA. A new wave of follicular development was detected on average 3.7±0.9 d after CIDR insertion. Although heifers receiving ECP had a shorter (P=0.02) interval from CIDR removal to ovulation than GnRH heifers (63.8±12.4 and 71.6±10.1 in ECP and GnRH groups, respectively), the pregnancy rate was not different (P=1.0) among groups. A pregnancy rate of 73.3% was obtained after the first synchronization

cycle for ECP, and GnRH treated heifers. An overall pregnancy rate of 93.3% was obtained after two or three synchronization cycles for ECP or GnRH groups, respectively. Ovulation rate (100%) and diameter of ovulatory follicle (13.0±1.8 and 14.0±1.9 mm) did not differ (P>0.05) between ECP, and GnRH groups, respectively. In conclusion, the results from the present experiment demonstrated that ECP administration 24 h after the end of a CIDR treatment resulted in pregnancy rates comparable to the ones obtained after administration of GnRH 48 h after CIDR removal.

Key Words: Estrus synchronization, Dairy heifers, Estradiol cypionate

M15 Effect of estradiol cypionate (ECP) and estradiol benzoate (EB) on synchronization of follicle wave and luteal function in dairy heifers.

K. N. *, R. C. Chebel, A. C. Coscioni, J.E.P. Santos, R.L.A. Cerri, and S. O. Juchem, *University of California - Davis*.

Thirty post-pubertal Holstein heifers (13mo) were randomly assigned to one of four treatments: 1) Control (n=4); 2) 2.0mg of EB (N=6); 3) 1.0 mg of ECP (ECP1; N=10); and 4) 1.5mg of ECP (ECP1.5; N=10). Treatments were given by i.m. injections at 72 h after ovulation. Ovaries were scanned every 12h, and follicles ≥ 4.0mm and CL were tracked from the day before ovulation through the end of the estrous cycle. Blood was collected every 12h from the day of ovulation to 7 d after the treatments for measurements of plasma progesterone and estradiol. Prostaglandin F2a was given on d 17 after ovulation. Continuous data and repeated measurements were analyzed by the GLM and MIXED procedures of SAS (2001), respectively. Treatments were given at similar time after deviation of the dominant follicle (DF) of the first wave (FW1), and averaged 15.7h (P=0.83). Growth rate of the DF of the FW1 was retarded by all estradiol treatments (P<0.001), but EB was more effective than ECP (P<0.001). Hours from ovulation to emergence of FW2 were reduced by EB (178.0 h; P=0.03), but not by ECP1 (212.4 h) or ECP1.5 (218.4 h) compared to controls (234.0 h). Emergence of FW2 after treatment was earlier for EB compared to ECP1 and ECP1.5 (104 vs 140.4 vs 145.2h; P=0.04), and compared to control (162h; P=0.02). Deviation of the DF of the FW2 tended to be earlier for EB compared to control (250 vs 297h; P=0.08), but DF of the FW2 deviated at similar diameter in all four treatments (8.65mm; P=0.68). Relative to emergence of FW2, deviation occurred 67.7h later. Compared to control (17.2mm), both ECP (ECP1=14.9 mm; ECP1.5= 14.1 mm) and EB (11.6mm) reduced the maximum diameter of the DF of the FW1 (P<0.01), but EB was more effective than ECP (P<0.01). Treatment had no effect on the largest diameter of the DF of FW2 and on the diameter of the ovulatory follicle prior to ovulation (P>0.15). Corpus luteum growth after treatment was not altered by estradiol esters (P=0.62). Treatment with EB was more effective than ECP to cause DF turnover and synchronize emergence of a new follicular wave.

Key Words: Estradiol cypionate, Estradiol benzoate, Follicle development

M16 Reproductive management of dairy heifers using synchronization of ovulation and fixed-time artificial insemination (TAI) or artificial insemination after removed tail chalk.

H. Rivera*, H. Lopez, and P.M. Fricke, *University of Wisconsin - Madison*.

Holstein dairy heifers (n=352) between 13 and 14 mo of age were subjected to a 42 d AI breeding period in which heifers received AI after once daily evaluation of removed tail chalk. At AI breeding period onset (Day 0), heifers were randomly assigned to receive synchronization of ovulation and TAI (100 μg GnRH, Day 0; 25 mg $PGF_{2\alpha}$, Day 6; 100 μg GnRH+TAI, Day 8) followed by AI after removed tail chalk for the remainder of the AI breeding period (GPG; n=175), or AI after removed tail chalk for the duration of the AI breeding period (TC; n=177). Interval from AI breeding period onset to first AI service was greater (p<0.01) for TC than for GPG heifers (9.9 ± 0.6 vs. 7.5 ± 0.1 d), whereas conception rate at 30 d post AI was similar between treatments (46.5%, 80/172 vs. 38.3%, 67/175 for TC vs. GPG heifers, respectively). No treatment x AI technician interaction was detected (p=0.70); however, AI technician affected (p<0.01) conception rate (Tech 1=24.8%, 28/113; Tech 2=30.0%, 18/60; Tech 3=58.0%, 101/174). Pregnancy loss from 30 to 75 d post AI was 10.2% (15/147) and was similar between treatments. For GPG heifers, 17.7% (31/175) received AI before day 8 (Day 5.2 ± 0.2) and did not receive TAI. For GPG heifers receiving TAI, 90.9% (131/144) ovulated within 48 h after the second GnRH injection (double ovulation rate=4.9%, 7/144). Blood samples collected from GPG heifers at each injection were classified based on serum progesterone (P) concentrations as High (≥1.0 ng/ml) or Low (<1.0 ng/ml). The proportion of GPG heifers with a functional CL (High P) at $PGF_{2\alpha}$ was 91.6% (132/144), and 96.2% (127/132) of functional CL had regressed (Low P) by 48 h after $PGF_{2\alpha}$. We conclude that this protocol for fixed-time AI of dairy heifers can yield acceptable conception rates if estrus detection and AI is conducted between the first GnRH and $PGF_{2\alpha}$ injections and the effect of AI technician is optimized. *Supported by Hatch project WIS04431 to PMF*

Key Words: Dairy heifers, Synchronization of ovulation, Timed artificial insemination

M17 Effect of a rapid resynchronization of nonpregnant cows with estradiol cypionate (ECP) and PGF2a on pregnancy rates (PR) and pregnancy loss (PL) in lactating dairy cows.

R. C. Chebel*, R.L.A. Cerri, K. N. Galvao, S. O. Juchem, and J.E.P. Santos, *University of California - Davis*.

Nonpregnant Holstein cows inseminated 2 or more times between 28 and 34 d after the pre-enrolment AI were assigned to a rapid resynchronization (Quicksynch; N=159) or to the Heatsynch (N=183) protocol. Cows between 28 and 30 d after AI with a follicle larger than 10mm were assumed to be in first follicular wave of a new estrous cycle and assigned to the Quicksynch protocol, which consisted of injections of 25mg of PGF2a (Pharmacia Animal Health) followed 24h later by 1mg of ECP (Pharmacia Animal Health). Cows were inseminated if observed in estrus or at fixed time 48h after ECP. Cows between 28 to 30 after AI with follicles less than 10mm and cows between 31 and 34 d after AI were enrolled in Heatsynch group and received 100g of GnRH (Merial Ltda), followed 7 d by PGF2a, and ECP 24 h after the PGF2a. Insemination was performed as indicated for the Quicksynch group. Continuous and binomial data were analyzed using the GLM and the LOGISTIC procedures of SAS (2001), respectively. Lactation number, BCS, DIM and milk yield were similar for Quicksynch and Heatsynch cows (P>0.15). The proportion of cows inseminated at fixed time was similar for both protocols (85.0%). Cows in Quicksynch and Heatsynch had similar PR on day 28 (18.9 vs 24.0%; P=0.54) and 42 (17.6 vs 20.8%; P=0.77) after the resynchronized AI. Pregnancy loss between 28 and 42 d after AI was unaffected by treatment (Quicksynch=6.7 vs Heatsynch=14.0%; P=0.41). Cows inseminated during heat stress had lower PR (23.3 vs 11.8%; P=0.03) and higher PL (30.8 vs 6.7%; P=0.02) than those inseminated during the cool season. More Heatsynch than Quicksynch cows had a CL on the day of PGF2a (77.1 vs 62.3%; P<0.001), and presence of a CL increased PR (P<0.001) for both Heatsynch (27.7 vs 11.9%) and Quicksynch (25.3 vs 8.3%). Rapid resynchronization of nonpregnant cows with PGF2a and ECP between 28 and 30 d after the pre-enrollment AI resulted in similar PR and PL compared to the Heatsynch protocol, but PR was improved when a CL was present at the PGF2a injection.

Key Words: Resynchronization, ECP, Dairy cows

M18 Use of intravaginal progesterone-releasing devices (CIDR) to resynchronize postpartum dairy cows previously synchronized for anestrus.

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Introduction: In New Zealand, a fixed breeding season begins about 3 months after calving has begun. At this time, any cow that is greater than 21 days in milk and has not shown a heat is considered to be anestrous **(A)**. These cows may represent up to 20 percent or more of the breeding herd. A animals may be treated with an intravaginal progesterone-releasing device **(CIDR)** to induce cyclicity. Although about 85% of these animals will show estrus and be bred after CIDR removal, only about 40% of these cows will conceive to first AI. Of the remaining cows, almost half (43 percent) will not show estrus 14 to 28 d after first AI. To reduce the problem of these "phantom pregnant" cows, a resynchrony protocol was developed.
Objective: To determine the difference in pregnancy rates **(PR)** at 28 and 56 d post insemination(following an initial CIDR treatment)and the final PR of previously A cows at the end of the breeding period between a no resynchrony group, a resynchrony protocol using a low dose

(0.5mg)of estradiol benzoate **(EB)** only , and a resynchrony group using GnRH and low-dose of EB.

Material and Methods: A cows (n = 971 in 8 herds) were initially treated (7 d prior to the start of the breeding season)with a CIDR for 6 d with injection of 1 mg of EB one day after device removal (day of EB injection = Day 0). Cows detected in estrus between D 0 and 3 were randomly assigned to be treated with a) reinsertion of a used P-releasing device for a period of 8 days on D 15 with 0.5 mg of EB at time of reinsertion and again one day after removal *(EB-low)*, b) as for a) except that 250 mg of GnRH was substituted for EB at CIDR reinsertion *(GnRH-EB-low)* or c) left as untreated controls *(control)*. Cows detected in estrus within 6 wks of commencement of the breeding program were submitted for AI. Bulls were then introduced to the herds for a further 13.5 weeks (stdev = 1.7, range = 11.3-16.9 weeks). Enrolled cows were pregnancy tested twice (with a 6 wk interval) and the conception date estimated.

Results and Conclusions: Fewer cows were pregnant by D 28 and 56 of the breeding program following *GnRH-EB-low* than *EB-low* and *control*, but the final pregnancy rate was higher following *EB-low* than *control* or *GnRH-EB-low* (95.0%, 88.3%, 88.6%, respectively; $p<0.05$). It is concluded that *EB-low* resynchrony enhances reproductive performance of anestrous cows compared to *GnRH-EB-low* resynchrony or no resynchrony under New Zealand conditions.

Key Words: Resynchrony, Intravaginal progesterone releasing device, Cattle

M19 Selective re-synchronization of estrus and timed insemination in lactating dairy cows. J. A. Bartolome*[1], A. Sozzi[1], J. McHale[2], A. Arteche[1], F. Silvestre[1], P. Melendez[1], K. Swift[2], D. Kelbert[2], L. F. Archbald[1], and W. W. Thatcher[1], [1]*University of Florida, Gainesville, Florida, USA,* [2]*NFH Inc., Bell, Florida, USA.*

Objective was to compare pregnancy rate (PR) to re-synchronizations based on uterine and ovarian status. Holstein non-pregnant cows (n=877), were classified at ultrasound on d0 (30d afterAI) as: diestrus (CL, follicle≥12 mm), metestrus (edema, CH, foll.<12 mm), proestrus (tone, foll.≥12 mm), cystic (foll.≥15 mm, no CL, no tone), or anestrus (foll.<12 mm, no tone). Cows in diestrus were assigned to Ovsynch (n=216), Quicksynch ($PGF_{2\alpha}$ [PG] d0, 1 mg ECP d1, and TAI d3; Jan.-May; n=92), or Modified Quicksynch (PG d0, ECP d1, AI at pedometer d2-3, and cows with no activity begin Ovsynch on d4; Jun.-Dec; n=110). Cows in metestrus were assigned to Ovsynch (n=54), Heatsynch (n=50) or GnRH+Ovsynch (GnRH on d0, GnRH d8, PG d15, GnRH d17, and TAI at 16h; n=44). Cows in proestrus assigned to Ovsynch (n=71) or GnRH+Ovsynch (n=73). Cows with ovarian cyst assigned to Ovsynch (n=75) or GnRH+Ovsynch (n=78). Diagnosis (US) for pregnancy was at 30d after TAI. PR was evaluated using multiple logistic regression adjusting for season, parity, number services and inseminator. Cows were classified as: diestrus 47.7% (418/877), metestrus 16.9% (148/877), proestrus 16.4% (144/877), cystic 17.4% (153/877) and anestrus 1.6% (14/877). PRs for diestrus were: Quicksynch 21.7%, Modified Quicksynch 28.2% (32.9% [26/79] at pedometer, 16.0% [5/31] TAI), Ovsynch 34.7%; metestrus: Ovsynch 24.1%, Heatsynch 18%, GnRH+Ovsynch 31.8%; proestrus: Ovsynch 31.0%, GnRH+Ovsynch 27.4%; cystic: Ovsynch 20.0%, GnRH+Ovsynch 30.8%. Ovsynch for cows in diestrus was used as the referent. There were decreases in PR for: Quicksynch cows in diestrus ($P<0.02$); Heatsynch ($P<0.02$) and Ovsynch ($P<0.13$) cows in metestrus; Ovsynch cows with ovarian cysts ($P<0.01$). PR to re-synchronization can be improved by assigning TAI protocols according to uterine and ovarian status. Strategies to increase the number of cows in diestrus at US, reduce treatment time and costs are underway.

Key Words: Re-synchronization, Time insemination, Cattle

M20 Enhancing the efficiency of AI in dairy cattle through modified systematic breeding protocols utilizing heat detection and timed AI. J. C. Dalton[1], R. Manzo*[2], and A. Ahmadzadeh[2], [1]*Caldwell Research and Extension Center, Caldwell, ID,* [2]*University of Idaho, Moscow, ID.*

The objective of this study was to compare the conception rates of lactating dairy cattle subjected to four different artificial insemination (AI) protocols. Two commercial dairies utilizing daily lock up, tail chalk, and once daily AI participated in the study. Cows (N = 432) were administered GnRH (100 ug) on d -7 and received tail chalk daily. Cows detected in estrus according to chalk removal (roughened tailhead hair) prior to d 0 received AI immediately. Cows not detected in estrus by d 0 were administered prostaglandin (PGF; 25 mg) and continued to receive tail chalk daily until d +2. All cows detected in estrus prior to and including d +2 received AI immediately and were considered treatment 1 (T1; n = 46). Cows that were not detected in estrus and not inseminated by d +2 were assigned randomly to one of three treatment groups: GnRH on d +2 and timed AI 16 h later (T2; n = 132), GnRH and timed AI 64 h after PGF (T3; n = 127), or timed AI 64 h after PGF (no GnRH) (T4; n = 127). Pregnancy was diagnosed 38-45 d after AI by rectal palpation. Median days in milk were 112, 120, 128, and 119 for T1, T2, T3, and T4, respectively. Mean milk yield was 39.2, 39.5, 39.0, and 38.2 kg/d for T1, T2, T3, and T4, respectively. Conception rates (adjusted proportion pregnant) were 25.4%, 29.8%, 21.2%, and 16.5% for T1, T2, T3, and T4, respectively. The conception rate (adjusted proportion pregnant) was higher for T1 and T2 compared to T4 ($P = .06$). The conception rate (adjusted proportion pregnant) was not different between T3 and T4. Nearly 11% of all cattle enrolled exhibited spontaneous estrus, received immediate AI (T1), and achieved an acceptable conception rate. Consequently, dairy producers should consider including heat detection in all systematic breeding programs. Timed AI (without GnRH) 64 h after PGF administration (T4) is not recommended as this treatment resulted in an unacceptably low conception rate (adjusted proportion pregnant).

Key Words: Artificial insemination, Estrus, Conception rate

M21 Reproductive efficiency in cattle selected for ovulation and twinning rate. S. E. Echternkamp* and K. E. Gregory, *USDA, ARS, RLH US Meat Animal Research Center.*

Effect of ovulation rate on cow productivity was evaluated in the MARC Twinner herd by comparing ovulation rate (i.e., CL) at pregnancy diagnosis to calving results and progeny performance. Numbers of fetuses and CL were determined by scanning the uterus and ovaries transrectally with a 3.5 MHz, convex-array, real-time, ultrasound probe at 75 d after first d of the 1995 to 2002 spring and fall breeding seasons; females < 35 d of gestation were re-examined 35 d later. Progeny BW was measured at birth and 200 d of age. Effects of type birth on progeny BW and survival were analyzed by GLM ANOVA with age of dam, sex of calf, dystocia, year, season, and uterine location in the model and on calf survival by Chi-square analysis. Incidence of fetal mortality (abortions) from ultrasound to calving was 6.0% for single, 12.2% for twin, and 50.0% for triplet pregnancies ($P < 0.01$; n = 890, 583, and 28 cows, respectively). Percentage of females calving did not differ ($P > 0.1$) between single ovulations occurring on the left vs right ovary (84.9 vs 82.8%), but twinning rate was greater ($P < 0.01$) for bilateral twin ovulations (61.3% twins and 20.9% singles) compared with unilateral twin ovulations on left (55.4% twins and 27.9% singles) or right (53.6% twins and 27.0% singles) ovary. Calf birth weight and survival were also greater ($P < 0.01$) for bilateral vs unilateral twins (38.5 ± 0.3 kg and 91.8 ± 1.1% vs 36.8 ± 0.3 kg and 82.3 ± 1.1%, respectively). Single-born calves were heavier ($P < 0.01$) than twin or triplet calves at birth (48.7 ± 0.1 vs 37.6 ± 0.1 or 30.5 ± 0.6 kg) and at 200 d of age (256.9 ± 1.4 vs 222.4 ± 1.4 or 210.6 ± 7.0 kg); whereas, number weaned and total 200-d BW per cow calving increased ($P < 0.01$) from single (0.89 ± 0.01 calf and 220.8 ± 2.5 kg) to twin (1.54 ± 0.01 calves and 343.6 ± 3.4 kg) to triplet (1.80 ± 0.08 calves and 378.3 ± 17.8 kg) birth. Bilateral twin ovulations produced the greatest increase in reproductive efficiency in cattle; whereas, increased pre- and postnatal mortality for triplet ovulations and births compromise such gains.

Key Words: Twins, Survival, Cow productivity

M22 CIDR-based protocols for synchronizing bovine embryo transfer recipients without estrus detection. M. G. Colazo[1], J. P. Kastelic*[2], P. R. Whittaker[1], and R. J. Mapletoft[1], [1]*WCVM, University of Saskatchewan,* [2]*Agriculture and Agri-Food Canada, Lethbridge, AB.*

The objective was to compare two protocols to synchronize embryo transfer recipients without detecting estrus. On Day 0 (start of experiment), lactating beef cows (n = 70) were given a CIDR device (Bioniche Animal Health); 36 cows (ECP group) were concurrently given im injections of 1 mg estradiol cypionate (ECP; Pharmacia Animal Health) and 50 mg progesterone (Progesterone 5%; Vtoquinol). On Day 1, the other

34 (GnRH group) were injected im with 100 ug of GnRH (Cystorelin; Merial). On Day 8, CIDR devices were removed, an ultrasonographic examination was done, and cows were given im 500 mg of cloprostenol (Estrumate, Schering Plough). Cows in the ECP or GnRH groups were subsequently administered im 0.5 mg ECP or 100 mg GnRH on Days 9 and 10, respectively. On Day 17, cows with a corpus luteum (CL) > 10 mm in diameter (determined ultrasonically) received a frozen-thawed embryo by nonsurgical, Direct Transfer (utilization rates of 91.6 and 94.1% for cows in the ECP and GnRH groups, respectively). In these two groups, the proportions of cows with two CL were 1/33 and 15/32 (P<0.001) on Day 8 and 6/33 and 3/32 (P<0.3) on Day 17. There was no difference (P<0.5) between the ECP and GnRH groups for CL diameter (22.7 ± 6.3 and 21.7 ± 5.3 mm) or luteal area (302 ± 98 and 296 ± 98 mm2) on Day 17, or for pregnancy rate 68 d after transfer (42.4 and 40.6%). Although cows with two CL on Day 17 had a greater luteal area than those with only one CL (437 ± 70 vs 276 ± 82 mm2, P<0.0001), pregnancy rates were not affected (5/9, 55.5% vs 22/56, 39.2%; P<0.35). However, pregnancy rate was affected by CL diameter (≤ 18 mm, 3/17, 17.6% vs > 18 mm, 24/48, 50.0%; P<0.02) and by the presence of a central luteal cavity on Day 17 (21/43, 48.8% vs 6/22, 27.2%, for cows with and without a cavity; P<0.05). Both treatment protocols resulted in acceptable rates of recipient utilization and pregnancy, but CL diameter and the presence of a central luteal cavity at transfer significantly affected pregnancy rate.

Key Words: Estrus synchronization, Embryo transfer, CL diameter

M23 Effect of a single treatment with estradiol cypionate (ECP) on dominant follicle (DF) and superovulatory response in dairy heifers.

R. C. Chebel*, A. C. Coscioni, K. N. Galvao, R. L. A. Cerri, S. O. Juchem, and J. E. P. Santos, *Veterinary Medicine Teaching and Research Center, University of California - Davis*.

Effect of a single treatment with estradiol cypionate (ECP) on dominant follicle (DF) and superovulatory response in dairy heifers Thirty-one postpubertal Holstein heifers (13mo) were randomly assigned to one of three treatments: Control (N=10); 1 mg of ECP i.m. on d 3 after ovulation (ECP; N=11); and DF aspiration (ADF; N=10) on d 5 after ovulation (ovulation: study d 0). Superovulatory treatment with FSH (400 mg) started on study d 6, concomitant with insertion of a CIDR. During the 6th and 7th FSH treatment, PGF2a was given and the CIDR removed after the last FSH. An injection of GnRH was given 24 h after CIDR removal and heifers were inseminated twice, 12 h apart, with the first insemination at 12 h after GnRH injection. Heifers were flushed on d 7 after the first AI and structures evaluated. Ultrasonographic examination of the ovaries was performed from study d 0 to 6, and blood samples were collected twice daily from study d 2 to 6 for measurements of progesterone and estradiol. Continuous and count data were analyzed by the GLM and GENMOD procedures of SAS (2001), respectively, and heifer was the experimental unit for analyses. Number of CL on d 7 after AI was higher for ADF than ECP and Control (9.8 vs 5.9 vs 4.3; P<0.01). Number of structures collected was higher for ADF than ECP and Control (8.7 vs 4.7 vs 3.6; P<0.01), but ADF also resulted in higher number of degenerated embryos than ECP and Control (3.1 vs 1.1 vs 1.4; P<0.01). Control heifers had more unfertilized oocytes than ECP (1.5 vs 0.5; P<0.04). Number of grades 1 and 2 embryos was higher for ADF and ECP than control (3.7 vs 2.7 vs 0.6; P<0.01). Percentage of total structures collected as grades 1 and 2 embryos tended to be higher for ECP than control (64.8 vs 30.0%: P=0.10), but it did not differ from ADF (40.7%). Within ECP heifers, those with growth rate of the DF after ECP injection less than 0.9mm/d had higher number of structures collected (7.0 vs 2.0; P<0.01) and more embryos grades 1 and 2 (3.8 vs 1.4; P<0.02) than heifers with DF growing more than 1 mm/d. Treatment with ECP 3 d prior to initiation of superovulation improved number of transferable embryos collected and response was higher when the DF regressed.

Key Words: Estradiol cypionate, Superovulation, Embryo quality

M24 Small follicle numbers in a selected population of Holstein cows: Association with superovulation response.

S. B. Sherwood, R. W. Silcox*, S. Mertens, D. L. Eggett, and J. E. Knowles, *Brigham Young University, Provo, UT*.

The relationship between numbers of small antral follicles and superovulation response in a select population of Holstein cows was examined in this study. Eight daughters of a cow (Integren Secret Sonata-ET) which has consistently responded to superovulation by producing large numbers of embryos (576 total embryos/ova and 400 transferable embryos in 27 collections) and four non-related herd mates were studied. Ovaries of all Sonata daughters in a single herd (n= 32) were observed twice (15 day interval) using ultrasonography to obtain an estimate of the number of small follicles (3-5mm) present. Sonata daughters with greater than 25 3 small follicles/observation were assigned to a high group (n = 4). Sonata daughters that had fewer small follicles (11 2) as compared to the number of small follicles (15 7) present on all of her daughters were assigned to a low group (n = 4). Non-related herd mates (n=4) that were of similar age, stage of lactation, and milk production were assigned as controls. In experiment 1, ovaries of all cows in each group were observed using ultrasonography every twenty-four hours through two consecutive follicular waves. The number of small follicles/day (18 0.4, 13 0.4, and 11 0.4; high, low, and control groups, respectively) differed between the groups (P < 0.0001). In experiment 2, all cows were superovulated three times to obtain a mean superovulation response. Five days following marker heat detection, all follicles >4 mm were ablated. Follicle stimulating hormone (Folltropin) was administered every twelve hours in decreasing doses over four days, beginning 24 hours after follicle ablation. Ova/embryos were collected nonsurgically, seven days after insemination. The number of corpora lutea at embryo recovery (12.3 1.8, 10.6 1.9, 7.4 2.1; high, low, control, respectively), total ova/embryos (7.5 1.7, 9.3 1.8, 3.6 2.0; high, low, control, respectively), transferable embryos (4.6 1.4, 7.5 1.4, 3.1 1.6; high, low, control, respectively), and degenerate embryos (3.0 1.1, 2.3 1.1, 0.6 1.2; high low, control, respectively) recovered did not differ between groups (P>0.05). The number of small antral follicles present on the ovaries of selected sub-populations of Holstein cows was positively associated with the superovulation response.

Key Words: Cattle, Follicle, Superovulation

M25 Adrenal production of cortisol and progesterone in lactating dairy cows with ovarian follicular cysts.

T. B. Hatler*[1], A. S. McGinnis, and W. J. Silvia, *University of Kentucky, Lexington, Kentucky*.

The adrenal gland may play a causative role in the formation of ovarian follicular cysts in cattle. Two experiments were conducted to determine if adrenal secretion of steroids differed between cows that formed follicular cysts versus normal cycling cows. In experiment 1, lactating Jersey and Holstein cows were diagnosed as having ovarian follicular cysts (follicle diameter ≥ 20 mm) via palpation of ovaries per rectum. Ovaries were examined by transrectal ultrasonography three times weekly to detect ovulations (OV; n=8) and/or new cyst formations (NCF; n=9). Venous blood samples were collected daily to quantify circulating concentrations of cortisol (CORT). The average CORT concentration (μg/dl) across the 10 day period prior to OV was not different from the concentration prior to NCF. In experiment 2, secretion of CORT and progesterone (P4) was examined in cows with ovarian follicular cysts (OFC;n=4) and control cows (CONTROL; n=4) in the follicular phase of the estrous cycle. An adrenocorticotropin hormone (ACTH) challenge (Cortrosyn, 0.06 mg, i.v.) was administered to cows with OFCs. CONTROL cows were treated with prostaglandin $F_{2\alpha}$ (Lutalyse, 25 mg, i.m.) twice, 12 hours apart to induce luteolysis and the onset of the follicular phase. For CONTROL cows, the ACTH challenge was administered 36 hours after the first injection of prostaglandin $F_{2\alpha}$. Jugular venous blood samples were collect at -60, -30, 0, +10, +20, +30, +60, +90, +120, +180, +240, +300 and +360 minutes relative to ACTH administration. A rapid increase in both CORT and P4 was observed immediately following administration of ACTH in each treatment group (OFC and CONTROL). Peak concentrations of both steroids were achieved 30 minutes post ACTH administration. Mean concentrations of CORT and P4 did not differ between treatment groups (OFC vs. CONTROL) with respect to response and/or area under the curve. In summary, no differences in adrenal function were detected between normal cycling cows and cows with ovarian follicular cysts.

Key Words: Progesterone, Cortisol, Ovarian follicular cyst

M26 Effects of immunization of gilts against 17α-hydroxyprogesterone on follicular size distributions and follicular steroid synthesis. N. Post*[1], D. Kreider[1], K. Cole[1], M. Nihsen[1], and C. Maxwell, [1]*University of Arkansas.*

The objective of this experiment was to evaluate the effects of immunization of gilts against 17α-hydroxyprogesterone on follicular size distributions and follicular steroid synthesis. Thirty-six crossbred gilts at 147 d of age were immunized against adjuvant (Control, n = 18) or 17α-hydroxyprogesterone (17OHP, n = 18). Gilts were given an initial 0.6 ml injection divided between two subcutaneous sites at the base of each ear, followed four weeks later by a single booster injection. Estrus was checked twice daily with a boar. At 16 to 17 d following first estrus gilts were sacrificed, tracts were recovered and uterine weight, uterine length, number of corpora lutea, and number of small (0-3 mm), medium (4-6 mm), and large (> 7 mm) follicles was determined. Serum binding of 17α-hydroxyprogesterone in 17OHP was greater than (P < 0.01) Control and increased with time (P < 0.01). Age at puberty was not affected by treatment (P = 0.28) and averaged 187.1 ± 0.4 and 183.9 ± 1.7 d for Control and 17OHP, respectively. Serum progesterone during the first 17 d of the estrous cycle was higher for 17OHP than Control (P = 0.09). Serum estradiol-17β was not affected by treatment (P = 0.84). Serum progesterone (P < 0.01) and estradiol-17β (P < 0.01) were affected by time. Uterine weight was increased (P = 0.12) in 17OHP vs. Control, while mean uterine length was numerically greater (P = 0.18) in 17OHP vs. Control (716.8 ± 47.8 vs. 625.3 ± 30.1 g and 214.8 ± 10.7 vs. 211.1 ± 11.2 cm., respectively). Ovulation rate at first estrus was higher in 17OHP than Control (15.8 ± 0.6 vs. 13.4 ± 0.4). Follicular fluid estradiol-17β did not differ between treatments (P > 0.62) for any follicular size class; however, testosterone was higher (P = 0.16) in medium follicles of 17OHP than Controls (133.1 ± 22.5 vs. 94.5 ± 13.6 ng/ml, respectively). These data suggest that immunization against 17OHP altered follicular growth and steroid synthesis.

Key Words: Gilts, Ovulation rate, Steroids

M27 A direct injection of vascular endothelial growth factor (VEGF) gene to the ovary promotes follicular development in miniature gilts. T. Shimizu, H. Sasada, and E. Sato*, *Tohoku University, Sendai, Japan.*

Ovarian follicular angiogenesis initiates early during follicular development and continues throughout follicular growth. In general, vascular endothelial growth factor (VEGF) is thought to be a central factor for regulation of thecal angiogenesis during follicular development. We investigated whether follicular development was promoted by inducing extraproduction of VEGF with direct ovarian injection of its gene in miniature gilts. Using a TAP Express KitTM, porcine VEGF gene was transformed into a transcriptionally active PCR fragment that is used for direct introduction into mammalian tissues according to the manufacture's instrument. Eleven prepubertal miniature pigs were used and divided in three groups. The first group was injected i.m. with 500 IU of eCG to induce follicular development, and the second was injected with saline as a control. The third group was directly injected with VEGF gene fragments into both ovaries, followed by administration i.m. with 500 IU of eCG 7 days later. Animals from each group were ovariectomized 72 h after eCG or saline injection. The number of the preovulatory follicles increased in the VEGF-treated ovaries compared to those of either the control or the eCG alone. No atretic follicle with larger than 3.0 mm was observed in the ovaries treated with VEGF gene injection. In the ovaries injected with VEGF gene, the vascular density in medium follicles ranged between 3.0 and 4.9 mm in diameter increased approximately two folds compared to those of the eCG alone. The follicles with larger than 6.0 mm in diameter, which were appeared only in the gilts received the injection of VEGF gene, had significantly higher vascular density than those of other follicles. Our findings demonstrated that the direct injection of VEGF gene into the ovary induces the development of the vascular network in the thecal cell layers and can promote follicular development by reflection on rescue of the atretic follicles.

Key Words: Thecal angiogenesis, Follicular development, Atretic follicle

M28 Effects of the ovulatory response to the first GnRH injection on synchronization and pregnancy rates in lactating dairy cows. RM Santos*[1], JLM Vasconcelos[2], M Meneghetti[2], EPBC Silva[2], and FS Wechsler, [1]*FCAV - Unesp, Jaboticabal,* [2]*FMVZ - Unesp, Botucatu.*

Data from 2 trials were analyzed to evaluate the effect of ovulation to the first GnRH treatment in synchronization of ovulation protocols in lactating dairy cows. In trial 1, 136 lactating Holstein cows, with 23.7±5.8 kg milk/d and 138.4±72 DIM, were randomly assigned to one of 2 groups that differed in the dosage of GnRH: G1 (N=68), Ovsynch with 1.0 mg of gonadorelin (Fertagyl®, i.m.); and G2 (N=68), Ovsynch with 2.5 mg de gonadorelin. In trial 2, 204 crossbred lactating cows, with 13.8±4.0 kg milk/d and 99.8±73.6 DIM, were randomly assigned to one of 2 groups: G1 (N=102), GnRH+CIDR in-6d-PGF2α+CIDR out-48h-GnRH-12h-AI; and G2 (N=102), GnRH+CIDR in-6d-PGF2α+CIDR out-24h-ECP-36h-AI. Data were analyzed by the CATMOD procedure of SAS with a mathematical model that included the effects of breed, ciclicity, milk production, parity and treatment. No effects of treatments were detected on trial 1. However, in trial 2 treatment influenced synchronization rate (P<.10), but not pregnancy rate. Ovulatory response to the first GnRH injection averaged 55

Key Words: Synchronization, GnRH, Dairy cow

M29 Effects of nutrition and progesterone therapy on ovulation, embryonic survival, and pregnancy rates in ewes. B. R. Faris*, J. E. Otero, T. T. Ross, A. S. Carmen, R. W. Montgomery, L. A. Terrazas, and D. M. Hallford, *New Mexico State University, Las Cruces, NM/USA.*

This study was conducted to determine the effect of pre- and post-ovulatory nutrition with or without supplemental progesterone (P_4) on ovulation, embryonic survival, and pregnancy rates in multiparous ewes. Multiparous ewes (n=66) were randomly assigned to a 3 x 2 factorial and fed individually. Groups 1 and 2 received a diet 2 x maintenance 2 wk prior to mating (d 0), and 2 x and 1 x maintenance, respectively, up to d 15 post mating with half of each group receiving P_4 supplementation via a controlled internal drug releasing device (CIDR) starting 24 h post estrus (d 2). Group 3 received a diet 1 x maintenance 2 wk prior to and during breeding season with and without P_4 supplementation via a CIDR starting 24 h after estrus. After d 15 post mating, all diets were 1 x maintenance. Ewes were bred via natural service after estrus was detected using a vasectomized ram and the HeatWatch® system. Progesterone therapy continued until d 23 after mating. Ovulation rate was determined (mid-ventral laparotomy) using five randomly selected ewes from each treatment ranging from d 4 to d 8 post breeding. Blood samples were collected (jugular venipuncture) from these 30 ewes every third day from d 2 to 29 at 1800 h. Plasma insulin and P_4 concentrations were determined by RIA. Insulin was not affected (P > 0.20) by P_4 treatment. Group 1 had a greater (P < 0.03) insulin concentration than 2 and 3. Progesterone was elevated (P < 0.01) for ewes receiving CIDR starting 12 h after insertion through d 11. Ewes in nutritional groups 1, 2, and 3 differed (P < 0.05) in P_4 concentration (0.9, 1.6, and 2.4 ng/ml, respectively). Number of corpora lutea present was similar (P > 0.50) across CIDR and nutritional treatments. Additionally, no difference (P > 0.30) was observed across nutritional treatments for ewes ultrasounded as having zero, single, or twin lambs. However, ultrasound data indicated ewes receiving CIDR had a higher incidence of singles and lower twinning rates (P = 0.01). This was verified by ultrasound data from all ewes on the project for P_4 therapy (P = 0.05). In summary, P_4 therapy decreased the number of ewes with multiple fetuses. Nutrition did not influence ovulation rate or pregnancy rate.

Key Words: progesterone, ovulation, embryonic survival, pregnancy rate, insulin

M30 Effects of feeding supplemental safflower seed with human chorionic gonadotropin following AI on pregnancy rates in heifers. R. S. Walker*[1], P. D. Burns[2], G. E. Sides[3], and D. D. Zalesky[1], [1]*San Juan Basin Research Center, Hesperus, CO, USA,* [2]*Colorado State University, Fort Collins, CO, USA,* [3]*Intervet, Inc., Millsboro, DE, USA.*

The objective of this study was to determine the effects of supplementing 0.96 kg of whole safflower seed with an hCG injection post AI to

increase fertility in heifers. Primiparous crossbred beef heifers (n = 96) were divided into two breeding seasons, early breeding heifers (EBH, n = 48) and late breeding heifers (LBH, n = 48), and randomly assigned to one of two dietary supplement groups by weight and age for both EBH and LBH. Heifers were fed a control diet (CON) consisting of mixed alfalfa/grass hay and oat grain or a safflower seed diet (SAFF) consisting of the control diet plus safflower seed high in oleic (69.9 %) acid. Diets were fed 35 d prior to AI and continued 20 d post AI. Diets were formulated to be isocaloric and isonitrogenous for both groups. Heifers in each supplement group for both EBH and LBH received either an injection of hCG (3,300 IU) or saline 5 d post AI. All heifers were synchronized using 7-11 MGA Select Synch. Heifers were bred AI 12 h after the onset of estrus. Jugular samples were collected three different times prior to AI to determine changes in plasma fatty acid profiles. Body condition score, reproductive tract score, and weight did not differ ($P > 0.05$) between supplement groups for EBH and LBH, therefore, EBH and LBH were pooled together. There were no differences ($P > 0.05$) in conception rates for each supplement group or for hCG injected heifers ($P > 0.05$). More hCG injected heifers in both treatments conceived to AI (66.7 vs 59.5 %), but did not differ from saline treated heifers ($P > 0.05$). Plasma stearic acid increased ($P < 0.01$), while plasma linolenic acid decreased ($P < 0.01$) in both supplement groups. Plasma oleic acid increased for the SAFF group ($P < 0.01$) verses the CON group. Feeding 0.96 kg of whole safflower seed 35 d prior to AI did not improve fertility, yet conception rates appeared to increase when hCG was given 5 d post AI.

Key Words: Beef hiefers, Safflower, hCG

M31 Effect of exogenous progesterone before calf removal and prostaglandin $F_2\alpha$ on estrous response and pregnancy rates in 3-year-old beef cows. J. L. Olson*[1], A. J. Roberts[2], J. A. Paterson[1], and R. N. Funston[3], [1]*Montana State University, Bozeman,* [2]*USDA-ARS, Miles City, Mt,* [3]*University of Nebraska, Lincoln.*

Objectives for this experiment were to determine effects of a 7 d pretreatment with an intravaginal progesterone insert (CIDR) on estrous response and pregnancy rates in 3-year old postpartum beef cows synchronized with calf removal and prostaglandin $F_2\alpha$. Cows (BW = 488 ± 7.4; body condition score = 3.8 ± .07; days postpartum = 58.7 ± 1.2) were randomly allotted to either control (n=22; i.m. injection of 25 mg $PGF_2\alpha$ [Lutalyse®] on d 0) or CIDR treatment from -7 to 0 d preceding, $PGF_2\alpha$ injection on d 0 (CIDR; n=18). All calves were weaned on d 0. Cows were observed for estrus for 120 h after $PGF_2\alpha$ and inseminated by AI approximately 12 h after the onset of estrus. A bull was placed with cows 12 d after $PGF_2\alpha$ and removed 40 d after $PGF_2\alpha$. Circulating progesterone (P4) concentrations were determined in blood samples collected on d -7, 0, and 11. Pregnancy status was diagnosed by ultrasonography on d 54 and 145 after $PGF_2\alpha$. Synchronization rates were higher ($P < 0.05$) for CIDR (100%) compared to Control (77%) cows. Time of estrus did not differ ($P > 0.10$) between Control and CIDR cows (2.41 ± .15 d). Pregnancy rates by AI were not different ($P = .28$), between Control (18%) and CIDR (33%) cows. Overall pregnancy rates were higher ($P < 0.10$) in Control (97%) compared to CIDR (80%) cows. Concentrations of P4 on d -7, d 0, and d 11 did not influence ($P > 0.10$) overall pregnancy rates; however, progesterone concentrations were increased ($P < 0.05$) in CIDR cows on d 0 (5.6 vs. 2.9 ng/ml, for CIDR vs. Control) and d 11 (7.1 vs. 4.8 ng/ml, for CIDR vs. Control). Administration of a CIDR 7 d before calf removal and $PGF_2\alpha$ increased concentrations of P4 on d 0 and 11, and increased the proportion of cows exhibiting estrus. However, CIDR treatment did not improve conception and AI pregnancy rates and reduced overall pregnancy rates in this study.

Key Words: Postpartum, Beef cows, CIDR

M32 Effects of glucose concentration and presence of EGF and hormones on bovine oocyte maturation. D. J. Walker*, J. F. De La Torre-Sanchez, and G. E. Seidel, Jr., *Colorado State University Fort Collins, CO 80523.*

The purpose of this study was to examine effects of glucose concentration, epidermal growth factor (EGF), and hormones (FSH, LH, and estradiol 17 β) during bovine oocyte maturation on in vitro production of blastocysts. Oocytes from slaughterhouse ovaries were divided among the 12 factorial combinations of 3 glucose concentrations (0.5, 2.0, and 5.5 mM), presence or absence of 50 ng/ml of EGF, and presence or absence of LH, FSH, and E_2 in CDM-1, a chemically defined medium similar to SOF. Oocytes were matured at 38.5C in 5% CO_2 in air for 23 1 h. After maturation, oocytes were fertilized at 1 X 10^6 sperm/ml in 6 replicates in F-CDM (0.5 mM glucose), and then cultured 2 days in CDM-1 (0.5 mM glucose) and 4 days in CDM-2 (2 mM glucose). Glucose concentration in maturation medium at 0.5, 2.0, and 5.5 mM had no effect on blastocyst rates per oocyte, 33%, 32%, and 31% respectively. However, 0.5 mM glucose resulted in a cleavage rate of 87%, higher than 81% seen for both 2 and 5.5 mM glucose (P=.004). EGF and hormones independently enhanced cumulus expansion, but there was no synergism between them, and they had no affect on cleavage or blastocyst rates. Both cleavage (P=.0003) and blastocyst rates (P=.02) were affected by which of 3 bulls was used for fertilization.

Key Words: Bovine, Embryo, Oocyte

Triennial Reproduction Symposium

M33 Post-thaw fertility of bovine semen aged within an AI straw for 8.5 hours. J. L. Edwards*[1], M. N. Malone[1], F. N. Schrick[1], H. H. Dowlen[2], H. D. Moorehead[2], P. A. Lunn[2], and A. M. Saxton[1], [1]*The University of Tennessee, Knoxville,* [2]*Dairy Experiment Station, Lewisburg, TN, USA.*

Objective was to evaluate fertility of frozen-thawed semen aged for 8.5 h. Estrus was visually assessed three times daily for at least 30 minutes each time. Jersey heifers (age: 13.9 ± 1.4 mo; weight: 272.8 ± 19.2 kg) observed standing to be mounted between 0700 and 1200 h were randomly assigned to be inseminated with a straw of frozen semen that had been thawed and maintained in a Cito Thaw Unit (34.4°C water bath) for 8.5 ± 0.04 min (Control; range 3-14 min) or 8.5 ± 0.68 h (Aged; range 6-10 h). Heifers observed in estrus after 1200 h were inseminated with control semen. All heifers were inseminated according to AM/PM rule. To age sperm, a straw of frozen semen was thawed immediately after visual detection of a heifer in estrus and then maintained in a Cito Thaw unit until insemination approximately 8.5 h later. Frozen semen was purchased from various AI organizations (n=6). Individual Jersey bulls (n=30) were randomly and evenly distributed across treatments. Establishment of pregnancy was determined by palpation per rectum at 45 to 65 d post-insemination. Animals were monitored throughout pregnancy and upon calving, sex of offspring was recorded. Data were analyzed using Chi-Square; variables of interest included proportion pregnant, calving, and sex of resulting offspring. Effects of inseminating Jersey heifers with sperm aged within an AI straw for 8.5 h post-thaw were minimal. Fifty percent of heifers inseminated with aged semen became pregnant and delivered a live calf at term (Table). Proportion of female offspring was similar. Ability to maintain frozen-thawed semen within an AI straw for 8.5 h in a 34.4°C water bath without significant reductions in fertility demonstrates that sperm can be held post-thaw for extended time periods and suggests potential for manipulation post-thaw for sexing or performing diagnostics.

Treatment	No. Bred	Pregnant (%)	Calved (%)	Female (%)
Control	59	37(62.7)	37(62.7)	19(51.4)
Aged	56	28(50.0)	28(50.0)	11(39.3)
P-value		0.19	0.19	0.45

Key Words: Frozen semen, Aging, Artificial insemination

M34 Effects of presynchronization and/or post-breeding treatment with porcine LH or hCG on pregnancy rates in dairy cows. J. P. Kastelic*[1] and J. D. Ambrose[2], [1]*Agriculture and Agri-Food Canada, Lethbridge, AB, Canada,* [2]*Alberta Agriculture Food and Rural Development, Edmonton, AB, Canada.*

The objectives were to determine the effects of presynchronization with a prostaglandin F2α analogue and/or post-breeding treatment with porcine LH (pLH) or hCG on pregnancy rates in dairy cows. In three experiments, an Ovsynch protocol was used to synchronize ovulation in

lactating Holstein cows (range, 50 to 125 d postpartum). Cows were given im injections of 100 μg GnRH (Fertiline; Vetoquinol) on Days -10 and -1 and 500 μg cloprostenol (Estrumate; Schering Plough) on Day -3, with fixed-time AI on Day 0. Pregnancy was diagnosed by palpation per rectum between 45 and 60 d after AI. In Experiment 1, cows were randomly allocated to either a standard Ovsynch protocol (n=92) or to a presynchronization protocol (n=86; 500 μg cloprostenol given twice, 14 d apart) followed by Ovsynch, with the first GnRH given 12 d after the second cloprostenol. Pregnancy rates were 35 and 49%, respectively (P<0.06). In Experiment 2, cows were given im injections of 2 mL saline, 12.5 mg pLH (Lutropin-V; Bioniche Animal Health), or 2500 IU hCG (Chorulon; Intervet) 5 d after timed-AI (41, 41 and 39 cows, respectively). Pregnancy rates were 22, 33 and 37% (P=0.32). Experiment 3 was a 2 x 3 factorial, with the factors being presynchronization and post-breeding treatment (as done in Experiments 1 and 2, respectively). Pregnancy data are presently available from 86 cows, with data collection ongoing on several farms. Pregnancy rates in the six treatment groups ranged from 40 to 55% (ns). Pregnancy rates were 47 and 50% without and with presynchronization, respectively, and were 42, 48 and 55% in cattle treated with saline, pLH and hCG, respectively (P<0.6). In conclusion, pregnancy rates to timed-AI were improved by presynchronization. Post-breeding treatment with pLH or hCG 5 d after timed AI numerically improved pregnancy rate.

Key Words: Ovsynch, Fertility, Dairy cows

M35 Pregnancy outcome in dairy cows fed diets supplemented with flaxseed or sunflowerseed. J. D. Ambrose*[1], J. P. Kastelic[2], R. Corbett[1], P. A. Day[1], J. A. Small[3], and H. V. Petit[4], [1]*Alberta Agriculture Food and Rural Development, Edmonton, AB,* [2]*Agriculture and Agri-Food Canada, Lethbridge, AB,* [3]*Brandon, MB,* [4]*Lennoxville, QC, Canada*.

The objectives were to determine if a diet enriched in α-linolenic acid (ALA; C18:3n-3) would enhance embryo survival and pregnancy rates in dairy cattle. Holstein cows were assigned to diets supplemented with about 2.35 kg of either rolled flaxseed (FS; 56.7% ALA, n=62) or rolled sunflowerseed (SS; 0.1% ALA, n=59) to provide approximately 750 g oil/cow/day beginning 4 wk before breeding (5522 d, meansd, postpartum). Diets continued for 32 d after timed-AI (Day 0) following a presynch/ovsynch protocol using Estrumate (cloprostenol, Schering Plough) and Fertiline (GnRH, Vetoquinol). Barley silage- and barley grain-based rations were formulated to meet or exceed NRC (2001) requirements. Metabolizable protein and NE_l concentrations were similar in diets. Based upon a mean DMI of 24.2 kg/d, cows fed FS or SS consumed >410 g or <1 g of ALA, respectively. Plasma progesterone concentrations determined on Days -10, -3, 0, 7, 21 and 24 were not affected by diet. Pregnancy was confirmed by ultrasound 32 d after AI and pregnant cows received no further oilseeds. Nonpregnant cows were placed on a second ovsynch regimen and rebred 42 d after first AI, and received oilseeds until 32 d after second AI. Relative to pre-diet levels, FS and SS diets increased the ALA content of milk by 187% and 21%, respectively. Presumptive pregnancy (plasma progesterone >1 ng/mL on Days 21 and 24) and confirmed pregnancy rates to first AI were higher in cows fed FS than in cows fed SS (72.6 vs 47.5%, P=0.01; and 48.4 vs 32.2%, P=0.07, respectively). Confirmed pregnancy rates (combined for both AI) were 67.7 vs 59.3% for FS vs SS (P>0.10). Apparent embryo survival rate was higher at Day 24 in cows fed FS, but it was not affected by diet between Days 24 and 32. Inclusion of rolled flaxseed in the diets of postpartum dairy cows improved fertility, apparently through enhanced early embryo survival.

Key Words: Pregnancy, Flaxseed, α-Linolenic acid

M36 Completion of the Midwest Consortium Project: Sequencing of 21,499 reproduction ESTs and comparative mapping of 721 selected genes. C. K. Tuggle*[1], J. A. Green[2], C. Fitzsimmons[1], R. Woods[2], R. S. Prather[2], S. Malchenko[3], M. B. Soares[3], T. Kucaba[3], K. Crouch[3], C. Smith[3], D. Tack[3], N. Robinson[3], B. O'Leary[3], T. Scheetz[3], T. Casavant[3], D. Pomp[4], J. B. Edeal[4], Y. Zhang[1], Z. Hu[1], M. F. Rothschild[1], K. Garwood[5], and W. Beavis[5], [1]*Iowa State University, Ames, IA,* [2]*University of Missouri-Columbia, Columbia, MO,* [3]*University of Iowa, Iowa City, IA,* [4]*University of Nebraska, Lincoln, NE,* [5]*National Center for Genomic Resources, Sante Fe, NM*.

To accelerate genetic improvement of reproductive traits, both molecular and comparative genomic data are required. We are developing extensive sequence and mapping data for cDNAs expressed in female reproductive tissues. We have produced 25 cDNA libraries from different stages of estrus or gestation for embryo, anterior pituitary, hypothalamus, ovary, uterus, and term placenta. A total of 21,499 EST sequences from random clones have been submitted to Genbank. The average read length across this dataset is >400 base pairs. As assessed by clustering analysis, these data represent 10,574 different genes. A BLAST analysis of these clusters indicates that 4,652 are unique relative to porcine Genbank genes/ESTs (BLAST score <200). To facilitate selection of genes for comparative mapping, we have developed software to predict the cytogenetic location of pig ESTs. We identified pig EST matches (BLAST score >200) to human loci that have consistent cytogenetic and RH mapping locations, and then predicted the pig location of high-scoring ESTs based on mapping data and human:pig chromosome painting information. A total of 721 loci have been mapped across all chromosomes, concentrating on pig chromosomes (1,4,6,7,8,15,X) where litter size or other reproductive QTL have been localized. More than 90% of these loci map to the chromosome predicted by comparative data. A WWW site (http://pigest.genome.iastate.edu) has been established for access to these sequences and the analysis data. This set of sequence and map data can be immediately used to study reproductive biology and look for genes controlling quantitative reproduction traits.

Key Words: Expressed sequence tags, Porcine reproduction, Comparative mapping

M37 Effect of semen packaged in 0.25 and 0.50 cc straws on conception rate of lactating dairy cows. N. Michael*, C. Marti, E. Roberts, and M. Pace, *ABS Global, Inc.*.

Cost and efficiency of semen storage can be dramatically improved by packaging semen in 1/4 cc straws. However, it is not clear if fertility of lactating dairy cows would be different by using 1/4 cc straws compared to 1/2 cc straws. This study evaluated the effect of straw packaging size (1/4 cc vs 1/2 cc straw) on conception rates in lactating dairy cows. At time of collection, semen from each A.I. sire (n = 8) was divided equally between 1/4 and 1/2 cc straws using a split collection technique. All straws were packaged and frozen using the ABS Global wind-tunnel freezing process. Numbers of sperm per straw were the same for 1/4 and 1/2 cc straws. Both straw types were equally divided by sire within each herd where herd owners chose the A.I. sires used in their herd; the number of sires used within the herds was one to four, for a total of 17 sire within herd comparisons. The fewest number of inseminations per herd x sire x straw type was 125. Cows (n = 6602) from eight herds located in Idaho and California were randomly inseminated by odd-even days of the month to receive A.I. in the uterine body from either (even day; n = 3373) or 1/4 cc (odd day; n = 3229) straws from seven professional A.I. technicians between September 2001 and October 2002. Straws were thawed in 35 # 37°C water baths for a minimum of 30 seconds and then held thermo-neutral until A.I. Pregnancy diagnoses were performed between 35 and 42 days following A.I. by the herd veterinarian in cows that had not returned to estrus during this period. Cows that were detected in estrus and re-inseminated between A.I. and pregnancy diagnosis were defined as not pregnant. All inseminations and pregnancy diagnoses information were entered into Dairy Comp 305. Data were retrieved from Dairy Comp 305 from each herd, summarized by sire comparison within herd and entered into Excel. Data were analyzed using a paired t-test on the conception rate means for each straw package type. Conception rates were similar (P > 0.05) between 1/2 (31.1 %) and 1/4 cc (31.3 %) straws. In summary, comparison of multiple A.I. sires in multiple locations indicated that

fertility was not different from semen in 1/4 vs 1/2 cc straws packaged using the ABS Global wind-tunnel freezing process.

Key Words: Semen packaging, Conception rate, Dairy cows

M38 Ovarian follicular development in first parity sows subject to varied split-weaning protocols. J. Barry*, W. T. Dixon, and G. R. Foxcroft, *Swine Research & Technology Centre, University of Alberta, Canada*..

Split-weaning (SW) of first parity sows decreases the weaning to estrous interval (WEI) and advances ovarian follicular development. However, follicles ovulating soon after weaning start development during lactation when sows are often in a catabolic state. We hypothesise that an extended interval between SW and final weaning will induce atresia in this wave of disadvantaged follicles, trigger a new wave of follicle development after weaning when sows will be less catabolic, marginally increase the WEI, but improve overall sow fertility. To test this hypothesis, first parity sows with standardized litters were randomly allocated to be either Control (C; n=45) or SW (all but the lightest 6 piglets removed) at d14 of lactation (n=45). Feed intake, litter growth and sow metabolic state were monitored during lactation. Ovarian follicular development was determined morphologically after euthanizing groups of C and SW sows (n=15) on d16, 18 and 20 of lactation. A baseline of follicular development was established in an additional group of 15 sows euthanized on d14 (C14). Fewer (5/15; $P<0.05$) C14 sows had follicles $\geq$3mm diameter compared to all other groups, indicating a critical and possibly coordinated wave of follicular development between d14 and 16 of lactation. SW increased ($P<0.05$) the total number of follicles $\geq$3mm, mean size of the largest 10 follicles, maximum follicle size, mean FF volume, and the percentage of follicles in the $\geq$5mm category. SW increased ($P<0.05$) plasma IGF-1 at weaning (105$\pm$3 vs. 87$\pm$3 ng/mL) and decreased sow body mass loss during lactation (5.9$\pm$1.0 vs. 9.1$\pm$1.0 kg). Also, irrespective of treatment, plasma IGF-1 was lower ($P<0.05$) at d14 and weaning, and the decrease in loin muscle depth during lactation was greater ($P<0.05$), in sows with follicles <3mm diameter at slaughter. Increased catabolism during lactation can therefore critically limit follicle development. Refinements in SW protocols, based on a better understanding of ovarian follicular development in SW sows, have the potential to improve the fertility of weaned, first parity, sows.

Key Words: sow, lactation, ovary

M39 Do calcium-mediated cellular signalling pathways, PGE_2, estrogen or progesterone receptor antagonists, or bacterial toxins affect bovine placental function in vitro? C. Weems*[1], Y. Weems[2], T. Welsh[3], G. Carsten[4], and R. Randel[5], [1,2]*Univ. of Hawaii,* [3,4,5]*Texas A&M Univ.*

The bovine placenta secretes little progesterone (P_4) when the CL is functional (Conley and Ford, J. Anim Sci 65:500, 1987), while the placenta secretes half of the circulating P_4 at day-90 of pregnancy in sheep (Weems et al Prostaglandins 46:277, 1992) and PGE_2 appears to regulate ovine placental secretion of P_4 (Bridges et al, Prostaglandins and Other Lipid Mediators 58:113, 1999). Calcium has been reported to regulate placental P_4 secretion in cattle (Shemesh et al, PNAS 81:6403, 1983). Diced placental slices from 193-243 day Brahman and Angus cows were incubated in vitro at 39.5 C under 95% air:5% CO_2 at PH 7.2 in 5 ml of M-199 for 1 hr in the absence of treatments and for 4 and 8 hr in the presence of treatments at a dose of 100ng/ml to determine regulation of placental function. Treatments were: vehicle; R24571; Compound 48/80; IP3; PGE_2; $CaCL_2$; cyclosporin A; lipopolysaccharide from Salmonella abortus, enteriditis, and typhimurium; monensin;, ionomycin; arachidonic acid, mimosine; palmitic acid; androstenedione, estradiol-17β; A23187; RU-486; or MER-25. Jugular and uterine venous plasma and culture media were analyzed for P_4, PGE_2, and $PGF_2\alpha$ by RIA. Hormone data in blood were analyzed by a one way ANOVA and in culture media by a 2x21 Factorial Design for ANOVA since breeds did not differ ($P>0.05$) and were pooled. PGE_2 in uterine venous blood was two fold greater ($P< 0.05$) in Angus than Brahman cows. PGE_2 and $PGF_2\alpha$ in the vehicle controls increased from 4 to 8 hr ($P<0.05$), but not P_4 ($P>0.05$). Progesterone in culture media treated with RU-486 increased ($P<0.05$) at 4 and 8 hr compared to vehicle controls and was not affected by other treatments ($P>0.05$). All treatments decreased ($P<0.05$) PGE_2 at 4 and 8 hr except treatment with PGE_2 at 4 and 8 hr and RU-486 at 8 hr ($P>0.05$). $PGF_2\alpha$ was increased ($P< 0.05$) by RU-486 at 8 hr and no other treatment affected $PGF_2\alpha$ at 4 or 8 hr ($P>0.05$). In conclusion, modulators of cellular calcium signalling pathways given alone does not affect placental P_4 secretion, P_4 receptor-mediated events appear to suppress placental $PGF_2\alpha$ secretion, and P_4 receptors may play a role in placental secretion of P_4 in cattle. In addition, PGE_2 does not appear to regulate bovine placental P_4 secretion.

Key Words: Placenta, Progesterone, Prostaglandins

M40 Does estrous synchronization affect corpus luteum (CL) function? C. Weems*[1], Y. Weems[1], S. Tatman[2], A. Lewis[2], D. Neuendorff[2], and R. Randel[2], [1]*Univ Hawaii,* [2]*Texas A&M Univ.*

Bovine CL secretes PGE_2 and $PGF_2\alpha$ in vitro, which increases with time (Weems et al, Prostaglandins 55:359, 1998). Synchronization with Synchromate B (SMB) in Brahman heifers decreases LH, conception rates, and circulating progesterone (P_4; Rentfrow et al, Therio 28:355 , 1987). Nitric oxide (NO; Jaroszewski & Hansel, Proc Soc Expt Biol Med 224:50, 2000) and endothelin-1 (ET-1; Milvae, Rev Reprod 5:1, 2000) were reported to be luteolytic. In Expt 1, estrus in Brahman cows was synchronized with SMB and d-13 to 14 CL and caruncle slices were weighed, diced, and incubated in vitro. Treatments(100 ng/ml) were: vehicle A, L-NAME, L-NMMA, DETA, DETA-NONOate, sodium nitroprusside, or ET-1. In Expt 2, estrus was synchronized with Lutalyse, a CIDR, or natural; CL were collected and weighed on d-14; and CL slices were diced and incubated in vitro with treatments. Treatments (100 ng/ml) were: vehicle, L-NAME, L-NMMA, DETA, DETA-NONOate, sodium nitroprusside, SNAP, or ET-1. Tissues were incubated in M-199 for 1 hr without and for 4 and 8 hr with treatments. Media were analyzed for P_4, PGE_2, and $PGF_2\alpha$ by RIA. Hormone data in Expts 1 and 2, were analyzed by a 2x7 and a 3x2x8 Factorial Design for ANOVA, respectively, and CL weights in Expt 2 by a one way ANOVA. Concentrations of P_4 were similar ($P>0.05$) among treatments within experiments. Concentrations of PGE_2 in CL samples in Expt 1 were undetectable in 90 and 57 % of the samples at 4 and 8 hr, respectively and $PGF_2\alpha$ increased ($P<0.05$) with time but did not differ ($P>0.05$) among treatments. Secretion of PGE_2 or $PGF_2\alpha$ by caruncles increased ($P<0.05$) with time and was not affected by treatment ($P>0.05$). In Expt 2, CL weights were decreased ($P<0.05$) by Lutalyse. Concentrations of PGE_2 and $PGF_2\alpha$ increased ($P<0.05$) with time in controls of all three synchronization regimens. DETA-NONOate, SNAP, sodium nitroprusside (NO donors) and ET-1 increased ($P<0.05$) PGE_2 except in the CIDR group ($P>0.05$), and no treatment increased ($P>0.05$) $PGF_2.\alpha$ in any synchronization regimen. It is concluded that SMB and a CIDR alters CL PGE_2 secretion, Lutalyse lowers CL weights in the next estrous cycle, and NO or ET-1 given alone are not luteolytic agents. It is possible that NO could have indirect luteotropic effects via increasing PGE_2 secretion by luteal tissue.

Key Words: Estrous synchronization, Progesterone, Prostaglandins

M41 Photoperiod and diet effects on heifer development. J. A. Small*[1], A. D. Kennedy[2], and D. R. Ward[1], [1]*Agriculture & Agri-Food Canada, Research Centre, Brandon, MB, Canada,* [2]*University of Manitoba, Winnipeg, MB, Canada.*

A 2*2 factorial arrangement of photoperiod (A vs W) and diet (C vs S) treatments was applied to spring-born crossbred beef heifers (n = 144) assigned at weaning (Sep 21; 0 wk) by body weight (247$\pm$19 kg) and age (191$\pm$12 d) to one of four pens in one of two similar open shed/drylot facilities. Supplemental light (350 lux, 1 m above ground) was used to extend photoperiod (natural + supplemental light) to 16 h for 12 wk starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant (C), or low then high (S) gain during the prepubescent (4 to 16 wk) and pubescent (16 to 24 wk) periods, respectively. One diet for moderate gain was provided to all groups from 0 to 4 and 24 to 32 wk. From 0 to 32 wk, observations of estrus were made twice daily, and estrus confirmed by progesterone in blood serum collected 8 to 12 d later, and body weight, backfat and serum prolactin were measured for each 4 wk period. Ambient temperatures averaged 3.4$\pm$12.1°C, -16.0$\pm$7.4°C and 0.3$\pm$8.0°C for the autumn (0 to 12 wk), winter (12 to 24 wk) and spring (24 to 32 wk) periods. During the prepubescent period, weight gain was greater for C than S (0.74 vs 0.66 $\pm$0.01; $P<0.05$), backfat greater for A than W (1.24 vs 0.87 $\pm$0.08; $P<0.05$), and only 9% of heifers attained puberty by 12 wk. During the pubescent period, diet influenced growth such that, as yearlings (24 wk), weight and backfat were lower for C

than S (392 vs 381 ±3.4 kg and 2.6 vs 3.3 ±0.12 mm; P<0.05), but the proportion of heifers that had two estruses was greater for A than W (48.6% vs 30.9%; P<0.05). Prolactin, initially 16.3±1.6 ng/ml, was higher for A than W from 4 to 12 wk, and lower for A than W from 16 to 24 wk (12 wk; 10.1 vs 1.1 and 24 wk; 6.7 vs 20.0 ±1.8 ng/ml, P<0.05). Extended photoperiod in autumn advanced puberty independently of the effects of diet on growth, and acute change in photoperiod influenced prolactin, in heifers housed outdoors.

Key Words: Photoperiod, Puberty, Prolactin

M42 Heat shock increases glutathione in bovine oocytes. R. R. Payton*[1], P. Coy[2], R. Romar[2], J. L. Lawrence[1], and J. L. Edwards[1], [1]*The University of Tennessee, Knoxville, USA,* [2]*The University of Murcia, Murcia, Spain.*

Heat shock increases glutathione (GSH) content in a variety of cell types including embryos. Objective of this study was to examine GSH content in bovine oocytes cultured at an elevated temperature during maturation. Cumulus-oocyte complexes were randomly allocated to one of three treatments and then cultured in the following manner: 38.5°C for 24 h (Control), 41°C for 6 h followed by 38.5°C for 18 h (HS 0-6), or 41°C for 12 h followed by 38.5°C for 12 h (HS 0-12). After 24 hours, oocytes presumed mature were denuded of cumulus by vortexing. Pools of oocytes (25-32/treatment group) were solubilized in 0.63 M phosphoric acid and frozen at -20°C until further analysis. Glutathione content was determined using a 5,5*′*-dithiobis(2-nitrobenzoic acid)-glutathione disulfide reductase recycling assay and was expressed as per oocyte. Intra-assay coefficient of variation was 7.7%. Data were analyzed using an incomplete block design using mixed models of SAS after testing for normality. The experiment was replicated on 5 occasions and included a total of 8 to 11 pools of oocytes per treatment (236-330 total oocytes/treatment). Culture of oocytes at 41°C during the first 12 h of maturation increased GSH content (4.4 versus 2.7 and 1.6 pmol/oocyte for HS 0-12, Control and HS 0-6, respectively; SEM=0.57; P=0.02). Increases in an antioxidant such as GSH, suggest heat-induced increases in free radicals. Cytoplasmic perturbations involving increased free radical production may be one of several mechanisms contributing to reduced developmental competence of heat-stressed oocytes. Supported in part by USDA Initiative for Future Agricultural and Food Systems Program, "Improving Fertility of Heat-Stressed Dairy Cattle"; Grant #2001-52101-11318.

Key Words: Heat shock, Oocyte, Glutathione

Lactation Biology

M43 Intramammary infusion of prostaglandin E_2 (PGE) increases mammary development and milk yield of cows induced to lactate. J. M. Lukas*[1], W. J. Weber[1], R. J. Collier[2], J. L. Vicini[3], M. F. McGrath[3], and B. A. Crooker[1], [1]*University of Minnesota, St. Paul,* [2]*University of Arizona,* [3]*Monsanto Agricultural Group, St. Louis, MO.*

Effects of intramammary infusions of PGE on mammary development and milk yield of cows induced to lactate were evaluated using a half-udder model. Multiparous, nonpregnant, healthy, reproductive cull Holstein cows (N = 11) were dry for 50 d prior to treatment initiation. Cows were induced to lactate by twice daily subcutaneous (SQ) injections of 17β-estradiol (0.05 mg/kg BW/injection) and progesterone (0.125 mg/kg BW/injection) on d 1 through 7 and once daily SQ injections of POSILAC® (500 mg bST) on d 1, 11 and 21. On d 13, 16, 18 and 20, right and left quarters of each cow were infused with 10 ml of PGE (0.85 mg) or excipient and the quarters massaged to disperse infusate. Intramuscular injections of dexamethasone (0.05 mg/kg BW/d) were administered on d 21, 22 and 23 and 2X milking initiated on d 22. Cows received bST on d 31. Change in mammary gland development was assessed by photo documentation. Milk yield per quarter was determined for 14 d and half udder samples collected at 5 and 12 d in milk (DIM) for composition analyses by DHIA. Data from udder halves were analyzed as repeated measures using PROC MIXED of SAS with $P < 0.05$. Nine cows had visibly larger PGE treated half-udders by d 18. One cow was milked for only 2 d due to temperament. All cows were induced successfully as the untreated udder halves produced at least 4.5 kg/d by 14 DIM. Milk yields were greater in PGE half-udders in all cows on all days (5.1 vs. 9.4 ± 0.7 kg milk; 6.5 vs. 12.3 ± 0.8 kg FCM; 6.1 vs. 11.4 0.8 kg SCM). Milk composition did not differ between halves at 5 or 12 DIM. Milk fat content was unchanged (5.5 ± 0.2%) but protein (4.3 vs. 3.7 ± 0.1%) and log SCC (5.5 vs. 5.0 ± 0.1) decreased and lactose (4.7 vs. 5.0 ± 0.05%) increased from 5 to 12 DIM. Results indicate PGE either enhanced mammary development or differentiation resulting in increased milk yield from cows induced to lactate.

Key Words: Induced lactation, Mammary development, Milk yield

M44 Effects of induced lactation on milk fatty acid profiles in multiparous Holstein cows. H. C. Hafliger, III*[1], L. H. Baumgard[1], W. J. Weber[2], M. Chahine[2], G. C. Lamb[2], T. H. Klusmeyer[3], M. F. McGrath[3], J. L. Vicini[3], and B. A. Crooker[2], [1]*University of Arizona,* [2]*University of Minnesota,* [3]*Monsanto Animal Agriculture Group, St. Louis, MO.*

Fatty acid profiles of milk from cows (previous 305 ME > 8,400 kg) that calved or were induced to lactate were compared to determine effects of induced lactation. Nonpregnant, reproductive culls were induced to lactate after a 50-d dry period by 2X/d subcutaneous (SQ) injection of 17β-estradiol (0.05 mg/kg BW/injection) and progesterone (0.125 mg/kg BW/injection) for 7 d (-13 to -7 DIM) and 0 or 1 SQ injection of POSILAC® (500 mg bST) at -13 and -3 DIM. An intramuscular injection of dexamethasone (0.05 mg/kg BW/d) was administered at 0 DIM and 3X milking initiated at 1 DIM. Induced cows received bST at 7 and 17 DIM and at 14-d intervals thereafter. Calved cows received bST at 14-d intervals after 63 DIM. Milk samples collected at 2 and 12 weeks of lactation (WOL) from a subset of successfully induced (10 of 34) and calved (10 of 19) cows were analyzed for fatty acid content. Method (calved, induced) and WOL effects were assessed by PROC MIXED of SAS with $P < 0.05$. Milk yield and composition of the subsets did not differ from their respective groups. During 2 and 12 WOL, milk yield of calved and induced cows averaged 40.6 and 22.4 kg/d. Milk from calved cows contained more protein (3.5 vs. 3.0%) and other solids (5.9 vs. 5.6%) but fat (4.3%) and log SSC (5.6) did not differ from induced cows. On a weight (mg/g) and molar (% of total moles) basis, *de novo* fatty acid synthesis and incorporation of preformed fatty acids into milk fat were similar for calved and induced cows. Substrate to product ratios (a proxy of Δ^9-desaturase capability) of $C_{14:0}/C_{14:1}$, $C_{16:0}/C_{16:1}$, $C_{18:0}/C_{18:1}$ and *trans*-11 $C_{18:1}$/*cis*-9, *trans*-11 CLA were 16 to 28% less for induced cows. Total percentage of *cis*-9, *trans*-11 CLA did not differ but contents of *trans*-$C_{18:1}$ isomers were 17 to 20% less in induced cows. Although induced cows produced less milk and had an enhanced Δ^9-desaturase system, overall milk fatty acid profiles were similar.

Key Words: Milk fat, Induced lactation

M45 Effects of different milking intervals on composition of cisternal and alveolar milk in dairy cows. M.A. Ayadi, G. Caja*, X. Such, and E. Albanell, *Universitat Autonoma de Barcelona, Spain.*

Milk composition change in cisternal and alveolar compartments at different milking intervals has been rarely studied. Interest is higher as a consequence of robotic milking and milking omission routines. Four Holstein cows (20.5 kg/d, 215 DIM) regularly milked daily at 0800 and 1800 were used to study the effects of different milking intervals on cisternal milk (CIS) and alveolar milk (ALV) in a 5 wk experiment. Experimental milkings were made at random and in duplicate at 4, 8, 12, 16, 20 and 24 h after a regular milking. A wash-out period of 2 d with regular milkings was allowed between experimental milkings. A teat cannula was used to drain CIS after an i.v. injection of an oxytocin receptor blocking agent (Atosiban; 10 μg/kg). Oxytocin was then injected to remove ALV. Samples of each milk fraction per quarter were analyzed for composition. Ratio of CIS:ALV varied according to milking interval and averaged 30:70. Milk fat content decreased in CIS and increased in ALV as milking interval increased (P<0.001). Minimum fat percentage in front and rear CIS (0.93%) was reached at the same milking interval (16 h). Milk fat content in ALV was constant during the first 16 h, increasing rapidly thereafter. Final fat content in ALV (6.95%) was higher than CIS initial (5.62%; P<0.05) and final (0.96%; P<0.001) values. Total

fat yield tended to increase for CIS with longer milking intervals, but increased markedly for ALV (P<0.001), indicating that fat globules do not pass freely from the alveoli to the cistern between milkings. Milk protein content increased in CIS (P<0.001) and tended to increase in ALV with longer milking intervals. Initial and final milk protein content did not differ between CIS and ALV. Total protein yield increased with milking interval in both fractions (P<0.05) and was greater in the rear quarters than in the front quarters (P<0.01) for both milk fractions. We concluded that effects of milking interval on milk composition can be explained by changes in alveolar and cisternal milk ratio.

Key Words: Milk composition, Alveolar milk, Cisternal milk

M46 Description of glucose transport in isolated bovine mammary epithelial cells by a 3-compartment model. C. T. Xiao*, V. M. Quinton, and J. P. Cant, *University of Guelph, Ontario, Canada*.

The carrier-mediated glucose transport in isolated bovine mammary epithelial cells displays moderate degrees of asymmetry and cooperative interactions between export and import sites when described by a fixed-site carrier model. The present study examines the hypothesis that these model features are due to compartmentalization of intracellular glucose. Net uptake of 3-O-methyl-D-[1-^{3}H]glucose (3OMG) by isolated bovine mammary epithelial cells was measured at 37 °C. The time course curve of 3OMG net uptake could be better fitted by a double exponential equation than a single or triple exponential equation. Compartmental analysis of the time course curve suggested that translocated 3OMG is distributed into two compartments with fractional glucose spaces of 32.6±5.7% and 67.4±5.7%, respectively. The results support the view that glucose transport in bovine mammary epithelial cells is a multi-step process consisting of two serial steps: fast, carrier-mediated, symmetric translocation of sugar across the cell plasma membrane into a small compartment, and subsequent slow exchange of post-translocated sugar between two intracellular compartments. A 3-compartment model of this system successfully simulated the observed time course of 3OMG net uptake ($R^2 = 0.98$) and the observed dependence of unidirectional entry rates on intra- and extracellular 3OMG concentrations ($R^2 = 0.99$). Parameters of the fixed-site carrier model derived from the simulation results represented a significant degree of asymmetry and a moderate degree of negative cooperativity. The results indicate that compartmentalization of intracellular glucose exerts significant effects on glucose transport behavior and should be considered when modeling this process.

Key Words: Glucose transport, Bovine mammary epithelial cell, Model

M47 Over-expression of IGF-I in lactating porcine mammary tissue has a differential effect on amino acid transport systems. D. E. Gronlund, W. L. Hurley*, M. H. Monaco, M. B. Wheeler, and S. M. Donovan, *University of Illinois*.

Uptake of amino acids (AA) by the lactating mammary gland is critical for milk protein synthesis. Several transport systems are responsible for AA uptake by mammary epithelial cells. Understanding of the regulation of AA transport is limited, but may include regulation by mammary growth factors. We compared the kinetic properties of a sodium-independent AA transport system (for lysine) and a sodium-dependent AA transport system (for taurine) in mammary tissue from nontransgenic sows (control; n = 5) and transgenic sows (n = 5) that over-express insulin-like growth factor-I (IGF-I) in their mammary gland during lactation, under the direction of the α-lactalbumin promotor. Mammary tissue was collected on day 20 ± 1.8 and 21 ± 2.1 of lactation for control and transgenic sows. Tissue explants were incubated in isosmotic physiological buffer with the respective radiolabeled AA tracer and either lysine from 50 μM to 12.8 mM, or taurine from 1.25 μM to 320 μM. Extracellular volume of explants was determined using radiolabeled sucrose as a nonpermeable tracer. Kinetic parameters for lysine transport were not different between control and transgenic sows (Km = 2.1 ± 0.4 vs 1.5 ± 0.2 mM; Vmax = 6.1 ± 0.7 vs 7.5 ± 1.6 mmol/kg cell water/30 min). The Km of taurine transport was not different between control and transgenic sows (20 ± 3.1 vs 30 ± 5.0 μM). However, the Vmax of taurine transport was significantly lower for control vs transgenic sows (70 ± 16 vs 118 ± 29 μmol/kg cell water/30 min; P < 0.05). Mammary over-expression of IGF-I by sow mammary tissue did not affect lysine uptake, a sodium-independent transport system, nor did it affect the affinity of the taurine transport system. However, the maximal rate of taurine transport was increased in sow mammary tissue of IGF-I transgenic sows, suggesting that the effect of IGF-I over-expression may occur through a regulation of cellular sodium transport systems. Funded in part by the USDA CSREES under project NRICGP 00-35206.

Key Words: Mammary gland, Amino acid transport, Growth factors

M48 The acyclic period postpartum in automatic and conventional milking. D. Weiss*[1], M. Reist[2], and R. M. Bruckmaier[1], [1]*Inst. of Physiology, Technical Univ. Munich, Germany,* [2]*Novartis Centre de Recherche Sante Animal St-Aubin, Switzerland*.

The postpartum acyclic period is prolonged in cows due to frequent suckling as compared to twice daily milking. In conventional milking systems twice daily (2X) milking is typical, while in automatic milking systems (AMS), three and more daily milkings are common in early lactation. This study tested whether increased milking frequency in AMS delays postpartum cyclic activity and pregnancy in dairy cows. Simmental cows (n=124) were studied during the postpartum period until the onset of the ovarian cycle and pregnancy. Calvings were evenly distributed throughout the one-year experimental period. Cows were housed in one barn, and 62 cows were milked voluntarily in the AMS (AC), while 62 cows were milked in the conventional milking parlor (PC) 2X. Other management was identical for both groups. Milk yields and number of milkings were recorded in both systems. Milk samples were analyzed for progesterone twice weekly to determine ovarian activity until cows were pregnant. First and second ovulation was determined by progesterone profiles of each individual cow. The mean milking frequency during the first 3 weeks after parturition was higher in AC (3.030.02) than the 2X milking in PC. Individual milking frequency within AC for the first 3 weeks varied between 2.080.11 and 4.280.02 milkings. Milk yield in the first 6 weeks was higher (p<0.05) in AC compared to PC (30.00.1 vs. 22.70.2 kg/d). The day of the first and second ovulation did not differ between groups (27.61.5 and 36.41.4 vs. 27.51.1 and 36.11.3 in AC and PC, respectively). Within AC no relation was observed between milking frequency and duration of acyclic period. The first and second ovulation was earlier (p<0.05) in primiparous cows (24.00.1 and 34.11.3 d) as compared to multiparous cows (30.50.1 and 38.31.4 d). Days open was similar in AC (73.47.1 d) and PC (74.75.7 d). Increased milking frequency in AMS did not delay postpartum cyclic activity and pregnancy in dairy cows.

Key Words: Acyclicity postpartum, Milking frequency, Automatic milking

M49 Change from conventional to automatic milking in cows with and without previous experience. D. Weiss* and R. M. Bruckmaier, *Institute of Physiology, Technical University Munich, Germany*.

Effects of a change from milking in a conventional parlor to an automatic milking system (AMS) on milk yield was investigated. Cows had either no experience in AMS milking (n=17) or were previously milked for at least one lactation in the AMS (n=9). Experienced cows (EC) were older (3.6±0.5 lactations) than unexperienced cows (UC; 1.8±0.3 lactations). EC were milked for 36.4±5.1 d after parturition in the parlor before changing to the AMS. EC obtained no training before changeover. Milk yields were recorded in the parlor for 10 d prior to changeover. Milk yield in the parlor was 26.3±2.3 kg/d in UC and 37.6±1.7 kg/d in EC. UC were trained intensively in the AMS area for 3 d before changeover, while still being milked in the parlor, and the first AMS milking was performed on the fourth day, i.e., after at least 8 visits to the AMS. Although offered concentrate, UC had to be pushed into the AMS milking stall for the first one to two visits. EC entered the AMS milking stall voluntarily. In UC the rate of voluntary visits were 0, 32, 48, 56, 81, 86, 91, 94, 93 and 97% during the first 10 d of AMS milking. In UC, milk letdown was disturbed during the first visits and mean yield at the first milking in the AMS was lower than in the parlor (67.5±4.8%, p<0.05). In EC, milk letdown was not disturbed and yield at the first AMS milking was 101±3% of the yield in the parlor. Rate of voluntary visits and the degree of disturbance of milk letdown in UC was independent of lactation stage and age of the animals. During the first 10 d of milking in the AMS the mean frequency was 2.67 and 2.88 milkings/d in UC and EC. Milk yield at the first 15 AMS milkings was lower in UC (86.8±4.7%) and higher in EC (108.5±1.8%) compared to the yield obtained in the parlor (p<0.05). In conclusion, cows with previous experience to AMS milking do not need an adaptation period after transient

parlor milking. Furthermore, milk yield is increased in these cows from the increased milking frequency. In contrast, unexperienced cows need intensive adaptation to the AMS.

Key Words: Automatic milking, Milk yield, Dairy cow

M50 Use of digital pictures to study udder morphology in dairy sheep. M. Rovai*[1], D. L. Thomas[1], Y. M. Berger[1], and G. Caja[2], [1]*University of Wisconsin-Madison,* [2]*Universitat Autonoma de Barcelona, Bellaterra, Spain.*

Ewe udder shape and size are related to milk yield and milking time, and culling for undesirable udder traits can improve the efficiency of machine milking. Measurements from digital pictures of ewe udders may provide an easy and accurate method for measuring ewe udders. Udder traits were measured on 120 dairy ewes and from digital pictures of their udders taken at the time of the in vivo measurements. Measurements were taken at wk 5, 11, and 17 of lactation 4 hr before the pm milking. Ewes were milked 2X/d. Udder height, udder width, teat length, teat angle, and cistern height were measured in vivo using a ruler and protractor. Udders also were assigned scores from the 9-point scoring system developed by De la Fuente et al. (1995) for teat size, teat angle, udder height, and udder shape. Following in vivo scores and measurements, digital pictures of the rear udder of each ewe were taken. While taking each picture, a ruler was held parallel to the ground in the same vertical plane as the back of the udder and a few cm below the bottom of the udder to serve as a calibration device for measurements on the digital pictures. Likewise a plumb bob was suspended vertically in back and in the middle of the udder while taking each picture to give a true vertical line as a reference for measuring teat angle. Measurements from the digital pictures were obtained using the public domain software, Image Tool from Texas University, available on the Internet. All digital measurements were significantly ($P<0.0001$) correlated with those measured in vivo. Correlations were 0.73 for udder height, 0.67 for udder width, 0.47 for teat length, 0.88 for teat angle, 0.68 for teat size score, 0.79 for teat angle score, 0.88 for udder height score, and 0.89 for udder shape score. Advantages of the digital picture method over in vivo measurements are that pictures can be taken faster than the in vivo measurements at the farm, they can be analyzed at your convenience, and they provide a permanent record for future use.

Key Words: Digital pictures, Dairy sheep, Udder traits

M51 Udder traits of dairy ewes on U.S. commercial farms and their effects on milk yield. M. Rovai*[1], D. L. Thomas[1], Y. M. Berger[1], and G. Caja[2], [1]*Univ. of Wisconsin-Madison,* [2]*Univ. Autonoma de Barcelona, Spain.*

Rapid scoring systems have been developed in Europe to categorize udder shapes of dairy ewes, and these scores are related to milk yield and milking time. These scoring systems were evaluated in U.S. ewes of dairy-meat crosses. Ewes were scored by one classifier 3 hr before the pm milking using a linear udder scoring system (De la Fuente et al., 1995) based on a 9-point scale per trait: udder depth, teat angle, and udder shape. Udders also were scored for typology (Gallego et al., 1983): 1 = horizontal teats, 2 = teats at 45 degrees, 3 = vertical teats, and 4 = misshaped udder. Ewes were from two commercial dairy sheep farms (A, n = 177; B, n = 166) and one university farm (C, n = 120). Ewes were milked 2X/d. Flocks differed in breed composition: A: East Friesian (EF) crosses (10 to 50% EF); B: EF crosses (10 to 75% EF); and C: EF (50 or 75% EF), 50% Lacaune (LC), and 25% EF-50% LC (EF-LC) crosses. Remainder of breeding was of non-dairy domestic breeds. Effects of parity and stage of lactation also were considered. Percentage of EF breeding had no effect on milk production or udder trait scores in farms A and B. In farm C, LC ewes had the most ($P<0.01$) horizontal teats, and EF-LC ewes had the highest ($P<0.0001$) milk yield. Milk production ($P<0.05$) and udder depth score ($P<0.001$) increased significantly as parity number increased in all farms. Udder depth score and milk production decreased ($P<0.05$) through lactation in farms A and B. Udder depth scores did not change with stage of lactation in farm C. Ewes in later lactation tended to have more horizontal teats and faulty (type 4) udders than ewes in earlier lactation. Udders of type 2 were more frequent than other types in all flocks. Farm C also had a high percentage of ewes with udders of type 1 which may be related to LC ewes. Within all genotypes and farms, positive correlations were observed between udder depth scores and milk yield (0.20 to 0.46; $P<0.05$). High correlations were observed between udder shape and teat angle scores (0.80 to 0.93; $P<0.0001$).

Key Words: Dairy sheep, Udder traits, Linear scores

M52 Udder traits of U.S. dairy ewes and their effects on milking time and milk yield. M. Rovai*[1], D. L. Thomas[1], Y. M. Berger[1], and G. Caja[2], [1]*Univ. of Wisconsin-Madison,* [2]*Univ. Autonoma de Barcelona, Spain.*

Udder shape and size is related to milk yield and milking time in specialized dairy sheep breeds in Europe. This study determined if similar relationships exist among U.S. dairy-meat cross ewes. Ewes (n=120) of 4 breed groups (50% East Friesian, EF; 75% East Friesian, EE; 50% Lacaune; LC; and 25% East Friesian-50% Lacaune crosses, EF-LC; remainder breeding of each group was domestic non-dairy breeds) were utilized. Ewes were milked 2X/d. Measurement of udder size (depth, height, width, and circumference), teat size (length and width), teat angle, and cistern height was done 6 hr after the am milking by one technician at wk 5, 11, and 17 of lactation. Cistern area by ultrasonography and kinetics of milk emission (lag time, volume the 1st minute, total volume, and milking time) also were measured. Cisternal scans were obtained by a portable ultrasound scanner with 3.5 MHz sectorial transducer. Milk yield was highest ($P<0.0001$) in EF-LC ewes, increased ($P<0.001$) with age, and decreased ($P<0.0001$) through lactation. LC ewes had the shortest ($P<0.01$) teats (3cm) and highest ($P<0.0001$) teat insertion (59). Cistern height and udder size were larger ($P<0.05$) in LC and EF-LC ewes than in the other two breed groups. EE and EF-LC dairy ewes had greater ($P<0.001$) cistern area (30 and 32 cm2) than ewes of the other two breeds. Udder and teat size increased ($P<0.001$) with parity. Udder size decreased ($P<0.0001$) through lactation while teat angle and cistern height increased ($P<0.0001$). Cistern area decreased through lactation ($P<0.0001$) and increased ($P<0.0001$) with parity. Total milking time was greatest ($P<0.05$) in EF-LC ewes, increased ($P<0.05$) with parity, and decreased ($P<0.05$) during lactation. Udder traits correlated with daily milk yield ($r = 0.21$ to 0.50; $P<0.01$) and milking kinetics ($r = 0.15$ to 0.38; $P<0.05$). Cisternal area correlated with daily milk yield ($r = 0.63$; $P<0.0001$), milk volume during the 1st minute ($r = 0.34$; $P<0.0001$), measures of teat size ($r = 0.18$ to 0.25; $P<0.01$), and udder height ($r = 0.20$; $P<0.01$).

Key Words: Dairy ewes, Udder traits, Milking kinetics

Animal Health

M53 Binding of IgM to non-apoptotic bovine blood neutrophils . S. N. Knight*, M. Worku, and P. L. Matterson, *NC Agricultural & Technical State University , Greensboro, NC.*

Receptors for IgM have been identified on bovine neutrophils. The objective of this study was to evaluate the association of IgM binding with apoptosis of bovine blood neutrophils. A modified assay to detect apoptosis by comparing the effect of actinomycin-D (160μM), sodium butyrate (160μM), E.Coli lipopolysaccharide (LPS) (10ng/ml) treatments versus untreated isolated neutrophils in the presence or absence of purified bovine IgM was used. Whole blood was collected from healthy, lactating Holstein cows (N=4) in 15 ml vacutainer blood collection tubes pretreated with 250 IU of heparin sodium. The blood was pooled, diluted with 1X PBS, separated by gentle centrifugation and RBC were lysed with 0.83% ammonium chloride several times until a white pellet and clear supernatant was obtained. Viable, isolated PMN were verified by microscopic observation and counting, using Trypan Blue exclusion for viability (98.0%) and Wright stain differentials. Treated and control PMN were spotted onto poly-L-Lysine, subbed slides. After drying, slides were then assayed for the apoptosis using Promega's Apoptosis Detection Kit which is based on the TUNEL method of labeling fragmented DNA of apoptotic cells with Flourescein. The percentage of cells incorporating green fluorescence was evaluated microscopically. Neutrophil isolation, Actinomycin D and Dexamethasone induced apoptosis. Bacterial endotoxin, Sodium butyrate and IgM binding showed the least amount of apoptosis. Treatment with IgM had no effect on apoptosis

due to treatment. The Fc receptor for IgM may serve as a marker of non-apoptotic neutrophils.

Key Words: Neutrophils, Bovine, Apoptosis

M54 Dissociation of glucocorticoid and tumor necrosis factor-α (TNF-α) responses to repeated endotoxin (LPS) challenges: effects of individual versus group penning. S. Kahl* and T.H. Elsasser, *USDA, Agricultural Research Service, Beltsville, MD.*

The development of effective intervention strategies to limit overproduction of proinflammatory cytokines during immune challenge depends on an accurate assessment of how animal-to-animal variability influences the interpretation of data and subsequent conclusions. Our objective was to determine the effect of two consecutive LPS challenges (LPS1 and LPS2, 5 d apart; 0.2 μg/kg BW, i.v., *E.coli* 055:B5,) on plasma TNF-α and cortisol (C) responses in heifers kept in individual or group pens before and during the challenge. Forty two heifers (309 $\pm$ 4 kg) were fed a forage-concentrate diet (15% CP) to appetite and assigned to individual (IND, n = 32) or group (GRP, n = 10) pens. For LPS challenges and each blood collection, GRP heifers were moved from a group pen to a semicircular holding pen leading to the squeeze chute. The total moving distance was less than 50 m. In IND heifers LPS challenges and blood collection were performed in each animal's assigned individual pens, loosely haltered, without animal transfer. Indwelling Teflon^{TM} jugular catheters were implanted one d prior to challenge. For each challenge, blood samples were obtained at 0, 1, and 2 h relative to LPS injection. The primary response to LPS challenge was measured as area under the time $\times$ concentration curve (AUC, ng/ml $\times$ h). Overall mean plasma TNF-α and C responses were lower after LPS2 than LPS1 (respectively, 2.64 vs 4.57, $P < 0.01$ and 48.2 vs 54.8, $P < 0.05$). However, TNF-α responses were greater in IND than GRP heifers both after LPS1 (5.20 vs 3.92, $P < 0.05$) and LPS2 (3.93 vs 1.35, $P < 0.01$). There were no differences in C responses between IND and GRP heifers in both LPS1 and LPS2 (52.3 vs 50.8, $P > 0.05$), although initial plasma C concentrations at 0 h of LPS2 were higher in GRP than IND heifers (10.8 vs 3.1 ng/ml, $P < 0.01$). Results indicate that handling and management of heifers prior to and during acute phase response (APR) to LPS challenge affect the magnitude of proinflammatory cytokine release as modeled with TNF-α. The data also suggest an animal management-related dissociation between glucocorticoid and TNF-α response during APR that compromises interpretation of the degree to which LPS tolerance develops.

Key Words: Cortisol, Endotoxin, Tumor necrosis factor-α

M55 Effects of age at transport on health and development of neonatal dairy calves. T. A. Johnson*[1] and S. D. Eicher[2], [1]*Purdue University, West Lafayette, IN,* [2]*USDA-ARS, West Lafayette, IN.*

Stress associated with transportation at an early age can have immunological effects as well as effects on performance. The purpose of this study was to evaluate the effects of age at transport on immune development. Holstein calves (n=47) were randomly assigned to treatments by day of transport; 2-3 d (A), 4-5 d (B), or 6-8 d (C) within a completely randomized design. Colostrum was administered to each calf within 24 h of birth followed by two equal feedings a day of all milk replacer (4 L/d) and offered ad libitum grain-based dry feed. Calves were transported (6h) and then placed in outdoor individual hutches for the remainder of the study. The mean plasma protein was 6.38 dl ($\pm$ 0.70) at 2 d-of-age. Blood samples, obtained by jugular venipuncture, were collected pre- and post-transport then on d 7, 14, 21, 28, 35, and 42. Mixed model procedures of SAS were used to analyze the data as a repeated measure. Hematocrit percents of peripheral blood were different over wk ($P<.01$). Both granulocyte counts and white blood cell counts increased ($P<.05$) during the first 2 wks, but remained constant throughout the study. At wk1, groups A and B had more cells positive for CD18 than group C ($P<.05$). Group A had greater phagocytosis in wk 1 through wk 3 and at wk 6 compared to group C ($P<.01$). Both chemiluminescence and phagocytosis increased over time ($P<.01$), but were not different among treatments. Plasma fibrinogen was different among treatments ($P<.01$), but no time effect or interaction was detected. Group A had greater fibrinogen concentration than group C on d 0 ($P<.05$) and at wk 2 ($P<.01$). Group A also had a greater fibrinogen concentration than group B on d 0 ($P<.01$) and group B tended to have greater concentrations than group C at wk 5 ($P<.10$). This study indicated that age at transport primarily impacts the health of a dairy calf during the first few weeks of age, however differences after that are minimal.

Key Words: Dairy calves, Transport, Stress

M56 Carbadox does not alter immune cell phenotypes in mesenteric lymph nodes of pigs challenged with *Salmonella enterica* serotype Typhimurium. K. A. Skjolaas, T. E. Burkey, M. R. Barker, S. S. Dritz, and J. E. Minton*, *Kansas State University.*

Carbadox is widely used in nursery pig diets for growth promotion, but the mechanism of action of this class of antibiotics has not been thoroughly elucidated. One action of carbadox could be to change pathogen load in the lower gut and thereby alter populations of immune cells in mesenteric lymph nodes of pigs. Weaned pigs were housed in an environmentally controlled nursery and fed diets containing no added antibiotic (n = 8) or carbadox at 55 ppm (n = 8). No other antimicrobials were included in the diets. Pigs were fed their respective treatment diets for 14 d, then all pigs were challenged orally with 10^6 CFU *Salmonella enterica* serotype Typhimurium. Samples of mesenteric lymph nodes draining the terminal jejunum and ileum were obtained from all animals at sacrifice 14 d after bacterial challenge (after 28 d on experimental diets). Lymph nodes were disrupted mechanically to obtain single cell suspensions. Cells were prepared for flow cytometric analysis with primary antibodies to cell surface antigens, followed by FITC-labeled secondary antibodies. Primary antibodies recognizing CD4, CD8, B cell, and granulocyte/monocyte surface antigens were used. The proportion of lymphocyte-gated cells positive for CD4 (29.0 $\pm$ 2.7 and 31.6 $\pm$ 2.7), CD8 (24.0 $\pm$ 1.4 and 24.5 $\pm$ 1.4), and B cell (64.9 $\pm$ 5.3 and 56.7 $\pm$ 5.3) markers did not differ between pigs fed carbadox and control diets, respectively. Similarly, proportions of gated cells labeled with the granulocyte/monocyte marker did not differ between carbadox (85.4 $\pm$ 4.5) and control (86.3 $\pm$ 4.5) treatments. The results suggest that dietary carbadox, at levels commonly used for growth promotion in swine nursery diets, does not affect major immune cell populations in mesenteric lymph nodes following challenge with an enteric pathogen.

Key Words: Carbadox, Pig, Immune cells

M57 Effects of conjugated linoleic acid (CLA) and trans-$C_{18:1}$ fatty acids (TFA) on production variables and immune indices following castration in beef cattle. L. H. Baumgard*[1], C. E. Moore[1], C. R. Baily[1], M. BenAbdallah[1], P. S. Cuneo[1], S. Dial[1], D. Luchini[2], and G. C. Duff[1], [1]*The University of Arizona, Tucson,* [2]*BioProducts Inc., Fairlawn OH.*

Feeding CLA alleviates the growth-suppressing effects (cachexia) caused by an activated immune system in rodent models. Larger animals often experience cachectic symptoms (decreased feed efficiency and reduced ADG) immediately (7-14 d) post-castration. Growing male beef cattle (n=30, 359 60 kg BW) were fed isoenergetic diets (steam-flaked sorghum based) supplemented (top dressed) with rumen protected (RP) palm oil (559 g/d; EnerGII®[EII]; control), RP TFA (594 g/d) or RP CLA (609 g/d) from #7 to 28d relative to castration. Each treatment provided 475 g lipid/d and RP TFA consisted of 17.2% *trans*6-8, 8.7% *trans*-9, 8.8% *trans*-10, 5.8% *trans*-11 and 7.3% *trans*-12 $C_{18:1}$ and the RP CLA contained 6.5% *cis*-9, *trans*-11, 5.4% c/t-8, c/t-10, 8.25% c/t-11, c/t-13 and 7.9% *trans*-10, *cis*-12 CLA. All bull calves were weighed on d #7, 0, 3, 6, 9, 12, 15, 21, 28 and blood collected on d #7, 0, 3, 6 and 9 relative to castration. On d 0 testicles were banded with latex tubing and scrotums surgically removed on d 3 (post-banding). During wk 1 and 2 post-castration all animals had reduced DMI (7.8%), lost BW (ADG, -0.69 kg/d) and reduced feed efficiency (G:F, -0.15) and there was no treatment by wk interaction on these measurements. Overall (d-7 to 28), CLA supplementation decreased DMI ($P = 0.04$; 7.6, 7.4 and 6.1 kg/d for EII, TFA and CLA, respectively) and did not effect G:F (0.013) or ADG (0.17 kg/d). Compared to d 0, body temperature on d 3 and 6 were elevated ($P < 0.05$) by 0.54 and 0.19C. Castration had little effect on total white blood count, monocytes or eosinophils. but neutrophils were reduced ($P<0.001$) 23%, lympocytes increased 10%, basophils increased 266% and the neutrophil:lympocyte ratio decreased 29% on d 9 (post-castration). Treatment had no effect on aforementioned immune variables. Unique fatty acids evaluated in this trial were ineffective at

preventing the negative side effects on production immediately following castration.

Key Words: CLA, Castration, Beef cattle

M58 Suppression of Th1-like BoCD4$^+$ T lymphocyte proliferative response by BoCD8$^+$ T lymphocytes stimulated with staphylococcal enterotoxin C is induced by type II cytokines. Y. H. Park*[1], W. A. Ferens[2], W. C. Davis[3], J. S. Ahn[4], N. H. Kwon[1], and G. A. Bohach[2], [1]*Seoul National University, Seoul, Korea,* [2]*University of Idaho, Moscow, USA,* [3]*Washington State University, Pullman, USA,* [4]*National Veterinary Research and Quarantine Services, Anyang, Korea.*

Staphylococcal isolates from bovine mastitis often produce superantigen (SAg) exotoxins. We previously demonstrated that the SAg staphylococcal enterotoxin C (SEC) leads to an inversion of the CD4:CD8 T cell ratio and generation of an atypical CD8$^+$ T-cell subpopulation. In the present study, we examined T cell proliferation and apoptosis profiles of subpopulations of bovine peripheral blood mononuclear cells (PBMC) in cultures stimulated with SEC. DNA synthesis in cultures stimulated with SEC was low during the first four days and increased greatly on day 5. In contrast, DNA synthesis in concanavalin A (ConA) stimulated cultures increased continuously from day 1 through day 5. SEC stimulated cultures showed exceed apoptosis of CD4$^+$ T cells at early stage and predominant proliferation of CD8$^+$ T cells at late stage. Type II cytokines were predominantly transcribed at late stage of culture. While transcription of type I cytokines reached peak, but low level compared with ConA stimulated PBMC. Our results suggest that SEC promotes *Staphylococcus aureus* survival by induction of a specific subset CD8$^+$ T cells and suppression of CD4$^+$ T cells may be via type II cytokines in CD8$^+$ T cells.

Key Words: Staphylococcal enterotoxin C, Bovine T cells, Cytokine mRNA

M59 Increased levels of LPS-binding protein (LBP) in bovine blood and milk following bacterial lipopolysaccharide challenge. D. Bannerman*[1], M. Paape[1], W. Hare[1], and E. J. Sohn[2], [1]*USDA-ARS, Beltsville, MD,* [2]*University of Maryland, College Park, MD.*

Approximately 40% of the clinical cases of mastitis that occur annually are caused by Gram-negative bacteria. The most common Gram-negative pathogens implicated in mastitis are *Escherichia coli, Klebsiella pneumoniae*, and various species of *Enterobacter*. A common denominator to all of these bacteria is the presence of endotoxin or lipopolysaccharide (LPS), which is found in the outer membrane of all Gram-negative bacteria. LPS is a highly pro-inflammatory molecule that is shed from the bacterial surface during bacterial replication or death. The bovine mammary gland is highly sensitive to LPS, and LPS has been implicated, in part, in the pathogenesis of Gram-negative mastitis. Recognition of LPS is a key event in the innate immune response to Gram-negative infection and is mediated by the accessory molecules CD14 and LPS-binding protein (LBP). Previous studies have demonstrated an increase in soluble CD14 in milk following intramammary challenge with LPS. The objective of the current study was to determine whether LBP levels increased in the blood and mammary gland following LPS challenge. The left and right quarters of five mid-lactating Holstein cows were challenged with either saline or LPS (100 ug), respectively, and milk and blood samples collected. Basal levels of plasma and milk LBP were 38 and 6 ug/ml, respectively. Plasma LBP levels increased as early as 8 h post-LPS challenge and reached maximal levels of 138 ug/ml by 24 h. Analysis of whey samples derived from LPS-treated quarters revealed an increase in milk LBP by 12 h. Similar to plasma, maximal levels of milk LBP (34 ug/ml) were detected 24 h following the initial LPS challenge. These data suggest a possible role for LBP in mediating mammary gland response to LPS.

Key Words: Mastitis, Endotoxin, LPS-binding protein

M60 Establishment of a bovine cell-culture system to study the genomic response of mammary epithelial cells to infection with *Staphylococcus aureus*. O. Wellnitz* and D. E. Kerr, *University of Vermont, Burlington, VT.*

A cell-culture system was developed to study changes in gene expression during mammary epithelial cell infection. Primary cell cultures from three healthy Holstein cows were prepared, passaged twice, and frozen in liquid nitrogen until infection experiments. Cryopreserved cells were thawed, grown in plastic culture flasks, then split once into 6-well plates. After 24 h cells were infected with 2x10^8 cfu/well of *Staphylococcus aureus*. Sterile, mock-infected plates were included as controls. Three hours post-infection the extracellular bacteria were removed by changing the medium and addition of gentamicin (100μg/ml). Cells were grown for another 21 h after which medium and total RNA were harvested. Lactoferrin concentrations in conditioned medium, measured by ELISA, were 1.2$\pm$0.1μg/ml and 2.3$\pm$0.4μg/ml in sterile or infected cells, respectively (P=0.07). Lactoferrin mRNA expression, as detected by northern blot ananlysis, was 1.8$\pm$0.3 fold higher (P<0.05) in infected cells compared to sterile cells. Tumor necrosis factor alpha (TNFα) mRNA expression was detected by quantitative RT-PCR using SYBR Green. The TNFα response to the infection protocol was variable, being numerically increased 43, 22 and 2 fold as compared to the mock-infected cells (P>0.05). The analysis of lactoferrin and TNFα were chosen to detect an infection response, because bovine lactoferrin concentrations in milk often increase during mastitis and the cytokine TNFα is known to play an important role in inflammatory processes. The increase of lactoferrin expression in cells after infection establishes a direct connection between infection and epithelial cell lactoferrin production and reflects the increased milk lactoferrin concentrations seen in mastitis. The biological replication from simultaneous analysis of cells from different animals is an advantage over experiments with an immortalized cell line. The current model provides substantial quantities of RNA (> 100μg/plate) that will be useful for techniques such as microarray analysis.

Key Words: Mastitis, Cell culture, Gene expression

M61 Results of bovine mastitis target pathogen susceptibility monitoring program for 2001. C. J. Lindeman*, E. S. Portis, and S. A. Salmon, *Pharmacia Animal Health.*

A bovine mastitis pathogen susceptibility monitoring program was initiated by Pharmacia Animal Health (PAH) in 2001 to monitor *in vitro* activity of ceftiofur, pirlimycin, a lincomycin/neomycin combination, and a penicillin/novobiocin combination. Minimum inhibitory concentrations (MICs) were determined for 354 bacterial strains isolated from bovine mastitis cases at 6 veterinary diagnostic laboratories in the US and Canada. Isolates were forwarded to PAH for MIC determinations using a commercially available broth microdilution system that conforms to National Committee for Clinical Standards (NCCLS) guidelines. MIC_{90}values were calculated from data obtained for the bacterial strains that were received. Ceftiofur was the only compound tested which exhibited consistent activity against both gram-negative and gram-positive pathogens tested, with the exception of the enterococci. Penicillin/novobiocin showed excellent activity against the gram-positive organisms and was highly active when tested against the enterococci. Lincomycin/neomycin showed excellent activity against *S. agalactiae, S. aureus* and other *Staphylococcus* spp. Pirlimycin was also active against the staphylococci and streptococci.
Minimum Inhibitory Concentrations (MIC_{90}) for Antimicrobial Agents Against Organisms Isolated from Cases of Bovine Mastitis

Organism (No. tested)	Ceftiofur	Lincomycin/ Neomycin	Penicillin/ Novobiocin	Pirlimycin
Streptococcus agalactiae (20)	≤0.06	≤0.06	≤0.06	0.12
Streptococcus dysgalactiae (32)	≤0.06	0.12	≤0.06	≤0.06
Streptococcus uberis (17)	0.12	64.0	0.12	8.0
Streptococcus spp. (25)[a]	≤0.06	8.0	0.12	1.0
Enterococcus spp. (15)	>64.0	16.0	1.0	16.0
Staphylococcus aureus (68)	1.0	0.5	≤0.06	0.25
Staphylococcus spp. (88)	1.0	.25	≤0.06	0.5
Escherichia coli (63)	0.5	>64.0	32.0	>64.0
Klebsiella spp. (19)	0.5	2.0	32.0	>64.0
Other Gram-negative bacilli (7) [c]	**[b]	**	**	**

[a] Includes *Streptococcus* spp. (23), *Lactococcus* spp. (2) [b] MIC_{90} not calculated for organisms with less than 10 isolates [c] Includes *Pasteurella* spp. (2), *Citrobacter* sp. (1), *Enterobacter* sp.(1), *Serratia* sp. (1), *Acinetobacter* sp.(1), *Pseudomonas* sp. (1)

Key Words: Mastitis pathogen, Minimum inhibitory concentrations, Susceptibility

M62 Comparison of Petrifilm^{TM} with standard and augmented culture techniques for the isolation of pathogens on milk samples.

B. O. Silva, D. Z. Caraviello*, and P. L. Ruegg, *University of Wisconsin - Madison*.

The objective of this study was to compare the 3M^{TM} Petrifilm^{TM} with different methods of isolation of udder pathogens from milk samples. Composite (n = 29) and quarter (n = 362) milk samples were collected. Staph express Petrifilm^{TM} and Enterobacteriaceae Petrifilm^{TM} were compared with standard and augmented culture techniques for isolation of Staphylococcus aureus and coliforms respectively. Standard culture technique consisted of streaking 0.01 ml of milk on sheep blood agar and processing samples using NMC procedures. Augmented culture techniques consisted of samples processed using centrifugation (5 ml centrifuged at 2000 x G for 15 min) or incubation (18 h at 37^{o}C) and plated similar to the standard method. S. aureus was isolated from 5.4%, 6.1%, 6.9% and 7.7% of samples for standard, centrifuged, incubated and Petrifilm^{TM}, respectively. Coliforms were isolated from 10.5%, 9.4%, 17.4% and 15.7% for standard, centrifuged, incubated and Petrifilm^{TM}, respectively. Overall, 8.2% of the samples were positive for S. aureus and 20.2% of the samples were positive for coliforms. Test characteristics were determined using the number of isolates positive by any method as the gold standard for comparisons. The sensitivity for S. aureus was 65.6%, 75.0%, 84.4% and 87.5% for standard, centrifuged, incubated and Petrifilm^{TM}, respectively. The sensitivity for coliforms was 52.0%, 46.6%, 86.3% and 78.1% for standard, centrifuged, incubated and Petrifilm^{TM}, respectively. Two presumed S. aureus isolates from Petrifilm^{TM} were determined to be coagulase negative Staphylococcus species resulting in a relative specificity of 99.4% for the 3M^{TM} Staph Express. The specificity of the 3M^{TM} Enterobacteriaceae Count Plate was 100%. According to McNemar's test for paired data, both Petrifilm^{TM} tests were significantly different (P< 0.05) from standard technique. Results show a great potential for the use of Petrifilm^{TM}, an easy and rapid method, in a herd evaluation program when S. aureus and coliforms are the pathogens of interest.

Key Words: Mastitis, Petrifilm, Microbiology

M63 Effect of intramammary infection at calving caused by environmental pathogens on lactation performance, mastitis incidence, and somatic cell counts in lactating Holstein cows.

S. O. Juchem*[1], L. G. Corbellini[2], K. N. Galvao[1], J.E.P. Santos[1], and M. Villaseñor[1], [1]*Veterinary Medicine Teaching and Research Center, University of California - Davis,* [2]*Universidade Federal do Rio Grande do Sul - Brazil*.

An aseptic milk sample composited from all 4 quarters was collected in the first 3 d after calving from 1290 Holstein cows not displaying signs of clinical mastitis. Samples were cultured in blood agar and BHI medium for microbiological analyses at the Milk Quality Laboratory (VMTRC, Tulare). Results were grouped into 5 treatments: no growth (NG), coliforms (COL), coagulase negative Staphylococcus spp. (SS), non-agalactiae Streptococcus spp. (STC), and a mixed culture of SS and STC (MX). Data from monthly production and clinical mastitis (CM) cases were collected for the first 300 d in milk (DIM). Diagnosis of CM was performed at every milking by the herd personnel. Continuous and binomial data were analyzed using, respectively, the MIXED and the LOGISTIC procedures, and number of mastitis cases per cow by the GENMOD procedure of SAS (2001). Interval from calving to first CM case was analyzed by the Survival Analysis procedure of MINITAB (2000). Results are shown according to the following order: NG, COL, SS, STC and MX. Yields (kg/d) of milk (37.3 vs 34.3; P<0.05) and 3.5% fat-corrected milk (37.6 vs 34.2; P<0.05) were lower for STC than NG, but they did not differ among the other groups. Fat and true protein in milk was similar for all 5 groups (P>0.15) and they averaged 3.6 and 3.2%, respectively. Similar to yields of milk, fat and true protein production was higher for NG than STC cows (1.32 vs 1.2 and 1.19 vs 1.09 kg/d; P<0.05). Linear SCC scores (1.8 vs 2.4 vs 2.5 vs 3.3 vs 2.7; P<0.01) were higher for STC, but not different from MX. Cows in NG had lower incidence of CM during lactation (11.4 vs 31.3 vs 21.7 vs 43.2 vs 28.6%; P<0.01). The mean number of CM cases per cows during lactation was lower for NG than the other groups (0.04 vs 0.6 vs 0.26 vs 1.54 vs 0.55; P<0.01). The interval from calving to the first CM case was affected by bacterial isolate at calving (254 vs 134 vs 248 vs 201 vs 102 d; P<0.01). Intramammary infection with no signs of clinical mastitis in the first 3 d postpartum affects lactation performance, increases linear SCC and occurrence of CM.

Key Words: Mastitis, Milk culture, Dairy cows

M64 Safety and compatibility of Orbeseal® during the dry period and early lactation when used in conjunction with commercially-available intramammary dry cow therapies.

R. Hassfurther*[1], D. Earley[2], and N. A. Evans[2], [1]*Pfizer Veterinary Medicine, Terre Haute, IN USA,* [2]*Pfizer Animal Health Group, New York, NY USA*.

Orbeseal® is an internal teat sealant designed for use at dry-off. It is an inert viscous paste consisting of bismuth subnitrate in a paraffin base and is aseptically administered at dry off. The sealant mimics the natural keratin plug and provides immediate closure of the teat canal thus helping to prevent intramammary infections during the entire dry period. It is likely the US dairy industry will use Orbeseal® in combination with intramammary dry cow antibiotics. The current study examined the safety and compatability of Orbeseal® when administered concurrently with any 1 of 4 commercial dry cow antibiotics. Thirty cows were treated at dry off with Orbeseal® or a dry cow antibiotic in conjunction with Orbeseal® in each quarter. Systemic observations and gland assessments were made throughout the dry period and post-calving in order to evaluate product compatibility. Bismuth subnitrate is radiopaque, and radiographs of teats were taken throughout the dry cow period and at calving to evaluate the presence of the plug. At calving, foremilk was stripped and physical presence of Orbeseal® was determined. Milk production was measured for 20 days post-calving and composite milk samples were collected to investigate bismuth levels. Orbeseal® did not compromise gland health and was physically compatible with licensed dry cow antibiotic therapies. The radiographs and the physical presence of the seal at calving support evidence that Orbeseal® remains intact in the teat cistern until physically removed post calving. Treatment with Orbeseal® had no effects on early lactation milk production and no deleterious impact on antibiotic residues in milk. Collectively, these data demonstrate that Orbeseal® is a safe and reliable dry cow product when used alone or in conjunction with licensed dry cow antibiotics.

Key Words: Orbeseal®, Dry Cow, Teat Sealant

M65 Test-day milk loss associated with elevated test-day somatic cell score. R. H. Miller*, H. D. Norman, G. R. Wiggans, and J. R. Wright, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.*

To determine usefulness of current and previous test-day somatic cell score (SCS) in predicting test-day milk yield, test-day records from Holstein first and second calvings between 1995 and 2002 were examined. Initial selection required that cows have at least the first four test days with recorded milk yield and SCS for both parities 1 and 2. Least-squares analyses were conducted for milk yield on test days 2 through 10 within herd and cow. The model included regressions on both current test-day SCS and mean SCS of all previous test days with separate estimates by parity; effects for parity and calving year also were included as well as a regression on days in milk on test day 1. Error degrees of freedom ranged from 143,748 to 214,526. Highest SCS was most often on test day 1 (20%) followed by test day 10 (14%). Ranges of regression coefficients (kilograms of milk per unit of SCS) are in the table. Effect of current SCS on test-day milk yield was much greater for parity 2 than for parity 1 but only slightly greater than effect of mean of previous test-day SCS on milk yield for parity 1. Milk loss from elevated SCS likely results both from mammary status on test day and from direct and residual influences of elevated SCS earlier in lactation. Mastitis in early lactation appears to have a carryover effect on milk yield for the remainder of the lactation.

	Previous test-day Maximum effect		SCS mean Minimum effect		Current test-day Maximum effect		SCS Minimum effect	
Parity	Coeffi-cient	Test day	Coeffi-cient	Test day	Coeffi-cient	Test day	Coeffi-cient	Test day
1	-0.346	9	-0.142	2	-0.401	10	-0.216	3
2	-0.366	4	0.021	10	-1.209	10	-0.489	4

Key Words: Somatic cell score, Test-day milk, Mastitis

Breeding & Genetics

M66 Optimising genetic gain in a small population. A. Karlsen*, T. Steine, and E. Sehested, *GENO Breeding and A.I. Association.*

Small farms characterize dairy production in Norway. The average herd size in 2002 was 15.3 cows. Although the herd size is increasing, the number of cows has been slowly decreasing over the last years. The Norwegian Dairy Cattle (NRF) population is currently about 300,000 cows. Phenotypic data on health, fertility traits, production (yield and beef), calving information and management has been reported to the Norwegian Dairy Herd Recording System (NDHRS) since 1978, and recordings are compulsory for members. In 2002 96% of the cows were part of the NDHRS. These cows represent the breeding population of NRF. Dams are considered as sire mothers if their total merit index, milk production and pedigree meet the requirements. Every year about 400 bull calves are purchased based on their pedigree information at approximately 3-4 months of age. In the period between 5-12 months of age, they are evaluated for growth rate, conformation and semen quality. The 120 best young bulls are then selected for progeny testing. Several functional traits (fertility, mastitis resistance, other diseases, calving ease and stillbirths) are included in the total merit index. To perform progeny testing for these traits, breeding values are based on 250-300 daughters. After progeny testing the best 10-12 sires are selected as elite sires. Selection is based on total merit index and also on number of sire lines represented and number of close relatives in use. To prevent inbreeding, a restriction is put on the use of sires. The optimum distribution between use of young bulls for progeny testing and elite sires are 40:60 in the NRF population. A computer program is distributed to all farmers that optimise use of young bulls and elite sires in the herd, and suggest the optimum mating combinations. Farmers can download the program freely, or get a breeding plan from the dairy advisor that runs this program on routine basis for the farmers. It is assumed that approximately 90% of the farmers use the breeding plan. Through this breeding scheme a small population is turned into a large breeding population.

Key Words: Genetic gain, Small population, Norwegian dairy cattle

M67 Identification of quantitative trait loci affecting birth and weaning weights in pigs. J. W. Holl*[1], J. P. Cassady[2], and R. K. Johnson[1], [1]*University of Nebraska, Lincoln, NE,* [2]*North Carolina State University, Raleigh, NC.*

A whole-genome scan was used to identify chromosomal regions and estimate quantitative trait loci (QTL) that affect individual pig birth weight (BWT) and weaning weight (WWT). A three-generation resource population was developed by crossing a randomly selected control line with high-indexing pigs from a line selected for an increased index of ovulation rate and embryonic survival. Phenotypic data were collected on F_2 females, born in three replicates, for BWT (n = 428) and WWT (n = 405). Grandparent, F_1, and F_2 animals were genotyped for 151 microsatellite markers. Calculations of logarithms of odds (LOD) scores were by least squares. The full model included fixed effects of replicate, sire-dam combination as a polygenic effect, and coefficients for additive and dominance effects as fixed regression coefficients. The reduced model included fixed effects of replicate and sire-dam combination. Genome-wide critical $\alpha = 0.01$, $\alpha = 0.05$, and $\alpha = 0.10$ levels were established using a permutation approach. There was evidence ($P < 0.10$) for QTL affecting BWT on SSC8 between markers OPN and SO178 and on SSC12 between markers SO143 and SX957, with additive effects of the allele inherited from the control line of -0.020 ± 0.017 kg and -0.059 ± 0.019 kg and dominance effects of 0.085 ± 0.031 kg and -0.073 ± 0.037 kg, respectively. No QTL were detected for WWT. Knowledge of QTL for BWT should be considered to maintain neonatal survival in selection programs that may indirectly have an adverse affect on BWT.

Key Words: Pigs, Quantitative trait loci, Weight

M68 Detecting quantitative trait loci for twinning and production traits in Holstein dairy cattle. J. Cruickshank*[1], M. R. Dentine[1], P. J. Berger[2], and B. W. Kirkpatrick[1], [1]*University of Wisconsin-Madison, Madison, Wisconsin,* [2]*Iowa State University, Ames, Iowa.*

Twinning in dairy cattle has been associated with many negative health and reproductive events that cause economic loss to the producer. Reports have suggested that twinning rates are increasing and that there may be a positive relationship between milk production and twinning frequency. Quantitative trait loci (QTL) for twinning rate on bovine chromosomes 5, 7, 19, and 23 have been previously identified in other populations. The objectives of this study were to detect and confirm the existence and effects of these QTL and to look for QTL for milk yield, fat and protein yield and percent, somatic cell score (SCS), and productive life in those same chromosomal regions. Half-sib families of 25 North American Holstein sires with high twinning rate PTA comprised the population under investigation. This project utilized sire predicted transmitting ability (PTA) values for the production traits from USDA. Twinning rate PTA values were estimated from calving data. DNA extracted from semen samples was analyzed using 45 microsatellite markers across the four chromosomes. Marker heterozygosity of the patriarchs averaged 56%. Evidence of twinning QTL was found in multiple families on chromosomes 5 and 23 at a chromosome-wise $p<.05$. Similarly, evidence of QTL was found on chromosome 7 for milk; chromosomes 5, 7, and 19 for fat yield and fat percent; chromosome 7 for protein yield; chromosome 5 for protein percent; and chromosomes 5, 19, and 23 for SCS. Most of these families are related within three generations and will be combined into larger, multi-generation families for further analysis. For twinning QTL replicated in Holsteins, chromosomal positions will be more narrowly defined by haplotype analysis. Frequencies of haplotypes associated with twinning will be estimated in elite Holstein cow populations.

Key Words: QTL, Twinning, Cattle

M69 Development of three repeat microsatellite loci in Korean cattle. S. Chen, H. Chung*, D. Yoon, I. Cheong, and S. Lee, *National Livestock Research Institute, Suwon, Korea.*

Microsatellite, which contained tri repeats, have been isolated in Korean cattle (Hanwoo). The pooled Korean cattle genomic DNA, which was digested with Sau3AI and separated onto agarose gels, was recovered

for 3 sections (200 to 500 bp, 500 to 1000, 1000 to 2000). For the construction of the bovine genomic libraries, a PCR-enrichment procedure was employed resulting in 14 libraries. Selection process for the tri and tetra repeat sequences were performed using PCR with biotined oligo primers. After blue/white colony selection, the positive colonies were sequenced with an ABI 3730 automatic sequencer to identify the repeat sequence. A total of 14 genomic libraries were constructed for Korean cattle using 4 unrelated individuals. Clones, which were 8,198 from 14 Hanwoo genomic libraries for 3 repeat sequences, were identified and sequenced. The association test was conducted for weight traits using the isolated microsatellite.

Key Words: Microsatellite, Bovine, Weight

M70 Graphical approach to evaluate genetic estimates of calf survival. H. Schlesser*[1], R. Shanks[1], J. Berger[2], and M. Healey[2], [1]*University of Illinois Urbana-Champaign,* [2]*Iowa State University*.

Identification of bulls with bimodal pattern of inheritance could allow for more selective and efficient genotyping. A bimodal pattern of inheritance for calf survival was identified in sons of Holstein bulls. This pattern of inheritance is indicatice of an allele effect or a sire of mates effect. Large allelic effects could lead to bimodal pattern of inheritance for bulls heterozygous for quantitative trait loci affecting calf survival. However, caution is needed because unequal distribution of sire of mates may indicate nonrandom matings. Data on predicted transmitting ability (PTA) for the first and second parity of 12034 sons were collected from 1984 through 1997 from seven Midwestern states. Fifty-four bulls had at least 50 sons and were included in the analysis. The data set was further restricted to fifty-two bulls having at least 25 sons with first parity PTA for calf survival. Seventeen bulls were identified with a potential bimodal pattern of inheritance, through a graphical method. In order to graphically determine a bimodal pattern of inheritance, PTAs for first parity were multiplied by one thousand and truncated to form an integer score for each son. This created several sons with the same score as other sons. These scores were then plotted against number of sons with each score. The bimodal patterns were quantified by equating coefficients of variation between the two groups. The seventeen bulls were analyzed to determine the distribution of the sires of mates between groups. Sires of mates were nonrandomly distributed between groups for fifteen of the seventeen bull families.

Key Words: Mating distribution, Calf survival

M71 Analysis of health and fertility traits for proven and young sires in herds participating in a progeny test program using data from on-farm herd management software. N. R. Zwald*[1], K. A. Weigel[1], and B. Welper[2], [1]*UW-Madison,* [2]*Alta Genetics*.

The objective of this study is to analyze health and fertility traits within a selected group of 126 Holstein herds using DC305, PCDART, or DHIPLUS and enrolled in the same progeny test program. Herds range in size from 200 #3300 cows and are located in the Northeast (VA, MA, NY, PA, OH), Midwest (WI, MN, IA, IL, MI), the West (CA, OR, WA, ID), and Texas. Herds have been tested to have accurate DNA results, and perform regular pregnancy exams. Service sires were analyzed for male fertility on a conception rate basis, with all AI services being considered. 301,777 services were analyzed on 95,321 animals for 3646 service sires from 1/1/01-2/1/03. The model was response=HYS + cow + herd*service sire + service sire + type of sire (young sire vs. proven) + type of animal (heifer vs. cow) + dim. Overall conception rate was 26.2%, and conception rate on young sires was 22.9%, and was 29.2% on proven bulls. Conception rate on virgin heifers was 50.8% and was 23.3% on milking cows. The proportion of the total variance attributed to the service sire was 1.36%. The correlation between the results of this analysis and the ERCR ranking was 31%. This research shows that if pregnancy exam data was stored and could be used for fertility evaluations, the accuracy and heritability of both female and male measures of fertility would be increased. Disease incidence was also studied to determine possibilities for genetic evaluations for health traits. 60 of the 126 herds were recording some type of early metabolic disorder, 47 were recording clinical mastitis, and 44 were recording lameness or foot trimming events. Disease incidences on herds recording data were: 14.8% for mastitis and 11.0% for early metabolic disorders, which included ketosis (5.2%), Metritis (1.8%), displaced abomasums (1.8%), and retained placentas (2.3%). This suggests that efforts need to be made to improve the recording of health traits on all farms before any national genetic evaluation for these traits is warranted, however groups of herds using similar sires with accurate identification and proper recording of health information could be used to test for genetic differences to disease resistance within progeny test situations.

M72 Post-weaning relative growth in body weight of black bengal and its half bred kids. L. B. Singh*[1], D. K. Singh[1], N. Kumar[1], N. S. Singh[1], A. K. Pal[1,2], and S. B. Jadhao[2], [1]*Ranchi Veterinary College,Ranchi 834007,* [2]*Agricultural Research Service, Central Instt. Fisheries Education, Mumbai400061,India*.

The present study was conducted on 614 (145, Black Bengal; 310, 1/2 Jamunapari + 1/2 Black Bengal and 159, 1/2 Beetal + 1/2 Black Bengal) kids of 51 sires born during 1981-86 under All India Coordinated Research Project on Goats at this institute. Relative growth rate (RGR) in body weight was studied during 12-24, 24-36, 36-48, 12-36, 12-48 and 24-48 weeks of age. The variation in RGR during 12-24 weeks of age due to year of birth ($P \leq 0.01$) was significant. While RGR during 24-36 weeks of age varied significantly due to season of birth and birth weight ($P \leq 0.01$). During 36-48 weeks of age, the effects of year of birth and sex ($P \leq 0.01$) on RGR was significant. However, during 12-36 weeks, it varied significantly due to season of birth ($P \leq 0.05$) and birth weight ($P \leq 0.01$). During 12-48 weeks of age, the effect of type of birth and parity of dams on RGR was significant ($P \leq 0.05$). In general, the random effect of sire on RGR was not significant except during 24-36 weeks of age. Heritability estimate of RGR in post-weaning body weight (0.023 + 0.225 to 0.216 + 0.153) was low to medium. The RGR during 12-24 weeks had positive and significantly ($P \leq 0.01$) phenotypic (0.293) association with RGR during 12-48 weeks of age.

Key Words: Kids, Relative growth rate, Half bred

M73 Genetic correlations among body condition score, dairy form and disease from the US. C. D. Dechow*[1], G. W. Rogers[1], T. J. Lawlor[2], L. Klei[2], A. E. Freeman[3], and G. Azim[3], [1]*University of Tennesse,* [2]*Holstein Association USA, Inc.,* [3]*Iowa State University*.

The objectives of this study were to estimate genetic correlations among body condition score (BCS), dairy form (DF) and measures of cow health. Observations for BCS and DF were obtained from Holstein Association USA Inc. Body condition score and DF records were edited to include those cows with valid BCS and that were classified between 24 and 60 months of age and between 0 and 335 days in milk. A minimum of 10 cows per herd-classification visit (HV) and 20 daughters per sire were required. Only one record per cow was used in the analyses. Records were available for 183,044 cows after edits. Health data were obtained from several herds that participated in a Genex/CRI pilot health recording study and recorded all veterinary treatments. The diseases included in the analyses included displaced abomasums (DA), metabolic disease, foot diseases, uterine diseases and mastitis. Herd mates that calved during the same year and season of cows with one or more observations for disease, but that did not have a disease observation were assumed to be disease free. A minimum of 5 cows per herd-year-season (HYS) was required. The edited data set included 6247 cows, 221 of which had BCS and DF observations available. Genetic correlations among disease, BCS and DF were estimated with multiple trait sire models in ASREML. Models included age at calving nested within lactation group, 5th order polynomials of DIM nested within lactation group, fixed HV effects and random sire and error for BCS and DF. Models for disease traits included a fixed HYS effect, age at calving nested within lactation group, and random sire and error. Body condition score was significantly correlated with lower incidence of DA (-0.84) and metabolic disease (-0.95), whereas DF was significantly correlated with higher incidences of DA (0.86) and metabolic disease (0.96). Cows that are genetically inclined to have high dairy form or low BCS may be more susceptible to DA and metabolic disease.

Key Words: Body condition score, Dairy form, Health

M74 Estimation of genetic parameters in Japanese Holsteins using random regression test-day models with Legendre polynomials. C. Fujii* and M. Suzuki, *Obihiro University of A & VM, Obihiro-shi Japan.*

Legendre polynomials were adopted for drawing lactation curves. The objective of this study was to test statistically which order of polynomial can fit the lactation curve most effectively. Data were provided by Livestock Improvement Association of Japan and consisted of 19,397,399 test-day records and 4,087,621 pedigree records. The test-day records included 6 to 365 DIM. To determine the order of the polynomial, a sample data set with about 30,000 test-day records for 3000 cows in the first lactation was extracted from the entire data set. Pedigree records included up to three generations per animal. Using the sample data set, additive genetic variance-covariance components were estimated by REML for four models with second to fifth order Legendre polynomials. All effects in the models, except the order of the polynomial, were the same. The models included herd-test-day, season and age group effects as fixed, and additive genetic and permanent environmental effects as random. Setting the estimate from the fifth order polynomial to the criterion, the F test was used to find out the goodness of fit among the models. The difference between random regression models with the second and the third order polynomials was significant, and no difference was found between those with the third and the fourth order polynomials. The model with the third order polynomial better explained the lactation curve with fewest parameters. All data were divided into 400 datasets because of lack of computation memory, and ten sub datasets were sampled randomly. Genetic parameters were estimated using the random regression test-day model with the third order polynomial for the ten sub datasets. For each dataset, heritability was estimated at twelve points from DIM 30 to 360. The heritability estimates were 0.23 and 0.34 at DIM 30 and 360, respectively, increasing with DIM. The range of the heritability estimates (0.11) was smaller and more stable than that of other studies.

Key Words: Random regression, Test-day record, Holstein

M75 Comparisons of purebreds and multi-breed crosses for preweaning performance, in swine. A. Barreras-Serrano*, J.G. Soto-Avila, and M. Montaño-Hodgers, *Universidad Autónoma de Baja California, Mexicali, B.C. México.*.

A total of 214 litters sired by Landrace, Yorkshire or Duroc-Hampshire boars out of Landrace, Yorkshire, or multi-breed crosses sows were evaluated for preweaning performance. Traits of the dam (litter) that were studied included litter size, number born alive, litter birth weight, number alive at weaning, litter weight at weaning, and percentage of piglets born alive surviving at weaning. Other traits studied were piglet birth weight, weaning weight, and preweaning average daily gain. Six-subclass year-season were defined as result of combining three years (1999 to 2001) and two seasons (hot=from May to October, and cold=from November to April). The records were collected from 1999 to 2001. Data was analyzed using Henderson methods 1,2 and 3 and maximum likelihood using computer program PC-2, and using GLM and Mixed procedures from SAS software. Sire breeding values were estimated using progeny records. Landrace- or Duroc-Hampshire-sired litters were larger in number ($P<.01$) and heavier at birth ($P<.01$) than Yorkshire-sired litters. However, pigs sired by Yorkshire boars had higher birth weight ($P<.01$) than pigs sired by Landrace boars. Landrace-sired litters were larger in number alive ($P<.05$) at weaning than Yorkshire-sired litters. No significant differences among the sow breeds were noted in number at birth and alive at weaning or birth weight. Pigs out of Landrace and Yorkshire sows had higher weaning weight ($P<.01$) and higher ($P<.05$) preweaning average daily gain than pigs out of multi-breed crossed sows. Litters sired by Yorkshire boars showed higher percentage of pigs born alive surviving at weaning than litters sired by Landrace or Duroc-Hampshire boars. Heritability values estimated were moderates for growth performance indicating presence of genetic variability. In general, Duroc-Hampshire sires were the best ranked by breeding values for preweaning traits.

Key Words: Swine, Growth performance, Genetic evaluation

M76 Genetic parameters for longevity in a colony of German Shepherd dog guides. J. B. Cole*[1], D. E. Franke[1], and E. A. Leighton[2], [1]*Louisiana State University, Baton Rouge, LA,* [2]*The Seeing Eye, Inc., Morristown, NJ.*

Data on longevity for 1,304 German Shepherd dogs (GS) was used to estimate genetic parameters for working life. A Cox proportional hazards model on unadjusted working life was used to test the assumption that the baseline hazard function for the population is a Weibull hazard. The rejection of that assumption led to the definition of two measures of working life: estimated for working life to 18 months post-graduation (EWL) and working life beyond 18 months post-graduation (LWL). For EWL, 92.45% of the records were censored after 540 days, while for LWL 47.89% of the records were censored after 4,361 days.
The Survival Kit v3.12 was used for variance components and breeding value estimation. Estimates of additive sire genetic value for Cox and unstratified Weibull models were 0.87 and 0.36 for EWL and 0.05 and 0.03 for LWL, respectively. Heritability estimates on a log scale (assuming no censoring) were 0.19 and 0.61 for EWL and 0.09 and 0.04 for LWL, respectively. For both traits, the standard deviations and skewness of the posterior densities of the sire variance were fairly large. Due to the small size of the dataset and the large number of censored records, it was not possible to obtain more precise estimates of the sire variance. The large heritabilities observed for EWL under the Cox and Weibull models should be interpreted with caution because virtually all EWL records were censored. Pearson's product-moment correlation coefficents for sire breeding values estimated under the Cox and Weibull models were 0.99 for EWL and 0.88 for LWL, respectively. The low correlation between the models for LWL may be due to large prediction error variances and the skewness of the posterion distribution of sire effects, although these problems were noted for EWL as well.

Key Words: Variance components, Working life, Dog guides

M77 Genetic parameters for net feed efficiency of beef cattle measured during postweaning growing versus finishing periods. D. H. Crews, Jr.*, N. H. Shannon, B. M. A. Genswein, R. E. Crews, C. M. Johnson, and B. A. Kendrick, *Agriculture and Agri-Food Canada Research Centre, Lethbridge, Alberta, Canada.*

Individual feed intake was recorded during 84-d growing and 112-d finishing periods on Charolais-sired crossbred steers (n = 410). Steers consumed a barley silage-based diet during the growing period, and a barley grain-based diet during the finishing period. Following finishing, steers were harvested at a commercial packing facility where carcass data were collected 24 h postmortem. Net feed efficiency was estimated for the growing (NFG) and finishing (NFF) periods using linear regression procedures such that within-period phenotypic correlations of efficiency measures with average daily gain and average metabolic body weight were zero. Net feed efficiency during the growing (finishing) period varied from an efficient -4.10 (-4.77) kg per d to an inefficient 4.65 (3.30) kg per d. Using an animal model and restricted maximum likelihood, genetic parameters were estimated among NFG, NFF, and age-adjusted (463 d) carcass traits, including hot carcass weight (HCW), fat thickness (FAT), longissimus muscle area (REA), and marbling score (MAR). The relationship matrix among 975 animals included a minimum of a three generation pedigree for the 34 Charolais bulls that sired steers with records. Heritability estimates were moderate for NFG (0.30 ± 0.06) and NFF (0.26 ± 0.07), whereas carcass trait heritabilities were constrained to literature averages to avoid convergence failure. Phenotypic and genetic variance estimates for NFG were higher than those for NFF. The genetic correlation between NFG and NFF was 0.55. Genetic correlations of NFG and NFF with HCW and REA were weak to moderate and positive, but were negative and generally weak with FAT. The genetic correlation of MAR with NFG was near zero (0.08) but was strongly negative (-0.44) with NFF. These results suggest that a high and positive genetic association exists between net feed efficiency measured when cattle were consuming roughage- versus grain-based diets, although these traits may not be biologically equivalent.

Key Words: Beef cattle, Net feed efficiency, Genetic parameters

M78 Preliminary study of daily gain in central station-tested Nelore bulls. J.A.C. Pereira*[1] and J. E. Chavez[2], [1] *Gabriel Rene Moreno University,* [2] *ASOCEBU.*

The objectives of the study were 1) to investigate a method to base the selection of Nelore bulls on their growth performance in a grassing system under subtropical conditions, and 2) to determine the preferable trait to be used as a selection criterion in a central evaluation station. Each year approximately 1.500 weaned, young bulls were available to be tested. This number was restricted due to the physical limitations of the station. Therefore, each year, a pre - classification of the bulls was performed. Only young bulls with weaning weights above the herd average and acceptable conformation were selected. In this study data was collected on 130 young sires from different farms over four consecutive years. They were kept on pasture before and during the test (280 days). All the animals were managed under a rotational grazing system. The only *ad libitum* supplementation was mineral salt. During the test period the animals were weighted every 28 days. Six traits were measured; Birth Weight (BW), Beginning Weight at Test (BGT), Age in Days at the beginning of the Test (ADT), Daily Gain from birth to the beginning of the test (DG1), Daily Gain during the test (DG2) and the Final Weight at the test (FW). Harvey's least square program was used to analyze the data. The model used was the pre determined "model 1" of fixed effects. The results showed that BW, DG1 and FW were significantly different among farms and were not used as selection criteria. It is proposed to select bulls using their DG2 value, which is a preferable selection criterion because it was not affected by farm. The results also indicated that Nelore bulls might have great potential to be selected under grazing systems. The adjusted daily gain measured in the four consecutive years ranged between 0.658 and 0.726 grams per day. Further research should be performed including other effects such as dam's parity, in order to estimate the genetic performance more accurately. In addition, a new approach (testing on farms) should be investigated in order to include all the young bulls weaned each year.

Key Words: Grazing systems, Nelore, Daily gain

M79 Setting up the Gelbvieh multiple breed evaluation. A. Legarra*[1], T. Strabel[2], J. K. Bertrand[1], and I. Misztal[1], [1] *University of Georgia, Athens, GA,* [2] *Agricultural University of Poznan, Poznan, Poland.*

The Multiple Breed Evaluation for the Gelbvieh breed was developed, generally following ideas applied first in the Simmental evaluation by Cornell University. The main challenges for genetic evaluation were related to assumptions of grouping breeds to form super-breeds and fixing the (arbitrary) accuracy of the priors for heterosis and breed of founder genetic group effects. The data set did not allow for a correct estimation of all these effects, so priors were taken from literature. Genetic difference between Gelbvieh and Angus breed of founder priors were 26.5 (var=7.48E-05) and -3.7 (var=0.11E-05) kg for weaning weight and yearling gain respectively. Some results of the evaluation were strongly affected by the priors, although results for Gelbvieh as the main breed stayed basically the same. Gametic trends for Gelbvieh were: 0.34 and 0.33 kg/year for weaning weight and 0.43 and 0.44 kg/year for yearling gain with or without priors, respectively. For Angus, trends were non-linear and about 0.10 and 0.32 kg/year for weaning weight and 0.71 and 0.67 for yearling gain with or without priors, respectively. As the number of pure-bred Angus animals in data was very low (97 out of 666,513) it seems that gametic trends for Angus were a mixture of the evolution of Angus genes in the Gelbvieh population and the original Angus population. Differences between Gelbvieh and Angus gametic average breeding value for year 1995 were 0.87 and 9.91 kg for weaning weight and -3.64 and -4.04 kg for yearling gain with and without priors, respectively. The results from the study indicate that estimation of genetic differences between breeds in current pure-breed associations data banks is very dependent on the weight given to the prior literature values relative to the data. More understanding on how results are influenced by priors and data is needed.

Key Words: Gelbvieh, Multiple breed evaluation, Genetic evaluation

M80 Differences in growth trajectories in seven beef breeds. J. Bohmanova*[1], I. Misztal[1], and J. Pribyl[2], [1] *University of Georgia, Athens, GA,* [2] *Research Institute of Animal Production, Prague, Czech Republic.*

The objective of this study was to estimate average breed growth curves and assess differences in growth performance between breeds and sexes. A total of 140,503 weight records from birth to 360 days on 60,284 animals provided by Czech Beef Breeders Association were used to compare growth of Charolais (14,340), Simmental (10,382), Angus (9,622), Limousin (6, 046), Hereford (16,362), Blond D' Aquitaine (2,020) and Piedmontese (1,512). Effects included in the model of analysis were herd, year and dam age class and regression on orthogonal polynomials nested within sex. Adjusted mean weight from birth to 360 days was estimated for heifers and bulls. All computations were by breed. Charolais bulls and heifers had the highest birth weights with 41 kg and 39 kg, respectively. Hereford bulls and heifers had the lowest birth weights with 30 kg and 29 kg, respectively. Simmental and Charolais were the fastest growing breeds, with bulls from these breeds weighing 484 kg and 467 kg at 360 days of age, respectively. Herefords had the slowest growth of all breeds. Simmental, Charolais, Angus and Blonde D' Aquitaine bulls had similar growth trajectories. Sex differences in body weight at 240 days of age ranged from 33 kg in Blond D' Aquitaine to 18 kg in Hereford. Growth of heifers slowed down considerably after 240 days of age. Angus and Piedmontese heifers stopped growing at 330 days. Bulls grew linearly till 270 days of age, after which their growth accelerated considerably. This increased growth after 270 days of age can be explained by an increasing proportion of records coming from bulls raised in test stations.

Key Words: Beef cattle, Growth, Breed differences

Swine: Impact of Weight and Sex on Meat Quality, Effect of Age Management on Biochemical Parameters, Disinfectant, Gilt Selection and Sow Longevity

M81 Economic evaluation of sow longevity using data from commercial herds. S. L. Rodriguez-Zas*[1], B. R. Southey[1], R. Knox[1], J. F. Connor[2], J. F. Lowe[2], and B. Roskamp[2], [1] *University of Illinois Champaign-Urbana, Urbana, IL,* [2] *Carthage Veterinary Service, Ltd., Carthage, IL.*

Sow longevity and lifetime production are critical determinants of the profitability of pork production systems. A study was conducted to assess the impact of genetic line on multiple indicators of sow longevity and production traits. Records from more than 100,000 sows in 32 US commercial herds across five years were analyzed using survival and mixed effect repeatability models. The variation among genetic lines was evaluated in biologic and economic units using the net present value per sow. Explanatory variables included herd, year of entry into the herd and genetic line. Significant differences in sow longevity and production traits were observed between genetic lines. Since the economic magnitude of the effect of sow longevity primarily depended on the discount rate and net income per litter per sow, all genetic lines were assumed to differ in the median longevity. Hence, the results from the economic analysis apply to the average sow from each genetic line. Assuming zero discount rate per parity, the genetic line with longer herd life showed greater profit than genetic lines with the shorter herd life. Under these conditions and assuming a $10 net income per litter, no genetic line was profitable. Assuming a $50 net income per litter, the difference in net present value per sow between the highest and lowest lines for longevity was $52.39 and the difference between the highest two lines for longevity was $13.94. Assuming a $10 net income per litter, the difference between the highest and lowest lines for longevity was $10.48 per sow and the difference between the highest two lines for longevity was $2.79 per sow. The difference in net present value between genetic lines was considerably reduced with increasing discount rates and was reversed with high discount rates and low net income per litter. The significant differences in sow longevity among genetic lines were not translated into substantial economic differences for the range of discount rates considered. Results from this economic analysis indicate that the manipulation of the genetic line composition of a herd is an important factor in the achievement of a profitable swine production.

Key Words: Economic, Survival, Swine

M82 Gilt selection based on age at first estrus and breeding herd efficiency. J. L. Patterson*[1], G. R. Foxcroft[2], M. J. Pettitt[1], and E. Beltranena[1], [1]*Prairie Swine Centre, Inc., Saskatoon, SK,* [2]*Swine Research & Technology Centre, University of Alberta, Edmonton, AB.*

The impact of gilt selection based on age at first estrus on breeding herd performance was determined in 509 C22 and L42 (PIC Canada) gilts given direct daily contact with vasectomized boars from 140.1 ± 5.1 d of age and classified with respect to age at first estrus (Early: EP, 148.0 ± 0.5; Intermediate: IP, 159.8 ± 0.4; Late: LP, 175.7 ± 0.5 d; or Non-Responsive by 180 d: NR; P≤0.05). For gilts in estrus by 180 d, breeding at third estrus resulted in differences in body weight at breeding (EP: 130 ± 2; IP: 143 ± 2; and LP: 153 ± 2 kg; P≤0.01). Breeding rate (percentage of gilts on inventory eventually bred) was lowest for NR gilts (EP: 96.2; IP: 91.3; LP: 90.3; and NR: 72.3 %; P≤0.01). Age at first estrus did not affect farrowing rate of gilts bred (EP: 92.0; IP: 93.6; LP: 92.1; and NR: 86.2 %; P≥0.05) or pigs born alive (EP: 10.0 ± 0.4; IP: 10.5 ± 0.3; LP: 10.3 ± 0.4; and NR: 9.7 ± 0.5; P≥0.05), but did affect pigs born dead (EP: 0.48 ± 0.17; IP: 0.45 ± 0.14; LP: 1.10 ± 0.17; and NR: 0.46 ± 0.21; P≤0.01). Preliminary data from weaned, parity 1 sows indicate no significant effects on weaning-to-estrus interval (EP: 5.2 ± 0.6; IP: 6.0 ± 0.5; LP: 4.9 ± 0.6; and NR: 7.1 ± 0.8 d; P≥0.05) or percent sows rebred after weaning (EP: 91.7; IP: 80.6; LP: 83.6; and NR: 80.0 %; P≥0.05). However, estimates of cumulative non-productive days (NPD) per gilt originally on inventory, inclusive of NPD due to gilts and sows culled by d 18 after weaning, were EP, 37; IP, 60; LP, 80 and NR, 80 d. Corresponding estimates of NPD per pig born in the first litter were EP, 4.3; IP, 6.8; LP, 9.7 and NR, 13.0 d. These data indicate important differences in production efficiency related to selection on age at first estrus. Considered together with increased costs of higher replacement rates, costs of time spent on unproductive heat checks and increased breeding costs per pig born, our data suggest substantial savings can be realized by identifying late-cyclic and non-cyclic gilts at an early age.

Key Words: Gilts, Puberty, Productivity

M83 Reproductive survival of exotic sows in the humid tropics of Samoa. C. Okere* and A. O. Ajuyah, *The University of the South Pacific.*

Reproductive records from the International Fund for Agricultural Development (IFAD) pig project and the Swine Research Unit at the School of Agriculture, University of the South Pacific, Alafua Campus, Samoa involving 26 (Large White and Duroc) sows and 152 litters up to the 8^{th} parity were analyzed for breed and parity effects. For both Large White and Duroc sows, overall mean values for litter traits were (113.8±2.2 vs. 115.0±1.05 days) for gestation length; (10.5±2.2 vs.9.2±2.3) for litter size; (8.8±2.4 vs. 8.3±1.71 kg) for litter birth weight; (1.34± 0.1 kg vs. 1.34±0.14 kg) for piglet birth weight; (8.1±1.95 vs.6.7±1.03) for number weaned and (72.5±17.6 vs.66.7±11.6 kg) for litter weaning weight respectively. Differences between breeds were significant (P≤0.05) only for the mean weaning weights in the first parity and in litter size between the 3^{rd} and 8^{th} parities. There was a tendency for Large White sows to have slightly more weaned piglets in their first and subsequent parities than Duroc sows. Taken together, these results suggest a greater reproductive adaptability for Large White sows to the humid tropical conditions in Samoa.

Key Words: Reproductive survival, Pigs, Samoa

M84 Use of the DF-200 HF decontamination foam in swine farrowing facilities. K Christensen* and J. D. Thomas, *New Mexico State University.*

DF-200 HF, a Sandia National Laboratories product developed to be both fire extinguishment foam and a decontaminant, was chosen to be applied on used, empty swine farrowing facilities to determine ability of the foam to eliminate bacteria. Before the decontaminate foam was applied, samples were obtained from 10 specific areas of empty farrowing crates by using moistened swabs, swabbing an area, and transferring the sample onto the plates. The plates were then placed into an incubator at 32 C for approximately 19 h. These plates exhibited rapid growth with numerous colonies of unknown bacteria. After initial sampling, the decontaminant foam was thoroughly applied to all surface areas. After a drying period of 1 h, the surface areas were rinsed with cold water to remove the foam residue. Samples taken after decontamination showed an extreme decrease in plate count numbers and in the types of colonies grown. While the majority of the samples taken post-treatment had no bacterial growth, there were some samples which did produce viable colonies. Colonies were isolated from these plates and identified using API identification strips (Biomerioux). Specific bacteria identified included *Staphylococcus hyicus, Aeromonas salmonicida ssp salmonicida, Chromobacterium violaceum* and *Pseudomonas florescens/putida.* It is believed these bacteria survived the decontamination foam because they were in areas high in organic matter. The ability of the foam to effectively penetrate organic matter is unknown. Thorough removal of all organic matter prior to decontamination may be necessary for complete elimination of bacteria. If proven to be cost effective, DF-200 HF decontamination foam could be a viable means for sanitizing farrowing crates.

Key Words: Decontamination, Foam, DF-200

M85 Fat content of corn, animal plasma and fish and soybean meals is the main single parameter affecting retention of aromatic compounds typical of a strawberry flavor. I. Perez-Portabella, C. Ibañez, C. Puyuelo, R. Fontanillas, J. Sola, I. Blanco, and E. Roura*, *Lucta, S.A, Barcelona, Spain.*

Flavoring compounds used in feeds interact with the feedstuffs to such extent that flavor performance may differ if feed ingredient formulation changes. Earlier studies have shown that content of crude protein, starch and crude fat of feedstuffs account for most of the interactions with flavoring compounds. In the current study, corn, soybean, blood plasma and fish meal where flavored with a strawberry aroma in powder form, and the release of selected aromatic compounds at 0, 7 and 21 d post-application of an accelerated stability test was traced and quantified by Head Space-Solid Phase Microextraction and Gas Chromatography-Mass Spectrometry. The selected aromatic compounds were ethylbutirate (bp760=121C, MW=116.16), isoamyl valerianate (bp760=191C, MW=172.27) and alpha-ionone (bp760=250C, MW=192.30)and were chosen to represent very high, high and medium volatilities, respectively. The feedstuffs content of crude fat, crude protein, starch, moisture, crude fiber, Fe, Cu, Zn and total ash were evaluated and correlated with aromatic compound losses expressed as a percentage of initial values. Regardless of the feed ingredient, at d 7 no trace of ethylbutirate could be found, therefore linear correlations were very low ($R^2 \leq 0.20$). Losses of isoamyl valerianate were highly correlated linearly with crude fat content at d 7 (Y=-6.0036X+92.528, R^2= 0.9438) and 21 (Y=-1.8303X+101.35, R^2= 0.9549), indicating that the higher the fat content, the slower the aromatic compound release. Furthermore, alpha-ionone release, showed only a medium correlation with fat content at d 7 (R^2= 0.7857) and very low at d 21 ($R^2 \leq 0.20$). Overall, retention of all analyzed aromatic compounds revealed that the higher the fat content of the feedstuffs, the lower the losses (d 7: Y=-3,5744X+94,922, R^2= 0.9485; d 21: Y=-0,37017X+99,478, R^2= 0.9079).

Key Words: Feedstuffs, Crude fat, Strawberry flavor

M86 Effect of feeding management and feeding time on urea nitrogen levels in swine research. I. Moreira*[1], M. Kutschenko[1], A. Fraga[2], E. Sakaguti[1], G. Oliveira[1], and D. Souza[1], [1]*Universidade Estadual de Maringa-Maringá-PR/BRAZIL,* [2]*UNESP-Jaboticabal-SP/BRAZIL.*

Two experiments were conducted to evaluate the effect of feed management ("ad libitum" or fasting before bleeding) on the plasma urea nitrogen (PUN). All pigs (n = 30) were bled on the last (seventh) day of the experiments. Initial body weight was 46.1 kg in Exp l and 50.8 kg in Exp 2. Pigs were allotted in a 3 ×2 × 2 factorial arrangement of treatments (three protein concentrations in the Exp 1 or three lysine concentrations in Exp 2, two feed management schemes and two bleeding times) in a randomized complete block design conducted in 10 replicates. The three protein-lysine levels were 13.9-0.71, 16.4-0.83 and 18.9-0.95 %. The two feed management schemes were "ad libitum" or 12 h fasting (20:00 p.m. to 8:00 a.m.) before bleeding. After fasting, pigs were fed for l h, followed by 5.5 h of fasting and then bleed. The two bleeding times were in the morning (8:00 a.m.) and in the afternoon (2:30 p.m.). Results of PUN determinations were submitted to ANOVA and polynomial regression analysis. The ANOVA results showed higher PUN when bleeding in the afternoon, compared to the

morning, in both experiments. There were no differences on PUN values due to feed management schemes. There were no interactions. The coefficients of variation (CV) were similar for both bleeding times (Exp 1=22.9 and 22.2; Exp 2=24.2 and 24.5). The lowest CV found in the Exp 1 was for fasting (21.7) and the higher was for "ad libitum" (23.6). This result was inverted in the Exp 2, where "ad libitum" (21.1) was lower and fasting (27.9) was higher. These results show that fasting does not result in more accurate PUN values compared to "ad libitum" feeding, in detecting differences between dietary protein treatments for the growing pig. However, in Exp 2, "ad libitum" was more accurate when three lysince concentrations were fed. Because PUN was higher when pigs were bled in the afternoon, time of bleeding should be considered when PUN is measured.

Key Words: Methodology, PUN, Amino acid

M87 Evaluation of various factors affecting pigs blood (plasma or serum) urea nitrogen value. I. Moreira*[1], M. Kutschenko[1], A. Fraga[2], G. Oliveira[1], E. Sakaguti[1], and I. Sartori[1], [1]*Universidade Estadual de Maringa-Maring-PR/BRAZIL,* [2]*UNESP/Jaboticabal-SP/BRAZIL.*

A performance trial was conducted using 24 growing pigs (Initial BW = 23.7 kg) to study the effects of various factors on blood urea (BU) value. Pigs were allotted in a complete randomized design with a 3×2×2×2×2 factorial arrangement (three crude protein levels (CP): 13.6, 16.0 and 18.4 %; two blood fractions (BF): serum or plasma; two feeding systems (FS): "ad libitum" (AF) or a 12 hours fast (from 20:00 p.m. to 8:00 a.m.) followed by 1 h of feeding and then 5 h of fasting again before bleeding (FF); two floor types (FT): compact floor (CF) or shallow pool (SP) and two bleeding places (BP): "sinus orbital" or vena cava). Initially, all pigs were bled to measure the base line BU. A total of 96 samples were analyzed. There was an effect (P≤0.05) of FT, increasing linear effect of CP levels and of baseline on BU. None of the other factors (BF, Fs ir BP) were significant (P≤0.05). There was an interaction (P=0.054) between FT and the linear effect of CP levels. There was no interaction (P≥0.05) between any other factors. However, there were different linear regression coefficients for CF (b=1.7799) and SP (P=2.4389). The two smallest CVs were for CF (20,5) and AF (21,1) and the two highest were for SP (27.6) and AF (25,3). It was concluded that choosing which feeding system, bleeding place and blood fractions, depends on researchers choice. However, shallow pool flooring should be avoided when intending to measure blood urea nitrogen in pigs.

Key Words: Methodology, PUN, Protein

M88 Serum enzyme profile and biochemical constituents of blood in cross-bred pigs during growth. G. DilipKumar*[1] and P. E. Prasad[2], [1]*Washington state University,* [2]*A.N.G.R.Agricultural University.*

Biochemical changes taking place during different stages of growth have been attributed to the changes in the activities of certain enzymes and biochemical constituents which have clinical importance in assessment of their growth, health, nutritional status, diagnosis and prognosis of metabolic disorders. The present research has been under taken to study the enzymes-AST, ALT, ALP, LDH and certain biochemical constituents like glucose, total proteins, albumin, globulin and urea concentrations of blood in crossbred growing pigs. The level of AST, ALT, ALP, LDH enzymes in serum decreased significantly (p<0.01) as the age of piglets increased from 60 days to 120 days. However, the AST and ALP level at 90 days age are not significantly different from 120 days age. The level of glucose at 90 and 120 days was significantly lower compared to 60 days age. The total serum protein and albumin concentrations significantly (p>0.01) increased as the age of the piglets increased. The serum urea concentration of the growing piglets did not differ significantly as age advanced.

Key Words: Crossbred pigs, Enzymes, Blood constituents

M89 The effect of exogenous leptin on immunological parameters in growing pigs. T. E. Weber* and M. E. Spurlock, *Purdue University, West Lafayette, IN.*

To determine the effects of exogenous leptin on measures of cellular and humoral immunity, leptin was administered twice daily as an intramuscular injection to barrows (n=15; mean BW 63.4 kg) at a dose of 0.025 mg kg^{-1} for a period of 35 days. In addition, there was a control group that was injected with vehicle and allowed ad-libitum access to feed, and a third group that was injected with vehicle and had their feed intake restricted to that of the group injected with leptin. All of the barrows were injected intramuscularly with 1 mg of Limulus haemocyanin (LH) emulsified in incomplete Freund's adjuvant on days 0 and 14 of the experiment. Blood samples were collected on days 0, 7, 14, 21, and 35 for analysis of serum antibodies to LH (IgG1 and IgG2) and for the whole blood proliferative response to LH and to concanavilin A (Con A). Leptin reduced (P <0.05) average daily feed intake by 20.7 % as compared to the control group. All pigs developed an antibody response (IgG1 and IgG2) to LH by day 14. Pigs injected with exogenous leptin had lower (P < 0.05) serum IgG1 against LH on days 21 and 35 than did the control or limit-fed group. There was no effect (P > 0.05) of leptin on serum IgG2 concentrations. Leptin had no effect (P > 0.05) on the proliferative response to Con A or LH at any time point. For in vitro experiments, blood was collected from healthy pigs and peripheral blood mononuclear cells (PBMCs) were isolated to test the effect of leptin (0 or 100 nm) on the blastogenic response to Con A (5 g/mL) and interferon-γ (IFN-γ) production, and to determine whether these cells express the long form of the leptin receptor (Ob-Rb). Leptin had no effect on blastogenesis or IFN-γ production in the stimulated PBMCs. However, expression of Ob-Rb in these cells was confirmed at the mRNA level, and the relative mRNA abundance was down-regulated (P < 0.05) in response to Con A. These data indicate that leptin modifies antibody isotypes in the pig, and that the long form of the leptin receptor is regulated in response to some immunogens.

Key Words: Leptin, Pig, Immune system

M90 Evaluation of migratory distance and readability of passive transponders injected in different body sites of Iberian pigs. M. Hernandez-Jover*, G. Caja, X. Alabern, P. Virtudes, D. Garin, and B. Farriol, *Universitat Autonoma de Barcelona, Spain.*

A total of 189 half duplex passive injectable transponders (PIT) of two different sizes (31.5×3.8 mm, n=106; and, 23×3.8 mm, n=83; Tiris, Almelo, Holland) were used to identify 48 castrated Iberian pigs, in order to evaluate the effects of s.c. injections in different body sites (ear base, EB; ciliary arc, CA; armpit, AR; and, shinbone, SH). Pigs were randomly allotted into two groups (24 pigs each) and injected (four PIT per pig) at 4 mo of age. One group was kept indoors in intensive conditions and slaughtered at 9 mo of age (80 kg BW), whereas the other was kept outdoors in extensive conditions and slaughtered at 15 mo of age (120 kg BW). Readability of PIT (readable/injected) was checked weekly by using two types of handheld readers (Gesreader I, Gesimpex, Spain; and, Hokofarm, Insentec, Holland). Migration distance was measured by the X-Ray method (Caja et al., 1998; *Livest. Prod. Sci. 55:279*). Injection point was marked with a surgery clamp and pigs radiographed at 0, 7, 15, 30, 45, 90 and 180 d post-injection. Management system did not affect PIT performances. Readability did not vary by PIT size but was greater (P<0.05) for EB (93.6%) than other injection sites (CA, 59.6%; AR, 79.2%; and, SH, 74.5%). Only values in AR and SH did not differ. Up to 80% of unreadable PIT occurred during the first month in all injection sites. Migration distances were in all cases shorter than needle length (60 × 4.8 mm) and varied according to PIT size and injection site (P<0.05), and averaged: EB, 8.9 1.6; CA, 3.7 0.8; AR, 20.5 3.4; and, SH, 16.7 8.6 mm. Difficulties of PIT location at slaughter were very variable and no significant effects were reported in recovery time from the carcass (EB, 78; CA, 107; AR, 166; and, SH, 105 s). No recovery time was compatible with the average speed of swine commercial abattoirs. We conclude that no subcutaneous injection is recommended in the electronic identification of pigs for any of the body sites evaluated.

Key Words: Transponder, Migration, Electronic identification

M91 Sex effect on performance and carcass quality of heavy pigs. J. Peinado*[1], A. Fuentetaja[2], M. A. Latorre[3], G. G. Mateos[3], and P. Medel[1], [1]*Imasde Agropecuaria, S.L., Spain,* [2]*COPESE, S.A., Spain,* [3]*Universidad Politécnica de Madrid, Spain.*

A total of 150 Pietrain*Large White x Landrace*Large White pigs of 23.3 ± 1.6 kg of initial BW was used to study the influence of sex (castrated males, CM; castrated females, CF; entire females, EF) on

productive perfomance and carcass quality. Each treatment was replicated five times (10 pigs housed together). Males were castrated at birth and females at 75 d of age, and all the pigs were slaughtered at 120 kg BW. Feeding program was common for all the pigs and consisted of three commercial diets offered *ad libitum* (2.3 Mcal NE/kg and 0.97 % lys from 30 to 65 kg BW, 2.4 Mcal NE/kg and 0.70 % lys from 65 to 95 kg BW, and 2.4 Mcal NE/kg and 0.67 % lys from 95 kg BW to slaughter). From 30 to 65 kg BW, CF grew slower than CM, with EF showing an intermediate value (782, 710, and 761 g/d for CM, CF, and EF, respectively; $P < 0.05$). However, from 65 to 95 kg BW, there was a compensatory growth and CF tended to grow faster than EF ($P < 0.10$). For the whole period, growth rate, feed intake, and feed conversion were 830, 836, and 783 g/d ($P < 0.10$); 2,507, 2,330, and 2,176 g/d ($P < 0.05$); and 3.02, 2.79, and 2.78 g/g ($P < 0.05$) for CM, CF, and EF, respectively. Castrated females had more backfat (24.5, 22.4, and 25.2 mm for CF, EF, and CM, respectively; $P < 0.05$) and fat thickness at *Gluteus medius* than EF (22.7, 19.7, and 21.1 mm for CF, EF, and CM, respectively; $P < 0.05$). Besides, the percentage of pigs with a fat thickness equal or greater than 20 mm at the *Gluteus medius* was 72, 53, and 72 % for CF, EF, and CM respectively. In addition, loin yield was greater for EF than for CM (6.9, 6.7, and 6.6 % for EF, CF and CM, respectively; $P < 0.05$). It is concluded that castration of females improves productive traits and that castrates of both sexes produce carcasses that are adequate for the production of heavy pigs destined to the dry-cured ham and loin industry.

Key Words: Pigs performance, Castration, Carcass quality

M92 Effect of sex, castration, and slaughter weight on pork quality. J. Peinado*[1], J. Guirao[2], M. Nieto[3], G. G. Mateos[4], and P. Medel[1], [1]*Imasde Agropecuaria, S.L., Spain,* [2]*Estación Tecnológica de la Carne de Guijuelo, Spain,* [3]*COPESE, S.A., Spain,* [4]*Universidad Politécnica de Madrid, Spain.*

A total of 240 Pietrain*Large White x Landrace*Large White pigs of 60.5 ± 6.2 kg of initial BW were used to study the influence of sex and slaughter weight (SW) on meat quality. A completely randomized design was used, with six treatments arranged factorially with three sexes (castrated males, CM; castrated females, CF; entire females, EF) and two SW (114 kg; 122 kg). Each treatment was replicated four times (ten pigs housed together). Males were castrated at birth and females at 75 d of age. Pigs had free access to a feed based on barley, wheat, and soybean meal and were sacrificed in a commercial slaughterhouse following routine procedures. At 45 min postmortem, *longissimus* muscle samples were obtained at the last rib level from five pigs per each replicate and stored at 20°C until further analysis. Crude protein of loins was higher for EF than for CM (23.5, 23.0, and 23.3 % for EF, CM, and CF, respectively; $P < 0.05$). Castrated males and females had more intramuscular fat than EF (5.3 *vs* 4.3 %; $P < 0.05$). Protein and fat content of the loin were not affected by SW. Defrosting losses were greater for EF and CF than for CM (10.10, 10.05, and 8.25 %; $P < 0.05$), but no differences were found for dripping or cooking losses. Shear force tended to be higher for older pigs than for younger pigs (Warner-Bratzler values of 5.99 and 5.52 kp, respectively; $P < 0.10$). Meat from females had greater L* (48.04 *vs* 45.64; $P < 0.05$) and b* (9.85 *vs* 8.86, respectively; $P < 0.05$) values than meat from males but meat color was not affected by SW. Subcutaneous fat from EF had higher percentage of linoleic acid than subcutaneous fat from CM, with CF in an intermediate position (14.65, 13.50, and 12.75 % for EF, CF, and CM, respectively; $P < 0.05$). It is concluded that castration of both males and females improves quality of meat over EF. Therefore, castrated animals are preferred for production of heavy pigs destined to the dry-cured ham and loin industry.

Key Words: Pork quality, Sex, Slaughter weight

M93 Influence of sex and castration of males and females on performance and carcass quality of pigs. J. Peinado*[1], G. G. Mateos[2], A. Fuentetaja[3], J. Snchez[1], and P. Medel[1], [1]*Imasde Agropecuaria, S.L., Spain,* [2]*Universidad Politócnica de Madrid, Spain,* [3]*COPESE, S.A., Spain.*

A total of 200 Pietrain*Large White x Landrace*Large White pigs of 23.3 ± 1.4 kg of initial BW was used to study the influence of sex and castration (castrated females, CF; entire females, EF; castrated males, CM; entire males, EM) on productive performance. Each treatment was replicated five times (10 pigs housed together). Males were castrated at birth and females at 75 d of age. All pigs, except CM, were slaughtered at 105 kg BW and the effect of treatment on carcass quality was studied. The feeding program was common for all treatments and consisted of three diets: 2.3 Mcal NE/kg and 0.97 % lys from 30 to 65 kg BW, 2.4 Mcal NE/kg and 0.70 % lys from 65 to 95 kg BW, and 2.4 Mcal NE/kg and 0.67 % lys from 95 to 105 kg BW. Performance of females was penalised by castration in the first 15 d period following surgery, but the pigs recovered and showed a compensatory growth at the end of the trial. Castrates of both sexes grew faster (877, 868, 813, and 807 g/d for CM, CF, EM, and EF, respectively; $P < 0.05$) and tended to have poorer feed conversion (2.62, 2.55, 2.46, and 2.50 g/g for CM, CF, EM, and EF respectively; $P < 0.10$) than entires. Females had more carcass yield and fat thickness at *Gluteus medius* than entire males (75.1, 75.1, and 74.5 %, and 16.42, 16.58, and 14.87 mm for CF, EF, and EM, respectively; $P < 0.05$). Ham and loin yields were greater for EF than for EM, with intermediate values for CF (26.63, 26.12, and 26.54 % and 6.87, 6.59, and 6.82 % for ham and loin yields in EF, EM, and CF, respectively; $P < 0.05$). In conclusion, castrated pigs, both males and females grew faster and tended to have poorer feed conversion than entire pigs. Percentage of carcass fat was greater for castrated than for entire pigs.

Key Words: Pig performance, Sex, Carcass quality

M94 Effect of sex, castration and slaughter weight on pig performance and carcass. P. G. Lawlor*[1], P. B. Lynch[1], J. Kerry[2], and P. Allen[3], [1]*Teagasc, Moorepark, Fermoy, Co. Cork, Ireland,* [2]*Dept. of Food Technolgy, University College, Cork, Ireland,* [3]*National Food Centre, Ashtown, Dublin 15, Ireland.*

The aim of this study was to examine the effect of sex and slaughter weight on performance and carcass in pigs of a lean genotype. Ninety single sex pairs of pigs (Meatline Landrace sire on Landrace X Large White sows) were used in a 3 (sex) X 5 (slaughter weight) factorial design with 6 pairs per treatment. The experimental period was from weaning (mean = 26 days; 7 kg) to slaughter. Sexes were boar (B), castrate (C) and gilt (G), and the slaughter weights were 80, 90, 100, 110 and 120 kg liveweight. All pigs were fed the same diets based on wheat, barley and soybean meal ad libitum as dry pellets. Nutrient content of the diets were 14.5 MJ/kg digestible energy (DE) and 13.0 g/kg total lysine (LYS) from weaning to 15 kg; 14.1 MJ/kg DE and 13.0 g/kg LYS from 15 to 30 kg and 13.5 MJ/kg DE and 11.0 g/kg LYS from 30 kg to slaughter. Sex X slaughter weight interaction effects were not significant (NS; $P>0.05$). Daily weight gain and feed conversion ratio (FCR) were 748, 756 and 712 g (s.e. 10, NS) and 2.28, 2.49 and 2.46 (s.e. 0.03; $P<0.01$) for B, C and G, respectively. Backfat depth, muscle depth and carcass lean meat content (by Hennessy Grading Probe) were 12.2, 13.5 and 12.4 mm (s.e. 0.4; $P<0.05$); 55.9, 57.0 and 58.0 mm (s.e. 1.1; NS) and 579, 582 and 591 g/kg (s.e. 6, NS) for B, C and G, respectively. Daily weight gain and feed conversion ratio (FCR) for slaughter weights were 715, 737, 756, 737 and 748 g (s.e. 14, Linear effect (Lin) - $P=0.09$; Quadratic effect (Quad) - $P = 0.09$) and 2.24, 2.39, 2.41, 2.48 and 2.55 (s.e. 0.04; Lin - $P<0.01$) for 80, 90, 100, 110 and 120 kg, respectively. Backfat depth, muscle depth and carcass lean meat content were 11.2, 11.9, 13.0, 13.8 and 13.5 mm (s.e. 0.5; Lin - $P<0.01$; Quad - $P=0.09$); 52.1, 55.3, 58.4, 62.4 and 57.8 mm (s.e. 1.4; Lin - $P<0.01$; Quad - $P<0.01$) and, 55.3, 585, 588, 587, 592 and 568 g/kg (s.e. 7, Lin - $P=0.11$; Quad - $P<0.05$) respectively.

Key Words: Castration, Slaughter weight, Carcass

M95 Effects of feeding blends of grains naturally-contaminated with *Fusarium* mycotoxins on antibody-mediated immune response and brain neurochemistry in starter pigs. H.V.L.N. Swamy*[1], T. K. Smith[1], E. J. MacDonald[2], N. A. Karrow[1], and H. J. Boermans[1], [1]*University of Guelph, Guelph, ON, Canada,* [2]*University of Kuopio, Kuopio, Finland.*

An experiment was conducted in starter pigs to: (1) determine the effect of feeding blends of grains naturally-contaminated with *Fusarium* mycotoxins on antibody titers to sheep red blood cells (SRBC) and brain neurochemistry, (2) to delineate direct and indirect effects of *Fusarium* mycotoxicoses on antibody titers to SRBC and (3) to test the efficacy of a polymeric glucomannan mycotoxin adsorbent (GMP, MTB-100, Alltech Inc.) in preventing *Fusarium* mycotoxicoses. A total of 150 starter pigs (initial weight of 9.3 kg) were fed 5 diets (6 pens of 5 pigs per diet) for 21 days. Diets included: (1) control (2) a blend

of 17blend of 24.5group for comparison with the group fed 24.5of contaminated grains in the diet increased linearly the ratio of hypothalamic 3,4-dihydroxyphenylacetic acid to dopamine (DA) concentrations and cortex 5-hydroxytryptamine (5HT) concentrations, while hypothalamic norepinephrine and tryptophan, and pons DA and homovanillic acid concentrations were linearly decreased. Hypothalamic and pons 5-hydroxyindoleacetic acid to 5HT ratios responded quadratically to the inclusion of contaminated grains. The feeding of contaminated grains did not alter primary antibody response to SRBC but further studies on the secondary antibody response are warranted. It was concluded that the major effect of feeding *Fusarium* mycotoxin-contaminated grains to pigs is to alter brain neurochemistry.

Key Words: Antibody-mediated immune response , *Fusarium* mycotoxins, Neurochemistry

Nonruminant Nutrition

M96 Effect of dietary supplementation of 1% L-glutamine on the intestinal morphology of early weaned piglets 14d and challenged with transmissible gastroenteritis virus. H. Herrera*[1], A. G. Borbolla[1], H. Ramirez[1], and G. Mariscal[2], [1]*Universidad Nacional Autonoma de Mexico,* [2]*INIFAP CENID Fisiologia*.

The aim of this work was to determine the effect of dietary supplementation of L-glutamine (Gln) on villous height (VH) and crypt depth (CD) in three portions of the small intestine of piglets weaned at 14d and challenged with the transmissible gastroenteritis virus (TGV) after d4 of weaned (W). Weaned pigs (35) of 14d of age and weight of 4.660.2 Kg were used in this study. Thirty pigs were randomly assigned to two different treatments (tx): 1) 0% Gln and 2) 1% of Gln supplemented (1% Gln) and housed in 6 pens (3 pens of 5 animals per treatment), in facilities appropriate for the animal's age. The 5 remaining piglets were slaughtered on 0d (14d of age) to obtain VH and CD as baseline measures. Both groups received the same diet and a daily oral dose of water or 1% of crystalline L-Gln according to the amount of feed consumed the previous day. Feed intake was registered in a daily basis. On d4 after weaning, the piglets were oro-nasally inoculated with 1 $x10^6$ infective doses of TGV. On d5, 14 and 21, 5 pigs by tx were slaughtered with pentobarbital to measure VH and CD. The samples were included in paraffin for a later histological evaluation. Ten villous samples of each intestine portion were measured with a graduated ocular (1mm/100). Comparisons were made in time between animals in the same treatment versus the baseline measures. Of each pig, 10 cm of the middle jejunum was sampled to isolate the virus and blood serum to detect antibodies with a Kit ELISA. In the jejunum of all the inoculated pigs the TGV was isolated but antibodies were not detected. In the duodenum of the 1% Gln group, the VH was smaller ($P<0.05$) at 5d than 0d (450 vs. 258, 389 and 409 m for 0,5,14 and 2d W). In jejunum the tx 1% Gln showed an atrophy of 61 and 33% ($P<0.05$) the 5 and 14 vs 0d (456 vs 177, 303 and 445 m), while tx 0% Gln the atrophy it was of 36% ($P<0.05$) in the 5 and 14 d (456 vs 288, 287 and 527 m). Atrophy in ileum for tx 1%Gln were 24 and 18% ($P<0.05$) the 5 and 14 d (268 vs. 202, 219 and 297 m), and in tx 0% it was 30 and 16% ($P<0.05$) in the same period (268 vs. 187 and 225 and 265 m). The supplementation of 1% Gln doesn't prevent the atrophy of the villous during the first five days of viral challenge, but it accelerates the recovery of the intestinal damage caused by the virus and the effect of the weaning.

Key Words: Glutamine, Wean, Small intestine

M97 Effects of levels of organic acid complex and lactose in starter diet on growth performance and intestinal environments of weaned pigs. Y. W. Shin*, J. G. Kim, Y. H. Park, and K. Y. Whang, *Korea university, Seoul, Korea*.

A 2 x 3 factorial experiment in a randomized complete block design was conducted to evaluate the effects of lactose and organic acid complex consisted of butyrate, formate, lactate and phosphoric acid on growth performance and intestinal environments for 21 d after weaning. A total of 360 weaned pigs were used. The dietary treatments were: 1) high level of lactose (HL) + 0% organic acids, 2) HL + 0.15% organic acids, 3) HL + 0.30% organic acids, 4) low level of lactose (LL) + 0% organic acids, 5) LL + 0.15% organic acids and 6) LL + 0.30% organic acids. Feed intake and body weight of pigs were measured at d 0, d 7 and d 21. Five pigs per treatment were sacrificed at d 0, d 3, d 7 and d 21 for sampling of intestinal digesta, ileal tissues and blood. The ADG and ADFI were numerically higher in treatment 2 than other treatments. Feed efficiency in treatment 3 tended to be higher than other treatments during the entire experimental period. But no significant difference was observed. Pigs fed diets containing organic acid complex and high level of lactose showed better performance, in general, but it was not significantly different. The digesta pH was not different among treatments at d 3 and d 7. At d 21, treatment 3 had a higher pH of jejunal digesta ($P < 0.1$). Treatments 3 and 2 also showed a higher leukocyte counts at d 3 and d 21 than other treatments, respectively ($P < 0.1$ and $P < 0.05$). In gastrointestinal microbiology, there was no favorable effect of organic acids and lactose supplementation except decreased number of coliform bacteria in treatment 3 at d 21 ($P < 0.1$). Villus height and crypt depth were not different among treatments but villus height:crypt depth ratio was higher in treatments 2 and 5 at d 7 ($P < 0.1$). These results suggest that organic acid complex and lactose have no interactive effect on growth and intestinal environments in weaned pigs.

Key Words: Pigs, Organic acid, Lactose

M98 Bone mineral content gain is reduced in weaned pigs fed diets with low-buffer capacity and organic acids. G. Biagi*[1], A. Piva[1], T. D. Hill[2], D. K. Schneider[2], and T. D. Crenshaw[2], [1]*University of Bologna, Italy,* [2]*University of Wisconsin, Madison, WI*.

Consumer preferences continue to pressure reliance on sub-therapeutic use of antibiotics in swine diets. Current experiments were designed to evaluate diet buffer capacity and use of organic acids for their potential to maintain growth and bone status during the most problematic period of nutritional management, immediately after weaning. Three trials were conducted using either all 6 (Trial 1) or a subset (Trial 2 and 3) of 6 dietary treatments. Treatments were: 1) Control, complex diet with plasma protein and carbadox; 2) Plant protein, high-buffer diet; 3) Plant protein, low-buffer diet; 4) Diet 3 + 1% citric acid; 5) Diet 3 + 1% fumaric acid; 6) Diet 3 + 0.2% Tetracid 500 (a protected combination of organic acids, JEFAGRO Technologies Inc.). No antibiotics were added to Diets 2 through 6. Reduced buffer capacity involved shifts in sources (tricalcium phosphate and calcium sulfate) and concentrations of Ca and P (0.75% Ca, 0.81% P, diet 2; 0.50%Ca, 0.65% P, diet 3) previously shown to reduce undesired gut microbes. In trial 1, 96 pigs (PIC Cambrough X Line 19) were weaned (3 wk) and randomly allotted to diet groups for a 6 wk trial (Phase I, 6 diets, 14 d; Phase II, 6 diets, 14 d; Phase III, common diet, 14 d). In Phase I, pigs fed Control diets gained faster and more efficiently ($P < 0.01$) than those fed other diets, but no differences were detected ($P > 0.10$) in growth or efficiency among groups during Phase II or III. Duration of Trials 2 and 3 were 28 d and only diets 2, 3, 5 and 6 were included. On d 0 and 28 of Trials 2 and 3, 30 barrows were scanned by dual energy x-ray absorptiometry (DXA), and bone mineral content gain (BMC) was calculated. Pigs fed low-buffer diets and organic acids had 50% lower ($P < 0.01$) daily BMC gain (adjusted for differences in weight gain) over 28 d (10.8, 6.2, 4.8, and 5.6 g BMC/kg weight gain for pigs fed diets 2, 3, 5 and 6 respectively. The long-term consequences of feeding low-buffer diets and organic acids were not assessed in these trials.

Key Words: Bone, Buffer, Antibiotics

M99 Effects of feeding antibiotics versus mannanoligosaccharides on the growth performance of weanling pigs. J. Pulliam*, R. Clift, S. Chattin, and A. G. Mathew, *The University of Tennessee, Knoxville TN USA*.

To compare effects of the Carbadox and a mannanoligosaccharide product on performance, a total of 48 crossbred (Yorkshire × Landrace × Duroc) pigs were weaned at approximately 21 days of age and blocked by gender, genetics, and weight. Pigs were randomly assigned to one of 4 treatments with each treatment consisting of 3 pens and 4 pigs per pen. Treatments included 55 mg Carbadox/kg of feed, 0.4% Bio-Mos® (mannanoligosaccharide) in the feed, a rotation of the above two treatments,

or an NRC based control diet with no growth promoting additives. Each group was allowed ad libitum access to water and the assigned treatment as a single phase diet. Pens were used as the experimental units. Performance parameters, including average daily gain, average feed intake, and feed conversion ratio, were measured for a 28-day period and compared across treatments. Feed intake and feed conversion ratio were measured for individual pens. No treatment effects (P≥.05) were noted for any of the growth parameters measured. Although not significant, the Bio-Mos® treatment produced a numerically higher weight gain and lower feed consumption, which resulted in an improved feed conversion ratio when compared to the other treatments. These data indicate that growth performance parameters were not significantly affected by the addition of Carbadox or mannanoligosaccharides in the diet. It is possible that the lack of statistical differences was due to the controlled environment of the experiment, which may have reduced the level of disease challenge presented to the pigs and thereby reducing the intensity of growth promoting benefits. Further research will be necessary to determine the potential for mannanoligosaccharides as an effective growth-promoting alternative to antibiotics.

Key Words: Antibiotics, Mannanoligosaccharides, Pigs

M100 Effects of antibiotics versus mannanoligosaccharides on intestinal pH and volatile fatty acid concentrations in weanling pigs.

J. Pulliam*, R. Clift, S. Chattin, and A. G. Mathew, *The University of Tennessee, Knoxville TN USA*.

Three replicate trials with a total of 36 ileal cannulated pigs were conducted to observe intestinal pH and volatile fatty acid (VFA) concentrations. Individual pigs were used as the experimental units and were weaned at approximately 21 days of age, blocked by gender, genetics and weight, and allotted to pens in groups of three. Pens were randomly assigned to one of four treatments including: 55 mg Carbadox/kg, 0.4% Bio-Mos® (mannanoligosaccharide), a rotation of the above two treatments, or an NRC based control treatment with no additives. Pigs were allowed ad libitum access to water and the assigned treatment as a single-phase diet for a 35day period. Ileal digesta were collected on days 14, 21, 28, and 35 of the trial. Pigs were sacrificed on day 35 and digesta were collected from the duodenum, jejunum, ileum, cecum, and spiral colon. Digesta were analyzed for pH and VFA including: Acetate, Propionate, Butyrate, Valerate, Isovalerate, and Isobutyrate. Intestinal pH of the Carbadox treatment was more alkaline and the Control treatment was more acidic when treatments were compared (P=.0017). A site effect (P=.0001) was also observed where the ileum was more alkaline and the cecum more acidic. Treatment effects were noted for ileal Butyrate (P=.0001) and Acetate (P=.0174) where Acetate and Butyrate concentrations were greater in the ileum for the Carbadox and Rotation treatments compared to the Bio-Mos® and Control treatments (P≤.05). Time (day) affected ileal Isovalerate (P=.0113), Butyrate (P=.0001), and Acetate (P=.0001) concentrations. A site effect (P≤.05) was observed for all VFA concentrations. Treatment × site interactions were observed (P=.0297) for Valerate concentrations. These data indicate that dietary additives affected intestinal pH and VFA concentrations.

Key Words: Mannanoligosaccharides, pH, VFA

M101 Use of probiotics in the diet of weanling and growing pigs.

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Sixty crossbred pigs (6 kg BW and 21 d of age) were used to evaluate the efficacy of probiotics containing *Lactobacilli* on growth performance and fecal microflora. Pigs were randomly assigned to receive one of four treatments: (a) control diet with antibiotics (CA); (b) control diet without antibiotics and supplemented with 0.2% probiotics in feed alone, (PBF); (c) control diet without antibiotics and supplemented with 0.2% probiotics in the feed and 0.1% in water (PBFW); and (d) control diet without antibiotics and supplemented with 0.1% probiotics in water alone (PBW). Diets were fed from d 0 to 56 after weaning. Pig body weights and feed intake were measured biweekly to determine growth and feed efficiency. Fecal grab samples were collected weekly and dissolved in anaerobic diluents and analyzed for lactic acid bacteria and *Escherichia coli*. From d 0 to 56, ADG, ADFI, and gain:feed ratio of pigs fed the CA diet were not different (P > 0.05) from those pigs fed PBF, PBFW, and PBW. Colony forming units (CFU) of lactic acid bacteria of pigs fed the CA diet were not different (P > 0.05) from CFU in pigs fed PBF, PBFW, and PBW from d 0 to 14. Colony forming units of lactic acid bacteria were higher (P < 0.06) at d 21 in pigs fed PBF and PBFW and higher (P < 0.03) at d 28 in pigs fed PBF than CFU in pigs fed the CA diet. From d 0 to 28, *Escherichia coli* CFU of pigs fed PBF, PBFW, and PBW were not different (P > 0.05) from CFU in pigs fed the CA diet. From d 35 to 56, CFU of lactic acid bacteria of pigs fed the CA diet were not different (P > 0.05) from CFU in pigs fed PBF, PBFW, and PBW. Colony forming units of *E. coli* were higher (P < 0.001) at d 35 in pigs fed the CA diet than CFU in pigs fed PBF and PBFW. *Escherichia coli* CFU were higher (P < 0.06) at d 42 in pigs fed PBW than CFU in pigs fed PBF and PBFW and the CA diets. The results indicate that probiotics containing *Lactobacilli* can be supplemented without antibiotics in diets of weanling and growing pigs at a rate of 0.2% in feed and 0.1% in water without negatively affecting growth performance. Also, fecal microflora can be affected by the inclusion of probiotics during different stages of the growth period.

Key Words: Probiotics, Growth, Fecal microflora

M102 Dietary supplementation with botanical compounds depresses piglet feed intake while fecal E. coli counts remain unchanged.

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A four week trial was carried out at the "De Schothorst" Institute for Animal Nutrition Lelystad (The Netherlands) to study the effect of feed supplementation with botanical compounds on the performance and fecal content of E. coli in weanling piglets. 300 piglets weaned at 26 days of age with an initial body weight of 8 kg were randomly allotted in five experimental treatments of 10 replicates (pens) with 6 piglets per pen. The experimental treatments were: T0 (control, no growth promoter), T1 (500 ppm cinnamaldehyde), T2 (30 ppm carvacrol), T3 (40 ppm salvia dalmacia) and T4 (400 ppm cinnamaldehyde + 10 ppm capsicum). The piglets received a phase 1 diet during week 1-2 and a phase 2 diet during week 3-4 post weaning based on wheat, barley, soybean meal and milk products and did not contain any antibiotic growth promoting substances. Feed and water were offered ad libitum. Weights of piglets and feed intake per pen were recorded at day 0, 14 and 28 of the trial. Average daily gain (g/d), daily feed intake (g/d) and feed conversion were calculated for each phase and for the whole trial. Fresh rectal samples of two piglets per pen from six replicates of each treatment were taken at 14 days post weaning. Samples were pooled per pen and analysed for E.coli (log cfu/g). Daily feed intake and average daily gain of piglets fed with diets supplemented with botanical compounds were between 2 and 10% lower as compared to the control group. Decreases were statistically significant (p<0.05) for feed intake of T1 group during phase 1 (332 vs 300) and T3 group during phase 2 (832 vs 767) and overall (574 vs 526) as well as for average weight gain of T3 for the overall period (392 vs 357). Furthermore, botanical compounds supplementation did not significantly change (p>0.05) the number of colony forming units of E. coli in the feces (from 7.1 to 7.9 log cfu/g).

Key Words: Weanling piglets, Botanical compounds, E. coli

M103 Plant extracts enhance performance in broilers under Clostridium perfringens challenge.

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Many plant extracts have been reported to improve animal performance and well-being especially under dietary or other enteric stressors. A pilot challenge model to reproduce necrotic enteritis (NE) from Clostridium perfringens inoculation in broiler chickens was commissioned to evaluate a commercial product standardized in the active substances from capsicum, cinnamon and origanum extracts (XTRACT Code 6990, Canadian registration 982063). A total of 162 animals were randomly allotted to 3 floor pens of 18 birds each for three treatments of a commercial diet differing only with the inclusion of XTRACT at 150 ppm or 300 ppm. C. perfringens broth was administered via feed with approximately 10e7 cfu per ml at 14 days of age. Feed intake and growth were measured at day 1, 14 and 21. Mortality was recorded daily and necrotic enteritis lesion score was recorded at day 17 for five randomly selected animals from each pen. Raw data means were analysed by Analysis of Variance. In general, the NE challenge was successful, resulting in post-challenge NE mortality (14-21 days) ranging from 22.2% to 44.5%. Broilers on XTRACT at 300 ppm and 150 ppm showed significantly

(P<0.05) heavier liveweights in comparison to the control over the 1-14 days-of-age (XTRACT 300 ppm: 390 grams; XTRACT 150 ppm: 317 grams; control diet: 303 grams). Over the entire period, broilers fed the XTRACT at 300 ppm diet were 22% heavier (P<0.05) than the XTRACT at 150 ppm and control diets (XTRACT 300 ppm: 763 grams; XTRACT 150 ppm: 593 grams; control diet: 593 grams). Feed conversion ratio was similarly improved (XTRACT 300 ppm: 1.55; XTRACT 150 ppm: 1.72; control diet: 1.78). NE-mortality from days 14-21 was significantly reduced in the XTRACT at 300 ppm diet (XTRACT 300 ppm: 22.2%; XTRACT 150 ppm: 44.5%; control diet: 38.9%). Lesion score was unaffected by diet. In this study, broilers on XTRACT at 150 ppm showed improvements intermediate to those on XTRACT at 300 ppm and the control diet during the pre-challenge period, but did not maintain their advantage when challenged with Clostridium perfringens. The XTRACT at 300 ppm diet provided the most improvement (P<0.05) in broiler performance both before and after challenge with Clostridium perfringens.

Key Words: Plant extracts, Broilers, Necrotic enteritis

M104 The effects of herbal plant mixture(MIRACLE 20® supplementation on the growth performance, nutrient digestibility and serological changes in finishing pigs. O. S. Kwon*[1], I. H. Kim[1], J. W. Hong[1], J. H. Kim[2], Y. M. Seol[3], B. J. Min[1], W. B. Lee[1], and K. S. Son[1], [1]*Department of Animal Resource & Science, Dankook University,* [2]*Agribrands Purina Korea, Inc,* [3]*Hanpel tech. co. Ltd.*

The objective of this study was to determine the effect of an herbal plant mixture(containing *Angelica gigas* Nakai, *Rehmannia glutinosa* Liboschitz, *Cnidium officinale*, Glycyrrhizae glabra, *Schizandra chinensis* and *Dioscorea japonica* Thunberg, MIRACLE 20®) supplementation on the growth performance, nutrient digestibility, serological changes and carcass characteristics in finishing pigs. Eighty crossbred [(Duroc × Yorkshire)×Landrace] pigs (81.58kg average initial BW) were used in a 45d growth assay. Dietary treatments included 1) NC (negative control; antibiotics-free diet), 2) PC (positive control; NC diet added 0.1% of chlortetracycline), 3) HPM (NC diet added 0.1% of herbal plant mixture), and 4) PHPM (PC diet added 0.1% of herbal plant mixture). There were four pigs per pen and five pens per treatment. Experimental diets were formulated to contain 3,365Kcal/kg of DE, 14.80% of CP, 0.89% of lysine, 0.74% of Ca and 0.54% of P for the finishing pigs. ADG was significantly increased in PC and HPM treatments compared with NC treatment(P<0.05). ADFI and G/F were higher in pigs fed herbal plant mixture and antibiotics than pigs fed antibiotic-free diet with no significant differences(P>0.05). Backfat thickness was not significantly different among the treatments(P>0.05). Digestibility of DM and N were not affected by the herbal plant mixture supplementation. There were no significant differences in total protein, albumin and IgG(P>0.05). In conclusion, PC and HPM treatments improved ADG compared to antibiotics free diet.

Key Words: Herbal plant mixture, Pigs, Performance

M105 Effect of feeding germanium biotite on growth performance, nutrient digestibility and serum characteristics in nursery pigs. W. B. Lee*[1], I. H. Kim[1], J. W. Hong[1], O. S. Kwon[1], B. J. Min[1], K. S. Son[1], and Y. K. Jung[2], [1]*Department of Animal Resource & Science, Dankook University,* [2]*SEOBONG BioBestech Co., Ltd.*

The objective of this study was determined the suitability of germanium biotite as a dietary supplement on growth performance, nutrient digestibility and serum characteristics in nursery pigs. A total of seventy five pigs (intial body weight 21.18 ±0.15kg) were used in this experiment. This study was carried out for 21 days. The five treatments were control (CON, basal diet), GB0.5-200 (basal diet + 0.5% germanium biotite, 200mash), GB1.0-200 (basal diet + 1.0% germanium biotite, 200mash), GB0.5-325 (basal diet + 0.5% germanium biotite, 325mash) and GB1.0-325 (basal diet + 1.0% germanium biotite, 325mash). Each treatment had five replicates with three pigs per replicate. For overall period, average daily feed intake and gain/feed were not significantly different among the treatments (P>0.11). However, pigs fed GB1.0 diets had higher average daily gain than pigs fed GB0.5 diets with significant difference(P<0.03). Dry matter tended to increase as the particle size and dietary supplement of germanium biotite in the diet was increased. N and Ca digestibility were significantly different among the treatments (P<0.01). Supplementing germanium biotite in the diet reduced the fecal NH_3-N concentration. The fecal NH_3-N and butyric acid tended to increase as the particle size of germanium biotite in the diet was decreased (P<0.01). RBC and WBC were significantly different among the treatments (P<0.03). In conclusion, supplementing germanium biotite in diets for nursery pigs reduced fecal noxious gases.

Key Words: Germanium biotite, Performance, Pigs

M106 Effect of dietary green tea on productivity and egg composition in laying hens. C. J. Yang*[1], D. Uuganbayar[1], S. S. Sun[2], and J. D. Firman[3], [1]*Sunchon National University, Suncheon, Korea,* [2]*Chonnam National University , Chonnam, Korea,* [3]*University of Missouri, Columbia, MO.*

This experiment was designed to evaluate the effects of green tea on productivity and egg composition in laying hens. One hundred eighty Brown Tetran layers (40 weeks old) were randomly allotted to 6 treatments (control, antibiotics, green tea .5%, 1%, 1.5% and 2% supplementation) groups and 5 replications per treatment. Diets were formulated to provide a minimum of 15% CP and 2750 kcal/kg ME. Diets were fed in mash form, and feed and water offered ad libitum. The control diet was based on a corn-soybean meal mixture. Hen-day egg production, egg weight, egg mass, feed intake, FCR and egg shell thickness were determined every week. Five eggs from each treatment were selected for egg quality, egg yolk cholesterol, TBA value and fatty acid composition analysis. Hen-day egg production was not affected by dietary green tea supplementation (P > .05). The egg weight and egg mass were reduced in green tea .5% treatment (P < .05). The feed intake was increased in 1% and 1.5% of green tea treatments. Egg shell thickness was reduced significantly in all treatment groups (P < .05). The egg yolk cholesterol content was decreased significantly in 2% green tea treatments (P < .05). The value of TBA in egg yolk was reduced in 2% of green tea supplementation compared to control (P < .05). The yellowness of egg yolk was increased in dietary supplementation of 2% green tea (P < .05). There were no significant differences in juiciness, texture and overall acceptability of the eggs (P > .05). Palmitic acid content in eggs was increased in 1.5% green tea treatment but other fatty acids were not affected by any level of green tea treatment. These results indicate that dietary supplementation of 1 to 2% green tea didn't have negative effects on laying performance but dietary supplementation 2% of green tea could reduce the egg yolk cholesterol and increase the yellowness of egg yolk.

Key Words: Laying hens, Green tea, Egg yolk cholesterol

M107 Effect of dietary Korean, Japanese and Chinese green tea on growth performance and body composition in broiler chicks. C. J. Yang*[1], D. Uuganbayar[1], K. Sayama[2], N. Ishihara[3], and I. S. Shin[4], [1]*Sunchon National University, Suncheon, Korea,* [2]*Shizuoka University, Shizuoka, Japan,* [3]*Central Research Laboratories, Taiyo Kagaku, Japan,* [4]*American Soybean Association, Seoul, Korea.*

The objectives of this study were to determine the effect of Korean, Japanese and Chinese green tea on growth performance and body composition in broilers. One hundred sixty eight (1-day old) Ross broiler chicks were randomly allotted to 7 treatments with 4 replications (6 chicks per replication) and raised in battery cages. The seven dietary treatments were negative control (without antibiotics) and positive control (basal + .1% chlortetracycline) and 5 experimental diets (basal + .5% Korean green tea (KGT), (basal + 1% KGT, (basal + 1.5% KGT, (basal + 1.5% Japanese green tea (JGT) and (basal + 1.5% Chinese green tea (CGT), respectively. Basal and experimental diets were formulated to meet 23% CP and 3.2 Mcal/kg of ME. The basal diet was based on a corn-soybean meal mixture. Diets were fed in mash form, and feed and water offered ad libitum. The body weight gain was reduced slightly in broilers fed diets containing green tea supplements compared to antibiotics diet (P < .05) but it was no significantly different compared to control (P > .05). The feed intake was decreased significantly for KGT 1.5% (P > .05) but not consistent in other treatments. Feed conversion ratio was not significantly different between both 1.5% KGT and JGT and antibiotics diets. Also, there were no significant differences in the feed intake among treatments with 0.5% KGT, 1.5% CGT and control (P > .05). Green tea from different origins didn't have effect on the vital organs weight (P < .05). The TBA content in chicken meat was sligtly decreased when fed diets containing different levels of

green tea but there were no significant differences between green tea and control group (P >.05). The cholesterol content in chicken meat was reduced significantly (P < .05) in green tea 1.5% treatments. There was observed no significant difference (P > .05) in plasma cholesterol content but it tended to decrease when increasing green tea levels in broiler diet. These results indicate that supplementation of green tea in broiler diet slightly reduces weight gain of chicks but decreases cholesterol content in broiler meat.

Key Words: Broiler, Green tea, Cholesterol

M108 Effect of Dietary Korean, Japanese and Chinese Green Tea on Productivity and Egg composition in Laying Hens.

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The objectives of this study were to determine the effect of Korean, Japanese, Chinese green tea on productivity and egg composition in laying hens. One hundred sixty eight Brown Tetran laying hens (40 week old) were randomly assigned to 7 treatment groups. Layers were located in battery cage and environmentally regulated closed house and given ad libitum access to feed and water. Treatments were a control of corn-soybean based diet (15% CP, 2765kcal/kg ME, 3.9% Ca, .24 Pavail) and three diets containing 1% and three diets included 2% Korean (KGT), Japanese (JGT) and Chinese (CGT) green tea respectively. Hen day-egg production, egg weight, eggs mass, feed intake, FCR and egg shell thickness were determined every 7 days. Five eggs from each treatment were selected for egg quality, yolk cholesterol, TBA value and fatty acid composition analysis. Hen day-egg production was increased significantly at 1 to 2% of green tea supplement (P < .05). The CGT 1% showed significant increase in egg production rate and significant decrease in egg weight compared to control (P < .05). There was observed not significant difference between egg masses of the layers fed green tea diets (P > .05). Feed intakes of 2% KGT, 2% CGT and 1% JGT diets were reduced significantly (P < .05). Egg shell thickness was decreased significantly in layers consuming diets containing JGT at both levels of inclusion (P < .05). Egg yolk cholesterol tended to decrease with green tea supplemented diets. The CGT in both level of inclusion reduced significantly egg yolk cholesterol content (P < .05). There were no significant differences in β and D-homo-r-linolenic acids in the egg yolk from different dietary groups (P > .05). These results indicated that dietary supplementation of green tea in layer diets had positive effects in egg production and reduction of egg yolk cholesterol.

Key Words: Green Tea, Laying hens, Egg yolk cholesterol

M109 Feeding seaweed extract to nursery pigs alters circulating thyroid hormones.

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Alternative feed additives that may have value in replacing traditional antimicrobials in swine diets have received increased attention in recent years. Extracts of the seaweed *Ascophyllum nodosum* (AN) have been evaluated in nursery pig diets, and show some promise in supporting pig growth performance in the absence of other antimicrobials in the diet. However, the extract of this seaplant is relatively high in iodine. Thus, we hypothesized that feeding the product might affect the concentration of circulating thyroid hormones. Weaned pigs (initial mean wt 6.4 kg) were housed in pens in an environmentally controlled nursery. Pigs were fed diets containing 0 (control, n = 6) or 2 % AN extract (n = 6) for 4 wk. After 14, 21, and 28 d on treatment diets, jugular blood samples were obtained and sera evaluated for triiodothyronine (T3) and thyroxine (T4) by radioimmunoassay. No treatment x day interaction was observed for either T3 or T4 (data in table), However, the overall concentration of T4 was increased (P < 0.05) in pigs fed AN (48.1 ± 1.6 ng/mL) compared to pigs fed the control diet (42.2 ± 1.6 ng/mL). In addition, there was a strong tendency (P < 0.06) for T3 to be elevated by feeding AN (994 ± 70 vs 789 ± 70 pg/mL). In summary, feeding AN at 2 % of the diet for 28 d elevated T4 by about 14 % and T3 by about 26 %. Although feeding AN at this level may have implications relative to the ability of pigs to respond to thermal challenge, this level of dietary AN inclusion is at least fourfold greater than the rate of inclusion found to maximize growth performance in weaned pigs.

	Day of Treatment			
	14	21	28	SEM
T3, pg/mL				
0%	778	812	776	43
2%	1,021	981	980	43
T4, ng/mL				
0%	37.1	45.4	44.0	2.9
2%	45.1	51.7	47.5	2.9

Key Words: Seaweed, Pigs, Thyroid hormones

M110 Effect of supplementing meal (Macrocystis pyrifera) to wheat based diets for weaning pigs.

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An experiment was conducted to evaluate the effect of adding kelp (Macrocystis pyrifera) meal on the performance, incidence of diarrhea, and mortality of recently weaned pigs. Sixty-four crossbred (Landrace-Hampshire-Duroc) piglets weaned at 18-21d (5.79 kg av. Initial body wt.) were randomly allotted to four dietary treatments. There were four replicates of four pigs per treatment; the trial lasted three weeks. Treatments were: T1) wheat-soybean meal-milk whey basal diet, T2) + .10% antibiotic, T3) + 2.0% kelp meal, and T4) + 4.0% kelp meal. All diets contained the same amount of milk whey and were added with vitamins and minerals to meet the requirements of pigs within the range of 5 to 10 kg. Weight gain, feed intake, feed conversion, incidence of diarrhea and mortality were: 180, 180, 180, 170 g/d; 220, 270, 250, 240 g/d; 1.31, 1.47, 1.40, 1.52; 11, 10, 11, 11 pigs; 18.8, 6.3, 12.5, 12.5%, for treatments T1 to T4, respectively. None of the performance variables evaluated in this trial and the incidence of diarrhea were affected (P>.10) by the addition of either the antibiotic or the kelp meal. But, the antibiotic and kelp meal reduced the mortality of piglets in 66 and 33%, respectively. Although the incidence of diarrhea was not affected, the difference in mortality indicates that the antibiotic and kelp helped to reduce the severity of diarrhea in these animals. Thus, these data may suggest that kelp may stimulate the baby pig immune system or that it partially protects the pigs against pathogens, but this effect is around 50% less effective than that of the antibiotic added to the diet at sub-therapeutical levels.

Key Words: Kelp meal, Weaning pigs, Performance

M111 Supplementation of kelp meal (Macrocystis pyrifera) to wheat based diets for growing pigs.

M. Cervantes*[1], E. Chi[2], J. Yañez[1], J. Baeza[2], N. Torrentera[1], and M.A. Barrera, [1]*Instituto de Ciencias Agrícolas, UABC,* [2]*Colegio de Postgraduados*.

An experiment was conducted to evaluate the benefit of adding kelp meal (Macrocystis pyrifera) to wheat-based diets for growing pigs. Twenty-eight pigs (22.0 kg av. Initial body wt.) were randomly allotted to four dietary treatments; seven replicates per treatment, according to a complete block design. Treatments were: T1) wheat-based diet containing 100% the requirement of lysine, threonine, and methionine, T2) as in T1, + 1.5% kelp meal, T3) wheat-based diet containing 120% the requirement of lysine, threonine, and methionine, T4) as in T3, + 1.5% kelp. Average weight gain; intake of feed, lysine, and threonine, and feed conversion were: 610, 697, 603, 688 g/d; 1.56, 1.66, 1.52, 1.61 kg/d; 14.8, 15.8, 17.3, 18.3 g/d; 14.9, 15.8, 18.6, 18.5 g/d; 2.54, 2.38, 2.57, 2.34, respectively. Dietary amino acid level did not affect (P>.10) daily weight gain or feed conversion, although it increased lysine intake. But, the addition of 1.5% kelp meal increased (P<.01) 14.5% the weight gain, regardless of the amino acid level in the diet. Also, kelp meal tended (P<.10) to improve 6.7 and 9.9% feed conversion, when diets contained 100 and 120% the amino acid requirements, respectively. The amino acid level or the addition of kelp to the diet did not affect feed intake. Lysine and threonine intakes were higher in pigs fed the 120% diets. Pigs fed the diet with 100% the amino acid requirements utilized lysine more efficiently than those fed the 120% diet. Also, the efficiency of lysine utilization was better when kelp was added to the diet. These results indicate that the 100% diet indeed supplied the total requirement of amino acids for growing pigs. Also, these data suggest that

kelp has one or more compounds that improve the availability and/or the efficiency of utilization of amino acids, and that it exerts a growth promoting effect on growing pigs.

Key Words: Kelp meal, Amino acids, Swine performance

M112 Effect of kelp (Macrocystis pyrifera) meal supplementation to wheat based diets for finishing pigs. J. Yañez[1], M. Cervantes*[1], F. Copado[2], N. Torrentera[1], J. L. Figueroa[2], and M. Barrera[1], [1]*Instituto de Ciencias Agrícolas, Universidad Autónoma de Baja California, México,* [2]*Colegio de Postgraduados, Montecillos, México.*

An experiment was conducted to assess the effects of adding kelp (Macrocystis pyrifera) meal to wheat-based diets on the performance of finishing pigs. Forty crossbred (Landrace-Hampshire-Duroc) finishing (63.6 kg av. initial wt.) pigs were randomly allotted to four dietary treatments; five replicates of two pigs (one male and one female) per treatment. The treatments were: T1) basal diet, wheat plus lysine and threonine, T2) + 1.5% kelp meal, T3) + 3.0% kelp meal, and T4) + 4.5% kelp meal. The basal diet was formulated with wheat and crystalline lysine and threonine to meet or exceed the requirements of all the essential amino acids; a vitamin and mineral premix was also added to the basal diet to meet the requirements for these pigs. Weight gain, feed intake, feed conversion, back fat thickness, and loin area were: 707, 813, 776, 751 g/d; 2.15, 2.24, 2.03, 2.23 kg/d; 2.83, 2.70, 2.48, 2.74; 2.55, 2.42, 2.18, 2.55 cm; 26.2, 26.7, 29.8, 26.3 cm^2, for treatments T1 to T4, respectively. Growth rate was 15.0% higher ($P<.05$) in pigs fed the diet added with 1.5% kelp meal, but no further effect was observed with higher levels. In fact, the daily gain in pigs fed the diets containing 3.0 and 4.5% kelp meal was similar to that of pigs fed the basal diet. Kelp meal did not affect ($P>.10$) feed intake. Feed conversion improved 12.8% with the addition of 3.0% kelp meal; no difference was observed between pigs fed the diet added with 1.5 or 4.5% kelp meal and those fed the basal diet. Also, back fat thickness was smaller ($P<.05$) and the loin area bigger in pigs fed the diet added with 3.0% kelp meal. These data suggest that kelp meal in diets based on wheat contains one or more compounds with anabolic or growth promoting effects on finishing pigs, although the mode of action is unknown.

Key Words: Kelp meal, Swine, Performance

M113 Effects of kelp meal supplementation in lactation sow diet on the body condition of sows and early growth of piglets. J. G. Kim*, Y. W. Shin, H. J. Lim, Y. H. Park, and K. Y. Whang, *Korea University, Seoul, Korea.*

An experiment was conducted to evaluate the effects of dietary levels of kelp meal on the body condition of sows and the growth performance of piglets during lactation. Eighty cross breed sows (Landrace x Yorkshire) artificially inseminated with Duroc's semen were assigned to four dietary treatments. Basal diet was formulated to contain 16% crude protein, 3250 kcal/kg ME, and 3% of cellulose. Cellulose was replaced by kelp meal. Experimental diets contained 0%, 1%, 2%, or 3% of kelp meal. Post-farrowing body weight of sows was calculated by using gestation model. Weaning weights of sows and piglets were measured. The P2 back fat depth was measured both sides and an average value was used. Feed intake was increased untill 7 days after farrowing. After 7 day, sows were allowed to consume diet on ad libitum basis. There was no difference in body weights and P2 back fat depth changes among treatments. But, sows in 3% kelp meal group tended to lose less body weight and P2 back fat during lactation. In piglets, average daily gain was linearly increased as kelp meal contents in sow diet were increased. A model was developed to adjust weaning day (21 day) and suckling piglet number (9 piglets). The results of this experiment suggest that addition of kelp meal in lactation sow diet would improve suckling piglet growth without affecting body condition of sows.

Item	0%	1%	2%	3%
Change of sows				
Body weight(kg)	-8.97 ±4.45	-10.40 ±2.99	-3.72 ±2.06	-5.20 ±2.99
P2 depth (mm)	-4.23 ±1.09	-4.66 ±0.75	-4.19 ±0.48	-4.60 ±0.71
Piglets				
ADG (g/d)	225.81 $\pm16.75^{b}$	231.23 $\pm11.28^{ab}$	252.65 $\pm12.28^{ab}$	266.13 $\pm12.04^{a}$
Body weight change(kg)	4.74 $\pm0.35^{b}$	4.85 $\pm0.23^{ab}$	5.30 $\pm0.25^{ab}$	5.58 $\pm0.25^{a}$

$p<0.05$

Key Words: Kelp meal, Sow, Piglets

M114 A comparison of the effects of supplementations of probiotic and humad on egg production and quality during the late laying period in hens. M. A. Yoruk[1], M. Gul[1], A. Hayirli*[1], and M. Macit[2], [1]*Department of Animal Nutrition and Nutritional Diseases, School of Veterinary Medicine,* [2]*Department of Animal Sciences, College of Agriculture, Ataturk University, Erzurum 25700, Turkey.*

As an alternative to antibiotics, inclusions of probiotics and humads into rations as feed additives to promote growth and reduce subclinical infections is favorable due to a lack of harmful effects on consumers. This study was designed to investigate whether inclusions of probiotic and humad into diets of hens during the late laying period increase egg production and improve egg quality. Three hundred Hi-Sex Brown layers at age of 54 weeks were allocated randomly to receive a diet containing no probiotic and humad and diets containing either probiotic (0.1 and 0.2%) or humad (0.1 and 0.2%) for 12 weeks. Experimental units were 6 groups of birds with each containing 10 birds. Egg yield was recorded daily, whereas feed intake (FI) and egg weight (EW) were determined bi-weekly. Egg density, shape index, unbrokenness, shell length, yolk color, albumen index, yolk index, and Haugh unit were egg quality parameters. Twelve eggs from each experimental group were collected randomly to determine egg quality parameters every month. Data were analyzed using the Multivariate Analysis Procedure of SPSS with repeated measures option. Moreover, orthogonal contrasts to determine the effects of probiotic and humad and compare their effects and polynomial contrasts to evaluate the nature of responses to increasing levels of probiotic and humad were constructed. There were no orthogonal and polynomial effects of supplementations of probiotic and humad on FI and EW. Egg yields of hens supplemented with probiotic and humad were not different, but were greater than hens not supplemented with either. Egg yield and feed conversion efficiency (both kg feed per 100 eggs and kg feed per kg egg) linearly increased with supplementations of both probiotic and humad. There were no orthogonal and polynomial effects of supplementations of probiotic and humad on egg quality parameters. In conclusion, supplementations of probiotic and humad during the late laying period increase egg yield at similar magnitude, but do not improve egg quality.

Key Words: Probiotic, Humad, Hen

M115 WITHDRAWN. , .

M116 The effect of feeding processed soy protein on the growth performance in weanling pigs. B. J. Min*[1], I. H. Kim[1], J. W. Hong[1], O. S. Kwon[1], W. B. Lee[1], K. S. Son[1], J. H. Kim[2], and W. C. Cho[3], [1]*Department of Animal Resource & Science, Dankook University,* [2]*Agribrands Purina Korea, Inc,* [3]*Genebiotech Co. Ltd.*

This experiment was to determine the effect of feeding processed soy protein on the growth performance in weanling pigs. One hundred twenty Duroc ×Yorkshire×Landrace pigs(6.34 ±0.70kg average initial BW) were used in a 35d growth assay. There were six pigs per pen and four pens per treatment. Dietary treatments included 1) NC(negative control; basal diet), 2) PC(positive control; add 5% HP300®, HAMLET PROTEIN A/S, as protein source), 3) PSP2.5(add 2.5% Pepsoygen®, Genebiotech Co. Ltd., as protein source), 4) PSP5.0(add 5% Pepsoygen

® as protein source), and 5) PSP7.5(add 7.5% Pepsoygen® as protein source). For d 21, ADFI was increased in pigs fed PSP diets compared with PC diet($P<0.05$). ADG was tended to improve as concentration of PSP in the diets was increased. For d 21-35 and entire experimental periods, pigs fed PSP diets had more feed intake than pigs fed NC or PC diets($P<0.05$). For the whole period, ADG was improved in PSP treatments compared with NC treatment(Linear effect, $P=0.05$). On d 21 and d 35, digestibilities of DM and N were higher($P<0.05$) for pigs fed PSP diets than pigs fed NC diet and PSP2.5 treatment was the highest among the treatments. On d 21, digestibility of N was significantly improved in PSP treatments compared with PC treatment($P<0.05$). In conclusion, feeding processed soy protein for weanling pigs increased growth performance and nutrient digestibility.

Key Words: Processed soy protein, Growth performance, Pigs

M117 Potential for an animal-based fish meal analog protein as a replacement for fish meal in early-weaned pig diets. M. E. Davis*[1], C. V. Maxwell[1], Z. B. Johnson[1], and P. L. Bond, Jr.[2], [1]*University of Arkansas, Fayetteville,* [2]*Mid-South Milling Company, Inc., Memphis, TN.*

A total of 288 pigs (20 d of age; 7.9 ± 0.08 kg BW) were fed one of four dietary treatments to determine the potential for an animal-based protein with similar composition to fish meal (fish analog) to replace fish meal in early-weaned pig diets. Pigs were sorted into nine weight blocks, and pigs within each weight block were randomly assigned to pens of eight pigs each. Four dietary treatments fed from d 0 to 14 (Phase 1) after weaning consisted of: 1) positive control with 8% fish meal, 2) negative control with SBM and Lys replacing fish meal, 3) positive control with fish analog replacing 50% of the fish meal, and 4) positive control with fish analog replacing 100% of the fish meal. Fish meal was replaced in each diet on an equal Lys basis. Dietary treatments fed from d 14 to 28 (Phase 2) after weaning were similar to those in Phase 1, although the positive control diet contained 6% fish meal during Phase 2. A common Phase 3 diet was fed from d 28 to 42 after weaning. From d 0 to 7, d 7 to 14, and d 0 to 14, pigs fed the positive control diet and those fed fish analog replacing 100% of fish meal had similar ($P > 0.10$) ADG. From d 0 to 28, pigs fed the negative control diet had the highest ($P < 0.05$) ADG, while there were no differences ($P < 0.10$) in ADG between pigs fed the positive control diet and those fed fish analog at either replacement level. Gain:feed from d 0 to 7 was highest ($P < 0.05$) when pigs were fed the positive and negative control diets compared to pigs fed fish analog at either replacement level. Although BW of pigs fed fish analog at the 100% replacement level was lower ($P < 0.05$) than that observed in pigs fed the negative control diet at the end of Phase 1 and Phase 2, there were no differences between BW of pigs fed fish analog at the 100% replacement level and the positive control. This study indicates that fish analog protein results in comparable gain to fish meal when added to Phase 1 and Phase 2 diets for early-weaned pigs.

Key Words: Pigs, Protein, Fish meal analog

M118 Comparison of swine performance when fed diets containing corn root worm protected corn, parental line corn, or conventional corn grown during 2000 in Nebraska. R. L. Fischer[1], P. S. Miller*[1], Y. Hyun[2], G. F. Hartnell[2], and E. P. Stanisiewski[2], [1]*University of Nebraska, Lincoln,* [2]*Monsanto Company, St. Louis, MO.*

This study was conducted to evaluate growth performance and carcass quality measurements in growing-finishing pigs fed diets containing either Corn Root Worm Protected Corn (CRW0586) with event MON 863, the non-transgenic parental control corn (RX670), or two non-transgenic commercial corn hybrids (DK647 and RX740). The experiment used 72 barrows and 72 gilts with an average initial BW of 22.7 kg. The pigs were allotted using a randomized complete block design with a 2 × 4 factorial arrangement of treatments. Barrows and gilts were housed separately in 1.5 × 4.8 m pens (n = 6/pen). Pigs had ad libitum access to feed and water for the duration of the experiment. The experiment continued until the average BW was 117 kg, at which time all pigs were slaughtered. Real-time ultrasound measurements of tenth-rib backfat (BF) and longissimus muscle area (LMA) were recorded on the final day of the experiment. Carcass quality measurements were made 24 h postmortem. Average daily gain, ADFI, and ADG/ADFI were not affected by corn line ($P > 0.25$), but there was an effect of sex for all growth traits, with barrows having greater ADG (0.96 vs 0.86 kg; $P < 0.01$) and ADFI (2.52 vs 2.18 kg; $P < 0.01$) than gilts and gilts having greater ADG/ADFI (0.39 vs 0.38; $P < 0.01$) than barrows. Ultrasound measurements were similar among corn lines ($P > 0.60$); however, a sex effect was detected for BF depth, with gilts having less ($P < 0.01$) BF than barrows (1.98 vs 2.48 cm). Proximate analysis of longissimus muscle composition revealed no effect ($P > 0.20$) of corn line or sex for protein, fat, and water percentages. In summary, there were no differences in growth performance or carcass measurements in growing-finishing pigs fed diets containing either Corn Root Worm Protected Corn with event MON863, its control, or the reference corn hybrids.

Key Words: Pigs, Transgenic corn, Growth

M119 Performance comparison of growing-finishing pigs fed diets containing Corn Root Worm Protected corn (Event MON 863) or conventional corn hybrids. G. E. Bressner[1], Y. Hyun*[2], E. P. Stanisewski[2], G. F. Hartnell[2], and M. Ellis[1], [1]*University of Illinois, Urbana, IL, USA,* [2]*Monsanto Company, St. Louis, USA.*

This study compared growth and carcass traits of growing-finishing pigs fed diets containing Corn Root Worm Protected corn (event MON863/ Trt. A), a non-transgenic genetically similar corn (Trt. B), and two commercial non-transgenic corn hybrids (Trt. C and D). The study used randomized complete block design with four trts, each based on a single corn hybrid. Hybrid pigs (n=160, 40 pigs/trt; equal numbers of barrows and gilts) were used. Test period was from 30 to115 kg BW with pigs kept in single-sex groups of five. Pigs were given ad libitum access to feed and water. The study was carried out in a controlled environment finishing facility, with part-slatted, part-solid concrete floors. A three-phase diet program was used. Growing diets (30 to 50 kg BW) had 1.0% total lysine, 17.8% CP, and 3340 kcal ME/kg. Early- (50 to 80 kg BW) and late- (80 to 115 kg BW) finishing phase diets had 0.8 and 0.7% lysine, 15.0 and 13.5% CP, and 3368 and 3390 kcal ME/kg, respectively. Diets were formulated with a fixed corn inclusion level for all trts of 65, 72, and 76% for grower, early- and late-finishing phases, respectively. At the end of test, pigs were slaughtered at a commercial facility and carcass measurements taken. Treatment had no effect ($P > 0.05$) on ADFI (2.60, 2.41, 2.54, and 2.46 kg for Trt. A, B, C, and D, resp.; SEM 0.08), ADG (0.86, 0.86, 0.89, and 0.91 kg, resp.; SEM 0.02), and G:F (0.34, 0.36, 0.35, and 0.37 kg/kg, resp.; SEM 0.01). Carcass measurements were similar ($P > 0.05$) for the four treatments. Differences in performance between castrates and gilts were in line with previous research. Results indicate that performance of growing-finishing swine fed diets containing Corn Root Worm Protected corn (event MON 863) is equivalent to that of animals fed non-transgenic genetically similar corn and conventional corn hybrids.

Key Words: Swine, Growth, Transgenic corn

M120 A comparison of swine performance when fed diets containing Roundup Ready® wheat (event MON 71800) and conventional wheat varieties. B. A. Peterson*[1], Y. Hyun[2], E. P. Stanisiewski[2], G. F. Hartnell[2], and M. Ellis[1], [1]*University of Illinois, Urbana, IL,* [2]*Monsanto Company, St. Louis, MO.*

This study was conducted to evaluate growth and carcass traits of growing-finishing pigs fed diets containing Roundup Ready wheat (event MON 71800), the non-transgenic genetically similar control wheat (MON 71900) and four commercial varieties of non-transgenic wheat (Zeke, Hank, 926, and Express). The study was carried out as a randomized complete block design with six dietary treatments, each treatment based on a single wheat variety. Hybrid pigs (n=240; 40 per treatment; equal numbers of barrows and gilts) were used. Pigs were grown from 29.5 ± 0.29 to 114.5 ± 2.23 kg BW in single-sex groups of five pigs and had ad libitum access to feed and water. The study was carried out in a controlled environment facility with part-slatted, part-solid concrete floors. A three-phase dietary program was used. Phase 1 diets (25 to 50 kg BW) contained 1.00% lysine, 18.9% CP, and 3,428 Kcal ME/kg. Phase 2 (50 to 80 kg BW) and Phase 3 (80 to 110 kg BW) diets contained 0.77 and 0.62% lysine, 16.0 and 15.0% CP, and 3,363 and 3,363 Kcal ME/kg, respectively. Diets were formulated with a fixed wheat inclusion level for all treatments of 70, 80, and 85% for Phases 1, 2, and 3, respectively. At the end of test period, ultrasound backfat thickness and longissimus area were taken at the tenth rib. Pigs fed the six wheat lines had similar ($P>0.05$) ADFI (mean 2.26 kg, SEM 0.06; range 2.20

to 2.32 kg) , ADG (mean 0.85 kg, SEM 0.03; range 0.82 to 0.87 kg), and G:F ratio (mean 0.38, SEM 0.01; range 0.37 to 0.38). In addition, there was no effect (P>0.05) of wheat variety on ultrasound measurements. These results indicate that performance of growing pigs fed diets containing Roundup Ready wheat (event MON 71800) is equivalent to that of pigs fed diets containing non-transgenic control wheat or commercial wheat varieties.

Key Words: Swine, Growth, Transgenic wheat

M121 Pea and Lupin (*lupinus albus*) as an alternative protein source in growing pig diets. F. Masoero[1], A. Prandini[1], G. Piva*[1], M. Morlacchini[2], M. Moschini[1], and D. Diaz[3], [1]*Universit Cattolica del Sacro Cuore, Piacenza, Italy,* [2]*CERZOO, San Bonico, Piacenza, Italy,* [3]*Fondazione Parco Tecnologico Padano, Lodi, Italy.*

The use of alternative Mediterranean feed protein sources into piglet diets was investigated. One hundred forty Duroc × (Large white × Landrace) piglets (10.4±2 kg live weight) were randomly assigned to 5 dietary treatments and raised in 35 pens (7 pens per treatment/4 animals per pen). Experimental treatments were identified by the protein source as: soy bean meal (control) (C); raw pea (RP); extruded pea (EP); Lupin (*lupinus albus* variety multitaglia) (L); extruded lupin (EL). Diets based on corn, wheat and barley plus synthetic amino acids were isoenergetic and isonitrogenous and supplied 18% crude protein, 1% lysine, 0.6% methionine + cystine, 0.64% threonine, 0.2% tryptophane and 9.84 MJ/kg NE. When used, RP and EP were included into diets at 20%, L and EL at 17%. Diets were fed *ad libitum* for the duration of the experimental period (42d). Animals were weighed at 0, 21 and 42d on trial. Pig mortality (1.6% for the all experiment) was recorded daily and dead animals were removed and weight was recorded. The pen feed consumption and weight were recorded weekly and the pen final weight was cleared from weight of removed animals. The pen average daily gain (ADG) was obtained and adjusted gain to feed ratio (G:F) of experimental periods was obtained by dividing the total weight gain of surviving and dead animals by the feed consumption per pen. The ADG, average daily intake (ADI) and G:F were not statistically affected by the treatment diets. Data suggest partial substitution of soybean with pea or lupin, either extruded or not, had no effect on animal performance and could represent an alternative valuable protein source in swine diet formulation.

Key Words: Swine, Lupin, Pea

M122 Methods of improving the nutritive value of Jackbean for poultry industry in the tropics. B. O. Esonu* and A. B. I. Udedibie, *Federal University of Technology, Owerri, Nigeria.*

Methods of improving the nutritive value of the jackbean for poultry have been developed and tested by many researchers. The discepancies between the findings of different researchers make it difficult to make clear and definite conclusions as to which method is most scientifically appropriate and relevant and can be used as a standard method for improving the nutritive value of this tropical legume for poultry. Besides the scientific aspect, the appropriateness of the method to be used must be based also on the local context and available facilities as well as economic viability. This paper, reviews five different methods farmers and feed millers could employ to improve the nutritive value of jackbean: 1. Dry urea treatment prior to toasting 2. Two-stage cooking 3. Sprouting 4. Cooking in Trona solution 5. Crack and cook method

Key Words: Jackbean, Nutritive value, Poultry

M123 Growth performance of growing-finishing pigs fed low-protein, low-energy, grain sorghum-soybean meal diets. J. L. Figueroa*[1], M. Mendez[1], M. Cervantes[2], and J. M. Cuca[1], [1]*Ganaderia, Colegio de Postgraduados,* [2]*Instituto de Ciencias Agricolas, Universidad Autonoma de Baja California.*

Two experiments were conducted to assess the effect of reducing the content of metabolizable energy in low-protein grain sorghum-soybean meal diets on the performance and carcass composition of growing-finishing pigs. In Exp. 1, 32 growing (35.3 kg initial weight) pigs were randomly allotted in a randomized complete block design to four diets, with four two-pig (a gilt and a barrow each) replicates. Diets were as follows: T1) grain sorghum-soybean meal, 16.5% CP, 3265 Mcal/kg, control diet; T2) grain sorghum-soybean meal, 12.5% CP, 3265 Mcal/kg; T3) as in T2, but with 3165 Mcal/kg; T4) as in T2, but with 3065 Mcal/kg. Energy concentration was obtained by substituting grain sorghum with wheat bran and sand, until the energy level was reached. There was no effect (P > 0.05) of CP nor ME on ADG (0.981, 0.932, 1.016, and 1.049 kg for T1, T2, T3, and T4, respectively), ADFI/ADG ratio (2.42, 2.508, 2.667, 2.459 kg/kg), ADLG (0.351, 0.358, 0.355, 0.378 kg), backfat thickness (38.9, 38.4, 37.4, 37.8 mm), longissimus muscle area (35.2, 36.48, 32.9, 36.64 cm2), and percentage of lean tissue (32.56, 33.8, 32.72, 32.74). There was an increase (P < 0.05) in ADFI (2.362b, 2.287b, 2.673a, 2.532a) as ME was reduced. In Exp. 2, 32 finishing (56.2 kg initial weight) pigs were randomly allotted in a completely randomized design to four diets, with four two-pig (a gilt and a barrow each) replicates. Initial weight was used as a covariate for all variables. Diets were as follows: T1) sorghum-soybean meal, 13.5% CP, 3265 Mcal/kg; T2) sorghum-soybean meal, 9.5% CP, 3265 Mcal/kg; T3) as in T2, but with 3165 Mcal/kg; T4) as in T2, but with 3065 Mcal/Kg. The ME concentration was obtained as in Exp. 1. There was no effect (P > 0.05) of CP nor ME concentration on ADFI (2.825, 2.854, 2.878, 2.823 kg), ADG (0.968, 0.844, 0.783, 0.792 kg), ADFI/ADG ratio (2.994, 3.433, 4.22, 3.733 kg/kg), ADLG (0.317, 0.231, 0.317, 0.239 kg), backfat thickness (37.9, 37.7, 35.3, 39.3 mm), longissimus muscle area (44.72, 40.32, 43.94, 42.88 cm2), and percentage of lean tissue (35.52, 34.2, 36.47, 34.58). These results showed that the growth performance and carcass characteristics of growing and finishing pigs fed low-protein, grain sorghum-soybean meal diets are not affected by the decrease of dietary energy content.

Key Words: Pigs, Low-protein diets, Low-energy diets

M124 Effect of amino acid intake on fecal digestibility of amino acids and on urinary amino acid excretion of adult roosters. L. Babinszky*, J. Tossenberger, and K. R. Kovacs, *University of Kaposvar, Faculty of Animal Science, Hungary.*

Urinary amino acid excretion of poultry is generally recognized to be very low. However, certain trial data show that poultry may have considerable levels of urinary amino acid excretion. Hence, the aim of our trials was to determine the effect of feeding diets with identical total but different digestible amino acid contents on the digestibility of anino acids and on the quantity of urinary and fecal amino acid excretion of roosters. The trials were conducted with 4 adult roosters per treatment, in two replicates (n=8/treatment). Prior to the trial a simple T-cannula was implanted in the terminal colon of the birds, allowing separate quantitative collection of faeces and urine (van Leeuwen et al., 2000). Nutrient content of the trial diets followed the NRC (1994) requirements. The two treatments of the trial were (i) a the diet formulated using "low digestible" ingredients (LD), (ii) a diet formulated with "high digestible" ingredients (HD). The AMEn and total LYS, MET+CYS and THR contents of the two diets were similar (13.1 MJ/kg, 7.1-, 4.5-, 5.8 g/kg, respectively), the calculated digestible amino acid content, however, differed by 10 %. The experimental data were analyzed by means of ANOVA (SAS, 1991). Our results showed, that in the LD-group the apparent fecal digestibility of LYS, MET+CYS and THR was 84.5-, 89.6-, 82.8 %, respectively, while the same in the HD-group was 86.7-. 91.8 and 87.4 %. Digestibility measured in the HD-group was significantly higher in comparison to the LD-group (P≤0.05). Birds in the LD-group excreted via the urine 17 mg/kg$^{0.75}$ LYS daily, the HD-group value was 22 mg/kg$^{0.75}$ (P≤0.05), which were 34.2 % and 40.4 % of total excreted (fecal+urinary) LYS, respectively. MET+CYS and THR excretion showed similar trends. Our data show that adult roosters may have considerable levels of urinary amino acid excretion, which should be taken into account when determining the amino acid requirements of poultry.

Key Words: Rooster, Amino Acids, Urinary-excretion

M125 Evaluation of the effects of dietary fat, conjugated linoleic acid and ractopamine on the fatty acid profiles of fat and muscle tissue of lean gilts. T. E. Weber[1], B. T. Richert[1], M. A. Belury[2], Y. Gu[3], and A. P. Schinckel*[1], [1]*Purdue University,* [2]*The Ohio State University,* [3]*Research Institute of Bastyr University.*

Lean gilts (n = 180), with an initial BW of 59 kg, were assigned to a 2 × 2 × 3 factorial arrangement consisting of ractopamine (RAC; 0 or 10 ppm), conjugated linoleic acid (CLA; 1% of a product containing 60% CLA isomers or 1% soybean oil), and dietary fat in an 8-wk feeding trial. Dietary fat treatments consisted of: 1) 0% added fat; 2) 5% choice white grease; and 3) 5% beef tallow. RAC treatments were imposed when the gilts reached an average BW of 85.5 kg and lasted for the final 4-wk until carcass data were collected at an average BW of 112 kg. Lipids from fat tissues of the belly, outer, and inner layers of backfat and *longissimus dorsi* were extracted and analyzed for fatty acid composition (six pigs/treatment; 72 pigs total). Dietary CLA increased the concentration of saturated fatty acids (43.1 vs. 35.9%; P < 0.001), decreased the concentration of monounsaturated fatty acids (41.4 vs. 47.5%; P < 0.001), and decreased IV values (56.1 vs. 63.0; P < 0.001) of the belly fat. Dietary fat reduced the concentrations saturated fatty acids (41.6 vs. 45.0%; P < 0.01) and increased IV values (60.7 vs. 57.4; P < 0.001) in the belly fat. Dietary CLA increased the concentration of saturated fatty acids in both the inner (44.1 vs. 37.6%; P < 0.01) and outer (43.1 vs. 35.9%; P < 0.001) layers of backfat. CLA increased the IV values of both layers of backfat (67.6 vs. 62.5%, inner 68.0 vs. 65.7%, outer; P < 0.001). Pigs fed diets containing 5% animal fat had increased IV values of the inner (66.5 vs. 62.1; P < 0.001) and outer layers (68.1 vs. 64.3; P < 0.01) over pigs fed diets without added fat. CLA increased the total saturated fatty acids (44.6 vs. 38.4%; P < 0.001) and reduced the IV values 57.9 vs. 65.2%; P < 0.001) in the *longissimus dorsi* muscle. Ractopamine decreased the intramuscular fat content of the *longissimus dorsi* (1.95 vs. 2.43%; P < 0.01) and increased the IV values of the outer (68.0 vs. 65.7; P = 0.07) and inner layer (66.2 vs. 63.9; P = 0.02) of backfat. These results indicated that CLA results in more saturated fat.

Key Words: CLA, Ractopamine, Fatty acids

M126 WITHDRAWN. , .

M127 A case for expanded spreadsheet use in animal science research. N. D. Paton*, *Akey, Lewisburg OH.*

Considerable effort is spent assembling datasets from research trials in preparation for statistical analysis. In many cases a spreadsheet such as Microsoft® Excel is used. Spreadsheets can be programmed to provide substantial amounts of information from data in the form of summaries and graphs before the statistical analysis is performed. These summaries assist the researcher in identifying problems and errors before a statistical analysis is made. These errors can be difficult or impossible to uncover if data has been passed to a statistical analysis package and checks are not performed there. Little emphasis has been placed on teaching students and researchers how to maximize the utility of spreadsheets. Consequently, many do not explore possibilities of dataset preparation beyond simple capabilities of summing and calculating averages for vectors of data. If researchers were aware of more complex formula they may develop spreadsheets that detect more errors allowing easier identification of problematic data. If spreadsheets were robustly built the same template sheet could be used to assemble numerous datasets in a rapid and efficient manner. In MS® Excel the use of the OFFSET, TRANSPOSE, MATCH, RAND, V and H LOOKUP, AND, OR, IF, CHOOSE, ISERROR and DATABASE (specifically DAVERAGE and DSUM) functions are of value to the animal science researcher. They facilitate rapid summarization of data. They ensure the continuity and interactivity of calculations that operate on raw data when summaries and means are calculated for analysis. Often discovery of an error in the raw data requires the regeneration of a summary before a statistical analysis is performed. If summaries are linked through formulas to raw data they change automatically when the raw data are altered. Formulas can be written to perform complex tasks. The programming of the spreadsheets is relatively simple and the uses of some of the above formula are detailed and can be easily taught. Spreadsheets are ubiquitous; most researchers have access to their use. Their utilization could be increased if effort was expended in learning more of their capabilities.

Key Words: MS Excel, Formulas, Dataset

Ruminant Nutrition

M128 In vitro gas production of Iranian barley silage treated and untreated by urea and formaldehyde. A. Taghizadeh[1], M. Danesh Mesgaran*[2], R. Valizadeh[3], F. Eftekhar Shahroodi[4], and K. Stanford[5], [1]*Ferdowsi university,Mashhad,Iran,* [2]*Ferdowsi university,Mashhad,Iran,* [3]*Ferdowsi university,Mashhad,Iran,* [4]*Ferdowsi university,Mashhad,Iran,* [5]*Lethbridge Research center,Alberta,Canada.*

In Vitro gas production Technique was used to measure the production gas from barley silages as experimental feed. The feeds were barley silage (untreated)(BS), BS treated with urea (20 g kg-1, DM)(BSU) or formaldehyde (4 g kg-1, DM)(BSF) or urea and formaldehyde (20 g kg-1 and 4 g kg-1 , DM, respectively)(BSFU). One steer (42018 Kg, fed a diet containing (as fed) 700 g kg-1 alfalfa hay/timothy and 300 g kg-1 a 15% CP concentrate) was used as ruminal fluid donor for the preparation of inoculums. The production of gas was measured in each vial after 0.0, 2, 4, 8, 12, 15, 24, 48, 72 and 96 h of incubation. Gas production data were fitted to a equation of p=a+ b (1- e-ct); where (p) is the gas production at time, t, (a) is intercept and ideally reflects the fermentation of soluble and readily available, (b) is the fermentation of the insoluble (but with time fermentable) fraction, (c) is the fractional rate at which b is fermented per hour. The soluble fraction (a) for BS, BSU, BSF and BSFU was 3.392, 4.84, -2.33 and #1.05, respectively. The insoluble (but with time fermentable) fraction (b) was 222.39, 185.45, 231.29 and 204.15, respectively. The fractional rate of fermentation (c) was 0.0418, 0.041, 0.049 and 0.0398, respectively. The results showed that the soluble fraction (a) of BSU was significantly (p< 0.05) higher than the other feeds. The potential fraction (b) of both BS and BSF were significantly (p< 0.05) higher than those recorded for BSU and BSFU. The gas production fractional rate (c) was significantly (p< 0.05) lower for BSFU compared with the other feeds. The results showed that the using of urea and/or formaldehyde in barley silage caused to change the fermentation parameters determined by In Vitro gas production Technique.

Key Words: Gas production, Barley silage, Urea

M129 The effects of dietary crude protein concentration on nitrogen absoption and retention by feedlot steers. A. Gueye[1], C. R. Richardson[1], J. H. Mikus[1], G. A. Nunnery*[1], N. A. Cole[2], and L. W. Greene[3], [1]*Texas Tech University, Lubbock, Texas,* [2]*USDA-ARS-CPRL, Bushland, Texas,* [3]*Texas Agricultural Experimentation Station, Amarillo, Texas.*

Twenty seven crossbred steers (average BW = 353.2 ± 8.4 kg) were used in a metabolism trial with three collection periods (approximately 35, 95, and 155 d on feed) to evaluate the effects of dietary CP source and concentration on nitrogen balance by steers. Treatments were arranged in a factorial arrangement and consisted of three dietary CP concentrations (11.5, 13.0, and 14.5%) and three supplemental urea:cottonseed meal (CSM) ratios (100:0, 50:50, and 0:100 of supplemental N). During each nutrient collection period steers were housed in individual metabolism stalls and urine and feces excreted were collected and frozen. Collection periods consisted of a 2- to 5-d adaptation period followed by a 5-d collection period. On d 35 on feed, total N excretion increased linearly (P = 0.002) with increasing CP concentration. Nitrogen absorbed (g/d) and N retained (g/d)linearly increased (P < 0.0001 and P = 0.01, respectively) with increasing CP concentration. On d 95 on feed, total N excretion linearly increased (P < 0.0001) with increasing CP concentration. Nitrogen absorbed (g/d) and N retained linearly increased (P < 0.0001 and P = 0.001, respectively) when CP increased from 11.5 to 14.5%. On d 155 on feed, DM digestibility decreased linearly (P < 0.05) with increasing dietary CP. Fecal N excretion increased linearly (P < 0.0001) with increasing CP. Nitrogen absorbed (g/d) decreased linearly (P = 0.03) with decreasing urea:CSM ratio. Nitrogen

absorbed (% of intake) increased quadratically (P = 0.05) with decreasing urea:CSM ratio. As days on feed increased, total N excretion also increased (P < 0.02). Based on our observations, feeding growing steers diets containing 11.5 to 13.0% CP and supplemented with higher proportions of degradable protein may potentially optimize N utilization and potentially reduces N losses to the environment.

Key Words: Retention, Dietary protein, Steers

M130 Effects of dietary crude protein on serum and urine urea nitrogen in feedlot steers. A. Gueye*[1], C. R. Richardson[1], J. H. Mikus[1], G. A. Nunnery[1], N. A. Cole[2], and L. W. Greene[3], [1]*Texas Tech University, Lubbock, Texas,* [2]*USDA-ARS-CPRL, Bushland, Texas,* [3]*Texas Agricultural Experimental Station, Amarillo, Texas.*

We evaluated the effects of dietary CP concentration and source on serum urea N (SUN) and urine urea N (UUN). A metabolism trial with three collection periods (approximately d 35, 95, and 155 on feed) was conducted using twenty seven crossbred steers (average BW = 353.2 ± 8.4 kg). Treatments were arranged in a factorial arrangement and consisted of three dietary CP concentrations (11.5, 13.0, and 14.5%) and three supplemental urea:cottonseed meal (CSM) ratios (100:0, 50:50, and 0:100 of supplemental nitrogen). During each collection period, steers were housed in individual metabolism stalls; urine collected and frozen; and blood samples obtained via jugular venipuncture. Collection periods consisted of a 2- to 5-d adjustment period followed by a 5-d collection period. On d 35 on feed, SUN as steers entered the stalls (SUN-in) increased linearly (P = 0.001) with increasing CP concentration. Urine urea nitrogen (mg/dL) responded linearly (P < 0.05) to increasing CP concentration, and steers in the 50:50 treatment tended (P = 0.10) to have higher UUN than steers in the 0:100 treatment. On d 95 on feed, SUN-in and SUN as steers exited the stalls (SUN-out) increased linearly (P = 0.03 and P = 0.009, respectively) when dietary CP increased from 11.5 to 14.5%. Urine urea N linearly (P < 0.0001) increased with increasing CP. On d 155 on feed, SUN-in and SUN-out linearly increased (P = 0.005 and P = 0.003, respectively) with increasing CP concentration. Urine output increased linearly (P = 0.009) when CP level increased from 11.5 to 14.5%. Increasing CP concentration produced a linear increase (P = 0.04) in UUN (mg/dL). Urine urea N (% of UN) decreased linearly (P = 0.007) with increasing CP. Results suggest that the amount and degradability of dietary protein affect urea metabolism by feedlot steers, as evidenced by changes in serum and urinary urea nitrogen.

Key Words: Urea nitrogen, Dietary protein, Steers

M131 Effect of a *Yucca Schidigera*-based surfactant on ruminal degradability of corn grain dry matter and starch. A. N. Hristov[1], J. K. Ropp*[1], and D. Greer[2], [1]*Department of Animal and Veterinary Science, University of Idaho, Moscow, ID,* [2]*AgriChem, Inc., Ham Lake, MN.*

The effect of a *Yucca Schidigera*-based surfactant (Grain Prep®, GP, containing 8.4% *Yucca Schidigera* saponins) on grain production and ruminal *in sacco* degradation parameters of flaked corn DM and starch was tested in a commercial feed mill setting. Over a two-day period, a total of 59 separate samples were collected. GP was applied at 22 g/ton grain; Control was water (average water addition during the flaking process was 3%). Three lactating Holstein cows fitted with ruminal cannulae, fed a 40% energy concentrate/17% protein concentrate/40% forage diet were used in the *in sacco* experiment. Flaked, intact corn kernels (34 lb./bu.) were incubated in the rumen for a period of 0, 2, 4, 6, 16, 24, 48, and 72 h. Bags were replicated within animal. Average DM and starch content of the grain were not different ($P > 0.05$) between treatments (meanSE): 80.00.17 and 73.11.07 %. Solubility of corn DM and starch was increased ($P < 0.001$) in GP compared to Control: 45.81.09 *vs* 39.61.11 % and 45.71.31 *vs* 38.61.36 % (DM and starch, respectively). The potentially degradable DM and starch in the rumen was reduced ($P < 0.05$) by GP compared to the Control: 52.11.88 *vs* 57.61.82 % and 55.42.06 *vs* 61.31.96 %, respectively. Rate of degradation of the potentially degradable DM or starch was not affected ($P > 0.05$) by treatment. Effective degradability of DM and starch in the rumen (calculated at 6% passage rate) was increased ($P < 0.001$ and $P < 0.05$, respectively) by GP compared to Control: 68.20.63 *vs* 65.10.64 and 70.90.75 *vs* 68.20.76 %, respectively. In conclusion, compared to untreated control, GP-treated corn had higher overall degradability of DM and starch in the rumen of lactating dairy cows. The difference was mostly due to an increase in the soluble/instantly degradable DM or starch with the GP corn. Increased ruminal degradation of corn starch may result in enhanced microbial protein synthesis and production in the rumen.

Key Words: Saponins, Corn, Starch degradability

M132 Effect of grain type and *Yucca Schidigera*-based surfactant on bacterial utilization of ruminal ammonia *in vitro*. K. L. Grandeen[1], A. N. Hristov*[1], J. K. Ropp[1], and D. Greer[2], [1]*Department of Animal and Veterinary Science, University of Idaho, Moscow, ID,* [2]*AgriChem, Inc., Ham Lake, MN.*

The objective of this study was to investigate the effect of grain type and a *Yucca schidigera* extract-based product, Grain Prep® (GP), on ruminal fermentation and specifically, ammonia utilization by mixed microbial populations, *in vitro*. Three, 8-h incubations were carried out with ruminal inoculum from two lactating dairy cows. GP-treated feed mix, containing 40% alfalfa hay/58% grain/2% soybean meal, was incubated at 1.5% concentration with buffer and ruminal inoculum. The grain part of the diet was either corn (C) or 50% corn and 50% high-amylopectin barley grain (B). GP was applied to the feed mix at 0, 60, and 120 ppm. At time 0 h, the ammonia pool was labeled with ^{15}N. Inclusion of 50% barley into the grain mix slightly increased ($P < 0.05$) media pH (6.68 *vs* 6.71, C and B, respectively) and decreased ($P < 0.05$) ammonia concentration (13.0 *vs* 12.7 mmol/L, respectively). Concentration of total and individual VFA was not affected ($P > 0.05$) by type of grain. GP had no effect ($P > 0.05$) on ammonia or VFA concentrations. Incorporation of ^{15}N into fluid bacteria tended to be greater ($P = 0.107$) in B than in C (0.69 *vs* 0.59 mg of 15N). Overall recovery of the ^{15}N tracer was not affected ($P > 0.05$) by type of grain. The proportion of bacterial N originating from ammonia N was also not different ($P > 0.05$) between C and B (16.5 and 17.6%). GP had no effect ($P > 0.05$) on the tracer-related parameters. At 8 h, B treatments had greater ($P < 0.05$) recovery of ^{15}N (23.5 *vs* 21.8 mg) and proportion of bacterial N originating from ammonia (35.1 *vs* 31.9%, respectively) than C. GP tended to increase ($P = 0.111$) the proportion of bacterial N originating from ammonia N (31.3, 33.6, and 36.2%, 0, 60, and 120 ppm GP). In conclusion, a 50% substitution of corn by barley had a positive effect on ammonia N utilization in the rumen, *in vitro*. A trend for enhanced bacterial incorporation of ammonia N was observed with GP addition.

Key Words: Saponins, Corn, Barley

M133 Changes in serum metabolites and growth characteristics of Korean steers fed alcohol-fermented feedstuffs. J. S. Shin*[1], B. W. Kim[1], and M. L. Eastridge[2], [1]*Kangwon National University,* [2]*The Ohio State University.*

This study was carried out to assess whether feeding alcohol-fermented feedstuffs (AFF) affects the nutritional metabolism and growth characteristics of Korean steers. Ten Korean steers were randomly assigned to one of two treatment groups. The treatments were AFF (50% commercial feeds for beef + 30% alcohol-fermented soybean curd dregs + 20% rice straw) and control (80% commercial feeds for beef + 20% rice straw). The change of serum metabolites and growth characteristics were measured every 2 mo at 2 h after feeding during the whole 12 mo experiment period, and the relationships between serum metabolites and growth characteristics were examined. The AFF had significantly higher (P< 0.05) serum alcohol (11.9 mg/dl), serum glucose (63.1mg/dl) and inorganic phosphorous (IP)(8.4 mg/dl) concentrations than control (4.9, 56.6 and 7.0 mg/dl, respectively), In both treatments, the glucose concentration increased dramatically when the BW reached about 600 kg, while IP concentration decreased at the BW. Lower concentrations of blood urea nitrogen (BUN) and cholesterol were observed for steers fed AFF until about 450 kg BW. The IP concentration was correlated with concentrations of BUN, cholesterol, and glucose in AFF but not in the steers fed controls. Daily gain was higher for steers fed AFF, especially from 328 kg to 500 kg. In this study, it is considered that the AFF affects serum metabolites and changes protein, fat and energy metabolism.

Key Words: Serum metabolites, Korean streers, Alcohol-fermented feedstuffs

M134 Effects of long-acting estrogen implant with and without trenbolone acetate on performance, carcass characteristics and meat tenderness in Holstein steers. J. L. Beckett*[1], R. N. Brewer[1], L. K. Hendricks[1], R. Botts[2], D. Cook[2], and P. Anderson[2], [1]*Cal Poly State University,* [2]*VetLife, LLC.*

Two hundred thirty-six Holstein steers (141 kg) randomly assigned to one of four treatment groups (A, B, C, D; n = 59) were used to investigate the effects of a long-acting estrogen implant with and without a trenbolone acetate/estradiol terminal implant on growth, performance and carcass characteristics. Implants contained zeranol (Z), progesterone (P_4), estradiol benzoate (EB) or trenbolone acetate (TBA) and estradiol (E_2). Animals were treated as described (table) and weight gain, average daily gain (ADG), and feed efficiency were calculated on 30-d intervals. Steers were harvested after 276 d on feed and carcass measurements were collected. All implanted groups had heavier (P<0.05) average final live weights and carcass weights, and improved ADG (P<0.05) compared with non-implanted controls. Cattle receiving the TBA/E_2 terminal implant produced heavier carcasses than implanted cattle not receiving the terminal implant (P<0.05). Average REA were significantly greater (P<0.05) for all groups receiving the terminal implant than either E_2 only or non-implanted groups. The percentage of carcasses with USDA quality grade of Choice or better was significantly lower (P<0.05) for treatment A (66.7%) than treatment B (83.9%) and non-implanted controls (85.2%), but treatment C (72.9%) was not different from any other treatment group. Based on these data, a long-acting estrogen implant is effective in increasing growth and efficiency compared with non-implanted controls. A TBA/E_2 terminal implant 180 d after the initial estrogen implant significantly improved growth and efficiency, yet did not significantly suppress quality grades compared with non-implanted controls.

Key Words: Holstein steers, Implants, Estrogen

M135 Use of exogenous fibrolytic enzymes and bluegrass seed straw in wintering beef cow feeding regimes. J. I. Szasz*[1], C. W. Hunt[1], K. A. Johnson[2], J. J. Michal[2], and D. J. Coonrad[2], [1]*University of Idaho,* [2]*Washington State University.*

Grass seed aftermath is abundant throughout many regions of Northwest US and may have potential as an economic feed resource for wintering beef cattle. A 2 x 2 factorial treatment arrangement was utilized to examine the impact of ammoniation and exogenous fibrolytic enzyme on performance of cows fed bluegrass straw diets. Approximately four months prior to the calving season, 89 crossbred beef cows (mean initial BW 636 kg) were stratified by days-to-parturition and randomly allotted the following treatments: 1) bluegrass straw, 2) ammoniated bluegrass straw, 3) bluegrass straw with enzyme, or 4) ammoniated bluegrass straw with enzyme. Cows were offered grass straw treatments *ad libitum*. Cows fed ammoniated straw also received 4.6 kg alfalfa daily while cows fed non-ammoniated straw received 6.1 kg alfalfa. The enzyme utilized contained xylanase and cellulase activity and enzyme activity was 676 μmol reducing sugars/g CP/min (20.9% CP). Enzyme was administered to straw by hand-spraying freshly prepared enzyme solution onto straw at a rate of 0.22 g enzyme (4.4 IU xylanase)/kg. When initial measurements served as a covariate, BW and condition score were not different ($P > 0.10$) among treatments at 260 d of gestation or at 2, 30, and 45 (adjusted) d post-partum. Calf BW at 2, 30, and 205 (adjusted) d of age did not differ ($P > 0.10$) among dietary treatments. Pregnancy rate at 60 and at 90 d post-partum did not differ ($P > 0.10$) between treatments. Likewise, treatment differences were not detected ($P > 0.10$) for percentage of cows pregnant at weaning. Cows fed ammoniated straws consumed less DM ($P < 0.001$) compared with cows fed non-ammoniated straw. No enzyme or enzyme by ammoniation effects were observed ($P > 0.10$) for any variable measured. Data indicate that while cows fed ammoniated straw diets consumed less DM, they maintained similar levels of production. Ammoniation of bluegrass straw may be cost-beneficial by reducing dependence on more expensive alfalfa hay to maintain proper body condition.

Key Words: Xylanase, Forage, Ammoniation

M136 Evaluation of alfalfa cubes with or without incorportated barley in beef cattle diets. P. A. Szasz*, C. W. Hunt, J. I. Szasz, and T. M. McCalmant, *University of Idaho.*

Metabolizable energy can often be supplied more economically from grain than from forages; however logistics often preclude inclusion of grain in wintering beef cattle rations. Incorporation of grain into pressed alfalfa cubes may provide a means of delivering energy via processed grain. Four ruminally cannulated Jersey steers were used to evaluate diets containing alfalfa fed coarsely chopped or as pressed cubes. These diets were fed with or without substituted barley. For the barley-containing diets, dry rolled barley was included at 40 percent of the diet DM as a separated ingredient when fed with chopped alfalfa or as an incorporated ingredient with the cubed alfalfa. Steers were fed a restricted amount of their respective diet equal to 1.2 times calculated maintenance requirement. Cubing the alfalfa had an inconsistent effect on *in situ* degradability. Substitution of barley into the diet reduced ($P < 0.05$) *in situ* DM and NDF disappearance of alfalfa for short ruminal incubation times (8, 16, and 24 h); however, DM and NDF disappearance was actually greater ($P < 0.05$) for longer incubation times (48, 72, and 96 h) when barley was included in the diet. No treatment differences were observed ($P > 0.10$) for ruminal pH. *In situ* degradability and fluid pH data indicate that barley substitution did not have an enduring detrimental effect on the ruminal environment. Total tract digestibility of DM and NDF was greater ($P < 0.05$) for diets containing barley suggesting that providing a portion of the dietary ME from barley might have actually increased ruminal microbial fibrolytic activity. Amount (kg/d) and percentage of DM and NDF digested was lower for the cubed alfalfa without barley diet than the other diets (cube x barley, $P < 0.05$). Results of this study indicate that isocaloric substitution of barley, either as a separate ingredient or as an ingredient of a pressed cube, is a feasible alternative strategy for meeting the energy requirements of wintering beef cattle.

Key Words: Grain, Metabolizable energy, Rumen fermentation

M137 Fermentation characteristics of ensiling wet corn distillers grains in combination with corn silage. K. F. Kalscheur*, A. D. Garcia, A. R. Hippen, and D. J. Schingoethe, *South Dakota State University, Brookings.*

Wet corn distillers grains (WDG) have become increasingly available as a feedstuff for cattle. The objective of this study was to evaluate the fermentation and preservation characteristics of ensiling WDG with corn silage (CS). Combinations of CS and WDG were ensiled in silo bags as follows: 1) 100% CS; 2) 75% CS + 25% WDG; 3) 50% CS + 50% WDG; and 4) 100% WDG. Samples from each treatment were collected for analyses prior to ensiling. Samples were collected from the silo bag at d 3, 7, 14, and 129 and evaluated for fermentation characteristics. The initial pH was the greatest for 100% CS and decreased (P < 0.05) as concentration of WDG increased (5.7, 4.6, 4.0, and 3.1 for 100%, 75%, 50%, and 0% CS, respectively). Dry matter of the feedstuffs prior to ensiling was 27.7, 28.6, 30.0, and 30.8% for 100%, 75%, 50%, and 0% CS, respectively. Concentrations of ammonia-nitrogen (1.2, 2.7, 4.1, and 5.1% DM) and crude protein (9.9, 15.6, 20.7, and 30.8% of DM) increased with increasing concentrations of WDG. Lactic acid prior to ensiling was greatest for 100% WDG (0.9% of DM) and decreased as CS was included in the treatments. Acetic, propionic, and butyric acids were not present prior to ensiling. There was no change in DM content, but Kjeldahl N and ammonia-nitrogen increased over time (P < 0.05) in all silages. The pH of the ensiled feeds had dropped below 4.0 by d 3, with no further decrease over time. Acetic acid increased (P < 0.05) from less than 0.01% of DM at d 0 to 3.89, 5.67, 4.32, and 0.23% of DM at d 129 as concentration of WDG increased. There was no ethanol detected prior to ensiling; however, it increased (P < 0.05) with time in all treatments. Ethanol concentration was highest (2.36% of DM) for 50% WDG on d 129. Ensiling WDG with CS can be an effective method of preserving WDG. Combining both feedstuffs at the 50% ratio resulted in a blend with an initial pH of 4.0 (day 0). The low initial pH coupled with the high acetic acid concentration verified for this treatment during days 3 (2.77%), 7 (3.25%), 14 (3.34), and 129 (4.32) suggests preservation could be enhanced by combining both feedstuffs.

Key Words: Wet distillers grains, Corn silage, Fermentation

M138 Increasing glucogenic precursors in range supplements fed to young pospartum beef cows. R. L. Endecott*[1], D. L. Dunlap[1], R. C. Waterman[1], A. C. Fitzgerald[1], V. A. Munn[1], C. A. Loest[1], D. E. Hawkins[1], K. K. Kane[1], F. Valdez[2], and M. K. Petersen[1], [1]*New Mexico State University,* [2]*Kemin Industries, Inc.*

Greater energy demands during late gestation and lactation may amplify the need for supplementation of cattle grazing dormant New Mexico range and metabolic glucose availability may affect postpartum energy balance. A study was conducted to evaluate responses of postpartum 2-year-old beef cows (n = 27) to supplements differing in glucogenic precursors. Cows were group fed (slick bunk 6 h post-feeding) a mixture of wheat straw and alfalfa hay adjusted monthly to match the CP percentage of native range (5 to 8% CP, OM basis) in central New Mexico from February to May. Supplements were individually fed three times weekly at 908 g·cow^{-1}·d^{-1} for 90 d postpartum and provided 1) 327 g CP, 118 g UIP, 47 g glucogenic potential (GP) (LGP), 2) 327 g CP, 158 g UIP, 63 g GP (MGP), or 3) 327 g CP, 164 g UIP + 100 g propionate salt (NutroCal, Kemin Industries, Inc.), 144 g GP (HGP). A glucose tolerance test was conducted 35 d postpartum and cows were milked by machine 50 d postpartum. Glucose and insulin areas under the curve were similar ($P > 0.05$) among treatments (11862, 10309, and 11805 ± 1063 and 462, 442, and 428 ± 49 for LGP, MGP, and HGP, respectively). Glucose half-life averaged 87, 77, and 95 ± 10 min, for LGP, MGP, and HGP, respectively ($P > 0.05$). Cows supplemented with HGP tended ($P = 0.13$) to produce more milk than did cows fed LGP, while MGP cows were intermediate (5087, 5220, and 5846 ± 330 g·d^{-1} for LGP, MGP, and HGP cows, respectively). A similar trend ($P = 0.14$) existed for lactose produced (251, 260, and 286 ± 16 g·d^{-1} for LGP, MGP, and HGP cows, respectively). Cows supplemented with HGP lost 30% more weight ($P < 0.05$) from pre-calving to BW nadir than did MGP-supplemented cows (59, 53, and 69 ± 4 kg for LGP, MGP, and HGP, respectively). Results suggest that the supply of additional glucogenic precursors from HGP supplementation of confinement-fed cows was used to produce more milk.

Key Words: Glucose, Propionate, Protein supplements

M139 Effects of corn flake weight on nutrient intake and retention by finishing heifers. B. S. Obeidat*, C. A. Loest, P. J. Defoor, J. E. Sawyer, V. A. Munn, and E. Y. Bsoul, *New Mexico State University, Las Cruces, NM.*

Eight Charolais-cross heifers (359 ± 28 kg) were used in a two period crossover design experiment to determine the impact of corn flake weight on nutrient intake and retention. Heifers were randomly assigned to one of two 85% concentrate diets (79% steam-flaked corn, 15% alfalfa hay, 3.0% molasses/fat blend, 0.5% urea, and 2.5% supplement) with corn steam-flaked at either 1) 322 g/L (25 lb/bu; SF25) or 2) 387 g/L (30 lb/bu; SF30). Dietary treatments were fed ad libitum to individually penned heifers. Each period lasted 14 d; 9 d for adaptation to dietary treatments and 5 d for daily collections of feed samples, feed refusals, and total fecal and urine output (using fecal bags). Rectal grab samples of feces were collected daily at 5 h after feeding to determine fecal pH. Daily fecal and urine output were mixed thoroughly and 5% aliquot retained and frozen for subsequent analysis. Feed, feed refusals, and fecal plus urine samples were composited for each heifer by period and analyzed for DM, OM, NDF, and N. Intakes of DM (7.72 and 8.64 ± 0.11 kg for SF25 and SF30), OM (7.26 and 8.09 ± 0.10 kg for SF25 and SF30), NDF (2.01 and 2.18 ± 0.03 kg for SF25 and SF30), and CP (1.02 and 1.19 ± 0.02 kg for SF25 and SF30) decreased ($P < 0.01$) with lighter flake weight corn (SF25). Retention of DM (76.1 and 77.8 ± 1.0% for SF25 and SF30), OM (81.1 and 81.8 ± 1.0% for SF25 and SF30), and NDF (56.5 and 59.7 ± 2.3% for SF25 and SF30) were not affected ($P > 0.15$) by level of corn processing, but CP retention (48.2 and 52.9 ± 2.1% for SF25 and SF30) tended ($P = 0.15$) to be greater for SF30 than SF25. Fecal pH (6.48 and 6.40 ± 0.04 for SF25 and SF30) was not affected ($P = 0.21$) by treatments. Results suggest that greater degree of corn steam-flaking decreases dietary intakes but does not affect nutrient retention and fecal pH of heifers fed an 85% concentrate diet.

Key Words: Heifers, Steam-flaked corn, Nutrient retention

M140 Effects of processing and bulk density of barley when fed to backgrounding calves. D. L. Boss*, J.G.P. Bowman, L.M.M. Surber, D. G. Sattroiva, and T. K. Blake, *Montana State University.*

A study was initiated to evaluate the effects of light or heavy bulk density (BD) barley fed whole or dry rolled to calves on a backgrounding diet. Eighty commercial Angus steers were allotted to 16 pens on an equal pen weight basis with treatment being randomly assigned to pen. A 2 x 2 factorial arrangement was used to test the effects of barley BD (light; 51.1 kg/hl vs. heavy; 61.7 kg/hl), processing (whole vs. dry rolled) and their interaction. Steers had ad libitum access to feed and water throughout the 56-d trial. The diets were balanced to meet or exceed all NRC requirements and to provide 1.45 Mcal/kg NEm and 0.86 Mcal/kg NEg, enabling a 340 kg steer to gain 0.9 kg/d. Diets were offered once daily at 0800 as a TMR and consisted of 49.0% Pubescent wheat grass (chopped to pass a 7.6 cm screen), 45.0% barley ("Morex") and 5.7% commercial backgrounding pellet on a DM basis. Water was used as a diet conditioner. Data were analyzed using GLM procedure of SAS. No interactions were detected ($P > 0.10$). Dry matter intakes were not different ($P = 0.51$, avg 8.9 kg/d) for the 56-d trial. There was no difference ($P > 0.05$) in final weights or ADG when light (380 kg, 1.1 kg/d) or heavy (382 kg, 1.1 kg/d) BD barley was evaluated. Feeding dry rolled barley resulted in heavier final weights ($P = 0.06$; 387 vs 375 kg) and increased ADG ($P = 0.001$; 1.2 vs 0.99 kg/d) when compared to whole barley-fed steers. Bulk density did not affect steer performance in the trial. However, processing the barley (dry rolling) before feeding it to steers in a backgrounding diet increased performance by 17% when compared to feeding the barley whole.

Key Words: Barley, Processing, Bulk density

M141 Effect of water and mineral source on performance of growing heifers. J. H. Mikus*, C. R. Richardson, G. A. Nunnery, and A. Gueye, *Texas Tech University, Lubbock, TX.*

Ninety-six beef heifers (British x Continental; average initial BW = 335.54 kg) were used in a randomized complete block design to determine the affects of water sulfate concentration and supplemental mineral source on animal performance. Two water and three mineral sources were applied in a 2 x 3 factorial arrangement. Water treatments contained either 39.5 mg/kg sulfate (no added sulfate; NS) or 1,810 mg/kg sulfate (added sulfate; WS). Mineral treatments were: no supplemental Zn, Cu, Mn, and Co (NTM); inorganic sources of Zn, Cu, Mn, and Co (ITM); and organically complexed sources of Zn, Cu, Mn, and Co (CTM). Mineral treatments were supplied via three separate supplements included in a 90% concentrate finishing diet. Heifers were fed for 56 d and weights were recorded on d 0, 28, and 56. Average daily gain of heifers consuming NS water was greater (P = 0.04) than WS heifers (1.83 and 1.61 kg/d, respectively) for the first 28 d, however, water source had no effect (P = 0.07) on ADG for the 29-56 d period or for the entire 56-d trial (P = 0.77). Mineral source had no effect (P = 0.31) on ADG for the length of the study. Dry matter intake was not affected by either water (P = 0.70) or mineral source (P = 0.18) for any period of the trial. Heifers consuming NS water were more efficient (P = 0.01) than heifers consuming WS water (4.41 and 5.01, respectively) for d 0-28. However, water source had no effect on feed to gain for d 29-56 (P = 0.06) or 0-56 (P = 0.44). Mineral source had no effect (P = 0.39) on feed to gain for the length of the study. Results from this trial indicate that heifers introduced to high sulfate drinking water (1,800 mg/kg) require an adjustment period, but soon perform at levels similar to animals consuming water with very low sulfate levels. Moreover, neither level nor source of supplemental trace minerals affected heifer performance, however, this may be a result of the relatively short duration of the trial.

Key Words: Heifers, Sulfate, Mineral source

M142 Effects of barley or corn on steer performance and digestibility in finishing diets. J. J. Kincheloe*, J.G.P. Bowman, L.M.M. Surber, D. L. Boss, M. F. McDonnell, K. A. Anderson, and T. K. Blake, *Montana State University, Bozeman, MT, USA.*

Barley is an important feed grain throughout Canada and the Pacific Northwest, while corn is the predominant grain source in finishing diets

throughout the United States. Limited comparisons are available evaluating differences between the feed value of corn and barley. Eighty steers (avg initial wt 344 kg) were fed finishing diets for 112 d to determine the effects of corn and three barley varieties (H3, Harrington, and Valier) on feedlot performance, nutrient digestion, carcass characteristics, and grain energy content. Grains were dry-rolled, and diets were formulated to contain 2.4% N, 2.03 Mcal/kg NE_m and 1.37 Mcal/kg NE_g. Steers were allotted by weight to 16 pens in a completely randomized design with pen as the experimental unit. Steers were weighed every 28 d and diet, ort, and fecal samples were collected, composited by pen, and analyzed for DM, N, ADF, AIA, and starch. Fecal output was estimated using acid insoluble ash as an internal marker. Steers were harvested when 70% were visually estimated to grade Choice. There were no differences ($P > 0.10$) among diets for ADG (avg 1.58 kg/d), feed efficiency (FE; avg 16.31 kg gain/100 kg feed), DMI (avg 9.62 kg), or starch digestibility (avg 97%). Fat thickness was greatest ($P = 0.03$) for steers fed corn (avg 1.2 cm), and least for steers fed H3 and Valier (avg 0.93 cm). Steers fed corn had higher ($P = 0.07$) yield grades than steers fed barley (avg 3.1 vs 2.8, respectively); however, there were no differences ($P > 0.10$) detected for any other carcass characteristic. Barley had similar ($P > 0.10$) NE_m and NE_g values as compared to corn (avg 2.19 and 1.53 Mcal/kg, respectively). Lack of differences in animal performance and grain energy values suggest that barley has equal feeding value to corn in finishing diets, and that the NRC may underestimate net energy values for barley.

Key Words: Barley, Corn, Grain net energy values

M143 Growth and carcass fatty acid composition of beef steers fed soybean oil for increasing duration before slaughter.

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Ninety-six Gelbvieh × Angus rotationally-crossed steers (293.6 ± 3.9 kg) were used in a 189-d experiment to evaluate duration of soybean oil (SBO) supplementation on feedlot performance, carcass traits, and *longissimus dorsi* (LD) fatty acid composition. Steers were blocked by initial BW and randomly assigned to one of 16 pens (6 steers/pen) in a randomized complete block design. Four experimental treatments consisted of 0, 77, 137, or 189 d of SBO supplementation before slaughter. Diets contained 78% cracked corn, 12% chopped (2.54 cm) oat hay, and 10% protein supplement, with or without 5% added SBO. Duration of SBO supplementation had no effect ($P \geq 0.44$) on ADG, DMI, or feed efficiency. Similarly, carcass traits were not affected ($P \geq 0.20$) by SBO supplementation. Total fatty acid content of the LD did not differ ($P = 0.15$) across treatments (avg = 34.9 ± 3.8 mg/g of fresh tissue). Duration of SBO supplementation did not influence total saturated ($P = 0.19$) or polyunsaturated (P = 0.47) fatty acid concentrations of LD. Total ($P = 0.09$) and 18-carbon ($P = 0.10$) monounsaturated fatty acid concentrations of LD tended to decrease linearly because C18:1c9 concentrations decreased linearly ($P = 0.03$) as duration of SBO supplementation increased. Neither isomer of conjugated linoleic acid (CLA) was affected ($P \geq 0.18$) by SBO supplementation (C18:2c9t11 = 0.08 ± 0.009 or C18:2t10c12 = 0.01 ± 0.001 mg/g of fresh tissue). However, total C18:1-trans tended ($P = 0.07$) to increase linearly because LD concentrations of C18:1t11 (TVA) tended to linearly increase ($P = 0.07$) with increased duration of SBO supplementation. Although supplementing SBO at 5% of dietary DM for 77 to 189 d decreased monounsaturated fatty acid concentrations, total saturated fatty acid content of beef was not affected by SBO supplementation. Despite the lack of improvement in CLA content, enhanced TVA concentrations associated with increasing duration of SBO supplementation may benefit consumers of lean beef.

Key Words: Soybean oil, Conjugated linoleic acid, Beef

M144 Influence of grinding oats and barley on cattle performance and in vitro starch degradability.

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Small beef producers often supplement growing cattle with small grains, and economics of processing are often questioned. Studies were conducted over a 3-yr period to determine the benefit of finely grinding (G) oats (O) and barley (B) compared to feeding whole grain (W). Hay and minerals were fed free-choice. In yr 1, 30 heifers (216 kg) were allotted to six pens and fed 2.4 kg (DM) per head daily of either WB or GB. Hay was 14.8 % CP and 32% ADF, while B was 13.1% CP, 5.5% ADF and 58% starch. Total DMI (7.2 kg/d) and hay DMI (4.8 kg/d) did not differ, but ADG (0.56 vs 0.85 kg/d) and gain to feed (0.076 vs 0.124) were lower (P<.05) for WB. In yr 2, 40 heifers (220 kg) were assigned to 8 pens and fed 2.3 kg (DM) per head daily of B or O, either G or W in a 2x2 factorial. Hay was 11.5% CP and 39% ADF, while O and B were 12.1 and 10.4 % CP, 12.3 and 7.6% ADF, and 47 and 60% starch, respectively. There was a grinding by grain interaction for ADG (P<.06; 0.31, 0.66, 0.49 and 0.64 for WB, GB, WO and GO, respectively) and gain to feed (P<.09; 0.045, 0.096, 0.072 and 0.093, respectively), but hay DMI (4.5 kg/d) and total DMI (6.9 kg/d) did not differ. In yr 3, 36 steers (219 kg) were assigned to 6 pens and fed hay only or hay plus 2 kg (DM) per head daily WO or GO. Hay was 13.1% CP and 38% ADF, and O were 11.8% CP, 12.7% ADF and 42.9% starch. Hay DMI (7.1, 5.6, and 5.7 kg/d, for hay, GO and WO, respectively) was higher (P<.05) for hay only than either O treatment, but total DMI (7.5 kg/d) did not differ. ADG (0.61, 0.81 and 0.82 kg/d for hay, GO and WO, respectively) and gain to feed (0.089, 0.109 and 0.108, respectively) was lower (P<.05) for hay only than for either O treatment. Whole grains from each study were ground coarse, medium or fine and 1-h in vitro enzymatic glucose release was used to estimate starch degradability. Grain, particle size, and grain by particle size interaction effects (P<.01) were noted. Starch degradability was 37, 30, 15, 53, 50 and 46% for fine B, medium B, coarse B, fine O, medium O and coarse O, respectively. These data suggest that grinding has less of an influence on performance of cattle fed O than B because particle size reduction is less important for starch digestion in O than it is in B.

Key Words: Small grains, Processing, Beef cattle

M145 Effects of exposure to ammoniated wheat straw as a suckling calf on subsequent utilization as a yearling beef heifer.

R. D. Wiedmeier*, P. R. Schmidt, B. A. Kent, B. R. Bowman, and D. M. Meek, *Utah State University, Logan, Utah*.

Ten crossbred yearling beef heifers (355 kg) were selected for the study. Five heifers were from cows wintered on an ammoniated wheat straw (AWS) diet from late gestation through early lactation (exposed). The other five heifers were from cows wintered on alfalfa-grass hay through the same period of time (nave). After weaning, heifer calves were placed in a common pen and fed a grower diet composed of alfalfa hay, corn silage, dry-rolled barley and vitamin-mineral premix until they were yearlings. Yearling heifers were then placed in individual pens to measure utilization of AWS. Each heifer received 2.94 kg DM of supplement daily that was composed of ground alfalfa hay, sugar beet pulp, dry rolled barley and vitamin-mineral premix. All heifers were offered adlibitum access to AWS with intake measured daily. Diets were fed for a 21 d adaptation period followed by a 5 d diet and fecal collection period to estimate DM digestibility. Acid insoluble ash was used as an internal marker to estimate apparent nutrient digestibility. Exposed heifers consumed more AWS than nave heifers (5.45 vs 4.89 kg/d, P = 0.04). Digestibility of DM was not affected by previous exposure to AWS (60.61% vs 60.17%, P = 0.45, exposed vs nave, respectively). Consequently, exposed heifers consumed 8% more DDM than nave heifers (5.09 vs 4.71 kg, P = 0.05, respectively). Heifer calves from cows wintered on AWS diets from late gestation through early lactation will exhibit higher AWS intake as yearlings compared to heifer calves without such exposure.

Key Words: Heifers, Ammoniated straw, Nutrition

M146 Effects of RumaPro on plasma ammonia and urea concentrations in beef steers.

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The objective of the experiments was to describe the ability of a slow urea release product (RumaPro) to alter plasma concentrations of ammonia and urea in steers after ingestion of a potentially toxic dose of urea. In Exp. 1, Four Angus beef steers (471±41 kg body weight) were group-fed ad libitum a high-concentrate diet (17% NDF, 15% CP) for several weeks before the start of the experiment. Steers were fed once daily, and water was available free choice. In Exp. 2, Six Angus steers (339±14 kg body weight) were fed fescue hay (63% NDF, 11.3% CP), for 3 wk before their initial dosing. Hay, mineralized salt, and water were provided ad libitum. Each experiment had a crossover design with steers selected at random to receive initial oral doses of urea or RumaPro(0.25 g of urea per kg of BW from either source). On sampling day, two hours after feeding, blood samples were collected into heparinized tubes -5,

5, 15, 30, 45, 60, 90, and 120 minutes after oral dosing with urea or RumaPro. Seven days later the process was repeated to complete the crossover design. ANOVA was conducted on ammonia and urea concentrations after concentrations were adjusted by subtraction of pre-dosing values within steer and treatment. Steers in both experiments had lower ($P < 0.05$) adjusted plasma concentrations of ammonia with RumaPro (0.066 mM)compared with the urea (0.122mM). Area under the curve calculations show that the amount of added ammonia over the time of the experiments was at least 1.6 times greater when urea was dosed than when RumaPro was dosed. Compared with steers fed the all-hay diet (Exp. 2), steers fed the high-grain diet (Exp. 1) had lower adjusted peak concentrations (0.15 vs 0.20 mM) and returned sooner to pre-dose ammonia concentrations. Treatments did not affect ($P > 0.15$) adjusted plasma urea-N concentrations (2.78 mM). The pattern of increased plasma urea-N concentration after dosing was similar between treatments in both experiments. We conclude that at doses calculated to be equivalent to 25% of the steers' daily CP requirement, RumaPro reduced hydrolysis of urea in the rumen and decreased ammonia absorption by approximately 50%.

Key Words: Beef Steer, Ammonia, Urea

M147 Effects of five grain conditioners, water, and bulk density on processing ease and flake quality with regards to steam-flaking corn. C. R. Richardson[1], K. F. Wilson*[2], and G. V. Pollard[3], [1]*Texas Tech Univ., Lubbock,* [2]*Loveland Ind., Greeley, CO.,* [3]*Southwest Texas State Univ., San Marcos.*

Processing ease for the five conditioners and water were determined by steam-flaking 27.2 kg batches of corn at bulk densities of .34, .36, .38, and .41 kg/L and measuring time to process (sec.), energy usage (kWh), and feeder speed (oscillations/sec.). To determine flake quality, flake durability (%) and fines (%) were collected and analyzed. Before processing, batches were treated with a commercial conditioner per recommended dosage rate and tempered to 18% moisture. Conditioners tested in this study were EZ-Flake®, EZ-Roll™, an alcohol based (AC), and a yucca based 1 (YU1) and 2 (YU2). Processing ease was determined on the running machine and flake qualities on subsequent samples of the batches. Data were analyzed as a factorial with resulting means separated by main effects, no interactions were observed. Time to process, energy usage, and flake durability revealed main effect differences for the products and bulk densities. However, feeder speeds and fines showed only bulk density differences. Means separation illustrated that when compared to water, EZ-Flake® and EZ-Roll™ improved ($P < 0.05$) processing time and decreased ($P < 0.05$) energy usage by approximately 20%, where as the AC conditioner increased time to process and energy usage by approximately 5%. Furthermore, improvements ($P < 0.05$) of roughly 1% were observed for flake durability with EZ-Flake®, EZ-Roll™, and YU2 when compared to water. As expected, increasing the bulk density decreased ($P < 0.05$) time to process, energy usage, and fines. Additionally, increasing the bulk density resulted in increased ($P < 0.05$) feeder speeds and flake durabilities. Results indicated that these conditioners, with the exception of the AC conditioner, were sufficient in improving processing ease and flake qualities as compared to water. These results are consistent with recognized characteristics of grain conditioners and were effective across all bulk density treatments.

Key Words: Grain conditioner, Bulk density, Steam-flaking

M148 Effects of five grain conditioners, water, and bulk density on the chemical constituents of steam-flaked corn. G. V. Pollard*[1], K. F. Wilson[2], and C. R. Richardson[3], [1]*Southwest Texas State Univ., San Marcos,* [2]*Loveland Ind., Greeley, CO.,* [3]*Texas Tech Univ., Lubbock.*

Chemical constituent evaluations were determined by steam-flaking corn with one of five conditioners or water, and processed to a bulk density of .34, .36, .38, or .41 kg/L. Before processing, batches were treated with commercial conditioner per recommended dosage rate and tempered to 18% moisture. Conditioners tested in this study were EZ-Flake®, EZ-Roll™, an alcohol based (AC), and a yucca based 1 (YU1) and 2 (YU2). All chemical constituents were analyzed from samples collected underneath rolls and frozen for subsequent evaluation. Analyses of chemical constituents consisted of moisture (%), starch availability (%), gelatinization score (%), free sulfhydryls (mol), dry-matter digestibility (%), and moisture uptake (mL). Data were analyzed as a factorial with resulting means separated by main effects or interaction. Interactions ($P < 0.05$) were observed for moisture, starch availability, gelatinization score, and free sulfhydryls. However, a statistical trend ($P < 0.05$) was noted for water yielding greater starch availability when compared to the conditioners, and EZ-Flake® yielding a greater gelatinization score and free sulfhydryls when compared to other conditioners and water. Main effect differences ($P < 0.05$) for bulk density were observed for dry-matter digestibility and moisture uptake. Furthermore, conditioner inclusion improved ($P < 0.05$) moisture uptake when compared to water. Results indicate that the conditioners tested and rates of application were not sufficient to improve starch availability, however, YU1 and EZ-Flake® tended ($P < 0.05$) to have the most improvement in the chemical constituents tested. Gelatinizaton scores and free sulfhydryls were improved ($P < 0.05$) by EZ-Flake® and YU1 treatment. All tested conditioners were superior to water for facilitating moisture uptake. While a grain conditioner's primary function is to improve processing ease and production, this study indicated constituent enhancement could occur.

Key Words: Grain conditioner, Bulk density, Moisture uptake

M149 Finishing diets with elevated levels of α-linolenic acid increase feed efficiency but do not alter beef carcass quality. S. L. Archibeque*[1], D. K. Lunt[1], R. K. Tume[2], and S. B. Smith[1], [1]*Texas A&M University, College Station, TX,* [2]*Food Science Australia, Tingalpa D. C. Queensland, Australia.*

We hypothesized that there would be an interaction between dietary α-linolenic acid and whole cottonseed (**WCS**) on beef cattle carcass quality and feed efficiency. Forty-five Angus steers (358 kg BW) were utilized in a completely randomized block design with a 3 x 3 factorial arrangement of treatments. The factors included the dietary inclusion rate of whole cottonseed (0, 5, or 15% DM) and the type of energy source (corn, flaxseed plus corn, or milo) fed for 135 d. During the feeding period, steers receiving the flaxseed or corn diet had a greater ($P < 0.01$) ratio of weight gained to feed consumed (0.119 and 0.108, respectively) than steers receiving the milo diet (0.093). There was a tendency ($P < 0.06$) for this gain to feed ratio to decrease with increased WCS inclusion in steers fed the milo diet. There were no differences in the ADG or final live weight among treatment groups. Following transportation to a local abattoir and overnight deprivation of food, there was a reduced ($P < 0.01$) percentage decrease in weight (i.e., shrink) in the steers fed the flaxseed diet (1.51%) than in the steers fed the corn (2.89%) or milo diet (3.11%). Marbling score was not affected by WCS ($P = 0.14$) nor was there an interaction between grain source and WCS ($P = 0.16$). There was an interaction ($P < 0.02$) in that lean maturity decreased with increasing percentages of WCS when the steers were fed the corn or milo diets, yet lean maturity remained unchanged in steers fed flaxseed. Ribeye area of steers fed milo was less ($P < 0.01$) than that of steers fed the corn or flaxseed diets. These data indicate that a ration formulated to provide increased levels of α-linolenic acid (i.e., flaxseed) will increase feed efficiency without altering either the quality or composition of the beef carcasses. Additionally, the inclusion of WCS in milo diets may cause a decrease in efficiency and less salable lean.

Key Words: Steers, Linolenic acid, Cottonseed

M150 Effect of feeding diets containing corn grain with corn rootworm protection (event MON863), control, or conventional varieties on steer feedlot performance and carcass characteristics. L. L. Berger*[1], N. D. Robbins[1], J. R. Sewell[1], E. P. Stanisiewski[2], and G. F. Hartnell[2], [1]*University of Illinois-Urbana,* [2]*Monsanto Company, St. Louis, MO.*

A steer finishing trial was conducted to determine the effect of feeding corn that was genetically modified to protect against corn rootworm (CRW) (event MON863) on performance and carcass characteristics. All hybrids were grown in Illinois, ground through a tub grinder and then stored in Harvestore silos. Continental-cross steers (n = 196) were assigned to one of four dietary treatments differing only in the corn hybrid fed. There were 7 pens with 7 head/pen in each treatment-group. Steers were adapted to a common finishing diet based on a commercially available corn over a 21-d period prior to starting the study. Feed intakes were adjusted for each pen on a daily basis and orts collected as needed. Two consecutive daily weights were taken and averaged for initial weight. All steers were harvested at a commercial packing plant after 102 d on trial. Data were analyzed using the PROC MIXED procedure of SAS with pen as the experimental unit for performance data and individual steer for carcass data. There were no significant differences

(P<0.05) in performance or carcass measurements of cattle fed corn protected against CRW or genetically similar control corn and reference corns.

	Treatments[a]				
	RX740	DK647	RX670	CRW	SEM
Performance					
Initial BW, kg	456	458	458	457	3
Final BW, kg[b]	598	609	614	609	7
DMI, kg/d	7.57	7.46	7.94	7.76	.16
ADG, kg/d	1.39	1.49	1.53	1.49	.06
ADG/DMI	.184	.198	.193	.193	.008
Carcass characteristics[c]					
Carcass wt, kg	367	374	377	374	4
Marbling score[d]	484	470	489	493	9
REA, sq cm[e]	97.3	99.5	95.6	97.2	1.5
Fat, cm	0.85	0.89	.99	0.92	.05
Yield grade	1.9	1.9	2.3	2.1	.1

[a]RX740, DK647=commercial hybrids containing no MON863, RX670=genetically similar control without MON863, and CRW=MON863. [b]Carcass weight adjusted by common dressing % (61.4%). [c]Carcass observations were n=195. [d]Marbling score where Slight 50=450. [e]REA is the longissimus dorsi area measured at the 12th rib.

Key Words: Corns, Corn rootworm, Feedlot performance

M151 Effects of trace mineral source and growth implants on performance and lipid metabolism of steers. K. L. Dorton*, T. E. Engle, C. V. Kimberling, G. Parsons, D. R. Ames, and R. M. Ames, *Colorado State University*.

Three hundred and twenty three steer calves (249 kg 1.9) were used to determine the effects of trace mineral (TM) source and growth implants on performance, carcass characteristics, and lipid metabolism. Steers were blocked by ranch and stratified by initial body weight and randomly assigned to one of 36 pens (n=9 to 12 steers/pen). Pens within a block were then randomly assigned to treatments. Treatment consisted of: 1) control (no supplemental Cu, Zn, Mn, or Co), 2) inorganic mineral (CuSO4, ZnSO4, MnSO4, and CoCO3), and 3) organic mineral (iso-amounts of Cu, Zn, Mn, and Co). At the beginning of the experiment, 6 pens of animals/treatment received an implant and the other 6 pens of animals/treatment received no implant. Steers were fed a corn silage-based growing diet for 56 d then were gradually switched to a high concentrate finishing diet for 132 or 156 d. At the beginning of the finishing phase, previously implanted steers were reimplanted. Treatments during the finishing phase consisted of: 1) control (no supplemental Zn); 2) inorganic Zn (30 mg of Zn/kg DM from ZnSO4); and 3) organic Zn (iso-amounts of organic Zn). During the growing phase, implant and TM supplementation had no effect on ADG, ADFI, and FE. During the finishing phase, steers that were implanted had greater final body weights (P < 0.01) and ADG (P < 0.02) than non-implanted steers. Overall, implanted steers had lower (P < 0.01) marbling scores than non-implanted steers and steers that were supplemented with TM had greater (P < 0.05) dressing percentage than controls. Longissimus muscle of implanted steers had greater (P < 0.01) C18:2 and lower C16:1 (P < 0.01) and C18:1 (P < 0.01) than longissimus muscle of non-implanted steers. Steers supplemented with inorganic TM had greater C18:O (P < 0.01) and C18:1 (P < 0.03) and lower (P < 0.03) C22:6 than steers supplemented with organic TM. These results indicate that TM source and growth implants may affect performance, carcass characteristics, and lipid metabolism in steers.

Key Words: Zinc, Implant, Carcass characteristics

M152 Influence of linseed supplementation on quality and fatty acids in beef. I. Holló[1], E. Szücs[2], K. Ender[3], J. Csapó[1], G. Holló[1], J. Seregi[1], J. Seenger*[2], and I. Repa[1], [1]*University of Kaposvár, Kaposvár-Hungary,* [2]*Szent István University, Gödöllo-Hungary,* [3]*Research Institute for the Biology of Farm Animals, Dummerstorf-Germany*.

Full fat linseed meal supplementation of diet on meat quality and fatty acid composition of intramuscular fat was investigated in this study. Hungarian Grey (HG) Holstein-Friesian (HF) growing-finishing bulls were fed rations consisting of either grass silage and concentrate or maize silage and concentrate with and without linseed supplementation according to 2×2 factorial experimental design in four groups A and B vs. C and D, respectively. Equal number (n=10 in each group) of animals were assigned to treatments above. Concentrates for groups A and C were supplemented 20% linseed meal containing 40% linolenic acid fed in the last month of growing-finishing period. Average final weights were actually identical in all groups (512.4±58.4 kg). The animals were slaughtered and after a 24hr chilling LD samples were taken from the right half carcasses. Data processing was made by SPSS 10.0 program package. Statistical differences were recorded between feeding intensities for dressing percentage, and that of lean and fat content of carcass (P<0.001), and pH_{45} (P<0.01). Meat color was measured by Minolta Chromameter the results of which differed among treatments in terms of a∗ and b∗ value (P<0.01, P< 0.001), but L∗(P>0.05). Dry matter and the moisture content of LD showed significant variation due to treatments, as well (P<0.001). Marked statistical differences were present for crude protein (P<0.001) and ether extract of LD (P<0.01) except for groups A and C. Higher concentrations of palmitic, stearic and oleic acids content in intramuscular fat were recorded in groups B and D than in A and C ones (79-82% vs. 73-74%, P<0.001). The rate of oleic acid seems to decline significantly (P<0.001) as a result of linseed supplementation. Means for group A and C were 29.6±1.9 and 28.3±2.5 vs. B and D 36.3±1.5 and 35.5±1.5, respectively). The ratio of PUFA increased. Means were as follows: groups A and C 13.7±3.0 and 16.5±3.4; groups B and D 7.3±1.8 and 9.4±2.5, respectively (P<0.001) with simultaneous decrease of n-6/n-3 ratio (A and C 3.4-4.1 vs. B and D 7.7-10.3, P<0.001). In conclusion, the fatty acid composition of intramuscular fat of beef can be modified favorably by feeding grass and concentrate supplementation rich in unsaturated fatty acids.

Key Words: Intramuscular fat, Fatty acids, Linseed supplementation

M153 Sodium monensin and Lasalocid used in growing calves consuming high levels of brewers grain. J. A. Piña, J. A. Fernandez, J. I. Aguilera, R. Bañuelos*, C. F. Arechiga, and S. Mendez, *UAMVZ-Universidad Autonoma de Zacatecas, Zacatecas, Mexico*.

Present work intended to evaluate the effect of sodium monensin and lasalocid on calves growth in the feedlot consuming high levels of brewers grain. The study was performed in north-central Mexico (22° 52′ north latitude, 102° west longitud, 2,153 m above the sea level. Calves (n=29) with an average body weight of 218 kg were alloted into 3 treatments: T1 Control group, T2 Lasalocid (30 g/ton) and T3 Monensin (50 g/ton). Rations included 70% of a conventional diet and 30% of brewers grain, offered throughout 89 d. Feed consumption and body weight were recorded daily and bi-weekly, respectively. There were no significant differences (P> 0.11), within treatments for daily weight gain, but there was a difference within the Control group and Lasalocid (P<0.05). Average daily gain was 1.24, 1.36, y 1.35 kg/d for Control, Lasalocid and Monensin respectively. Average feed conversion was 6.97, 6.48 and 6.49 kg in a dry matter basis. Annual profitability was 35, 49.4 and 49.6%, respectively. In conclusion, ionophores increase weight gain, conversion, and profitability in growing calves fed brewers grain.

Key Words: Ionophores, Brewers grain, Feedlot

M154 Effect of condensed-tannins addition to a corn-sunflower meal based feedlot diet. A. J. Pordomingo*, M. P. Azcarate, and N. A. Juan, *INTA Anguil Experiment Station, La Pampa, Argentina*.

Addition of condensed tannins in ruminant diets has been suggested to reduce rate and extent of rumen degradation of soluble proteins and increase nitrogen and feed efficiency. This experiment evaluated the effects of adding 2 levels of tannins, compared with a control and a metabolizable-protein (MP) balanced diet, on weight gain and feed efficiency of feedlot steers during a 92-day period. Ninety six Angus steers (live weight = 200 ± 5 kg) were distributed in a completely randomized design of 24 pens with 4 steers each. Treatments applied were: T1= Diet based on sunflower meal, alfalfa hay and corn grain, T2= Similar to T1 plus 2.5% tannins added on dry-matter (DM) basis, T3 = Similar to T1 plus 3.5% tannins; and T4 = Diet based on corn, no tannins added, and balanced for MP supply (NRC, 2000) with sunflower, feather and fish meal. Diets were equivalent in metabolizable energy content.

A mineral and vitamin mix (3%-DM basis) and monensin (33 mg/kg of mixed feed) were added to all diets. Treatment T1 served as control for tannin effects and T4 as a reference for maximum potential. Weight gains (ADG) were determined on day 0 and at the end of 4 periods on days 24, 46, 69 and 92 of trial, after a 17-hour fast. Feed intake was measured daily by pen and averaged by period. Albeit treatment by period interactions (P<0.05), after the 92 days of trial ADG resulted greater (P< 0.01; SE= 0.029) for T2 (1.67 kg/d), compared with the other treatments (1.56 kg/d; P > 0,257). Addition of tannins did not affect (P> 0.25) DM intake. Treatments 1, 2 and 3 resulted in greater intakes (P< 0.01) than T4 (8.73 vs 8.16 kgDM/d, SE = 0.262), maybe due to effects of protein profiles supplied Treatment 4, however, yielded the greatest feed efficiency (5.29:1 vs 5.42:1 for T4 and the combined T1, T2 and T3, respectively; SE = 0.226). Fitted to NRC (2000) model, treatments 2 and 4 showed improved nitrogen use efficiency compared with T1 and T3 (P< 0.05).

Key Words: Protein use efficiency, Feedlot cattle, Condensed tannins

M155 Effect of age, sex, and grain processing method on rate and efficiency of gain of beef cattle. B. M. Rainey*, J. A. Paterson, M. C. King, L. W. Barney, and W. T. Choat, *Montana State University, Bozeman, MT*.

The objectives of this factorial growth study were to determine the effects of animal age (cows vs. calves), animal gender (steers vs. heifers) and barley processing method (whole vs. rolled) on rate and efficiency of gain when fed as a supplement to medium quality grass hay (12.3% CP; 37.7% ADF, DM basis). Also evaluated was a control treatment in which animals were not supplemented with barley. Forty, 36 mo old, Angus cows (493 ± 49 kg), twenty-one, heifer calves (98 ± 8 d of age) (107 ± 15 kg), and nineteen, steer calves (99 ± 7 d of age) (121 ± 16 kg) were allotted to treatments in a 2 x 2 + 1 arrangement. All cattle were blocked by age and sex and fed for 65 d. Pen was the experimental unit. Light test weight barley (20.9 kg·bu^{-1}) was provided at 0.5% BW (2.4 kg·cow^{-1}·d^{-1} and 0.6 kg·calf^{-1}·d^{-1}, DM basis). Grass hay was provided to cows at 9.7 kg·d^{-1}·d^{-1} and to calves at 2.8 kg·hd^{-1}·d^{-1} (DM basis). Rations were formulated to be isonitrogenous using a 31.6% CP supplement and cows received 0.9 kg·hd^{-1}d^{-1}, while calves received 0.45 kg·hd^{-1}·d^{-1}. Individual full weights were taken on two consecutive days at the beginning and end of the study. Data were analyzed as a factorial for the main effects of animal age, barley processing method and the processing x age interaction. No interactions were measured in this study. Animals fed the control diet had a similar rate and efficiency of gain as supplemented animals. Barley processing had no effect on rate or efficiency of gain for cows or calves (P>0.05). However, age (cow vs. calves) was significant (P < 0.0001). Cows gained more weight than calves, consumed more DM but were less efficient (5.73) than either heifers (3.2) or steers (3.73). Similarly, ADG was faster (P<.01) for cows than calves.. These data suggest that improved performance was not measured when the barley was rolled. Also, even though cows gained at a faster rate than calves, gains were more efficient for calves than cows (1.04 kg vs 0.58), cow vs heifer and (P = 0.0019), (1.04 kg vs 0.51 kg) for cows vs steers. These data suggest that calves which are out performed are still more efficient in their gains than older animals.

Key Words: Barley, Processing, Cattle

M156 The effects of cottonseed hulls added to diets with and without live yeast or mannanoligosaccharide in Holstein calves. S. R. Hill*, B. A. Hopkins, S. Davidson, S. M. Bolt, C. Brownie, T. Brown, G. B. Huntington, and L. W. Whitlow, *North Carolina State University*.

The objective of this study was to investigate the effects of fiber from cottonseed hulls (CSH) added to the starter and of live yeast (YST) or mannanoligosaccharide (MOS) added to milk, on growth, intake, rumen development, and health parameters in calves. Bull and heifer calves (n=116) were assigned randomly at birth to one of six treatments for 63 d. Calves were dehorned at 42 d. Bulls were elastrated by 14 d. Calves were fed 3.8 L of colostrum once daily for the first 2 d and then 3.8 L of whole milk supplemented with either no additive, 4g YST, or 3g MOS once daily through weaning at 42 d. Treatments included: 1) a corn/soybean meal based starter, 20% CP, 6% ADF (CON), 2) a blend of 85% starter and 15% CSH, 18% CP, 15% ADF (CON + CSH), 3) starter and MOS (CON + MOS), 4) starter with CSH and MOS (CON + CSH + MOS), 5) starter and live yeast (CON + YST), and 6) starter with CSH and live yeast (CON + CSH + YST). Starter diets were offered from 1 d and daily amounts were increased by 0.09 kg when orts were 0 kg. Weekly measurements included body weight (BW), wither height, hip width, and dry matter intake from starters (DMI). Daily measurements included rectal temperatures, fecal, and respiratory scores. Twelve steers (2 per treatment) were sacrificed for rumen tissue samples. Data were analyzed for the main effects of CSH, YST, and MOS. Average DMI was greater for calves consuming CSH diets (0.41 kg) than diets without CSH (0.34 kg). Calves fed CSH treatments (54.9 kg) had greater BW than those fed diets without CSH (53.3 kg) ($P<0$ .05). Average daily gain was greater for calves fed CSH diets (0.58 kg/d) than diets without CSH (0.51 kg/d) ($P < 0.05$). However, calves fed diets without CSH had a greater feed efficiency (0.67 kg feed/kg BW gain) than those fed CSH diets (0.73 kg feed/kg BW gain) ($P < 0.05$). There were no significant effects of YST or MOS on DMI, gain, or feed efficiency ($P >0.05$).

Key Words: Dairy calves, Cottonseed hulls, Yeast

M157 Effects of grazing fresh forages on milk fat CLA. S. J. Freeman*[1], J. A. Bertrand[1], T. C. Jenkins[1], B. W. Pinkerton[1], and D. L. Palmquist[2], [1]*Clemson University, Clemson SC / USA,* [2]*Ohio State University, Columbus OH / USA*.

The objective was to determine effects of grazing different forages on concentrations of *cis*-9, *trans*-11 conjugated linoleic acid (CLA) in milk fat of Jersey and Holstein cows. Two treatment groups were utilized for each of three studies: control (C) or pasture (P). Cows on C were fed a total mixed ration (TMR) ad libitum, and P cows were fed pasture and supplemental feed, which was limited to 60% of ad libitum dry matter intake (DMI). In Experiment 1, Holstein and Jersey cows on P grazed ryegrass pasture. Milk samples from each cow were taken at the end of two three-week periods for four consecutive milkings. In Experiment 2, Holstein and Jersey cows on P grazed dwarf hybrid pearl millet pasture. Weekly milk samples were taken at four consecutive milkings for the six-week study. In Experiment 3, Jersey cows on P grazed rye pasture. Weekly milk samples were taken at four consecutive milkings during two five-week periods. Linolenic acid (C18:3) content was higher in P diets compared to C (31% and 4%, respectively). Saturated fatty acid content (C16:0 and C18:0) was higher in C diets than P (51% and 30%, respectively). For all three forages, C18:3 was the fatty acid in highest concentration, ranging from 48% of total fatty acids (TFA) in dwarf hybrid pearl millet, 49% in ryegrass, to 57% in rye. Palmitic (C16:0) and linoleic (C18:2) acids concentrations were each approximately 11% of TFA. DMI from pasture ranged from 54% to 77%. Milk fat CLA as a percentage of TFA were significantly higher for P cows in all experiments. In Experiment 1, milk fat CLA for cows on P was 0.47% of TFA for Holsteins and 0.42% for Jerseys. In Experiment 2, milk fat CLA for cows on P was 0.57% of TFA for Holsteins and 0.45% for Jerseys. In Experiment 3, milk fat CLA for cows on P was 0.44% of TFA. Substitution of fresh forage for a portion of TMR in dairy cows significantly increases CLA concentrations to twice that of the control, as well as differences between Jersey and Holstein breeds. Cows responded similarly to all three forages.

Key Words: Pasture, CLA, Dairy cows

M158 Effect of dietary cation-anion difference and crude protein content on milk yield and blood metabolites of lactating dairy cows during hot weather. C. D. Wildman*, J. W. West, and J. K. Bernard, *The University of Georgia, Tifton, GA*.

Thirty-two lactating Holstein cows averaging 225 ± 63 DIM were used in a 6 wk randomized complete block trial to determine the response to dietary cation-anion difference (DCAD) and dietary crude protein (CP) concentration fed during hot weather. The study was conducted from July 17 through August 27. Mean maximum and minimum temperature, relative humidity, and temperature-humidity index (THI) were 29.9 and 22.5^{o}C; 98.1 and 65.7%; and 80.5 and 72.3, respectively. Treatments were arranged as a 2 x 2 factorial to provide 15 or 17% CP and DCAD of 25 or 50 meq/100g DM (Na+K-Cl). A DCAD x CP interaction (P=0.09) was detected for average daily milk yield with high DCAD resulting in lower yield (27.8 kg/d) than low DCAD (31.4 kg/d) at high dietary CP. No differences were noted at low CP. High DCAD (P<0.01) and CP (P=0.06) resulted in higher milk fat percentage than low DCAD and

CP respectively . No differences between treatments were observed for intake of DM or milk protein percentage. Blood urea nitrogen (BUN) was higher for 17% CP than 15% CP ($P<0.01$). A DCAD x CP interaction ($P<0.01$) was noted for blood Na ($P<0.01$). At 17% CP, blood Na was higher at DCAD 50 versus 25. At 15% CP, no difference was observed. Fractional excretion of K ($P<0.01$) was greater at DCAD 50 than DCAD 25. A DCAD x CP interaction ($P=0.05$)was noted for fractional excretion of Na with a greater increase with increasing DCAD at 15% CP than at 17% CP. A difference was also observed for urinary bicarbonate level for low (47.7 mmol/l) and high (88.8 mmol/l) DCAD ($P<0.01$). No CP differences were observed for fractional excretion. While results of this research indicate a relationship between DCAD and dietary crude protein, the mechanism behind this relationship is unknown.

Key Words: Dietary cation-anion difference, Dietary crude protein, Heat stress

M159 Amino acid composition of ruminant feeds and feed fractions.

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To improve the ability to predict amino acid flows in ruminants, which will enhance the efficiency of use of absorbed nitrogen (N), a better description of the amino acid (AA) content of feeds used in ruminant diets is necessary. The objective of this study was to analyze the AA composition of some common dairy feeds to determine variation among and within feed fractions and to evaluate typical fractionation methods for AA recovery. Twelve feeds (three alfalfa silages (AS), four soy products (SOY) and five corn silages (CS)) were partitioned to yield six N containing fractions: whole feed (W), insoluble N (IN), true soluble N, neutral detergent (ND), acid detergent (AD) and lignin (L). Residues from these fractions were analyzed for AA content using HPLC after acid hydrolysis or preoxidation followed by acid hydrolysis. Dry matter, ash and N were determined on all fractions. True soluble N was precipitated with 10% tungstic acid. The IN, ND and AD residues were prepared using standard procedures; lignin was obtained by hydrolysis of AD residue in 72% sulfuric acid for 3 hr. Amino acid values are presented as the mean sd as the percent of the crude protein in the residue (CP, % DM). Within AS, the mean Arg contents of the fractions (W, IN, TIN, ND, AD and L) were 4.13 0.21, 4.51 0.59, 5.84 0.89, 3.15 0.85, 1.59 0.43, 1.94 0.80 (CP % DM) ($P < 0.008$). Within the ND residues of the AS the Met content was 1.16 0.56. Among the CS fractions the Leu contents were 8.47 0.40, 11.16 1.45, 14.62 5.10, 7.31 1.36, 4.80 2.24, 6.44 2.45 (CP % DM), respectively ($P < 0.001$). Within the CS the Lys contents of the W and IN fractions were 2.30 0.63 and 3.40 0.38 ($P < 0.039$) while the Thr contents were 3.26 0.09 and 4.08 0.37 ($P < 0.01$). For the SOY the mean Leu content of the ND residues was 7.16 3.92 with a range of 1.75 to 10.70 (CP, % DM). The Leu content of the AD residue of the SOY ranged from 7.16 to 14.67 with a mean of 10.96 3.07. The mean Phe contents of the SOY AD and L fractions were 6.12 1.86 and 3.35 1.13, respectively ($P < 0.012$). The results of this work demonstrate that variation exists among similar feeds and within routine chemically determined feed fractions.

Key Words: Amino acid, Feed, Nitrogen

M160 Effects of feeding graded amounts of liquid molasses to high producing dairy cows.

G. A. Broderick* and W. J. Radloff, *U.S. Dairy Forage Research Center, Madison, WI.*

Previously, we observed that feeding sugar as sucrose or dried molasses increased DMI and fat yield in lactating cows. This trial tested effects of replacing dietary high moisture shelled corn (HMSC) with liquid molasses. Multiparous Holstein cows (48) were assigned by DIM to 12 blocks; cows were fed a covariate diet formulated to 17% CP and 26% NDF containing (DM basis): 30% alfalfa silage, 20% corn silage, 37.4% HMSC, 7.0% soybean meal, 4.4% roasted soybeans, plus 1.2% minerals and vitamins. After a 2-wk covariate period, cows within blocks were randomly assigned to TMR supplemented with (DM basis): 0% molasses, 37.4% HMSC (covariate diet); 3% molasses, 34.4% HMSC; 6% molasses, 31.4% HMSC; or 9% molasses, 28.4% HMSC. Cows were fed experimental diets for 8 wk. Milk yield and DMI were measured daily. Yield of milk components was determined one day during the covariate period and every 2 wk during the trial. The statistical model included average covariate and treatment for each production trait. Least square means are reported. There were linear declines in yield with increasing molasses; this was driven by a reduction in all production traits at 9% molasses. Unlike previous trials, there was no quadratic effect on fat yield with feeding sugar. However, there were quadratic responses for DMI and yield of milk, FCM, protein, lactose, and SNF with a maximum at 3% molasses. A cubic response was noted for DMI. Replacing HMSC with liquid molasses optimized yield and DMI when fed at about 3% of dietary DM.

	Molasses, %							
Item	0	3	6	9	SE	L[1]	Q[1]	C[1]
			(kg/d)					
DMI	25.6^{b}	27.9^{a}	26.4^{b}	26.2^{b}	0.4	0.93	< 0.01	0.01
Milk	44.3^{a}	45.5^{a}	44.6^{a}	42.2^{b}	0.6	0.01	< 0.01	0.79
3.5% FCM	45.6^{a}	47.4^{a}	45.3^{ab}	42.1^{b}	1.2	0.02	0.04	0.61
Fat	1.63^{ab}	1.71^{a}	1.61^{ab}	1.51^{b}	0.06	0.11	0.16	0.51
Protein	1.39^{a}	1.41^{a}	1.35^{a}	1.23^{b}	0.03	< 0.01	0.01	0.65
Lactose	2.13^{b}	2.24^{a}	2.17^{ab}	1.99^{c}	0.04	0.01	< 0.01	0.74
SNF	3.91^{a}	4.06^{a}	3.91^{a}	3.57^{b}	0.07	< 0.01	< 0.01	0.76

[1]Probability of linear (L), quadratic (Q) and cubic (C) effects. ^{a,b,c}Means in rows without common superscripts are different ($P < 0.05$)

Key Words: Liquid molasses, Dietary sugar, Milk yield

M161 Soy hulls as barley grain replacement in pellets fed to lactating cows; effect on digestion and milk performance.

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The potential of soy hulls rich in primary cell walls for replacing of barley grain when included as major components in pellets fed to dairy cows was measured. Hypothesis being that this replacement can avoid the inhibitory effect of starch on neutral detergent fiber digestion and utilization in the rumen, while improving milk fat synthesis by the cow. Ten lactating cows, similar in initial average performance, were divided into two dietary groups of five cows each and fed two different diets based on 73% pellets and 27% oat plus vetch hays (2:1). The two dietary groups differed in the pelleted ingredient of the diets composing of either 48% rolled barley grains in B group or 48% soy hulls in the SH cows. The hays and pellets were mixed together and fed ad-lib in three meals during the day, allowing for 10% orts. Chromium oxide marker was used to measure digestibility. Cows were allocated for 42 d in individual metabolic stalls, had free access to water and milked twice daily. Data of individual cows were analysed by ANOVA using the GLM procedure of SAS (1996). Dry matter and NDF intakes were significantly higher in the SH cows (20.4 and 9.63 kg/d, respectively, P=0.05) compared to the B group (16.9 and 4.95 kg/d, respectively). The in vivo digestibility of organic matter was slightly higher (P=0.06) in the B cows, however, NDF digestibility was significantly higher in the SH group (50.9 vs 36.2%, P=0.02). This difference is probably a result of the inhibitory effect of barley starch on the cellulolytic population of the rumen in the B cows. Intake and digestibility differences were reflected in higher content of milk fat (P=0.04) and higher yield of milk fat and 3.5% fat-corrected-milk (P=0.01) of the SH cows (3.65%, 1.13kg/d and 31.6 kg/d, respectively) compared to the B group (2.32%, 0.67kg/d and 24.1kg/d, respectively). Milk and milk protein yields were similar in both groups. This study demonstrates that a dietary regime based on feeding high proportion of concentrated pellets to dairy cows (e.g. in dairy herds using robots for milking or concentrate feeders) should be based on soy hulls as starchy grains replacement, in order to maintain high milk fat level.

Key Words: Dairy cows, Soy hulls pellets, Barley pellets

M162 Effects of prepartum dietary energy level and calcium propionate supplementation on energy metabolism in transition dairy cows.

C. C. Stanley*[1], C. C. Williams[1], H. G. Bateman[1], A. E. Beem[1], D. T. Gant[1], Y. H. Chung[1], and F.R. Valdez[2], [1] *Louisiana State University Agricultural Center, Baton Rouge, LA,* [2]*Kemin Americas, Des Moines, IA.*

Forty-one Holstein cows were grouped by anticipated parturition date and assigned to one of four treatments that were arranged as a 2x2 factorial based on 105 and 145% (NRC, 2001) of prepartum dietary energy requirements with or without addition of Ca-Propionate (113.5 g /d provided as NutroCAL^{TM}, Kemin Americas, Des Moines, IA). Cows were fed treatment diets from 21 d prior to their anticipated parturition date

until parturition. After parturition, all cows were fed a standard lactation diet with Ca-propionate supplementation continued as assigned prepartum. Individual cow DMI were measured daily. Blood samples were collected during wk -3,-2,-1, +1, +2, and +3 relative to calving for glucose, nonesterified fatty acids (NEFA), urea nitrogen (PUN), insulin, and thyroxine concentrations. Cortisol and glucagon concentrations were measured at wk -1 and +1. At wk -1 and +1, minimal model intravenous glucose tolerance tests were performed to assess glucose effectiveness (S_G), insulin sensitivity (S_I), and the acute insulin response relative to glucose administration ($AIR_{Glucose}$). Glucose, NEFA, insulin, cortisol, and glucagon concentrations were not affected by diet energy level or Ca-propionate supplementation. There were diet by week by Ca-propionate interactions ($P < 0.05$) for thyroxine and PUN concentrations. The S_I and $AIR_{Glucose}$ were not affected by Ca-propionate supplement or diet. The S_G were not affected by Ca-propionate supplement but were greater for cows fed the low energy diet ($P < 0.05$). Clinical health problems not related to dietary treatments of the experimental herd pre- and post-partum may have affected DMI, and therefore these data may not accurately reflect treatment effects on glucose metabolism.

Key Words: Calcium propionate, Glucose metabolism, Transition cows

M163 Conjugated linoleic acid and transvaccenic acid content of milk from cows fed fish meal and extruded soybeans for an extended period of time. A. A. AbuGhazaleh*, D. J. Schingoethe, A. R. Hippen, and K. F. Kalscheur, *South Dakota state University, Brookings*.

The objective of this study was to determine the effect of feeding a conjugated linoleic acid (CLA)-stimulating diet for an extended period of time on milk CLA and transvaccenic acid (TVA) concentrations. Twenty cows (16 Holstein, 4 Brown Swiss) were divided into 2 groups (n=10/treatment) for the 10 wk study. Cows in the first group were fed a traditional corn-soybean meal-basal diet. Cows in the second group were fed a blend of 0.5% fish oil from fish meal (FM) and 2% soybean oil from extruded soybeans (ESB) to achieve higher milk fat CLA and TVA. Diets were formulated to contain 18% crude protein and were composed (dry basis) of 50% concentrate mix, 25% corn silage and 25% alfalfa hay. Intake of DM was not affected by diet (29.3 and 27.7 kg/d for groups 1 and 2, respectively). Milk production (34.5 and 38.9 kg/d) increased ($P < 0.05$) when fed the blend of FM and ESB. Milk fat percentages (3.74 and 3.17), and milk protein percentages (3.39 and 3.18) decreased ($P < 0.05$) with the FM and ESB diet. However, milk fat yield (1.29 and 1.21 kg/d) and protein yield (1.16 and 1.23 kg/d) were not affected by treatments ($P > 0.05$). Concentrations of milk *cis-9, trans-11* CLA (0.33 and 1.16 g/100g of fatty acids) and TVA (0.58 and 2.1 g/100g of fatty acids) were 2.5-fold greater ($P < 0.05$) for cows fed the FM and ESB diet during the 10 wk trial, increasing to approximately 3.5-fold higher than the control diet by wk 3, decreasing during wk 4 and 5, and remaining constant at approximately 2.3-fold higher throughout the remainder of the experiment. Yields of *cis-9, trans-11* CLA and TVA in milk fat can be increased by feeding a blend of FM and ESB and that increase is relatively constant after 5 wk on the diet.

Key Words: Conjugated linoleic acid, Milk, Fish meal

M164 The effect of short vs long term yeast supplementation during the transition period of Holstein cows. J. D. Ward*[1], [1]*LSU AgCenter, Southeast Research Station*.

A 56 d study using 30 component fed Holsteins was conducted to determine the effect of yeast culture supplementation during the transition period. Treatments were control, yeast supplementation from 21 d prior to expected calving date through 21 d after calving (short regimen) and yeast supplementation 21 d prior to expected calving date through 56 d after calving (long regimen). Prior to calving, cows received 3.6 kg of DM per d of a concentrate mix, ad libitum access to bermudagrass hay and pasture, and 3.8 kg of DM of corn silage every other d. After parturition, multiparous cows and primiparous cows received 8.1 or 7.3 kg of DM per d, respectively, of a concentrate mix. All cows received, for ad libitum consumption, a mixture containing on a DM basis 13.0corn silage, and 7.6and 113.4 g after calving) to the concentrate of treatment cows. Plasma was collected on d 7, 14, 21, 28, and 56 for BHBA analysis. Milk components were analyzed every 14 d. Milk production, BHBA on d 7, 14, 21, and 28 d, DMI, and milk component data were analyzed using the mixed models of SAS and differences among treatments were tested using single degree of freedom contrasts. General linear models of SAS were used to analyze BHBA concentrations on d 56 and differences among treatments were analyzed using single degree of freedom contrasts. The contrasts were yeast supplementation vs no supplementation, and length of yeast supplementation. Overall, yeast supplementation had no effect on DMI, or milk production. However, cows on the long regimen had greater (P = 0.02) milk production (36.2 vs 33.7 kg per d) and less (P = 0.06) grain intake (7.3 vs 7.4 kg of DM per d) than cows on the short regimen. Neither yeast supplementation nor length of supplementation had any effect on BHBA during the first 28 d of the study. However, on d 56 cows on the long regimen had lower (P = 0.06) plasma BHBA concentration than cows on the short regimen (5.11 vs 7.4 mg/dL). Neither yeast supplementation nor length of yeast supplementation had any effect on SCC or milk fat. However, yeast supplementation decreased (P = 0.09) milk protein content (2.67 vs 2.81beneficial when fed throughout the entire study.

Key Words: Transition cow, Yeast, Heat stress

M165 Silymarin and lycopene in peripartum dairy cows: Effect on milk productivity and quality. D. Tedesco*[1], S. Galletti[1], M. Tameni[1], S. Steidler[1], A. Costa[1], and P. Morazzoni[2], [1]*Department VSA, University of Milan, Italy,* [2]*Indena S.p.A., Milan, Italy*.

Objective was to test silymarin + lycopene (Indena S.p.A.) in transient cows, in a period when oxidative stress can impair health status. Silymarin is a hepatoprotective and antioxidant substance which has shown a positive effect on productivity and health in transition cows. Lycopene is a scavanger of oxygen radicals. 20 cows selected according to parity, previous production and BCS, were divided into two groups. From 7 d before expected date of calving to 14 d after calving, 10 cows received 50 g/d of a mixture of silymarin + lycopene by oral drench. Milk production was recorded daily for 305 d and samples were collected at 7, 14 and 21 DIM. The BCS was evaluated at -7, 0, 7, 14, 21d from calving. Body weight was recorded at 0, 21 and 30d after calving. Blood samples were collected at -7, 0 and 14 d from calving to evaluate anti-oxidant power (OXY) and reactive oxygen metabolites (ROMs) in sera with two colorimetric micromethods. Treatment increased milk production. The a, b and c parameters from Wood equation of both lactation curves showed significant differences ($P<.05$), on average 2.5 kg/d for each animal. No difference was found in BCS and body weight between groups. Protein, fat, lactose and urea content in milk was not influenced by treatment. No inhibent activity was detected in milk. Somatic cell count (SCC) was lower in treated animals. The values were significantly different at 14 and 21 DIM (respectively 337700 vs. 62625 and 261500 vs. 66333; $P<.05$). At the start of trial (-7d) a lower OXY level (expressed in μM HClO neutralized by serum) was found in the treated group. Antioxidant treatment significantly increased this value at calving ($P<.05$). No variations were found in the control group in all the considered days. No differences were found in ROMs values (expressed in mM H_2O_2) considering treatment and day effect ($P>.05$). These results suggest that silymarin + lycopene treatment increases milk production and may have an effect on udder health.

Key Words: Dairy cow, Somatic cell count, Silymarin + Lycopene

M166 Development of a method to assess nutritional motivation in dairy cattle. K. V. Shore*, T. M. Widowski, J. P. Cant, W. J. Bettger, and B. W. McBride, *University of Guelph, Guelph, Ontario, Canada*.

The objective of this experiment was to develop an apparatus to assess nutritional motivation. A push door was designed to fit within a cow's tie stall manger area, the width 92 centimeters and the height of the door 130 centimeters. The apparatus works by the animal pushing the door open with the crown of the head in a lunging action. Successive addition of weights was used to determine the level of nutritional motivation for a food reward. For validation, three non-lactating dairy animals of varying body weights were fasted for 0, 24, 48, and 72 hours. At these designated time points motivation was assessed with the offering of dry hay. The test was completed once the animal would no longer push the door to receive the reward. With advanced duration of fast, there was a significant increase ($p>0.05$) in the amount of weight pushed (0 to 24 hours - 19 $\pm$ 3.8 kg or 3% of body weight; 24 to 48 hours - 49.5 $\pm$ 3.7 kg or 7% of body weight; 48 to 72 hours - 83.5 $\pm$ 5.1 kg or 13% of

body weight). In conclusion, the push door proved an effective tool in determining the level of motivation to receive a food reward.

Key Words: Nutritional motivation, Push door, Dairy cattle

M167 Production efficiency of mid-lactation dairy cows fed yeast culture during the summer. K. N. Linke[1], D. J. Schingoethe*[1], K. F. Kalscheur[1], A. R. Hippen[1], D. R. Rennich[1], and I. Yoon[2], [1]*South Dakota State University, Brookings,* [2]*Diamond V Mills, Inc., Cedar Rapids, IA.*

Thirty-eight Holstein cows (26 multiparous and 12 primiparous), which averaged 105 d postpartum at the start of the experiment, were used to evaluate the feeding of yeast culture (Diamond V XP^{TM}) on production efficiency during hot summer weather. After a 2 wk covariate period, cows were fed a control diet or control diet with 60 g yeast culture/cow daily for 12 wk from early June until early September. Weekly daytime high temperatures averaged 33degC (28 to 39degC) during the 12 wk period. Total mixed diets contained 28.5% of DM as corn silage, 21.5% as alfalfa hay, and 50% as concentrate mix with the yeast culture added to the TMR at the time of feeding. Milk production (34.9 and 35.4 kg/d, for control and yeast culture, respectively), 4% fat-corrected milk (31.2 and 32.0 kg/d), and DM intake (22.9 and 22.2 kg/d) were similar (P > 0.05) for cows fed control and yeast culture diets. Percentages of milk fat (3.34 and 3.41) and true protein (2.85 and 2.87) were similar (P > 0.05) for both diets. Production efficiency defined as kg fat-corrected milk/kg DM intake was improved (P < 0.04) by 8% (1.38 and 1.49) for cows fed the yeast culture. Body weights (629 and 616 kg) and body condition scores (3.12 and 3.16) were similar (P > 0.05) for both groups. The results suggest that the yeast culture can improve production efficiency of dairy cows in mid-lactation.

Key Words: Yeast culture, Lactating cows, Production efficiency

M168 Effects of diet forage:concentrate ratio on splanchnic nutrient metabolism in lactating dairy cows. C. K. Reynolds*[1], J. A. Benson[1], P. C. Aikman[1], B. Lupoli[1], M. D. Hanigan[2], D. E. Beever[1], and J. C. MacRae[3], [1]*The University of Reading, Reading, UK,* [2]*Purina Mills LLC, St. Louis, MO,* [3]*The Rowett Research Institute, Aberdeen, UK.*

The objective was to determine the effects of diet forage:concentrate ratio on the net absorption and metabolism of nutrients by the portal-drained viscera (PDV) and liver of 6 multiparous, catheterized, lactating (214 DIM) Holstein X Friesian cows (713 kg BW). Treatments were forage (60:40 dehydrated alfalfa:grass silage) or an isonitrogenous concentrate (2.64 % N) fed as a TMR in ratios (DM basis) of 60:40 (F) or 40:60 (C) in a single-reversal study with 5 wk periods. Blood flow (L/h) and net PDV and liver nutrient flux (mmol/h) were measured hourly (n = 6) on the last d of each period. Diets were offered hourly at below ad libitum DMI and equal calculated ME, but DMI (18.9 vs. 19.6 kg/d) and N intake (488 vs. 510 g/d) tended ($P > 0.16$) to be lower for F, thus ME intake was greater ($P < 0.03$) for C (202 vs. 221 MJ/d). Milk yield (20.2 kg/d) and composition were not affected by diet, but milk fat concentration was numerically lower for C (44.6 vs. 40.8 g/kg, SEM = 2.0). Blood flow for PDV (1874) and liver (2267) and net PDV flux of oxygen, ammonia, urea, acetate, n-butyrate, β-OH-butyrate, or glucose (-3562, 736, -472, 2618, 169, 232, and -35, respectively) were not affected ($P > 0.10$) by diet. Similarly, net liver flux of oxygen, ammonia, urea, acetate, n-butyrate, and β-OH-butyrate (-3458, -754, 779, 563, -138, and 330, respectively) were not affected ($P > 0.12$) by diet. However, greater ($P < 0.03$) net PDV release of lactate (146 vs. 177) and numerically greater net PDV release (862 vs. 1140, SEM = 122) and liver removal (796 vs. 1074, SEM = 115) of propionate were associated with greater ($P < 0.04$) net liver release of glucose (620 vs. 713) and less ($P < 0.10$) net liver removal of lactate (69 vs. 28) for C. In conclusion, greater ME intake, from a higher concentrate diet, increased net splanchnic supply of glucose and lactate to peripheral tissues of late lactation dairy cows.

Key Words: Portal-drained viscera, Liver, Lactation

M169 Effect of the replacement of corn by citrus pulp on fiber effectivity. G. A. Andrade[1], J. C. Teixeira*[1], J.R.O. Perez[1], J. A. Muniz[1], P.C.A. Paiva[1], and J. S. Oliveira[2], [1]*Universidade Federal de Lavras,* [2]*Embrapa Gado de Leite.*

The objective of this experiment was to compare the part (CP50) and total (CP100) replacement of citrus pulp by finely ground corn (CP00) in lactating dairy cow diets in which the forage source was corn silage on fiber effectivity of the by-product. The hypothesis was that the use of citrus pulp in the place of corn increases the fat content in milk , the chewing activity and ruminal pH. Twelve cows at the middle third of lactation with an average yield of 28.5 kg of milk were utilized. The animals were fed twice per day with three diets ranging only the levels of NDF and ADF. The design was a replicate 3 x 3 Latin square design with 21-day periods. Two orthogonal contrasts for data analysis I (CP00 x CP100), II (2* CP 50 x CP 00 + CP 100) were utilized. The observations were of rumination, intake, mouth inactivity and water consumption, also the ruminal puncture was proceeded for the measurement of ruminal pH. No difference among the intake parameters according to the levels of replacement in relation to the CP00 treatment was detected, only the time spent with water consumption of kg of NDF was shorter for the animals when they were given CP100 diets. The time spent for rumination and of Kg of NDF was shorter for the animals fed CP100 diet. The time of mouth inactivity was longer for the animals when submitted to any of those experimental treatments utilized. Milk fat yield was higher for the animals when fed the CP100 diet and less when fed the CP00 diet.

Key Words: Citrus pulp, Corn meal, Fiber effectivity

M170 Feed consumption and efficiency of lactating cows submitted to part and total replacement of corn by citrus pulp. J. C. Teixeira*[1], G. A. Andrade[1], J. S. Oliveira[2], P.C. A. Paiva[1], J. A. Muniz[1], and J. R. O. Perez[1], [1]*Universidade Federal de Lavras,* [2]*EMBRAPA Gado de Leite.*

The objective of this work was to compare the part (CP50) and total (CP100) replacement of citrus pulp by finely ground corn (CP 00) in lactating dairy cow diets in which the source of forage was corn silage on milk yield and composition. The hypotheses were that use of citrus pulp in the place of corn does not show any fall in milk yield and increases the percent of fat and protein. Twelve cows at the middle third of lactation with an average yield of 28.5 kg of milk per day in two daily milkings were used. Milk samples were collected proportionally soon after milking and led to the analyses. The animals were fed twice per day with three diets containing the same nutritional pattern ranging only the replacement of corn by pulp. The experiment was a replicate 3 x 3 Latin square design with periods of 21 days. Two orthogonal contrasts were utilized for data analysis I (CP00 x CP100), II (2* CP50 x CP00 +CP100). Milk yield of the animals when they were fed the CP 50 diet was less than when the same animals were fed the CP00 and CP 100 diets, 28.32, 28.81, 28.58, respectively. Total yield and percent fat was less for the animals which were fed the CP00 diet and higher when they were fed the CP 100 diet , 0.96 x 1.10 kg and 3.37 x 3.84 %, respectively. The values for total yield and percent protein were the inverse of the found for fat with higher yields for the animals fed the CP00 diet and less for CP 100 (0.90 x 0.84) and 3.10 x 2.97.

Key Words: Citrus pulp, Corn meal, Milk production

M171 Effect of the replacement of corn by citrus pulp on nutrient consumption by lactating cows. G. A. Andrade[1], J. C. Teixeira*[1], J. A. Muniz[1], J. R. O. Perez[1], J. S. Oliveira[2], and P. C. A. Paiva[1], [1]*Universidade Federal de Lavras,* [2]*EMBRAPA - Gado de Leite.*

The aim of this experiment was to compare the part (CP50), total (CP 100) replacement of citrus pulp by finely ground corn (CP00) in diets for lactating diary cows in which the forage source was corn silage on feed consumption. The hypothesis was that the use of citrus pulp in the place of corn keeps the intake of dry matter with greater consumptions of neutral detergent fiber (NDF) and acid detergent fiber (ADF). Twelve cows at the middle third of lactation with an average yield of 28.5 kg of milk were utilized. The animals were fed twice per day with three diets ranging only the NDF and ADF levels. The experiment was a replicate 3 x 3 Latin square design with 21 days periods. Two orthogonal periods for data analysis I (CP 00 x CP 100), II (2* CP50 x CP00

=+ CP100) were used. DM consumption was higher for the animals fed CP00 and decreased according to the replacement of citrus pulp by corn (CP 00, 21.53; CP 50, 3.73; CP100, 4,26) was inverse to the dry matter consumption due to the large amount of fiber present in citrus pulp. The intakes of minerals, protein and energy among the animals fed the different diets was of same behavior of dry matter intake.

Key Words: Citrus pulp, Corn meal, Intake

M172 Use of intra-ruminal monensin capsules in dairy cows under alfalfa grazing conditions. I. Milk yield and composition. M. R. Gallardo[1], A. R. Castillo*[2], M. C. Gaggiotti[1], H. C. Castro[1], S. Aronna[1], S. Lettieri[1], D. Quatrin[1], and H. Perez-Monti[3], [1]*Experimental Station Rafaela, INTA, Argentina.*, [2]*UC Davis Cooperative Extension, U.S.A.*, [3]*Elanco Animal Health Div. Argentina.*.

This experiment evaluated short-term effects of intra-ruminal capsules of monensin on lactating dairy cows under alfalfa grazing condition. Fifty-six Holstein dairy cows (46 multiparous and 10 primiparous) were used in a repeated measures randomized design. The cows were blocked in pairs by calving date, previous milk yield, body weight and lactation number in two treatments: Control and Monensin. Treated cows received the intraruminal capsules 30 days before the expecting calving date and 60 days after calving. Short-term effects were evaluated during 150 DIM. All the cows were fed with the same diet, during the dry period a TMR and after calving alfalfa pasture and supplemented with TMR. Corn silage, alfalfa hay, corn grain, cottonseed, mineral and vitamins composed the TMR. Mean quality of the diet pre and postpartum were: 57.8 and 45.6%; 12.7 and 18.8%; 1.51 and 1.65 Mcal/kgDM; 52.1 and 35.8% for DM; CP; NEl; and NDF respectively. Dry matter intakes (DMI) were determines by offer and refusal in two different periods (25 and 50 DIM). Milk yield was recorded daily and milk composition twice weekly from calving to 60 DIM and once a week until 150 DIM. Dry matter intakes were comparable (P>0.05) between treatments, averaging 14.16 and 9.25 kgDM/cow/d TMR and alfalfa respectively. There were significant differences (P<0.05) in milk yield and milk composition (fat, protein, and non-fat solids). Monensin capsules improved lactation performance of dairy cows under alfalfa grazing conditions.

	Control	Monensin	Dif.	
Milk yield (L/d)	26.60	27.65	1.05	***
Milk composition (%)				
Fat	3.60	3.51	-0.09	*
Protein	3.25	3.24	-0.01	
Non-fat solids	8.94	8.95	0.01	
Components yield (kg/d)				
Fat	0.952	0.965	0.013	
Protein	0.860	0.890	0.030	***
Non-fat solids	2.374	2.460	0.086	**

* P<0.05; ** P<0.01; *** P<0.001

Key Words: Monensin capsules, Dairy cows, Alfalfa grazing

M173 Intake and milking performance of high producing cows fed starchy vs primary cell wall- rich pelleted additive. J. Miron[1], E. Yosef*[1], M. Nikbachat[1], E. Maltz[2], I. Halachmi[2], and D. Ben-Ghedalia[1], [1]*Institute of Animal Science,* [2]*Institute of Agricultrural Engineering*.

The potential of byproducts rich in primary cell walls for replacing commonly used starchy grains in pellets supplemented to a basic TMR of lactating cows was examined. Twenty four high producing cows were divided into two groups of 12 cows each similar in initial performance (45 kg milk/d, 59 DIM) and fed individually ad-libitum for seven weeks a diet containing 75% (on a DM basis) basic TMR (1.5 Mcal NEL, 17% CP) plus 25% additive of pellets. The two experimental diets differed only in the pelleted additive composed of either starchy grain plus soybean meal in the control pellets or soy hulls plus gluten feed in the experimental pellets. The two types of pellets contained 17% CP, and served to cows on top of the basic TMR in individual feeders in three meals, at around milking hours. The cows ingested the two types of pellets within 10-30 minutes after serving. This unique feeding system resembled the feeding regime commonly occurred in dairy barns using automatic feeders of concentrates or milking robots. Total NDF content was 40.3% and 31.0% in the experimental and control diets, respectively. Average voluntary DMI was higher in the experimental compared to the control cows (27.3 and 25.1 kg/d, respectively, P=0.01). Average daily milk fat content, milk fat yield and 3.5% FCM yield were higher (P<0.02) in the experimental cows (3.31%, 1.49 kg and 43.7 kg, respectively) compared to the control group (2.79%, 1.24 kg and 39.9 kg, respectively). Average milk and milk protein yields were similar in both treatments (44.6 and 1.39 kg/d). Data support our concept that pellets made of primary cell wall rich byproducts encourage milk fat production in cows when supplemented in concentrate feeders or milking robots.

Key Words: starchy pellets, primary cell wall-rich pellets, performance of dairy cows

M174 Effect of whole cottonseed, whole canola seed and crushed canola seed on milk yield and composition of primiparous Holstein cows. L. J Erasmus*[1], P. C Haasbroek[2], and J. B. J. Van Ryssen[1], [1]*Dept. Animal and Wildlife Sciences,University of Pretoria, Pretoria, South Africa,* [2]*Agricultural Research Council, Pretoria, South Africa*.

Canola is relatively new as a feedstuff in South Africa and is gaining in popularity. This study investigated the effect of replacing 10/% of the traditionally fed oilseed,whole cottonseed (WCS)with either 10/% whole canola seed (WCA) or 10/% roller milled crushed canola seed (CCA). Thirty primiparous Holstein cows were used in randomized block design and blocked on average production from d 17 - d 20 post partum. After blocking the cows were fed one of three experimental diets (WCS, WCA, CCA) for a period of 60 d. The diets were similar in chemical composition (17/% CP; 11.4 MJME/kg DM) and based on lucerne hay, oat hay, corn and oilseeds. Dry matter intake (20.5; 20.2; 20.3 kg/d), milk production (28.5; 29.4; 29.0 kg/d) body weight (553; 547; 549 kg) and body condition score (3,0; 2.9; 2.7) did not differ between treatments WCS,WCA and CCA respectively. Cows fed the WCA and CCA diets produced milk with a higher fat/%, compared to the cows fed WCS (3.84 and 3.95/% vs 3.47/%; P = 0.01). Supplementation with CCA decreased the concentration of C16:0 and increased some long chain fatty acids in milk compared to the cows fed the WCS diet (P<0.05). Processing of canola also decreased the C16:0 to C18 total fatty acid ratio from 0.48 to 0.36 (P<0.05) for cows fed the WCS and CCA diets respectively. It can be concluded that there is no need to process canola seed when fed to cows with an intake of around 20 kg DM/d and milk production of 28 - 30 kg/d. At higher intakes (>25 kg DM/d) it might be necessary to process canola due to higher ruminal outflow rates. If the objective is to produce a healthier milk with reduced C16:0 to total C18 fatty acids ratio, then processing would be necessary.

Key Words: Dairy cows, Canola, Milk composition

M175 Hepatic palmitate metabolism of periparturient dairy cows as affected by nutrients supplied in vitro. M. S. Piepenbrink* and T. R. Overton, *Cornell University, Ithaca, NY*.

Liver from Holstein cows (n=7) entering second or later lactation was utilized to measure responses of palmitate metabolism to candidate nutrient effectors. Liver slices were prepared from biopsy samples collected 21 d prepartum and 1, 21, and 63 d postpartum. Concentrations of nutrients used in liver incubations were: control (B), 75 μM choline chloride (C), 75 μM L-Met (M), C + M (CM), 75 μM D,L-2-hydroxy-4-(methylthio)-butanoic acid (H), 650 μM sodium propionate (P), 80 μM linoleic acid + 20 μM linolenic acid (E), C + E (CE), and M + E (ME). Liver incubated with CE had greater capacity for conversion of [1-^{14}]palmitate to CO_2 than P [4.1 vs. 3.5 nmol converted/(g wet weight x h)] and tended to be greater than liver incubated with C, CM, E, and ME (3.7, 3.6, 3.7, 3.6 nmol converted/(g wet weight x h)). On d 21 prepartum, slices incubated with CM tended to have lower conversion to CO_2 than those incubated with H and CE [2.98 vs. 3.8 nmol converted/(g wet weight x h)]. Liver incubated with P or E on d 1 postpartum tended to have lower capacities to synthesize CO_2 from [1-^{14}]palmitate than B. On d 63 postpartum, liver incubated with CE had the highest capacity for [1-^{14}]palmitate oxidation to CO_2 compared to all other treatments except E. The capacity of liver to store [1-^{14}]palmitate intracellularly as

esterified products (SEP) tended to increase from prepartum values on d 1 postpartum and then declined on d 21 and 63 postpartum [225, 241, 197, 197 nmol converted/(g wet weight x h)]. Overall treatment means of SEP tended to be lower for liver incubated with H, E, and ME compared to B [210, 206, 208 vs. 227 nmol converted/(g wet weight x h)]. Effects of treatment within day were only apparent on d 1 for SEP such that liver incubated with C (232; $P < 0.17$), E (231; $P < 0.15$), and ME (228; $P < 0.13$) tended to be lower than B (264 nmol converted/(g wet weight x h)). These data suggest that choline and essential fatty acids modulate liver fatty acid metabolism during the immediate postpartal period.

Key Words: Periparturient cow, Liver, Fatty acids

M176 Evaluation of dry matter intake equations by examining predicted change in bodyweight throughout lactation in dairy cows.

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In the dynamic modelling of dairy cow performance over a full lactation, the difference between NE intake, NE used for maintenance and output in milk accumulates in body stores. To select, out of some common DMI prediction equations, the one that results in a minimum cumulative bias in body energy deposition, a simple dynamic model of NE balance was constructed. Fat corrected milk yield (kg/d) was calculated as $a*[1\text{-}b0*e^{-b1*t}]*[e^{-c*t}]$, where a, b0 b1 and c were obtained by nonlinear fit to experimental data. Dry matter intake (DMI) was predicted from FCM yield and bodyweight, with one of the 4 CNCPS equations, the ARC equation or the NRC equation. Energy balance was calculated according to NRC as DMI*1.7-FCM*0.749-$BW^{0.75}$*0.08. Bodyweight change was 0.203 times NE balance if the balance was negative and 0.195 times balance if positive. The instantaneous bodyweight of cattle at progressive weeks of lactation (WOL) was then simulated as the numerical integral of the bodyweight change. Predicted DMI and body weight from each DMI equation were compared statistically with published observations on Holstein dairy cows with a variety of frame sizes and body conditions, and fed a variety of diets. Regression analysis was performed on all predicted DMI and body weight curves to determine goodness of fit. All equations over predicted body weight, with an increasing difference between predicted and observed body weight as lactation progressed, and this suggests a problem in energy balance calculation, most likely in the maintenance factor. A maintenance cost of 0.11 Mcal/$kg^{0.75}$ minimized residual sums of squares of body weight prediction, and taking into account this adjustment the body weight/energy balance of each DMI equation was examined.

Key Words: Energy balance, Dry matter intake, Dynamic modelling

M177 Effect of Tween 80 on milk production by Holstein cows.

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The effects of the surfactant Tween 80 on milk yield and composition, feed intake and body weight were studied using 108 multiparous Holstein cows in a 12-wk trial. Cows were ranked by previous milk yield and days in milk (DIM) and randomly assigned to three diets. Within diet, cows were further grouped as <30 or ≥30 DIM. The diets (CON, T1 and T2) were partial mixed rations (PMR) containing barley grain, grass silage, corn silage, grass hay, canola, bypass protein, mineral mix and 0, 0.25% or 0.50% Tween 80 (w/w). Diets were balanced to NRC requirements for milk production of ≤29 kg/d, and offered for ad libitum consumption. Cows producing >29 kg/d were also fed dairy concentrate (1 kg per 3 kg milk in excess of 29 kg/d). Data were analyzed using PROC GLM with LSMEANS, with diet and DIM (<30 or ≥30) as main effects, and significance set at ($P<0.05$). Across DIM groups, cows fed T1 and T2 produced more ($P<0.05$) milk with lower ($P<0.05$) fat content, than those fed CON. However, PMR intake and milk protein content were similar ($P>0.05$) across diets. Milk yield by cows fed CON, T1 and T2 averaged 30.8, 34.0 and 33.1 kg/d, respectively, with 3.7, 3.5 and 3.5% milk fat content. Among cows ≥30 DIM, intake of PMR was similar ($P>0.05$) across diets, but those fed T1 and T2 produced 3.75 and 3.03 kg/d more ($P<0.05$) milk, than those fed CON. Milk fat was reduced ($P<0.05$) from 4.0% with CON to 3.6 and 3.8% with T1 and T2, respectively), and protein content from 3.33% (CON) to 3.2 and 3.17% (T1 and T2, each $P<0.05$). Milk yield among cows <30 DIM at the start of the trial was similar to that observed in cows ≥30 DIM, however, milk fat and protein contents with T1 (3.4 and 3.0%, respectively) did not differ ($P>0.05$) from CON (3.5 and 3.0%), and both were higher ($P<0.05$) than with T2 (3.2% fat and 2.9% protein). Body weight losses by T1 and T2 cows were 50 and 80% lower ($P<0.05$), respectively, than those fed CON. Milk yield by dairy cows is improved by including Tween 80 in the diet.

Key Words: Tween 80, Milk production, Cows

M178 Comparison of analytical methods and the influence of milk components on milk urea nitrogen recovery.

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The objectives of this study were to determine the differences among analytical methods and to determine if any components in milk affected the recovery of milk urea nitrogen **(MUN)**. Duplicate milk samples were collected from 100 Holstein cows fed one ration on a commercial dairy herd with a rolling herd average of 20,600 lbs. One of each duplicate was spiked with a known quantity of urea N (final concentration 4 mg/dl) while the other was not. Recovery was calculated as the difference in MUN between the two samples divided by 4 mg/dl. Each pair of milk samples was sent to 14 independent laboratories involved in the MUN Quality Control Program through National DHIA and analyzed for MUN, fat, protein, lactose, somatic cell count, and total solids. The laboratories analyzed MUN using CL-10 (n=3), Skalar (n=2), Bentley (n=3), Foss 4000 (n=3) or Foss 6000 (n=3) systems. When recovery of MUN was evaluated among the 5 analytical methods, the mean recoveries for the CL-10, Skalar, Bentley and Foss 6000 systems were 85.3, 90.5, 92.8, and 94.0%, respectively and did not differ from each other (or from 100%). However, MUN recovery for the Foss 4000 system was much lower at 46.9% (SE = 6.7%) compared to the other systems and differed from 100% ($P < 0.05$). Recoveries from all systems except Skalar were influenced by the random effect of lab ($P < 0.0001$) and the variation associated with recovery was not influenced by the random effect of cow. However, as MUN concentration increased, recovery decreased using the CL-10 and Bentley systems ($P < 0.05$) and tended to decrease using the Foss 4000 system ($P = 0.05$). As milk protein concentration increased, MUN recovery tended to decrease using the Bentley system ($P < 0.10$). Recovery of MUN using four of the methods was unaffected by most milk components and did not differ from 100%. Only 47% of MUN was recovered using the Foss 4000 system which depended on the lab, and tended to be affected by MUN concentration.

Key Words: Milk urea nitrogen

M179 Feed intake and milk production of Holstein cows fed rations with glucogenic supplements during the transition period.

T. I. Belloso*, M. S. Gulay, M. Liboni, M. J. Hayen, and H. H. Head, *University of Florida*.

Multiparous Holstein cows were used to evaluate glucogenic supplements added to daily TMR. Treatments were 1)control, none, n=29; 2) Nutro-CAL (Kemin Americas^{TM}), 0.114 kg/d, n=33; 3) Metaxerol (Pestell America^{TM}), 0.454 kg/d, n=31; and 4) propylene glycol, 0.300 kg/d, n=31. All cows were fed twice daily and intakes recorded from -21 d prepartum through 28 d postpartum. Supplements were mixed with ∼13.5 kg of the TMR fed in a.m. Afternoon feed allotment contained no supplement and amount was adjusted for expected 5% orts. Close-up dry TMR was fed through day of calving then fresh cow TMR was fed through 100 DIM, but supplements were discontinued after d 28. Milk yields (MY) were recorded at each of the 3 daily milkings. Body weight (BW) and BCS were recorded weekly beginning -21 d prepartum. Prepartum feed intake (kg/d) at wk -3 (28.85), wk -2 (31.91) and wk -1 (28.89) did not differ due to TRT, except during wk -2 prepartum (1>2; 30.20 vs 27.37 kg/d). Feed intake decreased 17.8-30.9% the week before calving, greatest decrease was during the 2 d before calving. Postpartum feed intake increased in all TRT groups during each of the 4 wk (26.79, 32.78, 36.32, 38.03 kg/d, respectively). Within week no differences in intake were detected due to TRT except during wk 4 (1>2; 39.18 vs 36.50, P= 0.0608) and (3>2; 39.05 vs. 36.50, P=0.0698). MY for TRT groups did not differ during the first 4 wk when supplements were fed, except that cows in TRT 4 produced less milk (∼2.5 kg/d; P≤0.0356). Overall, 3.4 kg/d less milk was produced during hot season. MY did not differ due to TRT for 28-70 (P=0.7127) or 4-100 DIM (P=0.9072) and no TRT comparisons were significant; overall means were 41.77 and

40.26 kg/d. BCS and BW prepartum and postpartum did not differ due to TRT and no TRT comparisons were significant. Cows showed reduced BW and BCS after calving and through 60 d postpartum. Overall, results showed that cows in all groups had similar MY, maintained BW and BCS equally well, and had similar patterns of feed intake during prepartum and postpartum periods.

Key Words: Glucogenic precursors, Milk yield, Feed intake

M180 Effects of prepartum dietary carbohydrate source and monensin on expression of gluconeogenic enzymes in liver of transition dairy cows. E. L. Williams*[1], M. M. Pickett[2], L. C. Griel[2], K. S. Heyler[2], G. A. Varga[2], and S. S. Donkin[1], [1]*Purdue University,* [2]*Pennsylvania State University.*

Adequate provision of gluconeogenic precursors is crucial to the health of transition dairy cows. Non-forage fiber source (NFFS) diets act to increase dry matter intake in transition cows and therefore availability of glucose precursors. Feeding monensin favors enhanced supply of propionate for gluconeogenesis. The objective of this study was to determine the effects of NFFS and monensin on expression of gluconeogenic enzymes in the liver of transition dairy cows. Twenty-one multiparous Holstein cows were used in a complete randomized block design. The addition (+) or absence of (-) supplemental monensin (0 or 330 mg/d) was evaluated in a prepartum conventional (CONV) diet and a NFFS diet in a 2 x 2 factorial arrangement of treatments. The CONV diet contained 70% forage and 28% of the forage was replaced with cottonseed hulls and soyhulls in the NFFS diet. Diets were formulated to contain 1.55 Mcal NE_L/kg, 14% CP, and 40% NDF on a dry matter basis. Treatments began at dry off and continued through parturition. Monensin was topdressed from 28 d pre-calving through parturition. At calving all cows were placed on the same lactation diet. Liver biopsy samples obtained at -28, -14, +1, +14, and +28 d relative to calving (DRTC) were used to determine pyruvate carboxylase (PC) and phosphoenolpyruvate carboxykinase (PEPCK-C) mRNA expression. There was an overall effect ($P < 0.05$) of DRTC on PC and PEPCK expression. Expression of PC mRNA differed ($P<0.05$) with prepartum diet and DRTC x diet but there was no effect of diet on PEPCK mRNA. Feeding NFFS+ increased PC expression on +1 DRTC ($P < 0.10$) compared with CONV (0.48 0.12 vs. 0.84 0.16; CONV vs. NFFS+). Feeding NFFS+ and monensin results in a combined effect to induce PC expression at calving. Expression of PC mRNA is induced when transition cows are fed conventional diets. The data indicate that NFFS and monensin act in concert to further induce PC expression at calving and consequently suggests increased capacity for gluconeogenesis from lactate.

Key Words: Transition cows, Monensin, Liver

M181 Effects of method of lipid supplementation and physical form of the forage on milk yield and fatty acid composition of milk fat. J. J. Brownfield, E. J. DePeters, J. W. Pareas, and S. J. Taylor, *University of California Davis.*

Objective was to determine the effect of method of lipid supplementation and forage length on milk yield and composition, particularly the fatty acid composition of milk fat. Four primiparous Holstein cows were fed one of four diets containing soybean oil fed as part of a TMR (T) or as an individual meal prior to consuming their TMR diet (I). The forage portion of the diet was either chopped(C) through a 2.5 cm screen or sliced to an approximate 7.5 cm length by a bale slicer (S). Cows were fed 454 g soybean oil a day, 227 g in each feeding. Experimental design was a 4x4 Latin square. Periods were 21 d with the last 7 days of each period used for data collection. Statistical contrasts were I vs T and S vs C. Milk yield (kg/d), DMI (kg/d) and milk fat (%) were not affected by either method of oil feeding or forage length. Milk yield, milk fat and DMI for IS, IC, TS and TC were: 37.4, 3.73, 21.9; 38.1, 3.50, 21.4; 37.8, 3.65, 21.2; 39.2, 3.89, 22.9, respectively. Total fatty acids and sn-2 fatty acid composition of milk fat were determined by GLC. Differences in fatty acid profiles were observed for C18:0, C18:1 trans9, C18:1trans11, and C18:2 cis9 trans11 (CLA). An increase in C18:0 was observed in milk fat of cows fed soybean oil as T compared to I with means 14.49 (IS), 14.57 (IC), 16.01 (TS), 15.66 (TC) g/100g fat [IvT P=.04]. Increases inC18:1trans 9 occurred for I compared to T[IvT P=.00]. Both method of lipid supplementation and forage length affected concentrations of C18:1trans 11 and CLA in milk fat with I greater than T and C greater than S averaging 1.69(IS), 2.16(IC),1.41(TS), 1.48 (TC) g/100g fat [IvT P=.00, SvC P=.03], and 0.79 (IS), 1.01 (IC), 0.62(TS), 0.60 (TC) g/100g fat [IvT P=.00; SvC P=.05] respectively. Method of lipid supplementation and forage length did not affect milk yield and fat percentage, but the fatty acid composition of milk fat was altered.

Key Words: Soybean oil, Dairy cows, Milk fatty acid

M182 Effect of a liquid oral drench at parturition on blood metabolites and incidence of metabolic diseases in Holstein cows. M. A. von Keiserlingk*[1], W. K. Vanderkooi[2], and L. M. Rode[3], [1]*University of British Columbia, Vancouver, BC,* [2]*Nutritech Solutions Ltd., Abbotsford, BC,* [3]*Rosebud Technology Development Ltd., Lethbridge, AB.*

Seventy multiparous Holstein cows, within a commercial dairy herd, were used to determine the impact of a complex oral nutrient drench on plasma metabolites and the incidence of metabolic diseases at parturition. Cows were paired according to age, previous lactation production, and expected calving date, then randomly assigned to one of two treatments: Control or Drench. Prior to calving, all cows were fed a negative DCAD diet. Control cows were drenched with a placebo (16 L warm water) while the treated cows received 2.2 kg of a premix containing alfalfa meal (41.4%), Ca propionate (34.0%), Mg sulfate (10.0%), KCl (7.5%), monosodium phosphate (6.0%) and a probiotic preparation. The premix was suspended in 16 L of warm water prior to drenching. All cows were drenched within 6 h of calving. Blood plasma was obtained via venipuncture and subsequent centrifugation at 0 h (just prior to drenching) and at 12 and 48 $\pm$ 2 h. after parturition. Plasma samples were analyzed for total Ca, Mg, total P, NEFA and beta hydroxy butyrate (BHBA). Data were analyzed using the PROC MIX procedure (SAS Version 8) with the 0-h sample serving as the covariate. Cows receiving the drench had higher ($P\leq0.03$) plasma Ca levels compared to Control cows (2.18$\pm$0.025 vs. 2.10$\pm$0.024 mmol/L) at 12 h post-calving but plasma Ca was unaffected by treatment by 48 h (2.018$\pm$0.032 mmol/L for both groups). No treatment differences ($P\geq0.25$) were detected for plasma Mg, P, or NEFA at either time point. There was a time x treatment interaction with plasma BHBA concentrations. At 12 h, treated cows had lower BHBA (0.52$\pm$0.31 vs 0.62$\pm$0.029; $P\leq0.05$) whereas at 48 h, treated cows had higher BHBA levels (0.75$\pm$0.060 vs 0.70$\pm$0.057; $P\leq0.05$). There was no difference between treatment groups in the incidence of metabolic diseases. In this study, there was no measurable benefit to the use of a complex drench compared to a placebo drench of warm water other than a transient increase in plasma Ca. However, this elevated level of Ca is similar to what has been reported previously for less complex oral drenches containing Ca propionate/Ca chloride.

Key Words: Hypocalcemia, Drench, Parturition

M183 Feeding behaviour of dairy cows at peak lactation. T. J. DeVries*, M. A. G. von Keyserlingk, D. M. Weary, and K. A. Beauchemin, *The University of British Columbia, Vancouver, Canada.*

New technology has been developed that allows monitoring of feeding behaviour of cows fed via a feed alley in a free stall barn. Objectives were to: 1) determine which measures of feeding behaviour were most repeatable, and 2) describe changes in these measures over peak lactation. The Growsafe^{TM} system recorded cow presence (hits; 6 s resolution) at the feed bunk for 21 lactating cows for two 8 d periods starting at 57 $\pm$ 16 (mean $\pm$ SD) and 94 $\pm$ 16 DIM. Meal criterion (27.74 min) was calculated using a mixed distribution model to fit the log frequency distribution of the intervals between hits. This criterion was then used to calculate meal frequency (meals d^{-1}) and duration (min d^{-1}). Total hits d^{-1} and hits per meal min (hits d^{-1} / meal duration) were calculated. Linear regression was used to determine within cow repeatability from period 1 (independent) to period 2 (dependent). Regression coefficients were significant ($P < 0.05$) for all measures. Within cow repeatability was highest for hits d^{-1} (R^2=0.90) and hits per meal min (R^2=0.91), moderate for duration (R^2=0.75), and low for frequency (R^2=0.22). Estimates for intercept and slope of the regressions were used to determine if cows changed their feeding behaviour over time (intercept not equal to 0) and if this change was relative to initial values (slope not equal to 1). Slopes ($\pm$ SE) were significantly ($P < 0.001$) higher than 1 for hits d^{-1} (1.40 $\pm$ 0.11) and hits per meal min (1.67 $\pm$ 0.12) indicating an increase in feeding activity and intensity across the two periods. Meal duration and frequency intercepts tended to be above 0 (68.18 $\pm$ 37.17 and 3.04 $\pm$ 1.70) and slopes tended to be less than 1 (0.79 $\pm$ 0.11 and 0.53 $\pm$ 0.23), indicating that cows with high duration and frequency

tended to reduce these values, and those that began lower tended to increase. These results illustrate that some measures of feeding behaviour are highly repeatable within cows and demonstrate that feeding activity and intensity within a meal increase over peak lactation.

Key Words: Feeding behaviour, Dairy cattle, Lactation

M184 Implementation of a "user friendly" rumen simulation model through mixed language programming. J. A. N. Mills*, E. Kebreab, L. A. Crompton, and J. France, *The University of Reading, Reading, UK.*

Current rationing models for dairy cows tend to be factorial and static and consider energy and protein requirements. They demand little in terms of computational power and as a result have proved valuable as quick and easy methods for rationing dairy cattle. However, they are requirements based and do not predict the yield of milk constituents. Therefore, over the last three decades there has been considerable development of dynamic mechanistic models of ruminant metabolism. This approach offers the potential to predict responses to nutrient intake and quantify the outputs of fat, protein, and lactose in the milk. Although, many benefits have been observed in a research environment, their application on-farm has been limited firstly through computational requirements and more recently due to the esoteric nature of the specialist modelling software. However, this research has used mixed language programming as an alternative to the Advanced Continuous Simulation Language, in order to allow non-specialist users to interact with an extant rumen model. The model and the numerical integration routines were coded in FORTRAN 95 and the Graphical User Interface (GUI) was written using Visual Basic (VB) 6.0. The interface between FORTRAN and VB was handled with C routines, with code optimized for Pentium 4 processors. The GUI facilitates use by different user groups from farmers to scientists, each with their own information needs. A "drill-down" menu system prevents the user becoming overwhelmed with non-relevant information. Data are displayed graphically or in tabular form, at the discretion of the user. There are many advantages to the programming techniques used other than the ability to reach a wider audience. There are improvements in speed of processing, and the ease with which model simulations can be run. This project demonstrates the principles for developing a nutrient based feed evaluation system for dairy cows that can be applied on-farm.

Key Words: Model, Rumen, Programming

M185 Manipulating rumen fermentation of dairy cows fed fresh alfalfa using feed additives. A. R. Castillo*[1], M. R. Gallardo[2], M. C. Gaggiotti[2], M. S. Garcia[2], O. Quaino[2], and C. Arakiki[2], [1]*UC Davis, Cooperative Extension, U.S.A.*, [2]*Experimental Station Rafaela, INTA. Argentina.*

The purpose of this study was to evaluate the effects of different feed additives on rumen fermentation and performance of dairy cows fed springtime fresh cut alfalfa pasture. Eight Holstein lactating cows, four primiparous rumen fistulated (60 DIM) and four late lactating multiparous cows were used in two 4x4 Latin squares designs (4 wk periods). The treatments were the following: a controlled diet (Control) with no feed additives; a dietary buffer (DB) 200 g/cow/d comprised of a mix of sodium bicarbonate, magnesium oxide, calcium carbonate and bentonite; antibiotics (M+V), 300 mg monensin + 30 mg virginiamycin per cow per day and a yeast cultures commercial preparation (YC) 15 g/cow/day. A basal diet containing fresh alfalfa (pre-bloom, 16.4% DM, 25.9% CP and 33.9% NDF) was fed *ad lib* to each cow in individual pens. Fresh alfalfa was cut twice daily and supplied to each cow at 9 a.m. and 5 p.m. Intake, *in-vivo* digestibility, milk yield and composition was measured in multiparous cows. Rumen fluid samples from fistulated cows were collected at pre- and 2, 4, 6 hours post-feeding and analyzed for pH, NH3, VFA and concentration of amylolytic and celulolytic bacteria. Dry matter intake (DMI), organic matter digestibility (OMD), milk yield, milk composition and ruminal pH were not affected by the treatments. Ammonia was decreased by M+V and YC. Also, M+V had lower concentrations of total VFA and cellulolytic microorganisms (1.94 MPNx109/ml) compared to those under other treatments (averaging 2.36 MPNx109/ml) Based on these results future experiments under grazing could be defined

	Control	DB	M+V	YC	SED	P<
Multiparous Cows						
DMI (kg/d)	18.70	18.70	18.90	18.90	0.248	0.87
OMD (%)	74.96	74.85	74.40	75.66	0.907	0.62
Milk (kg/d)	16.30	16.90	16.20	16.40	0.871	0.84
Fat (%)	3.90	4.01	4.10	4.07	0.142	0.79
Protein (%)	3.46	3.43	3.48	3.50	0.036	0.40
Fistulated Cows						
pH	6.78	6.81	6.89	6.83	0.045	0.14
NH3 (mg/dl)	39.30	36.00	33.80	33.80	1.889	0.02
VFA (mmol/L)	138.80	143.50	122.50	140.70	5.015	0.01

Key Words: Rumen fermentation, Alfalfa pasture, Feed additives

M186 Evaluation of a novel anionic product for transition dairy cows. P. C. Aikman*[1], E. Virtanen[2], U. Tennberg[2], A. K. Jones[1], C. K. Reynolds[3], and D. E. Beever[1], [1]*CEDAR, The University of Reading, UK*, [2]*Kemira Animal Nutrition, Helsingborg, Sweden*, [3]*The Ohio State University, Wooster.*

The objective was to test the efficacy of gypsum-coated calcium chloride (GCC) as an anion source for altering dietary cation-anion difference (DCAD; mEq [(Na+K)-(Cl+S)]/kg DM) and urine pH of transition dairy cows. In experiment one, six dry, non-pregnant Holstein X Friesian cows were used in a balanced 6 x 4 Latin Square experiment with 10 d periods. Treatments were a control, maize silage-based diet (DCAD = 113) or the control diet plus either GCC, liquid hydrochloric acid (HCl) or hydrochloric acid bound to diatomaceous earth (HCl-Damolin). Anionic treatments reduced DCAD to -87. Anions reduced urine pH from 7.8 to less than 6.5 ($P < 0.001$), but DMI (7.7 kg/d) was unaffected. Urinary Ca excretion (g/d; estimated from urine creatinine) was increased ($P < 0.001$) by anions (2.55 versus 7.19, 7.15 and 7.18 for HCl, HCl-Damolin and GCC respectively). In experiment two, 26 multiparous Holstein X Friesian cows were assigned to one of three treatments three weeks prior to day 305 of gestation. Treatments were: a control maize silage-based ration (mean DCAD of 249; n = 10) or control plus GCC (n = 8) or a commercial anionic supplement (CAS) supplying chloride anions and micronutrients (n = 8). Anions reduced DCAD to a mean of -91. Blood and urine samples were taken weekly until calving. DMI (kg/d) was not affected by anions, but was lower ($P < 0.06$) for GCC versus CAS (11.1, 12.2, and 10.4 for control, CAS, and GCC, respectively). Anions decreased ($P < 0.001$) blood (7.45, 7.43 and 7.38) and urine (8.52, 6.16 and 5.62) pH (shown for control, CAS and GCC, respectively), but GCC lowered blood ($P < 0.004$) and urine ($P < 0.016$) pH more than CAS. Estimated urine Ca excretion (g/d) was increased by anions (1.70, 7.60 and 8.31 for control, CAS and GCC respectively; $P < 0.003$). The low urine pH on the GCC treatment indicates more efficient use of anions in this product. Reducing the dose of GCC may overcome the decrease in DMI. However, dose-response relationships need to be developed.

Key Words: Anionic salts, DMI

M187 Effect of parity and prior energy intake on development of fatty liver during feed restriction in dairy cattle. M. C. Rich*, S. J. Bertics, D. G. Mashek, and R. R. Grummer, *University of Wisconsin, Madison.*

Our hypotheses were that development of fatty liver differs between heifers and cows and that cows experiencing moderate feed restriction would be less susceptible to fatty liver during severe feed restriction. Twenty Holstein cows and 10 heifers were blocked by expected date of calving, each block consisting of two pregnant multiparous cows and one pregnant nulliparous heifer. Each of the multiparous cows were randomly assigned within the block to one of two treatments and fed a diet providing either 160% (MH) or 80% (ML) of their estimated maintenance energy needs. Nulliparous heifers were fed at 80% of estimated energy requirements for maintenance and growth (NL). All animals were fed a control diet ad libitum from 75 to 60 days prepartum during which covariate measurements were made. Treatment diets were fed from d-61

to d-40. On d-39 through d-32, all animals were fed an estimated 30% of maintenance energy needs to induce fatty liver. DMI for MH, ML, and NL were 12.7, 7.9, 8.0 kg/d from d-60 to d-40 and 2.8, 2.9, 3.5 kg/d from d-39 to d-32, respectively. There was a tendency for cows to have higher liver TG on d-32 and a larger change from d-39 to d-32 than heifers. At d-39, plasma non-esterified fatty acid (NEFA) concentrations were higher in ML compared with MH and blood glucose concentrations were higher in NL compared with MH and ML. This data suggests that cows are more susceptible than heifers to fatty liver development during feed deprivation and that prior energy intake did not influence development of fatty liver in multiparous cows. Values below are LSM (SE).

	Treatment			MH+ML	MH
	MH	ML	NL	vs. NL	vs. ML
Actual Energy Intake[1]	140	83	75	P=	
d-39 Liver TG, %DM	1.3 (0.2)	1.8 (0.2)	1.3 (0.2)	NS	NS
d-32 Liver TG, %DM	16.7 (3.5)	15.3 (3.1)	7.8 (3.8)	0.08	NS
Liver TG Change	15.61 (3.4)	14.2 (3.4)	6.5 (3.8)	0.08	NS
d-39 NEFA, μEq/L	146 (30.8)	279 (31.1)	238 (38.8)	NS	0.006
d-39 Glucose mg/dl	64.6 (1.2)	64.5 (1.2)	68.9 (1.5)	0.02	NS
d-39 BHBA[2], mg/dl	3.6 (0.5)	4.2 (0.5)	3.0 (0.6)	NS	NS

[1] % of requirement from d-61 to d-40. [2] β-hydroxybutyric acid.

Key Words: Parity, Energy intake, Fatty liver

M188 A mechanistic model of glucose metabolism and ketosis development in early lactation cows. J. Guo*, R. Kohn, and R. Peters, *University of Maryland at College Park Maryland.*

The coordinated changes in metabolism that initiate lactation imply that ketosis problem should be approached in a dynamic way to account for the non-steady state conditions of periparturient cows. A dynamic mechanistic model was constructed to study the mechanism of ketosis, and evaluated with regard to its ability to simulate published experimental data for the development of ketosis in transition cows. In the model, it was assumed that glucose was the limiting nutrient, and lactose synthesis in mammary gland was assigned to the highest priority according to the concept of homeorhesis. The driving variables for the model were dry matter intake, feed composition, milk production, and initial body fat content. For the developmental data set, the model simulates the adipose tissue loss and the changes in plasma glucose, nonesterified fatty acids (NEFA), and beta hydroxybutyrate (BHBA) during the first four weeks postpartum. The model predicted blood glucose, NEFA, and BHBA concentrations with a root mean square prediction error (RMSPE) of 3.4, 0.5, and 1.0 mmol/l, which represented 10.1, 18.4, and 41.5 % of mean predictions respectively. The maximum mobilization rate of adipose tissue occurred at around 5 d postpartum while blood BHBA level peaked at about 12 d after calving. The evaluation of the model by behavioral and sensitivity analysis revealed that glucose availability played an important role in the development of ketosis. Comparison of model predictions to data from three published studies showed that the model under-predicted glucose concentrations by 9.6 % of mean prediction, and over-predicted NEFA and BHBA by 32.6 and 82.7% respectively ($p<0.05$). The prediction errors for NEFA decreased as predictions increased ($p<0.05$). The model predicts that ketosis in transition cows can result from the homeorhetic states of glucose and fat metabolisms, and from the interaction between these two metabolisms.

Key Words: Mechanistic model, Ketosis, Transition cows

M189 Effect of an exogenous phytase enzyme blend and dietary phosphorus content on P excretion in lactating cows. K. F. Knowlton*[1], J. M. McKinney[1], K. F. Wilson[2], and C. Cobb[2], [1]*Virginia Polytechnic Institute and State University,* [2]*Loveland Industries, Inc.*

The effect of an exogenous phytase blend and dietary P content on P partitioning and excretion was evaluated in 9 early lactation cows (6 ruminally cannulated; mean = 27 DIM). Cows were assigned to treatments in 3, 3x3 Latin squares. Squares were balanced for residual effects of diet, and each cow received each treatment sequentially in 3, 21 d periods. Diets were 45% forage (all corn silage), 17.3% CP, 25.9% NDF, and 0.95% Ca, and included supplemental P (High P; 0.47%), no supplemental P (Low P; 0.32%), or no supplemental P with exogenous phytase (Low P-phytase; 0.32%). Pre-planned contrasts were used to evaluate the effect of dietary P (High P vs. Low P and Low P-phytase) and phytase addition (Low P vs. Low P-phytase). Total collection of milk, urine, and feces was conducted on d 19-21 of each period. Neither dietary P content nor exogenous phytase affected DMI (21.8 kg/d); milk yield (39.6 kg/d), or milk composition. Excretion of feces (5.85 kg/d DM and 37.9 kg/d wet) were unaffected by diet, but urine excretion was lower by cows fed the low P diets than cows fed High P (16.5 vs. 21.3 kg/d; $P < 0.01$). Compared to cows fed High P, cows fed the low P diets had reduced P intake (68.1 vs. 103.9 g/d; $P < 0.01$), reduced fecal (34.4 vs. 51.3 g/d; $P < 0.01$) and urinary P excretion (2.8 vs. 9.2 g/d; $P < 0.01$), and lower P balance (-8.0 vs. 4.4 g/d; $P < 0.01$). Milk P secretion as a percent of P intake was higher in cows fed the low P diets than in cows fed High P (51.5 vs. 34.9%; $P < 0.01$). Addition of exogenous phytase did not affect P intake, milk P, fecal P, or urinary P excretion, but apparent P digestibility tended to be higher in cows supplemented with phytase (50.1 vs. 40.5% for Low P-phytase and Low P, respectively; $P < 0.11$).

Key Words: Phosphorus excretion, Phytase, Lactating cows

M190 Milk fatty acids profile of dairy cows fed fresh alfalfa and different feed additives. A. R. Castillo*[1], P. T. Garcia[2], R. B. Páez[2], M. A. Taverna[2], M. S. Garcia[2], M. C. Gaggiotti[2], N. Pensel[2], and A. Quatrin[2], [1]*UC Davis Cooperative Extension, U.S.A.,* [2]*Estación Experimental Agropecuaria Rafaela, CICV, INTA, Argentina.*

The aim of this work was to evaluate the effect of different feed additives on milk fatty acids (FA) profile of lactating dairy cows fed fresh cut alfalfa pasture. Four late lactating multiparous Holstein cows were used in a 4x4 Latin square design (4 wk periods). The treatments were the following: a controlled diet (Control) with no feed additives; a dietary buffer (DB) 200 g/cow/d comprised of a mix of sodium bicarbonate, magnesium oxide, calcium carbonate and bentonite; antibiotics (M+V), 300 mg monensin + 30 mg virginiamycin per cow per day and a yeast cultures commercial preparation (YC) 15 g/cow/day. A basal diet containing fresh alfalfa (pre-bloom, 16.4% DM, 25.9% CP and 33.9% NDF) was fed *ad lib* to each cow in individual pens. The alfalfa pasture was cut twice daily and supplied to each cow at 9 a.m. and 5 p.m. Three milk samples of each cow per period were frozen at -20C. At the end of the trial, milk samples were thawed and mixed as a compound sample by cow per period and analyzed for FA profiles. Lipid extraction was performed according to the Folch method, followed by acid methylation. Fatty acid methyl esters were separated by gas chromatography with a CP-Sil 88 capillary column (100m x 0.25 mm i.d.). There were not significant effects ($P>0.05$) of the treatments on the milk FA composition. The results are reported as percentage of total FA, as follow:

Treatments	Control	DB	M+V	YC	SEM	P<
Fatty Acids						
4:0-13:0	6.14	5.85	5.90	6.41	0.507	0.24
14:0	8.59	8.83	9.13	8.75	0.356	0.44
14:1-15:0	2.10	2.42	2.38	2.24	0.169	0.18
16:0	27.55	27.11	28.29	27.20	2.004	0.37
16:1	1.67	1.40	1.46	1.50	0.107	0.34
18:0	11.07	10.95	11.33	10.87	0.279	0.72
18:1t	4.70	5.02	4.98	4.69	0.242	0.70
18:1c	21.02	20.09	19.99	19.91	2.096	0.33
18:2n6	2.09	1.98	2.07	2.00	0.023	0.23
18:3n6	0.28	0.25	0.27	0.29	0.002	0.65
18:3n3	1.46	1.48	1.57	1.47	0.017	0.46
*cis*9, *trans*11 CLA	1.20	1.26	1.32	1.26	0.016	0.83
20-22:6	1.34	1.48	1.16	1.48	0.16	0.29

Key Words: Milk fatty acids, Alfalfa pastures, Feed additives

M191 Prediction of methane emission from ruminal coenzyme M. M. S. Oatley, M. L. Nelson*, K. A. Johnson, and M. Ney, [1]*Washington State University, Pullman*.

Four mid-gestation, ruminally cannulated Hereford cows (629 ± 10.5 kg) were fed, at maintenance, full bloom Timothy hay plus 0% fat (control), 6% beef tallow (T), 6% yellow grease (YG) or 3% T and 3% YG in a 4 x 4 Latin Square design to quantify the relationship between Coenzyme M (CoM) in Archaea in the rumen and the amount of methane emitted measured using SF_6 dilution. An improved analytical procedure for CoM was developed and the impact of freezing (-25°C) and storage for 0, 1, 2, 14 or 28 d was determined. Freezing had no effect on the CoM standard but, due to small increases over time, may have improved CoM extraction from rumen contents, particulate, liquid and protozoal-rich fractions. Ruminal protozoa numbers (primarily *Entodinium spp.*, 5.2 vs 4.8 ± .08 Log_{10} scale) and methane emissions (157 vs. 98 ± 4.6 L/d) were greater ($P \leq .01$) for control than fat supplemented cows suggesting less methanogenic endosymbionts to produce methane. Ruminal fermentation end products, volume, mass, and rates of passage were not affected ($P \geq 0.10$) by dietary fat treatment. The best regression equation was CH_4 (mol/d) = 1036.4 (CoM, mmol/rumen) -573.2 with an R^2 of .94 using treatment means. Using ruminal CoM concentration is a new alternative for estimating methane emission.

Key Words: Methane, Cows, Fat

M192 Leucine metabolism in skeletal muscle of lactating dairy cows. K. A. Cummins* and D. R. Mulvaney, *Auburn University, AL*.

A study was designed to assess the effect of transition into lactation on skeletal muscle oxidation of branched chain amino acids. Muscle biopsies were taken from the semi-tendinosus muscle of 5 multiparous Jersey cows at -14, 5, 50, and 150 DIM. Biopsies were taken under local lidocain anesthesia. Muscle fibers were separated from surrounding tissue while still attached at each end and held under tension using a system of clips. Triplicate samples were then removed from the muscle and incubated in a Krebs-Ringer buffer system containing either 10 mM leucine labeled with carbon 14 at the 1 position or keto-isocaproate (the transamination product of leucine) labeled in the same manner. After 60 m incubation, carbon dioxide released from oxidation of leucine was trapped in KOH, and then carbon dioxide was non-enzymatically cleaved from any keto-isocaproate formed from the action of leucine aminotransferase but not further metabolized. This carbon dioxide was then trapped. The cows were fed corn silage-based TMRs throughout the study that were 16 % CP and 1.72 Mcal/kg DM basis until 90 DIM, then 15 % CP and 1.66 Mcal/kg. Mean production during the study was 5570, 281, and 211 kg of milk, fat, and protein, respectively. Milk production over the entire lactation for the 5 cows ranged from 5198 to 6253 kg. Milk production at 50 and 150 DIM was 27.5 and 21.1 kg/d, respectively. Transamination of leucine was 13, 11.2, 11.3, and 6.7 pMol/mg protein per minute at -14, 5, 50, and 150 DIM, respectively. Subsequent decarboxylation of keto-isocaproate formed from leucine was 2.0, 1.9, 2.1, and 1.2 pMol/ mg protein per minute at -14, 5, 50, and 150 DIM, respectively. No differences were found with stage of lactation for either metabolite ($P>0.1$). However, decarboxylation of keto-isocaproate provided directly to muscle strips was 7.4, 33.6, 31.5, and 20.5 pMol/mg protein per minute at -14, 5, 50 and 150 DIM, respectively. Onset of lactation resulted in an increase in metabolism of keto-isocaproate ($P<0.1$). Skeletal muscle of lactating dairy cows appears to develop the capacity to metabolize large amounts of leucine after the onset of lactation but control mechanisms associated with initial transamination prevent this occurrence

Key Words: Dairy , Transition, Muscle

M193 Effects of short-term drenching of transition cows with propylene glycol on early lactation performance and health. V. E. Lenkaitis, L. L. Contreras, C. M. Ryan, and T. R. Overton*, *Cornell University, Ithaca NY*.

Three-day drenching strategies of postparturient cows with propylene glycol (PG) have effectively decreased circulating concentrations of NEFA and BHBA during early lactation. Our objective was to determine whether a three-day drench of PG beginning at parturition would affect milk yield and circulating BHBA concentrations of dairy cows on commercial dairy farms. Holstein cows (n = 457) on three commercial dairy farms were assigned to a control (no drench) or a PG treatment (500 ml) administered on the day of parturition and the subsequent two days. Performance data were collected during the first four monthly test days of lactation. Milk yield (42.0 vs. 40.9 kg/d), milk fat percentage (3.52 vs. 3.54%), milk fat yield (1.52 vs. 1.48 kg/d), milk true protein percentage (2.80 vs. 2.84%), and milk true protein yield (1.22 vs. 1.18 kg/d) were not different ($P > 0.15$) between controls and PG-drenched cows, respectively. A trend ($P < 0.15$) for a treatment by month interaction existed for body condition score such that cows drenched with PG maintained slightly increased body condition score during early lactation. Concentrations of BHBA in plasma samples collected from each cow during d 5 to 10 of lactation were not different between treatments (8.8 vs. 8.7 mg/dl; $P > 0.15$). Cows assigned to the two treatments had similar reported incidences of ketosis, milk fever, displaced abomasum, and metritis; however, cows drenched with PG had decreased ($P < 0.05$) incidence of retained placenta. Overall, results from this experiment indicate that routine short-term drenches with PG beginning at parturition do not affect cow performance and most health variables. Further research should investigate herd-based factors that would be predictive of response to PG.

Key Words: periparturient cow, propylene glycol

M194 A commercial blend of essential oil components reduces ruminal degradation of protein supplements in ruminants. R. Molero[1], M. Ibaras[1], S. Calsamiglia[1], A. Ferret[1], M. Frehner*[2], P. Williams[3], and R. Losa[2], [1]*Universitat Autonoma de Barcelona, Bellaterra. Spain,* [2]*Crina S.A. / Akzo Nobel, Gland, Switzerland,* [3]*Akzo Nobel, Davis, CA*.

A proportion of the dietary crude protein (CP) is degraded during its transit through the rumen; thus only the undegraded proportion remains available for direct absorption in the small intestine. Essential oils (EO) can modulate rumen fermentation. In the present experiment (exp), the effect of the feed additive Crina® ruminants (commercial blend of EO components, BEOC) was estimated in situ on the rumen degradbility of different raw materials. In 2 exp, degradation of test materials (TM) was determined after incubation in Dacron bags in the rumen of 4 fistulated Holstein heifers used in a 4 x 4 Latin Square. Treatments were assigned in a 2 x 2 factorial design (diet: exp 1: 15F [85/15, concentrate/straw] or 60F [60/40, alfalfa hay/concentrate] and exp 2: 65F [65/35, forage/concentrate] or 40F [40/60, forage/concentrate]; BEOC: exp 1 & 2: with or without 0.7 g / day of BEOC). Adaptation was 10 and 28 days in exp 1 & 2, respectively, prior to TM incubations. TM (soybean meal, SBM; corn gluten feed, CGF; lupin seeds, LS; green peas, GP; sunflower meal, SFM; fish meal [exp 1] or alfalfa hay [exp 2]) were incubated in the rumen for up to 72 h. Results were analyzed with the PROC MIXED (SAS, 1989) and differences significant at $P<0.05$. Exp 1: In heifers fed 15F, CP degradation was lower than in those fed 60F (average 72.8 vs 77.9%). BEOC in 15F reduced CP degradation

of LS (84.6 vs 81.9%), GP (82.2 vs 76.9%) and SFM (80.3 vs 75.8%). There was no effect of BEOC in 60F. Exp 2: In heifers fed 40F, CP degradation of SBM and SFM was lower than in those fed 65F (64.5 vs 69.5% and 82.9 vs 84.1%, respectively). BEOC in the 65F diet reduced CP degradation of SBM (70.8 vs 68.2%) and SFM (85.1 vs 83.0%). The use of BEOC can reduce ruminal degradation of CP of some raw materials after a 10 day adaptation period when fed a high concentrate diet, or after a 28 day period when fed a high forage diet. Thus the use of BEOC could be economically interesting.

Key Words: Bypass protein, Rumen metabolism, Essential oil

M195 Methodology for estimation of Volatile Fatty Acid (VFA) kinetics in cattle. X. Markantonatos[1], J.W. Young[2], R. Tucker[2], L.F. Richardson[2], and G.A. Varga*[1], [1]*The Pennsylvania State University,* [2]*Elanco Animal Health.*

Four rumen cannulated Holstein heifers weighing 380 kg ± 25kg were used to develop methodology based on ^{13}C stable isotope to quantify in vivo VFA production in the rumen. Heifers were fed either low (L) concentrate (25%) a high (H) concentrate (70%) diets at amounts to provide for 0.34kg/d of BW gain. Isotopic tracers (1-$^{13}C_3$Na, 1-$^{13}C_2$Na, 1-$^{13}C_4$Na) at 20% enrichment were bolused and intraruminally infused. Three days prior to sampling, heifers were fed every 4 h for 2 d followed by 2 h feeding intervals 1 d prior to and the day of sampling. Before tracer administration, cows were restricted from water to keep fluid volume of the rumen as constant as possible. Sampling times were -30, -20, -10, 5, 10, 15, 20, 50, 80, 110, 140, 170, 200, 230, 260, 290, 320, 350, 380, 410, 440, and 480 min relative to initiation of tracer infusion Values for Tracer to Tracee Ratio (TTR) were determined by a GLC-mass spectrometry. The reported TTR values for the tracee were corrected (CTTR) for skeweness, graphed, and the disappearance TTR for the primary tracee was converted to the natural log form. Endogenous Pool Size (EPS) for acetate (Ac) was significantly higher for the L vs H diet (1.94 moles vs 1.13 moles). However, heifers fed the H diet had a larger EPS for propionate (Pr) (0.21 moles vs 0.33 moles) and the slower rate constant (0.49%/h vs 0.72%/h) for Pr turnover. EPS of butyrate (Bu) was 0.34 moles vs 0.31 (L vs H), while comparable values for rate constant were 0.57%/h vs 0.51%/h respectively. The plots of CTTR showed that there was only a trace of ^{13}C transferred to Pr, but no evidence for meaningful transfer from Pr to other VFA. However, CTTR plots suggested a higher incorporation of ^{13}C into Bu, presumably direct transfer from Ac, and small incorporation of ^{13}C from Bu back to Ac. Results from the three ^{13}C-VFA showed that each individual VFA acts kinetically as a single pool in the rumen. The study suggests that ^{13}C, a stable and non-radioactive isotope, could be used to quantitatively evaluate VFA production of the three major VFA in cattle.

Key Words: ^{13}C stable isotope, VFA kinetics

M196 Effects of supplemental amylase on *in vitro* fermentation by mixed ruminal cultures and the growth of pure cultures of ruminal bacteria. J. M. Tricarico* and A. E. Kozenski, *Alltech Biotechnology Inc. Nicholasville KY.*

A series of studies was performed to evaluate the effects of a supplemental enzyme preparation containing amylase activity on fermentation of feed by mixed ruminal cultures and the growth of pure cultures of representative strains of ruminal bacteria. The addition of 60.0 units amylase to 1-L ruminal-simulating continuous cultures fed a 30% forage-70% concentrate diet reduced the molar proportion of propionate (0.305 vs 0.291, $P<0.05$) and increased the molar proportion of butyrate (0.180 vs 0.206, $P<0.05$) after supplementation for 72 h and 96 h, respectively. Total VFA concentrations, molar proportion of acetate and pH did not differ in control or enzyme-supplemented cultures during the 5 d supplementation period. Growth of *Butyrivibrio fibrisolvens* strains D1, 49, and A38, *Streptococcus bovis* strain S1, *Megasphaera elsdenii* strain T81, and *Selenomonas ruminantium* strain GA192 was evaluated on pure cultures incubated anaerobically on medium 10 broth containing 1.0 g*L^{-1} soluble potato starch. Enzyme treatment was applied immediately prior to bacterial inoculation to provide a final concentration of 60.0 units amylase*L^{-1}. Microbial growth was estimated in each culture by measuring turbidity (600 nm) over time. The addition of supplemental amylase enhanced the growth rates of *Butyrivibrio fibrisolvens* strain D1 (0.007 vs. 0.168 OD*h^{-1}, $P<0.05$), *Selenomonas ruminantium* strain GA192 (0.004 vs. 0.085 OD*h^{-1}, $P<0.05$) and *Megasphaera elsdenii* strain T81 (0.012 vs. 0.036 OD*h^{-1}, $P<0.05$). Supplemental amylase had no effects on the growth rates of *Streptococcus bovis* strain S1 and *Butyrivibrio fibrisolvens* strain 49 and reduced the growth rate of *Butyrivibrio fibrisolvens* strain A38 (0.131 vs. 0.076 OD*h^{-1}, $P<0.10$). We conclude that low concentrations of supplemental amylase enhances the growth of specific strains of ruminal bacteria and may be used to manipulate ruminal fermentation.

Key Words: Ruminant, Enzyme, Amylase

M197 Oxidation of glucose, glutamate, and glutamine by isolated ovine enterocytes in vitro is decreased by presence of other metabolic fuels. M. Oba*[1], R. L. Baldwin, IV[2], and B. J. Bequette[1], [1]*Department of Animal and Avian Sciences, University of Maryland, College Park, MD,* [2]*Bovine Functional Genomics Laboratory, ANRI, USDA-ARS, Beltsville, MD.*

The objective of this study was to evaluate oxidative metabolism of glucose, glutamate, and glutamine by isolated ovine enterocytes in presence of other metabolic fuels in vitro. Mucosal enterocytes were isolated from crossbred wether sheep (n=6) fed a mixed forage-concentrate diet, and incubated for 90 min with 1 mM U-^{14}C-glucose, -glutamate, or -glutamine and alternative substrates (AS; water as negative control, acetate, propionate, butyrate, glucose, glutamate, or glutamine) at concentrations of 0.1, 1.0, and 10.0 mM. Oxidation of labeled substrates to CO_2 and net production of lactate and pyruvate in incubation media were measured. Oxidation of glucose and glutamine to CO_2 was decreased by all AS except acetate, and the extent of reduction differed by type and concentration of AS in incubation media. Our observations that glutamine oxidation can be reduced by presence of AS is contrary to observations in the literature using enterocytes from non-ruminants, indicating that ruminant enterocytes might rely on glutamine to a less extent as an energy source. Total glucose utilization was reduced by propionate (10 mM) by 16% compared to control, but was not affected by other AS. Glutamate oxidation to CO_2 was reduced by the presence of propionate (10 mM) or glutamine (1.0 and 10 mM), but not by that of the other AS. Acetate did not affect oxidation of glucose, glutamate, and glutamine. Propionate reduced oxidation of glucose and glutamate only at the highest concentration (10 mM), indicating that the sparing effects of propionate on substrate oxidation is affected its concentration in the incubation media. These observations indicate that ruminant enterocytes can alter substrate preference for oxidative metabolism depending on type and concentration of available AS.

Key Words: Sheep, Enterocytes, Oxidative metabolism

M198 Effects of urea and ammonia treatment on nutritive value of corn silage. A. Davtalabzarghi*, R. Valizadeh, and A. Naserian, *Ferdowsi University of Mashhad, Khorasan, Iran.*

Corn crop as a high energy cereal is cultivated and largely used in form of silage in Iranian dairy industry. Ammonia treatment has resulted: a) an economical source of crude protein b) Prolonged bunk life during feeding c) Less molding and d) decreased protein degradation in silo. The objective of this experiment was to determine the effect of urea and ammonia treatment on the nutritive value of corn silage. Corn crop was harvested, chopped (2-5cm) from the Ferdowsi University Dairy Farm in September. Poly-propylene containers with capacity of 1-2 kg were used for the following treatments; a) The control (corn silage) b) corn silage + 0.7Corn silage + 0.4crop, mixed manually and filled into the silos with aid of a hydraulic tool. Ammonia was injected in equivalent amount of nitrogen to urea by specific nosle. Silos were sealed properly. Three silos were prepared for each treatment. The silos were opened after 0, 2,3,21,45 days of ensiling. Therefore 12 containers (silos) were used. Two 50 gram samples from each treatment at different opening periods were diluted in 450 ml sterile deionised water and blended for 1 min. Silage pH was determined immediately. Dry matter, Crude Protein, ADF, NDF were measured by the methods of AOAC (1984). Ammonia-N was measured with sodium tetraburate (16g/L) and titrated with 0.1 N Hcl. The pH of forages was increased up to 9 following treatment with urea and ammonia while the pH of control was 6.2. pH of treated silage remained higher at subsequent samplings. There were no significant differences between DM, ADF, NDF in different treatments and each time point. CP and N-NH3 were significantly higher ($P\leq0.01$) in treated silages.

Key Words: Ammonia and urea, Nutritive value, Corn silage

M199 Determining the relationships among milk urea nitrogen and milk production and milk components from lactating dairy cows in Texas. G. M. Goodall*[1], M. A. Tomaszewski[2], D. A. Knabe[2], R. B. Schwart[2], J. W. Stuth[2], and L. W. Greene[3], [1]*Goodall's Consulting, College Station, TX/USA,* [2]*Texas A&M University, College Station, TX/USA,* [3]*Texas A&M Research and Extension Center, Amarillo, TX/USA.*

The objectives of this study were to determine the relationship between milk urea nitrogen (MUN) and milk production, milk protein, and milk fat of lactating cows and to determine the feed cost benefit of using best management practices (BMP) to reduce excessive nitrogen in the diet of dairy cows in Texas. The BMP were routine analysis of the formulated diet and MUN testing. There were two feeding systems evaluated, grazing herds and total mixed ration (TMR) fed herds. There were 16102 individual cow records that were evaluated. Milk fat did not impact MUN concentration (P≥.05) in either the grazing or the TMR fed herds. Milk production, lactation number, herd effects and test date significantly impacted (P≤.05) MUN concentration. The economic advantage of routine testing of MUN concentration and analyzing the diet was a daily feed cost savings of $.22/cow.

Key Words: Milk urea nitrogen, Dairy cattle, Ration cost

M200 Feedlot performance and carcass characteristics of feeder lambs implanted and re-implanted with zeranol implants. S. J. Talley, M. W. Salisbury*, B. J. May, M. A. Carr, C. B. Scott, and G. R. Engdahl, *Angelo State University, San Angelo, Texas.*

One hundred-twenty Rambouillet feeder lambs with a mean initial body weight of 29.5 kg were used to compare the effects of double and single implanting Zeranol hormonal implants and no-implanting on lamb performance (average daily gain and feed to gain ratio) and carcass characteristics. The lambs were blocked by sex and randomly assigned to three treatments: no implant (treatment 1), single implant (treatment 2), and double implant (treatment 3). Lambs had *ad libitum* access to feed and water. On d 0, lambs were weighed, vaccinated for overeating, dewormed, and those lambs in treatments 2 and 3 were implanted. Lambs in treatment 3 were re-implanted on d 56. On d 28, 56, 84, and 112, lambs were weighed and slaughterd when end weights of 54 kg were reached. Backfat thickness, leg circumference, hot carcass weight, United States Department of Agriculture (USDA) yield and quality grades were recorded, and dressing percentage and calculated yield grade (CYG) were calculated. Average daily gain (ADG) was higher (P <.05) for treatments 2 and 3 versus non-implanted lambs on d 28, 56, 84, and overall. Days on feed for treatment 2 and 3 was lower (P <.05) than non-implanted lambs, and feed to gain ratio was reduced (P <.05) in both implanted lamb treatments on d 56, 84, and overall. No differences in hot carcass weight, backfat thickness, leg circumference, yield grade, and calculated yield grade were noted, but double implanted lambs had a lower (P <.05) dressing percentage. Treatment 3 ewe lambs had a lower (P <.05) percentage of choice grade carcasses and higher (P <.05) percentage of no grades than other treatments. Also, treatment 2 and 3 wether lambs had a higher (P <.05) value and profit margin than implanted ewes and control lambs based on actual purchase price, feed cost and carcass value.

Key Words: Lambs, Feedlot performance, Zeranol implants

M201 An evaluation of rumen papillae in Holstein heifers during the transition period. W. C. Stone*, S. L. Bulkley, D. J. Aneshansley, and A. L. Alcaraz, *Cornell University. Ithaca, NY.*

An experiment was conducted to attempt to determine the rate of rumen papillae change when dairy cattle are exposed to diets containing higher levels of grain. Rumen cannulas were placed into four Holstein heifers during their seventh month of gestation. Papillae absorption studies were conducted when heifers were fed the bred heifer ration, weekly for five weeks when fed the pre-freshening ration, and weekly for five weeks following freshening when fed the fresh cow ration. Papillae were biopsied at most of these same time periods. Biopsied rumen papillae were evaluated histologically; additionally, their size was determined with an image analyzer. A solution containing 1.9 g of Co-EDTA and 2 moles of valeric acid, diluted to .8 l and with its pH raised to 6.0 with approximately 40 g of sodium hydroxide, was ruminally infused. Rumen fluid was then sampled at half-hour intervals over an 8 h time period. Valerate absorption was estimated by subtracting the ruminal clearance rate of cobalt from valerate.
Ruminal valerate absorption rates significantly increased during the prefreshening period, with rates increasing over the entire five week time period. Changes in papillae surface area during the prefresh period were less clear. Histologically, the epithelium became thinner during this time period. There was considerable variation in all measurements for all animals during the five week post-fresh period. This variation may have been caused by health problems associated with freshening and the transition period. The epithelium increased in keratinization, and had a reduction in keratinhyaline granules, during this time period. In conclusion, papillae absorptive capacity increased when animals were switched from the bred heifer to the prefresh ration. Both were balanced according to the 2001 Dairy NRC. The change in absorption rate occurred during the entire five week prefresh period. There were no clear trends in the measured papillae characteristics post-freshening, perhaps due to transition health problems. Progress made in increasing papillae size and absorptive capacity during the prefresh period can be rapidly undone during the post-fresh period.

Key Words: Rumen papillae, Dairy cattle

M202 Nitrogen, phosphorus, and other minerals in Idaho dairy diets. A. N. Hristov*[1], R. P. Etter[1], A. Melgar[1], J. I. Szasz[1], K. L. Grandeen[1], S. Abedi[1], J. K. Ropp[1], D. Falk[1], W. Hazen[2], and R. Ohlensehlen[2], [1]*Department of Animal and Veterinary Science,* [2]*Agricultural Cooperative Extension, University of Idaho, Moscow, ID.*

Rations from 21 dairies in South-Central Idaho were analyzed for mineral composition. Total number of cows fed in the participating dairies was approximately 31,000. Separate diets were fed to the fresh and lactating cows. Four samples per dairy were taken within a period of 4 months and analyzed for N, P, Ca, K, Mg, S, Na, Cu, Fe, Mn, and Zn. Bulk tank milk samples were analyzed for milk urea N (MUN) concentration. Average mineral content of the fresh cows diets was (DM basis, meanSE, min and max): 3.170.034%, 2.49 and 3.59% (N); 0.410.006%, 0.31 and 0.53% (P); 1.000.026%, 0.57 and 1.26% (Ca); 1.760.034%, 1.25 and 2.20% (K); 0.350.006%, 0.28 and 0.42% (Mg); 0.360.008%, 0.24 and 0.58 (S); 0.400.023%, 0.14 and 0.65% (Na); 21.70.90 ppm, 9.1 and 33.1 ppm (Cu); 224.010.3 ppm, 73.3 and 408.6 ppm (Fe); 60.12.46 ppm, 33.2 and 94.2 ppm (Mn); and 99.86.38 ppm, 19.5 and 245.8 ppm (Zn). Lactating cows TMR contained 3.000.022%, 2.38 and 3.66% (N); 0.430.005%, 0.31 and 0.65% (P); 0.910.016%, 0.53 and 1.34% (Ca); 1.790.040%, 0.90 and 3.27% (K); 0.350.005%, 0.25 and 0.45% (Mg); 0.340.006%, 0.23 and 0.71 (S); 0.350.019%, 0.07 and 0.86% (Na); 21.90.71 ppm, 9.9 and 57.2 ppm (Cu); 225.57.2 ppm, 74.7 and 465.2 ppm (Fe); 56.41.48 ppm, 20.0 and 102.8 ppm (Mn); and 103.26.25 ppm, 29.1 and 509.8 ppm (Zn). Except slight differences in N, Ca, and Na content, fresh and lactating cow diets had similar mineral composition. Average MUN concentration was 14.80.24 mg/dl (varying from 10.0 to 20.4 mg/dl) and did not correlate (r = 0.04, $P > 0.05$) to dietary N. Dietary concentrations of S, Na, and Mn were highly correlated to concentrations of K, Cu, and Zn, respectively (r = 0.62, 0.81, and 0.73, respectively, $P < 0.05$). This survey showed that diets from the participating dairies exceeded NRC Dairy (2001) recommended levels for all macro and micro minerals studied.

Key Words: Phosphorus, Minerals, Dairy diets

M203 Pasture performance, feedlot gain, and carcass traits of Romosinuano crossbred, F-1 (Hereford x Brahman), and Brahman steers. F. M. Rouquette, Jr.*[1], R. D. Randel[1], C. R. Long[1], C. C. Chase, Jr.[4], J. C. Paschal[3], and R. K. Miller[2], [1]*Texas A&M University Agricultural Research & Extension Center, Overton, TX/USA,* [2]*Texas A&M University, College Station, TX/USA,* [3]*Texas Cooperate Extension, Corpus Christi, TX/USA,* [4]*USDA-ARS Brooksville, FL/USA.*

Romosinuano (ROMO) are tropically-adapted, non *Bos indicus* which are native to Columbia, SA, and were imported into the US in the mid-1990s by USDA at Brooksville, FL (STARS). Three ROMO sires developed from STARS were bred to F-1 Angus x Brahman, (A x B) dams.

The fall-born, half-ROMO (ROMX) steers (n=43) were grazed on ryegrass and clover pre-weaning. Steers had average birth weight of 35 kg, birth-to-weaning ADG of 1.0 kg/d, and weaning weight of 290 kg at 258 days of age. During the post-weaning stocker phase, ROMX grazed bermudagrass (BG) with F-1 Hereford x Brahman (HXB) steers (n=11) from July through September. During the 84-d BG phase, ROMX steers had ADG of 0.44 kg/d and HXB steers had ADG of 0.81 kg/d (P<.0001). On Oct. 23, all ROMX and HXB steers as well as Brahman (BRM) n=10 steers were transported to a commercial feedlot and fed in pens according to breedtype to a visual backfat of 1cm. The HXB were lightest (P<.003) at feedlot entry (295 kg); whereas ROMX and BRM were similar at 323 and 345 kg, respectively. All three breedtypes had different (P<.001) feedlot ADG with ROMX at 1.46 kg/d, HXB at 1.75 kg/d, and BRM at 1.22 kg/d. Final weight of HXB steers (606 kg) was heavier (P<.01) than both ROMX (563 kg) and BRM steers (540 kg). Steers had similar dressing percent (63.7%), backfat (1.08 cm), marbling score (426), and ave quality grade (700). The ROMX steers tended (P<.08) to have better yield grade (2.53) compared to both HXB (2.90) and BRM (2.88) Warner-Bratzler shear values showed that ROMX at 3.33 kg were less (P<.02) than those of BRM (3.79 kg); whereas HXB steers were similar to both ROMX and BRM. Cooking loss was similar for ROMX (26.8%) and HXB (27.4%), and both were less than BRM (32.6%) steers.

Key Words: Romosinuano, Carcass, Feedlot

M204 Urinary pH and mineral serum levels of periparturient Holstein and Jersey cows fed diets varying in dietary cation-anion difference. E. Gutierrez-Ornelas, H. Bernal-Barragan, H. Solis-Medina, J. Colin-Negrete, and H. Morales-Treviño, *Universidad Autonoma de Nuevo Leon.*

Twenty five Holstein and 27 Jersey cows were assigned 21 days before parturition to a randomized complete block design (parity and expected calving date) in a 2 X 3 factorial arrangement to evaluate the influence of three dietary cation-anion differences (DACD = +21, -5 and -3 meq (Na + K)-(Cl + S) per 100 g diet DM) on urinary pH, serum Ca, K, Cl, and Na levels; milk yield in the first month of lactation and milk fever incidence. Prepartum basal diet (DACD = +21) contained (DM basis) 50.7 % corn silage, 8.4 % alfalfa hay, 8.2 % oat hay, and 32.9% protein, minerals and vitamins supplement. Two low DACD diets (DACD = -5 and DACD = -3) were evaluated including 0.93 % NH4Cl or 1.4% CaCl2 to the basal diet. Urine and blood samples were collected before treatments, within the 21 d before parturition and postpartum. There was no difference (P>.05) between breeds in urinary pH and mineral serum levels throughout the trial and results were pooled to analyze diet effects. Serum Na and K levels at parturition were 378, 346 and 348 mg/dL (P < 0.05) and 19.0, 16.8 and 21.3 mg/dL; respectively for cows receiving diets having DACD of +21, -5 and -3. Serum Cl level (mg/dL) reduced (P < 0.05) at parturition for cows receiving DACD of +21 (322) and -3 (394), but not for diets with DACD = -5 (456). Two Holstein cows presented milk fiver on diet with DACD = - 3, and 4 cows (3 Holstein and 1 Jersey) fed with DACD = -5 diet retained placenta. There was a trend (P=.14) for higher milk yield during the first month of lactation for cows fed basal diet (34.6, 31.5 and 30.4 Kg/d, for DACD = +21, -5, and -3; respectively). Diets with low DACD lowered urinary pH but had high incidence of milk fever and placenta retention.

Key Words: Dietry cation-anion difference, Urinary pH, Periparturient cow

M205 A field study of milk production and reproductive performance in dairy cows fed different levels of phosphorus. J. Fiorini*[1], J. D. Ferguson[1], S. Alexander[1], R. A. Kohn[2], L. D. Chase[3], K. F. Knowlton[4], Z. Wu[5], and Z. Dou[1], [1]*University of Pennsylvania,* [2]*University of Maryland,* [3]*Cornell University,* [4]*Virginia Polytechnic Institute and State University,* [5]*Penn State University.*

On many dairy farms, long-term manure application has led to phosphorus (P) buildup in soils with enriched P losses from these soils to waters. One cost-effective approach to reduce potential P loss and improve water quality is to minimize manure P excretion through manipulation of dietary P to a level that equates with the actual needs of the lactating cow. Currently, P is being fed on many farms at levels that exceed requirements necessary for optimal performance, due largely to concerns of possible negative impact on milk production and reproductive performance if dietary P is reduced. This USDA funded project was initiated to collect and analyze data from commercial dairy operations in five states in the NE and Mid-Atlantic region (PA, NY, DE, MD, VA). A total of 100 herds were selected, these were visited on a quarterly basis. During each visit, feed and fecal samples were collected and subsequently analyzed in laboratories. Milk yields and reproductive parameters were also obtained quarterly from the respective DHIA records. Feed analysis results showed dietary P levels ranging from .35% to .64% dry matter (DM). The farms were sorted into three groups according to their dietary P concentrations: low (.35 to .40% P), medium (> .40 to .45), and high (>.45). Preliminary data analysis indicated that there were no statistically significant differences between any of the groups for the following reproductive parameters: conception rate, heat detection rate, pregnancy rate, days to first breeding, and days open. Also, milk production did not correlate with dietary P. In conclusion, results to date of this field project indicate that feeding dietary P in excess of .35% P does not enhance milk production or reproductive performance in lactating dairy cows.

Key Words: Phosphorus, Reproduction, Production

M206 Conversion efficiencies of N and P to exportable product on Vermont dairy farms. . G. W. Weber*[1], W. E. Jokela[2], S. C. Bosworth[2], and W. S. Burhans[3], [1]*Vermont Dairy Farm Sustainability Project, Inc.,* [2]*University of Vermont,* [3]*Poulin Grain, Inc.*.

A collaboration by academic and industry participants assessed whole farm nitrogen (N) and phosphorus (P) efficiencies on seven Vermont dairy farms. Whole farm efficiency was calculated as ((exported milk + livestock + forage N or P)/ (imported bedding + forage + livestock + N fixation + fertilizer + manure + concentrate N or P))*100. Feed nutrient efficiency represents ((retained nutrients in milk + tissue) / nutrient intake)*100. Crop N and P balance was calculated as (available nutrient supply from manure, soil, sod, and fertilizer) - (calculated requirement based on soil type, analysis and yield goal (where applicable)). Biweekly (weekly on one farm) data collection and diet evaluations by lactating group were made using Cornell Net Carbohydrate and Protein System v4.0.31 (CNCPS) with intakes determined by two-day measured fed minus refused amounts; pasture intakes were CNCPS predictions. Measured inputs for each CNCPS simulation included milk production and components (monthly DHIA), silage and pasture analyses (NIR, wet chemistry minerals, n= simulation frequency), and ingredient analyses (n=variable). Results, weighted by cow days per diet or field, are tabled below. Variation across and within farms suggests potential to improve efficiency of nutrient use.

Farm	1	2	3	4	5	6	7
Milk Yield Kg/head/d	34.8	35.7	29.0	27.5	28.2	25.1	34.6
Mean Diet CP %	17.8	17.3	18.4	17.4	17.2	18.3	18.3
Animal Units/ Hectare	2.0	2.5	1.8	2.1	2.5	0.9	1.5
Whole Farm Efficiency %							
N	37.9	39.8	21.2	36.5	29.7	49.2	20.1
P	47.0	49.1	33.4	39.2	22.6	75.6	20.5
Lactating Feed Efficiency %							
n	20	19	25	18	14	13	23
N	28.2	29.6	25.6	27.0	26.7	23.3	26.7
SD	1.9	1.0	2.1	2.3	1.3	2.1	1.5
P	34.9	34.4	28.8	28.4	29.7	33.3	31.4
SD	4.5	2.0	3.5	4.0	1.6	4.1	4.2
Crop Balance Kg/ Hectare							
n	64	35	65	18	16	N/A	40
N	30.2	15.4	63.5	20.3	-30.3	N/A	17.6
SD	66.3	71.5	75.1	102.9	103.5	N/A	68.0
n	60	35	62	18	16	N/A	40
P	15.2	23.2	-3.6	32.9	68.7	N/A	10.4
SD	26.0	24.0	20.4	17.7	101.3	N/A	45.6

Key Words: Nitrogen, Phosphorus, Efficiency

M207 Supplementation of FEB-200^{TM} to Alleviate Endophyte Toxicosis in Steers. V. Akay*[1], M. Foley[1], J. A. Jackson[2], M. Kudupoje[1], and K. A. Dawson[1], [1]*Alltech Biotechnology, Inc., Nicholasville, KY,* [2]*University of Kentucky, Lexington, KY.*

Twelve Holstein steers (240 to 324 kg) were blocked by body weight and assigned to one of four treatments to investigate the effects of FEB-200^{TM} (modified glucomannan, Alltech, Inc., Nicholasville, KY) on the symptoms of fescue toxicosis in steers fed endophyte-infected (EI) or endophyte-free (EF) fescue seed during 27 d study. Treatments were: 1) EI fescue; 2) EI fescue plus FEB-200; 3) EF fescue; and 4) EF plus FEB-200. Diet consisted of cracked corn grain (24.2%), cottonseed hulls (24.6%), crimped oat grain (24.2%), fescue seed (12.1%, KY 31 or Jesup minus), soybean meal (12.1%), and vitamin and mineral supplementation (2.58%). The FEB-200 was added into Diet 2 and 4 at the level of 2 kg/tonne. Steers were kept in an environmentally-controlled room (30^{o}C) and fed ad libitum once daily. Dry matter intake, serum prolactin and alkaline phosphatase levels were lower (P<0.05) for EI diet compared to EF diet. Addition of FEB-200 to EI diet increased (P<0.05) DM intake compared to EI diet without FEB-200 (8.46 vs 7.81 kg/d). Serum alkaline phosphatase levels were higher (P<0.05) for EI plus FEB-200 diet compared to EI diet without FEB-200 (43.88 vs 34.99 U/L). Endophyte-infected fescue diet with FEB-200 had numerically higher serum prolactin levels however, it was not statistically significant (P>0.05). Ear and shoulder skin temperatures were similar among EI, EI+FEB-200 and EF diets however, addition of FEB-200 to EF diet decreased (P<0.05) ear and shoulder skin temperatures compared to EI, EI+FEB-200 and EF diets. Rectal temperatures were higher (P<0.05) for EI diet compared to EF diet (40.11 vs 39.57^{o}C). Addition of FEB-200 to EI diet decreased (P<0.05) rectal temperatures compared to EI diet without FEB-200 (39.56 vs 40.11^{o}C). Rectal temperatures were similar (P>0.05) among EI+FE-200, EF and EF+FEB-200 diets. In conclusion, dietary supplementation of FEB-200 to cattle maintained on EI fescue may alleviate some of the endophyte toxicosis associated with consumption of EI fescue.

Key Words: Endophyte, Modified glucomannan, Steers

M208 Influence of previous cattle and elk grazing on the subsequent quality and quantity of diets for cattle, deer and elk grazing late-summer mixed-conifer rangelands. D. Damiran*[1], T. DelCurto[1], S. L. Findholt[2], G. D. Pulsipher[1], and B. K. Johnson[2], [1]*Eastern Oregon Agricultural Research Center, Oregon State University, Union,* [2]*Oregon Department of Fish and Wildlife, La Grande.*

A study was conducted to determine foraging efficiency of cattle, mule deer, and elk in response to prior grazing by elk and cattle. Four enclosures, in previously logged mixed conifer (Grand Fir) rangelands were chosen, and within each enclosure, three 0.75 ha pastures were either: 1) ungrazed, 2) grazed by cattle, or 3) grazed by elk in mid-June and mid-July to remove approximately 40% of total forage yield. After grazing treatments, each pasture was subdivided into three 0.25 ha sub-pastures and 16 (4 animals and 4 bouts/animal) 20 min grazing trials were conducted in each sub-pasture using four steers, four tame mule deer, or four tame elk during August 1998 and 1999. A bite-count technique was used to determine foraging efficiency and composition of diet. Crude protein content of deer diets tended to be higher ($P < 0.20$) in pastures previously grazed by cattle; whereas ADF was higher ($P < 0.01$) and IVDMD was lower ($P < 0.05$) in pastures previously grazed by elk. Crude protein content of elk diets were not influenced ($P > 0.20$) by previous grazing, but diet ADF, NDF were lower ($P < 0.01$) in pastures previously grazed by cattle. Prior grazing did not influence ($P > 0.10$) intake rates of deer and elk. In response to cattle grazing, steer and elk diets shifted to more ($P < 0.10$) forbs and shrub/trees. In response to elk grazing, cattle consumed more grasses and sedges; whereas elk consumed more ($P < 0.10$) grasses and shrub/tree. Deer increased ($P < 0.10$) shrub/tree intake in previously grazed pastures. This study suggests that previous grazing by cattle or elk has very little effect on the subsequent foraging efficiency of deer and elk. In addition, early summer grazing by cattle improve the quality of subsequent elk diets, but previous grazing by elk may reduce subsequent diet quality for cattle, deer, and elk.

Key Words: Mixed species grazing, Forested rangelands, Forage quality

M209 Changes in Forage Quantity and Quality with Continued Cattle Grazing in a Mountain Riparian Pasture. E. Darambazar*[1], T. DelCurto[1], C. J. Ackerman[2], G. D. Pulsipher[1], and D. Damiran[1], [1]*Eastern Oregon Agricultural Research Center, Oregon State University, Union,* [2]*Department of Animal Sciences, Oregon State University, Corvallis.*

The objective of this study was to evaluate changes in the quantity, quality, and moisture of available forage in a riparian pasture, and shrub utilization by cattle during a 30-d late summer grazing period. A riparian pasture (44.7 ha) in northeast of Oregon was grazed with 30 yearlings (419 kg, BCS = 5.05) and 30 mature cows with calves (499 kg, BCS = 4.65) from early August to early September in 2001, and from late July to late August in 2002. Sampling dates were d0, d10, d20, and d30. The forage availability before grazing was 1058 kg/ha and declined to 323 kg/ha at the end of the grazing period ($P < 0.10$). Grasses dominated the pasture, followed by forbs, grass-like (sedges and/or rushes), and shrubs. Kentucky bluegrass was the most prevalent forage species followed by timothy, sedges, and common snowberry. The highest percent disappearances of forage species was (83.7 - 92.7%) observed with quackgrass, western fescue, California brome, redtop, and heartleaf arnica, though their initial contributions to the available forage were less than 5%. Timothy, elk sedge, red clover, and common snowberry were also preferred species and major components of the available vegetation. High levels of shrub utilization were observed from d 20 through the end of the grazing period (45% for willow and 59% for alder). Forbs and shrubs did not vary in moisture content over the 30 d grazing period and across the years averaging 59% and 61%, respectively ($P > 0.10$). In contrast, the moisture content of grasses were over 50% at the beginning of the grazing period and declined to 34% by d 20. Likewise, forbs and shrubs were higher than grasses in CP (11, 14, and 6%, respectively) and IVDMD (58, 49, and 42% respectively). In summary, our results suggest that cattle grazing late summer riparian pastures will switch to intensive shrub utilization when grasses decline in quality and quantity, and forbs decline in quantity.

Key Words: Riparian areas, Cattle, Utilization

M210 Effects of whole corn versus cracked corn on performance of growing-finishing Angus bulls. S. M. Emberson, B. J. May*, M. W. Salisbury, M. A. Carr, G. R. Engdahl, G. G. Hilton, C. B. Scott, and R. L. Reed, *Angelo State University, San Angelo, Texas, USA.*

Effects of whole corn versus cracked corn on the performance of growing-finishing Angus bulls in a 112-d growth study was conducted at the Angelo State University, Management, Instruction and Research Center in San Angelo, Texas. Forty spring-born Angus bull calves with an average weight of 317 kg were used. Bulls were blocked by live weight and divided into 8 pens (4 pens/treatment). Bulls were fed nutritionally identical diets containing either cracked or whole corn by hand to provide *ad libitum* consumption throughout the trial. Rations were formulated to meet or exceed nutritional requirements of growing finishing bulls. Chromium oxide was added to the rations as a marker for DM digestibility estimates. Bull weights and fecal samples were collected every 28 d. All feeds fed and refusals were weighed and recorded daily. Ration DM digestibility of cracked and whole corn diets was similar. Average daily gain and intake over the entire trial were similar for bulls fed whole or cracked corn. However, feed efficiency over the entire trial was improved with the whole corn diet. Data from this study indicate that cracked corn processing will not improve performance of growing bulls fed nutritionally similar diets with whole corn.

Key Words: Bulls, Performance, Corn

M211 Validation of a prediction equation for energy balance in Holstein cows and heifers. J. D. Brixey*[1], M. A. McGuire, and W. J. Price, [1]*University of Idaho.*

Cows undergo substantial changes in energy balance (EB) during the transition from dry to lactating. An understanding of EB on animal health and production requires the ability to predict EB in animals without individual feeding. The aim of this study was to validate a theoretical prediction equation for EB in early lactating dairy cows. Fourteen cows and five heifers were assigned at random to Calan® gates for individual feeding from 21 d prepartum until 70 d postpartum. Daily intakes and milk yields, biweekly composition, weekly body weights and

blood samples were collected. Blood was analyzed for NEFA concentrations. Energy balance was determined by the cows NE_L intake minus the sum of NE_L for maintenance and the NE_L for milk output (NRC, 2001). The model (EB = -3.14 - 0.009∗NEFA + 0.341∗DIM - 0.002∗DIM^2) was developed previously in multiparous cows and subsequently used to predict EB in both cows and heifers. Cows and heifers reached nadir EB 5 to 10 DIM and reached positive EB by 18 to 23 DIM while increasing in DMI and milk yield. Cows reached peak milk production of 56 kg at 44 DIM, where heifers peaked at 57 DIM yielding 45 kg. For both cows and heifers, the model validation followed observed EB trends well. However, for cows the model did under predict EB over DIM and NEFA values. Clearly there is a demand for energy in early lactation where the cow is mobilizing body reserves. Understanding the significance of EB on animal health requires large animal numbers such that an indirect estimation of EB is needed. The prediction equation for EB after more extensive validation may provide the tool.

Key Words: transition, energy balance

M212 Incidence of *Escherichia coli* 0157:H7 contamination in fecal, wool, and carcass samples from feedlot lambs. M. Long*[1], T. T. Ross[1], T. Edrington[2], J. D. Thomas[1], and K. Christensen[1], [1]*New Mexico State University,* [2]*USDA ARS*.

The present study examined the incidence of *E. coli* O157:H7 in feedlot lambs on the farm and at slaughter. We hypothesize that *E. coli* O157:H7 is prevalent in feces and on the pelt of feedlot lambs and the feces and pelt pose a potential source of carcass contamination. Fecal, wool, and carcass samples were examined for *E. coli* O157:H7 to evaluate potential carcass contamination sources. All fecal samples were enriched in a gram-negative broth prior to immunomagnetic separation and enrichment using anti-*E. coli* O157 antibody-labeled paramagnetic beads (Dynabead anti-*E. coli* O157, Dynal Inc., Lake Success, N.Y.). Wool and carcass swab specimens were enriched with sterile brilliant green bile 2% broth. Enrichments were plated onto a sorbitol MacConkey plate containing cefixime and potassium tellurite. Three sorbitol-negative colonies exhibiting typical *E. coli* colony phenotype were selected and cultured in MacConkey broth and trypicase soy broth. Broth cultures were heat killed at 100 C and tested with an enzyme immunoassay for reactivity with anti-*E. coli* O157 monoclonal antibody. A greater number of wool samples tested positive for *E. coli* O157:H7 than fecal samples. Of the eighteen wool samples, ten samples (56%) tested positive for *E. coli* O157:H7, of the thirty fecal samples, twelve (40%) were positive for *E. coli* O157:H7. However, all carcass samples were negative for *E. coli* O157:H7 contamination. In conclusion, wool and fecal samples tested positive for *E. coli* O157:H7 and may be a potential source of carcass contamination. Furthermore, a positive wool sample did not always correlate with a positive fecal sample. This indicates that one animal shedding *E. coli O157:H7* in its feces could contaminate the wool of multiple animals in the same pen and thereby increase the chance for carcass contamination. Additional research is needed to determine if *E. coli* O157:H7 was not transferred to the carcasses or if current techniques are unable to recover *E. coli* O157:H7 from the carcass.

Key Words: *E. coli* O157:H7, Feedlot lambs, Carcass

Forages & Pastures: Silages, forage supplementation

M213 In vitro dry matter digestibility and fermentation characteristics of sawdust-wheat bran mixtures fermented by *Aspergillus oryzae*, *Formitella fraxinea*, and *Sarcodon aspratus*. Y. K. Kim[1] and D. J. Schingoethe[2], [1]*Chungnam National University, Chungnam, Republic of Korea,* [2]*South Dakota State University, Brookings*.

The objective of this research was to determine the effect of fermentation by the mycelia of fungal species *Aspergillus oryzae*, *Formitella fraxinea* and *Sarcodon aspratus* on the in vitro dry matter digestibility and fermentation characteristics of mixtures containing sawdust plus 20% wheat bran w/w, on a dry matter basis, as a means to recycle sawdust including fungal mycelium into a feedstuff. The mixtures were unfermented (UFM) and fermented by *Aspergillus oryzae* (AOM) for 3 d and by *Formitella fraxinea* (FFM) and *Sarcodon aspratus* (SAM) for 2 wk at 29 C in an incubator. Neutral detergent fiber (NDF) contents in mixtures were lower for SAM and UFM (80.4 and 82.2%) than for FFM and AOM (88.3 and 86.9%) ($P < 0.05$). In vitro DM digestibility after 48 h was higher for SAM (21.2%) than for UFM, AOM and FFM (17.9, 14.9, and 12.2%) ($P < 0.05$). The average pH was lower for SAM (6.44) than for UFM, AOM and FFM (6.87, 7.01, and 7.34) after 48 h of fermentation ($P < 0.01$). Concentrations of sugar in fermented fluid after 48 h were higher for SAM (0.71%) than for AOM, FFM and UFM (0.34, 0.31 and 0.27%) ($P < 0.01$). Concentrations of acetate and propionate (mole/100 mole) were higher for SAM (54.21 and 19.04) than for AOM (34.06 and 11.08), UFM (17.94 and 7.96) and FFM (10.31 and 4.96) ($P < 0.05$). Concentrations of butyrate were not different between SAM and UFM. It was concluded that the sawdust-wheat bran mixture fermented by *Sarcodon aspratus* (SAM) increased the DM digestibility of the mixture and improved the production of VFA in fermented fluid of the mixture compared with unfermented and fermented mixtures by other fungal species.

Key Words: Fungal fermentation, In vitro DM digestibility, In vitro fermentation characteristics

M214 Nutrient content and protein quality in grass silages. W. Heimbeck*[1], M. Coenen[2], K. Suedekum[3], L. Hogeback[2], S. Hoepken[2], and K. Eicken[4], [1]*Degussa AG, Feed Additives, Hanau, Germany,* [2]*School of Veterinary Medicine, Hannover, Germany,* [3]*Christian-Albrechts University, Kiel, Germany,* [4]*Veterinarian Practice, Ovelgoenne, Germany*.

The quality of grass silage varies depending on botanical composition, harvesting conditions and the ensiling process. The protein fraction of grass silages may be subject to deterioration during storage. The goal of the present investigation was to study changes in the protein quality of grass silages during a complete winter season (October through March). Samples of grass silages, produced according to common practice, were obtained from 11 farms in Northern Germany in four week intervals and analyzed for major nutrients. Furthermore, the N-fraction was differentiated into true protein, amino acids, and soluble and insoluble nitrogen. On average, pH of silages was 5.2, lactic acid varied between 1.2 and 133 mmol/kg, while acetic acid averaged 95 mmol/kg. The range for dry matter (DM) contents of the silages was between 232 and 788 g/kg, while crude fiber varied between 227 and 330 g/kg DM. Mean crude protein was 203 (130-282) g/kg DM. True protein was on average only 50% of CP (39-163 g/kg DM). In some samples, the percentage of crude protein that was true protein was less than 30%. This corresponds to the analyzed total amount of protein-bound amino acids in the silages. The low proportion of true protein in crude protein, and the corresponding lower amino acid content, mean that the real protein supply arriving at the intestine can be quite low for cows eating high quantities of such grass silages. Because of the variation in true protein and amino acids in grass silages, the non-differentiated data for rumen degradability (UDP) in feeding tables, as well as assumptions about degradabilty for dynamic models, seems to be questionable and may not reflect the real quantity of protein which is available at the small intestinal level.

Key Words: Grass silage, Protein quality, True protein

M215 The effect of *Lactobacillus buchneri* 40788 on the fermentation of alfalfa silage ensiled for an extended period of time. M. P. Lynch, D. H. Kleinschmit*, J. M. Neylon, T. E. Ebling, M. Reddish, J. M. Ladd, J. E. Lynch, M. Steifel, T. Gassert, and L. Kung, Jr., *University of Delaware, Newark, DE*.

Treating silages with *Lactobacillus buchneri* are more stable when exposed to air because lactic acid is converted to acetic via a novel pathway. However, excessive production of acetic acid in silage could be detrimental and thus the objective of this study was to determine the effect of time of ensiling and effect of *L. buchneri* on fermentation profile of alfalfa silage. Wilted alfalfa (40% DM) was either untreated (U) or treated with *L. buchneri* 40788 (Lallemand Animal Nutrition, Milwaukee, WI, 400,000 cfu/g of fresh forage) (T) and ensiled in triplicate 0.4-L laboratory silos for 4 mo, 1 y, and 1.5 y. Changes in silage fermentation caused by T, were similar at all times of ensiling. On average, the pH of U (4.29) was less than T (4.63) ($P < 0.05$), due to the greater

concentration of lactic acid in U (4.55 vs. 3.77%). The concentration of acetic acid was dramatically greater in T (6.85%) vs. U (3.29%) and the ratio of lactate:acetate was also greater in U (1.39) vs. T (0.56). The concentration of NH3-N in T (0.275%) was greater than in U (0.165%), whereas the concentration of water-soluble carbohydrates was greater in U (1.4%) than for T (0.43%). In conclusion, treating alfalfa silage with *L. buchneri* 40788 increased the concentration of acetic acid by degrading lactic acid and the time of ensiling did not impact the quality of alfalfa silage treated with *L. buchneri* 40788.

Key Words: *Lactobacillus buchneri*, Silage, Fermentation

M216 The effect of *Lactobacillus buchneri* 40788 and *Pediococcus pentosaceus* on the fermentation and aerobic stability of corn silage.

D. H. Kleinschmit*, R. J. Schmidt, J. E. Lynch, J. M. Ladd, K. E. Stratton, J. G. Carr, M. Reddish, and L. Kung, Jr., *University of Delaware, Newark, DE*.

Some studies have shown that the increase in acetic acid in silage from *Lactobacillus buchneri* does not occur until after 4 to 6 wk of ensiling. In addition, the aerobic stability of silages treated with *L. buchneri* in the field has been perceived, by some, as being worse when compared to untreated silages. Therefore, the objective of this study was to determine the effect of a microbial inoculant, containing *L. buchneri*, on the fermentation and aerobic stability of corn silage during the early stages of ensiling. Whole plant corn (37%) DM) was ensiled in triplicate 20-L laboratory silos for 14, 28, 42, and 56 d. Fresh forage was either untreated (U) or treated with *L. buchneri* 40788 (400,000 cfu/g of fresh forage) and *Pediococcus pentosaceus* (100,000 cfu/g) (Lallemand Animal Nutrition, Milwaukee, WI) (T). After 14 d of ensiling, T had greater concentrations of lactic acid (5.07 vs. 4.79%), acetic acid (2.14 vs. 1.82%), and ethanol (0.66 vs. 0.34%) and aerobic stability was improved (117 vs. 79 h) compared to U ($P < 0.05$) although yeast counts were similar between treatments. The chemical composition and aerobic stability of both silages were similar after 28 and 42 d, however, the population of yeasts were lower in T compared to U at both time points (4.60 vs. 5.62 and 2.88 vs. 5.01 $\log_{10}$ cfu/g, 28 and 42 d, respectively). After 56 d of ensiling, T had a lower concentration of lactic acid (4.36 vs. 4.86%) and greater concentrations of acetic acid (2.73 vs. 2.05%), and ethanol (0.70 vs. 0.48%). The aerobic stability of T was greater than U (136 vs. 102 h), due to the lower yeast counts in T (< 2.00) compared to U (4.80). In conclusion, inoculating corn silage with *L. buchneri* 40788 in combination with *P. pentosaceus* improved aerobic stability consistently after 42 d of ensiling and provided a more efficient fermentation in the early stages of ensiling without compromising aerobic stability.

Key Words: Silage, Fermentation, *Lactobacillus buchneri*

M217 A summary of the effect of *Lactobacillus buchneri* on the fermentation and aerobic stability of silage.

D. H. Kleinschmit* and L. Kung, Jr., *University of Delaware, Newark, DE*.

Lactobacillus buchneri has been shown to improve the aerobic stability of a variety of silages. We have summarized the effects of *L. buchneri* on silage fermentation and aerobic stability from 25 published studies with 49 comparisons versus untreated silages. In descending order of numbers of comparisons, corn, grass, small grain, and alfalfa silages comprised the database. The effects of inoculation were summarized by separating the study treatments into the following categories: 1) untreated silage, nothing applied (U), 2) silage treated with *L. buchneri* at $\leq$ 100,000 cfu/g of fresh forage (LB1), and 3) silage treated with *L. buchneri* at $>$ 100,000 cfu/g (LB2). The pH and DM recoveries of LB1 and LB2 were unaffected compared to U. When compared by treatment, the lactic acid concentration was 5.49% for U and was lower ($P < 0.05$) for LB1 (4.27%) and LB2 (3.95%). Treatment with LB2 (4.53%) resulted in silage with greater amounts of acetic acid than for U (2.10%) and LB1 (3.30%). The lactate:acetate ratios reflected the concentrations of these acids and was lower ($P < 0.08$) in LB2 (1.01) and LB1 (2.29) than for U (3.76). Inoculation also increased ($P < 0.06$) the concentration of propionic acid in silage treated with LB1 (0.33%) and LB2 (0.44%) when compared to U (0.11%). Untreated silages averaged 3.52 $\log_{10}$ cfu of yeasts per g of silage whereas yeasts were lower ($P < 0.05$) in LB1 (2.50), however, LB2 had less yeasts than U and LB1 (< 2.00). When compared to U (113 h), inoculation with *L. buchneri* improved the aerobic stability of silages in a dose dependent manner (259 and 355 h for LB1 and LB2, respectively). There was a negative correlation between the concentration of acetic acid and population of yeasts in silage (r^2 = 0.34) and a positive correlation between the concentration of this acid and aerobic stability (r^2 = 0.28). The application rate of *L. buchneri* was positively correlated with the concentrations of acetic acid in silages (r^2 = 0.06) and aerobic stability (r^2 = 0.23). In conclusion, inoculating silages with *L. buchneri* results in greater concentrations of acetic and propionic acid, which inhibits the growth of yeasts and improves the aerobic stability in a wide variety of silages. Furthermore, the degree of effectiveness is dose dependent.

Key Words: *Lactobacillus buchneri*, Silage, Inoculant

M218 Effects of amino acid fermentation liquor byproducts upon corn silage fermentation and stability.

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The objectives of this study were to determine the effects of amino acid fermentation liquor byproducts upon ensilage of corn plant and its aerobic stability. Fermentation liquors from production of glutamic acid (EFS) or lysine (KFS) or Urea were added to fresh chopped corn plant to equal added N at 0.5 or 1.0% of fresh forage in laboratory silos (4.5kg) and compared with a non-treated control. Byproducts EFS and KFS contain about 16% N on a dry basis, primarily as ammonium chloride or ammonium sulfate, respectively. Silages were sampled after 80 days of ensiling and exposed aerobically for 7 days. Results are shown in the table. Within each level of added N, lactic acid was higher in Urea compared with EFS, KFS or Control (P<0.05). Acetic acid was greater in high EFS (P<0.05) and lower in Urea (P<0.05) compared with Control. Total true protein N was greater in high EFS or KFS (P<0.05) compared with Control and high KFS increased true protein N (P=0.05) compared with high Urea. The pH of silage on day 80 was higher in high Urea (P<0.05%) compared with Control and either level of EFS or KFS. After aerobic exposure (d 87), pH in both levels of EFS were similar and tended to be lower compared with Control (P=.16). On day 82 temperatures of all treated silages were numerically lower than Control. On day 87 only temperature of high EFS silage was significantly lower than Control. These results indicate that addition of fermentation byproducts to whole plant corn silage might reduce loss of true protein and prolong stability of silage when exposed to air.

Treatment 0.5% added N 1.0% added N Item Control EFS KFS Urea EFS KFS Urea SEM Lactic d80 (% of DM) 6.48^{a} 5.75^{a} 5.82^{a} 8.16^{b} 6.00^{a} 5.82^{a} 8.22^{b} 0.23 Acetic d80 (% of DM) 3.85^{ab} 4.20^{ab} 4.17^{ab} 3.42^{bd} 5.33^{c} 4.66^{ac} 2.69^{d} 0.20 True Protein N d80 (% of DM) 0.54^{a} 0.65^{abc} 0.63^{ab} 0.57^{a} 0.70^{bc} 0.75^{c} 0.63^{abc} 0.03 pH d80 3.9^{a} 3.9^{a} 3.9^{a} 4.1^{ab} 4.0^{a} 3.9^{a} 4.3^{b} 0.05 pH d87 5.1^{ab} 4.0^{a} 4.6^{ab} 5.9^{b} 4.0^{a} 4.8^{ab} 5.0^{ab} 0.29 Temp. Co d82 26.4 21.8 22.7 22.2 21.7 23.5 22.3 1.16 Temp. Co d87 32.6^{a} 28.3^{ab} 31.7^{a} 32.0^{a} 25.5^{b} 28.9^{ab} 29.5^{ab} 1.27

Key Words: Silage, Silage additive

M219 Feeding brown midrib-3 corn silage or conventional corn silage cut at either 20 or 66 cm of height to early lactation cows.

D. D. Dominguez*[2] and L. D. Satter[1,2], [1]*U.S. Dairy Forage Research Center, USDA-ARS*, [2]*Dairy Science Department, University of Wisconsin, Madison*.

The objective was to determine the impact on milk yield when brown midrib-3 corn silage (bm3, Cargill F-697) cut at 20 cm or conventional corn silage (Golden Harvest H-8250) cut at 20 (normal cut-NC) or 66 cm (high cut-HC) was fed to dairy cows during the transition period and early lactation. Sixty two Holstein cows (20 primiparous and 42 multiparous) averaging 24.8 days (±6.9) before calving were randomly assigned to trts. The silages were chopped at 0.95 cm theoretical length of cut, and stored in bunker silos. NDF content (% DM) of bm3, NC and HC silages was 40.6, 38.2 and 35.8. The precalving diets had 64.5, 64.5 and 69 % of forage for bm3, NC and HC trts, and postcalving diets had 61.5, 58.5 and 61.5 %. Corn silage accounted for 67 % of forage DM. The length of the experimental period after calving was 112 days. Statistical analysis was done by repeated measures analysis of unbalanced data. DMI prepartum and postpartum was not affected by trts. Means for DMI postpartum for primiparous and multiparous cows for bm3, NC and HC trts were 18.5, 22.6; 18.1, 22.6; 16.6 and 21.8 kg/d. Milk yield was not affected by trts in multiparous cows, but it was decreased (P $\leq$0.001) for HC in primiparous cows. Means for milk yield for primiparous and multiparous cows for bm3, NC and HC trts were 31.2, 39.3; 32.5, 40.8; 28.2 and 41.4 kg/d. FCM (3.5%) was not affected by trts in multiparous cows, but it was decreased (P $\leq$0.001) in primiparous cows with HC. Means for FCM for primiparous and multiparous

cows for bm3, NC and HC were 32.9, 44.3; 33.2, 45.0; 29.8 and 45.0 kg/d. Milk composition and body condition score were not affected by trts. Feed efficiency (kg milk/kg DMI) was not affected by trts in primiparous cows, but it was improved in multiparous cows with HC. Means for feed efficiency for primiparous and multiparous cows for bm3, NC and HC were 1.65, 1.78; 1.73, 1.84; 1.64 and 1.93.

Key Words: Corn silage, Brown midrib-3, Milk production

M220 Forage intake and digestibility of tropical grass and rhizome perennial peanut hay (Arachis glabrata) supplemented with fish silage. H. Diaz*, A. Rodriguez, T. Ruiz, and R. Fuentes, *University of Puerto Rico*.

Two experiments were conducted to determine the effect of fish silage (FS) supplementation on forage intake and digestibility of tropical grass hay (80 % Digitaria decumbens; 20% Panicum maximun; TGH) and rhizome perennial peanut hay (Arachis glabrata; RPP). Discarded fish were mixed with 20% cane molasses (w/w), a lactic acid producing bacterial-inoculant applied at 106 cfu/g fresh material and allows to ferment for 21 days. In experiment 1, TGH was offered as basal diet (Control) or was supplemented with FS at .45 % (T2) and .90 % (T3) of the animal LW daily. In experiment 2, RPP was offered as basal diet (Control) or was supplemented with FS at 0.225 % (T2) and .45 % (T3) of the animal LW. In both experiments, 9 rams were used as experimental units and submitted to 8 days of adaptation period and a 6-day data collection period. Data from both trials were analyzed according to a latin square design with three periods. In experiment 1, grass hay intake and digestibility increased ($P<0.05$) with supplementation at both levels of FS, but the positive response was greater in animals supplemented with 0.45% of LW. In Experiment 2, forage intake was similar in all treatments. However, dry matter digestibility was higher ($P<0.05$) for T2 than control animals, but was similar to that of rams of T3. In conclusion, animal response to FS supplementation differs between tropical grass and RPP hay. Fish silage increased tropical grass hay intake and digestibility regardless of level of supplementation, however, no effect on forage intake was observed when RPP was offered as basal diet but FS supplementation at the higher level increased dry matter digestibility.

Key Words: Fish silage, Supplementation, Tropical hay

M221 Fermentation characteristics of corn hybrids ensiled in mini-silos. D.J.R. Cherney*, J. H. Cherney, and W. J. Cox, *Cornell University, Ithaca, NY*.

A variety of traits and corn silage processing techniques are being promoted for high milk production through improved forage quality. In order to evaluate numerous experimental variables and their interactions involving different corn silage hybrids, scaled down mini-silos are necessary. Objectives of this study were to evaluate the influence of sample size on pH, NH_3, and volatile fatty acid profile of eight corn silage hybrids, selected to vary in fiber digestibility, ensiled in vacuum-sealed polyethylene bags for 60 d and to assess the suitability of these mini-silos for detecting differences among hybrids. Hybrids were grown at the Teaching and Research Center located near Harford, NY, and harvested at a DM of about 32% in fall 2002. Three field replications of each hybrid were chopped and vacuum ensiled in bags with sample sizes of 50, 100, 200, 400, and 600 g. Increasing sample size resulted in decreased lactic acid, acetic acid, total acids, and NH_3 ($P<0.05$). Most of the difference among sample sized occurred between the 50 and 100 g sample size. Lactic acid:acetic acid ratio (3.1±0.13) and pH (3.9±0.08) did not vary ($P>0.05$) among sample sizes. There was no detectable butyric acid in the samples. Fermentation characteristics suggested that all samples were well ensiled, but that the fermentation profile of the 50 g samples differed the most from other sample sizes. There were no differences ($P>0.05$) among hybrids in DM (32.6±0.73%) or NH_3 (0.64±0.16%). Hybrids did vary in lactic acid, acetic acid, lactic acid:acetic acid, total acids, and pH, however ($P<0.05$). Differences among hybrids were also noted for CP ($P<0.05$). It is possible to use vacuum-sealed plastic bags to ensile corn, with samples as small as 100 g, and to use these mini-silos to assess differences among hybrids.

Key Words: Corn silage, Fermentation, Laboratory silo

M222 Intake and milk yield of cows fed diets containing L. bucheri-inoculated corn silage and high moisture corn or acetic acid supplement . D. K. Combs* and P. C. Hoffman, *University of Wisconsin, Madison, USA*.

Lactobacillus buchneri is a hetero- fermentative inoculant that increases aerobic stability of ensiled forages and grains. Silages inoculated with L. buchneri have higher concentrations of acetic acid relative to untreated silages. Acetate can depress intake when infused into the rumens of cattle, but has also been used as a preservative for grain and corn silage. Small improvements or losses in animal performance could influence the economic incentives for using L. buchneri. This study assessed how feed intake and milk production are affected by feeding diets that contain corn silage and high moisture corn that have been inoculated with L. buchneri or that have been supplemented with acetic acid. Three total mixed rations (TMR) were fed to lactating dairy cows. TMRC was a diet of untreated corn silage and untreated high moisture shelled corn fed ad libitum. TMRB was formulated identical to TMRC, except that corn silage and high moisture corn were inoculated with L. buchneri at the time of ensiling. TMRA was a diet formulated to be isocaloric to TMRC and TMRB, but with untreated corn silage and high moisture grain and supplemented with 700 ml glacial acetic acid/cow/d. Corn silage was ensiled in two - 2.5 m diameter horizontal plastic bags. One bag was filled with corn forage inoculated with 5 x 10^5 CFU/g of L. buchneri. High moisture shelled corn was ensiled in two concrete silos and L. buchneri was applied to one silo at 5 x 10^5 CFU/g fresh material. Eighteen multiparous Holstein cows were used in the experiment. The design was as a replicated 3x3 Latin square. Cows were randomly assigned to squares and treatment sequences randomly were allocated within squares. Milk yield was not different ($P>0.05$) between TMRC , TMRB and TMRA (41.3, 42.2 and 41.9 kg/d, respectively). Milk fat percentage was higher ($P<0.05$) when cows were fed TMRA (3.12%) than when fed TMRC (2.92%) or TMRB (2.83%). Fat corrected milk (35.0 ± 0.5kg) and dry matter intake (21.2± 0.4 kg) were similar ($P>0.05$) between treatments. Neither inoculation of corn silage and high moisture corn with L. bucherii or feeding acetate depressed feed intake or milk production in dairy cattle.

Key Words: Dairy, Silage inoculant, L. buchnerii

M223 Characterization of corn endosperm properties in 33 germplasm sources for potential improvements in ruminal starch degradability. D. Majee*, R. D. Shaver, and J. G Coors, *University of Wisconsin-Madison*.

Starch degradation in corn is influenced by several interrelated endosperm characteristics. The objective of this study was to characterize corn endosperm properties of 33 germplasm sources for future development of corn hybrids with high ruminal starch degradability. These included 17 lines from the Germplasm Enhancement of Maize (GEM) project at Iowa State University; six flint lines from North Carolina State University (NCSU) and CIMMYT; six near-isogenic inbreds of Oh43 carrying *o2, fl2, su2, ae1, h1* and *wx1su2* alleles that affect endosperm composition; an experimental breeding population developed for improved silage quality (WQS C2) and three check inbreds; B73, Oh43, and W64A. Harvesting was done at milkline (ML) and black-layer (BL) stages. The BL samples had higher ($P<0.05$) weight of 1000 dried seeds (252.5 vs. 209.7g LSD=3.8). Dried kernels from middle portions of ears were used to determine % vitreousness (V) using a light box. Hardness was determined from a 20g sample using a Stenvert micro hammer-cutter mill that measured time to collect ground sample to a set receptacle height (T); total column height (TH); and height ratio of course to fine (C/F) particles. The ML samples had lower %V compared to BL samples (66.9 vs 72.4% LSD=0.8). Inbreds with softer endosperm ($P<0.05$) from BL samples were; *o2*(Oh43) (0% V; 11.2s T; 82mm TH; 0.02 C/F ratio); *fl2*(Oh43) (0% ; 9.8s; 86mm; 0.01 C/F ratio); and *h1*(Oh43) (20%; 15.3s; 81mm; 0.04 C/F ratio), compared to inbred check B73 (50%; 23.7s; 71mm; 0.37 C/F ratio). The remaining germplasm ranged from medium to hard (60-95% V and 0.47-0.90 C/F ratio). Correlations between %V and hardness factors were higher for BL samples compared to ML; TH (R^2= 0.79 vs. 0.39); C/F ratio (R^2=0.67 vs. 0.67); and T (R^2=0.66 vs. 0.42). These data show that a wide range of corn genetic material has potential for improving ruminal

starch degradability and that visual rating of vitreousness on corn harvested at BL stage can determine corn hardness properties with relative accuracy.

Key Words: Corn starch, Vitreousness

M224 Nitrate leaching in silage maize production on sandy soils. M. Wachendorf*, M. Buechter, K. Volkers, and F. Taube, *University of Kiel, Kiel, Germany.*

As part of an integrated research project, dealing with nitrogen (N) recovery in specialized dairy farms, a field experiment with maize for silage (cultivar Naxos) was conducted to assess the effects of mineral nitrogen fertilization (0, 50, 100, 150 kg N ha^{-1} yr^{-1}), slurry application rate (0, 20, 40 m^3 ha^{-1} yr^{-1}) and the use of an understorey with perennial ryegrass (cultivar Fennema) on the nitrate (NO_3) leaching losses. Samples of leachate were taken by ceramic suction cups. Water fluxes were derived from water balance calculations. An increasing N supply with mineral fertilizer or slurry resulted in increased leaching losses, with fertilizer N showing greater effects than slurry N. A grass understorey sown at the end of May significantly reduced the losses. Only with excessive amounts of N supply (>200 kg N ha^{-1}), NO_3 concentration in the leachate exceeded the European Union (EU) limit for drinking water (50 mg NO_3 l^{-1}). Regression analysis showed, that NO_3 leaching losses were positively related to the mineral N content in the soil at the end of the growing season, with leaching losses representing 50% of the mineral N in the soil on an average. At high levels of soil N content leaching losses were strongly reduced with a grass understorey, whereas no differences occurred at low levels. Leaching losses were positively related to the N balance at the field scale, which was calculated from the difference between N input (N from fertilizer and slurry) and N output (N removed with herbage mass). At a constant level of N surplus losses were smaller when maize was grown with an understorey. From the results obtained, it is suggested that, under the predominant soil conditions N leaching losses under maize can be estimated satisfactory by means of mineral nitrogen content in the soil at the end of the growing season as well as by the calculated N budget. At fertilizer rates of 40 m^3 slurry ha^{-1} plus 50 kg mineral N ha^{-1} as commonly applied in agricultural practice in northern Germany, no increased NO_3 leaching losses occure.

Key Words: Silage maize, Nitrogen losses, Environment

M225 Effects of forage quality and type of protein supplement on intake and digestibility in beef steers and performance of postpartum beef cows. J. J. White*, G. D. Pulsipher, and T. DelCurto, *Eastern Oregon Agriculture Research Center, Union, OR.*

Two experiments were conducted to evaluate the effects of forage quality and supplemental UIP level on intake, digestibility, and performance of beef cattle. In Exp. 1, five ruminally cannulated steers (BW = 456 ± 6 kg) were used in a 6 x 5 incomplete Latin square with treatments in a 2 x 2 factorial plus two controls. Factors were hay quality, moderate (**M**, 8.0% CP, 62.1% NDF) and low (**L**, 4.0% CP, 81.5% NDF), and supplement type, high UIP (**HUIP**, 60% UIP, 48% CP) and low UIP (**LUIP**, 40% UIP, 49% CP). Supplement was provided daily to meet 100% of CP requirements. Intake and total fecal output were measured on d 15 to 19, and total rumen evacuations on d 21. Supplementation increased ($P < 0.01$) DM intake and digestibility and NDF intake in steers fed L forage. An interaction ($P = 0.10$) occurred for NDF intake. In steers fed L forage NDF intake was greater with HUIP supplement (2.6 kg/d) than with LUIP supplement (2.4 kg/d), but in steers fed M forage NDF intake was greater with LUIP supplement (3.1 kg/d) than with HUIP supplement (3.0 kg/d). Ruminal NDF fill and liquid volume were greater ($P < 0.07$) in steers fed L forage compared to M forage. In Exp. 2, 96 postpartum multiparous cows (BW 555 ± 8 kg) were blocked by calving date and assigned to treatments in a 2 x 2 x 2 factorial arrangement within a split plot design. The additional treatment factor in Exp. 2 was supplement intake level, low or high 90 or 110% of CP requirements. Hay quality was L (6.3% CP 75% NDF) and M (8.6% CP and 74% NDF). Supplements were fed three times weekly to groups of four from calving to breeding. Cow BW and BCS were taken at calving and breeding. Cyclicity was determined prior to breeding and pregnancy was determined at weaning. Cows receiving the high intake level of supplement lost less ($P = 0.06$, -29 kg) BW than cows on the low level (-33 kg). These results indicate that quality of forage and protein supplement type interact to affect intake, but not postpartum cow performance.

Key Words: Forage quality, Protein supplementation, Beef cows

M226 Protein supplementation of Brangus stocker calves grazing winter Tallgrass Prairie. L. A. Appeddu*[1] and M. A. Brown[2], [1]*Southwestern Oklahoma State University, Weatherford, OK,* [2]*USDA-ARS Grazinglands Research Laboratory, El Reno, OK.*

In years when growing conditions are not favorable for establishment of fall wheat pasture in the Southern Great Plains, producers need cost-effective grazing alternatives for home grown calves until spring wheat pasture is available. The objective of this research was to evaluate the potential of wintering Brangus calves on perennial Tallgrass Prairie and offering limited amounts of a cottonseed meal (CSM) or feather meal (FM) based supplement. Two weeks after weaning in October 2000, calves were sorted by sex and placed on one of four pastures (Big Bluestem, Little Bluestem, Dropseed, Cheat; avg 49.5% ADF and 5.5% CP). Calves were supplemented by pasture with CSM (20 steers and 25 heifers) or FM (20 steers and 25 heifers) for 90 d. Measures included calf weights, hip height, serum metabolites and ADF digestibility using acid detergent insoluble ash as an internal marker. Supplements had 42% CP and similar *in situ* digestibilities. Calves lost weight during the first 40 d on pasture (-0.21 kg d^{-1}); therefore, daily supplement amounts were increased from 908 to 1362 g hd^{-1}. No differences in gain were detected between steer groups over the last 50 d (0.44 ± 0.038 kg d^{-1}), but heifers fed FM gained more ($P < 0.001$) than those fed CSM (0.42 vs 0.26 ± 0.034 kg d^{-1}). Calves fed FM vs CSM had a greater increase ($P < 0.05$) in hip height (3.3 vs 2.8 ± 0.23 cm). Steers had lower ($P < 0.001$) serum urea nitrogen levels than heifers (15 vs 21 ± 0.9 mg dl^{-1}). Serum glucose levels tended to be lower for steers fed CSM than FM (62 vs 73 ± 2.2 mg dl^{-1}), but similar between heifer groups (82 ± 2.0 mg dl^{-1}). By d 90, a higher ADF digestibility was found for heifers fed FM as compared to heifers fed CSM and steers fed CSM or FM (66 vs 56, 55, 51 ± 2.5%). Although supplying FM improve heifer utilization of winter Tallgrass Prairie, no differences were detected for subsequent 60 d gains (1.2 ± 0.06 kg d^{-1}) or pregnancy rates (66%) when heifers were placed on spring wheat pasture. Resuts suggest Brangus calves can be wintered on lower quality pasture with minimal inputs when annual cool season forages are not available.

Key Words: Forages, Protein Supplementation, Digestibility

M227 Interseeding triticale with windrowed millet as a winter feeding program for developing heifers. W. S. Mackay*, J. C. Whittier, D. Couch, and D. N. Schutz, *Colorado State University, Fort Collins, CO USA.*

Sixteen weaned crossbred beef heifers were used to compare two winter feeding programs. Heifers were randomly assigned to one of the following treatments: 1) Millet Only (MO), heifers grazing windrowed millet only, and 2) Triticale and Millet (TM), heifers grazing windrowed millet and triticale seeded between the windrows. In May of 2001, dry fertilizer was applied to a field, and foxtail millet was seeded July 5-6 and then windrowed in the late dough stage September 5-7. The field was divided into three plots and triticale drill seeded between the windrows of one of two subplots within each block. Both heifer groups grazed the windrowed millet for 89 days. Grazing access to windrows was restricted by an electric fence perpendicular to the windrows. The fence was moved weekly to provide access to ungrazed windrow and triticale forage. Clipped samples were taken twice monthly from ungrazed portions of the windrows and were analyzed to determine quality changes over time. Heifers were weighed on consecutive days at the beginning and the conclusion of the trial, and approximately every 30 days between. No differences ($P > 0.05$) were observed between treatments for beginning weight, final weight, 89 day ADG, and 30 day ADG for the three periods. The similarity in weight gain between treatments is likely due to the extremely low levels of precipitation during the trial, which prevented the triticale from growing. Continuous access to growing triticale, coupled with very low precipitation, may also have been a factor in low contribution from the triticale to the diet. Windrow quality was maintained throughout the trial. Crude Protein increased, possibly as

a result of leaching of other compounds. This leaching, as evidenced by decreasing NDF, left more protein as a percent of the whole. In conclusion, seeding triticale between windrowed millet offers no benefit if the triticale is not able to provide a substantial portion of the diet. However, windrowed millet is a viable, low cost option for winter-feeding.

Key Words: Heifer calves, ADG, Windrow grazing

M228 Forage intake and in vivo digestibility of two rhizoma peanut genotypes harvested for hay in the tropics. T. Ruiz* and L. Rivera-Estremera, *University of Puerto Rico, Mayaguez.*

Rhizoma perennial peanut (RPP) is a forage legume that has shown high nutritive value and yield potential when grown in the tropics. Two genotypes, TARS line nos. 17033 (PI No. 276233) and 17097 (PI No. 262839) with the highest and second highest DM yield, respectively, have an excellent potential for commercial release in the Caribbean. The apparent digestibility and intake of hay from these lines was determined in a feeding trial with young sheep (25 kg), during November and December of 2001. Animals were fed ad libitum to stimulate maximum consumption of hay from the two RPP lines and coastcross no. 1 Bermudagrass. Intake and apparent digestibility of DM and organic matter (OM) were similar between RPP lines. Compared to Bermudagrass, intake of DM (1.01 vs. .74kg/d), OM (.92 vs. .68 kg/d), and apparent digestibility of DM (57.7 vs. 47.7%) and OM (59.8 vs. 50.7%) were higher (P<.01) for the RPP hays. The apparent digestibility of CP was higher in 17033 compared to 17097 (64.6 vs. 59.4%) legume hay. The CP digestibility in the RPP hays was close to being twice that of the Bermudagrass hay (33.9%). Despite differences in DM and OM consumption among the treatments, the experimental animals consumed similar amounts of NDF (.50 kg/d). It can be concluded that these two RPP genotypes show similar quality potential which is greater than that of Bermudagrass hay harvested at a similar stage of maturity.

Key Words: Tropical legume, Bermudagrass hay, Rhizoma perennial peanut

M229 Apparent digestible dry matter intake of ammoniated wheat straw diets in beef cows as affected by wheat middlings and biotin supplementation. R.D. Wiedmeier*[1], P.R. Schmidt[1], B.A. Kent[1], and D.R. ZoBell[1], [1]*Utah State University, Logan, Utah.*

The objective of this study was to determine the effect of supplemental wheat middlings (WM) and biotin on intake and digestibility of ammoniated wheat straw (AWS) diets. Sixteen fall calving, lactating beef cows and their calves were stratified into four groups and placed in four pens, four cows and calves/pen. Each pen had a creep feeding area for calves with alfalfa hay (AH) offered ad-libitum. Two pens received 4.58 kg of AH and 0.22 kg of vitamin-mineral premix/cow/d. The other two pens received 4.08 kg of WM and 0.19 kg of vitamin-mineral premix/cow/d. All pens received ad-libitum access to AWS with intake measured daily. After a 60 d adaptation period apparent nutrient digestibility was estimated twice at 30 d intervals, each with a 5 d diet and fecal collection period and acid insoluble ash (AIA) as an internal marker. Intake of AWS was higher (P = 0.0001) when supplemented with WM compared to AH (12.41 vs 8.65 kg DM/cow/d, respectively). Digestibility of DM was also higher (P = 0.005) when supplemented with WM compared to AH (53.1% vs 47.76%, respectively). As a result, DDMI was 9.22 vs 6.42 kg/cow/d. After weaning, 12 of the dry, pregnant cows were stratified into six groups of two cows each per pen. Three of the pens received 2.73 kg/cow/d of WM supplement that was fortified with 30 mg of biotin (WMWB). The other three pens received 2.73 kg/cow/d of WM supplement without biotin (WMWOB) fortification. All pens received ad-libitum access to AWS with intakes measured daily. After a 30 d adaptation period, apparent nutrient digestibility was estimated with a 5 d diet and fecal collection period and AIA as an internal marker. Intake of AWS was not affected by biotin fortification (P = 0.89, 12.68, WMWOB vs 12.48, WMWB kg DM/cow/d). However, biotin fortification enhanced (P = 0.008) DM digestibility (52.75%, WMWOB vs 61.15%, WMWB). Thus, DDMI was improved by 14.6% with biotin fortification (8.13, WMWOB vs 9.32, WMWB kg/cow/d).

Key Words: Beef, Supplementation, Digestibility

M230 Influence of supplementing soybean hulls to steers consuming endophyte infected tall fescue pasture. R. B. Pugh*, J. B. Pulliam, J. C. Waller, and C. J. Richards, *University of Tennessee, Knoxville TN.*

Six steers (289 ± 2 kg BW) fitted with ruminal and duodenal cannulas were used in a crossover design to evaluate intake and site of nutrient digestion of fresh clipped endophyte infected tall fescue (*Festuca arundinacea*) pasture with or without soybean hull supplementation at 0.70% BW (DM basis). Steers were placed in metabolism units within an environmentally controlled room and provided with free choice access to fresh forage, water and a vitamin/mineral block. The spring growth of tall fescue was harvested daily for feeding during the experiment. Supplement was fed at 0700 with approximately 65% of the estimated daily forage. Additional forage was stored in a cooler and fed at 1900 to maintain a fresh forage supply. Periods were 21 d with 15 d of adaptation and six d of sample collection. Chromic oxide was dosed twice d starting on d nine for use as a digesta flow marker. Duodenal samples were taken 4 times d with times shifting one hour each d to represent all hours of a d. Soybean hull supplementation decreased (P < 0.01) forage intake from 2.6 to 2.2% BW, but increased (P < 0.01) total DMI from 2.6 to 2.9% BW. Apparent ruminal DM digestibility percentage (61%) was not affected (P > 0.10). Crude protein intake was not different (P > 0.10) between treatments, but duodenal CP flow for the supplemented treatment (775 g/d) was greater (P > 0.01) than the control treatment (563 g/d). Ruminal pH was not affected (6.5; P > 0.15) and ruminal ammonia nitrogen concentration was decreased (P < 0.01) from 3.7 to 2.3 mM with soybean hull supplementation. Supplementation of soybean hulls at a rate of 0.70% BW to calves consuming fresh tall fescue decreased forage consumption, but resulted in greater total intake, no change in percentage of ruminal dry matter digestion and greater flow of protein to the duodenum.

Key Words: Feed supplementations, Digestion, Forage

International Animal Agriculture

M231 Nitrogenous fractions of *Pithecellobium dulce* in tropical dry forest. T. Clavero* and R. Razz, *Centro de Transferencia de Tecnologia en Pastos y Forrajes. La Universidad del Zulia. Venezuela.*

In an *Pithecellobium dulce* plantation located in the western part of Venezuela a trial was carried out to assess the content of the nitrogenous fractions during different growing seasons. Three growing seasons were studied (maximum, P1; mean, P2 and minimum, P3; rainfall). The experiment was laid out as randomized block design with four replications. The data showed significant differences (P≤0.05) for total nitrogen content (TN), rumen soluble nitrogen (SN) and non protein nitrogen of the soluble nitrogen (NPN/SN) in relation to growing season. The solubility of the total nitrogen ranged from 38.3 to 45%. The highest values of TN and SN were reported during the maximum rainfall. Nitrogen fixed to the cell wall of the insoluble nitrogen and nitrogen in fiber acid detergent (NFAD) were not affected for growing season. *Pithecellobium dulce* has an adequate content of TN, SN and NPN/SN and represent an alternative as source of nitrogen for ruminant in tropical conditions.

Key Words: Nitrogenous fractions, *Pithecellobium dulce*

M232 Silage quality of *Leucaena leucocephala* ensiled with molasses. T. Clavero* and R. Razz, *Centro de Transferencia de Tecnologia en Pastos y Forrajes. La Universidad del Zulia. Venezuela.*

The study aimed to evaluate the influence of molasses in ensiling leucaena tops in western Venezuela. Chopped fresh plant materials of about 1 cm length were ensiled into laboratory silo and stored at 25C. The experimental design was a completely random with a 3x3 factorial arrangement. Factors studied were three rates of legumes:molasses, 1:4, 1:8 and

1:12(w/v) and three storage periods (2, 4 and 6 months). After opening the silos, DM, pH, total nitrogen content (NT), rumen soluble nitrogen (SN), protein nitrogen (NP), nitrogen in fiber acid detergent (NFAD), nitrogen fixed to the cell wall of the total nitrogen (NFND/NT), fiber acid detergent (FAD) and fiber neutral detergent (FND) were determined. DM of leucaena was not changed during ensiling and the molasses additive had not significant effect on the silage DM. Molasses addition decreased significantly ($P \leq 0.05$) pH values. The lowest pH value (3.8) was obtained with the relation 1:12. Longer storage period (4 months or more) significantly reduced pH in leucaena silages. Contents of NT, SN and NP increased significantly ($P \leq 0.05$) with increased level of molasses and decreased with storage period, respectively. No significant differences ($P \geq 0.05$) in NFAD, NFND/NT, FAD and FND were found between levels of molasses. The time of storage significantly affected ($P \leq 0.01$) the loss of NFAD and NFND/NT. According to the results, it is concluded that addition of molasses to leucaena improved silage quality characteristics.

Key Words: *Leucaena leucocephala*, Silage, Molasses

M233 The effects of rumen liquor pre-treatment of desiccated coconut waste on the performance of Growing Pigs in Samoa. A. O. Ajuyah, C. Okere*, and S. Kumar, *The University of the South Pacific, Alafua Campus, Apia, Samoa.*.

The feeding value of desiccated coconut waste (DCW) pre-treated with rumen liquor was investigated using 24 weaned crossbred (LW x LR) pigs weighing approximately 8.9 kg. DCW was fermented in rumen liquor for three days in a sealed container, and then sun-dried. Fermented DCW was incorporated into a weaner diet at 50% (Diet 1). Another diet (Diet 2), based on untreated DCW included at 50% in the diet, served as control. A third diet (Diet 3), a commercial pre-grower diet served as a practical control. Pigs were assigned to six pens (2 barrows and 2 gilts per pen) and fed as a group on ad libitum basis for six weeks. Daily feed intake and weekly live weights were recorded. The weekly backfat depth was determined with Recon Lean Meter. Dietary treatment means were compared and differences determined using the Least Significant Difference (LSD) test method. For pigs fed fermented DCW (Diet 1), the number of days required to attain the 30 kg target live weight was decreased by 4 days. This decrease was, however, not significant ($P \geq 0.05$). Also, for pigs on Diet 1, average daily gain increased by 3.0% and feed conversion ratio was reduced by 2.0% and average daily feed intake increased by 4%, these differences were, however, not significant ($P \geq 0.05$). Data obtained on backfat thickness indicated no significant differences ($P \geq 0.05$) between diets. These results suggest that pre-treatment with rumen liquor is a sustainable processing technique to formulate nutritionally effective and economically cheap weaner diets using DCW, the most abundant and cheapest local ingredient for use in pig feed formulations in the South Pacific region.

Key Words: Desiccated coconut waste, Pigs, Samoa

M234 Prediction of the amino acid content in wheat based on the crude protein value. M. Cervantes*[1], F. Copado[2], R. Soto[1], N. Torrentera[1], S. Espinoza[1], and J.L. Figueroa[2], [1]*Instituto de Ciencias Agrcolas, Universidad Autnoma Baja California, Mexicali,* [2]*Colegio de Postgraduados, Montecillos, Mxico.*

The amino acid (AA) composition in commercial wheat samples was analyzed, and models were created to predict the AA content on the basis of the cereal crude protein (CP) content. One hundred and fifty samples of the cereal were collected at the field during the 2001 harvest. The CP value was obtained by multiplying the nitrogen content by the 5.65 factor. The samples were grouped in three lots based on the percentage of CP (high, medium, and low). Nine representative samples of each group were analyzed for AA. Correlation and regression analysis were performed between the contents of real protein (sum of the contents of all AA) and each AA. Glutamate and proline were the most abundant AA. A high variation in the crude protein and amino acids content (CV from 7.4 to 14.0%) was observed in the evaluated wheat samples. The non-essential AA were mainly responsible for this variation, apparently because of their higher content, as compared with the essential AA. Phenylalanine, isoleucine and leucine were the AA with the highest variations; arginine, histidine, methionine, threonine and valine were of moderate variation; lysine was the less variable AA. There was a high ($r = 0.97$) and significant ($P<0.01$) correlation coefficient between the real and the CP content in the cereals. The regression was significant for all AA. The prediction models for histidine, threonine, methionine and lysine had the lowest regression coefficients. . The regression equations of the first limiting AA were as follows: Lysine = 0.15982 0.012 + 0.01709 0.001 ($P<0.01$; R 2 = 0.897); Threonine= 0.08364 0.011 + 0.02293 0.001 ($P<0.01$; R 2 = 0.952). These results show a great variation in the AA and the protein content in commercial wheat. Based on the regression analysis, it is concluded that protein content is a good estimator of the amino acid content in wheat, and that the regression models obtained from this study allow to save time and money in the analysis of the amino acid content in this cereal.

Key Words: Wheat, Prediction equation, Amino acids

M235 Effect of prepartum body condition and breed on production performance in crossbred dual purpose cows. O. Araujo-Febres* and J. A. Gutierrez, *La Universidad del Zulia, Maracaibo, Venezuela.*

Multiparous dual purpose crossbred cows (n = 28) were used in a randomized block design to determine the effect of prepartum body condition and racial predominance: of Holstein (H), Brown Swiss (BS) and Brahman (B) cows on milk production (MP) and calving to conception interval, in a tropical dry forest environment. Body condition is a useful tool to evaluate the energy status in cows. It was used on a scale of 1 to 5 to body score cows (1 = emaciated; 5 = obese). Data were collected every two weeks in six time periods: prepartum, at calving, postpartum, prebreeding, postbreeding and 120 days postpartum. Individual cows with multiple observations were included in the analysis as repeated measures (368). Cows were managed as a simple group. Body condition score changes were defined as BCS-final minus BCS-initial. Analysis of variance was conducted with GLM procedures of SAS. It was observed that the cows milk production was independent of precalving BCS, but cows that showed a greater milk production lost greater rank of BCS, obtaining a significant ($P<.05$) and negative correlation (r = -0,42). The H cows reached the greater average of MP and greater loss of BCS (9.50 L and -0.48, respectively); the BS cows were intermediate (8.94 L and -0.25) and the B were the inferior (8.28 L and -0.20). BCS had no influence on calving to conception interval, while racial predominance had influenced ($P<.05$) calving to conception interval (H = 86.8 days; BS = 101.6 d; and B = 183.0 d). It is concluded that BCS at the time of parturition is an important factor affecting subsequent milk production, while racial predominance affects either milk yield or calving to conception interval.

Key Words: Dual purpose cattle, Body condition, Milk production

ABSTRACTS
POSTERS, Tuesday, June 24, 2003

*** Author Presenting Paper**

Physiology: Nutrition-reproduction, gametes and uterus

T1 Effects of supplemental high-linoleate safflower seeds on ovarian follicular development and hypophyseal gonadotropins and GnRH receptors. E. J. Scholljegerdes*, B. W. Hess, E. A. Van Kirk, and G. E. Moss, *University of Wyoming*.

Experimental objectives were to evaluate effects of supplemental high-linoleate safflower seeds on ovarian follicular development and hypophyseal LH, FSH, and GnRH-receptors. Beginning 1 d postpartum, 18 primiparous, crossbred beef cows (BW = 410 ± 24.2 kg) were fed foxtail millet hay at 2.13% of BW and either a low-fat control supplement (61.2% corn, 32.1% safflower seed meal, 3.7% liquid molasses; Control) or a supplement containing 94% cracked high-linoleate (67% 18:2) safflower seeds and 6.0% liquid molasses (Linoleate). Supplements were formulated to be isonitrogenous and isocaloric and the Linoleate diet was formulated to contain 5% fat. Cattle were slaughtered for collection of tissues after 35 d of experimental treatment. Average total number of follicles, number of follicles with in each size classification (1 to 4), and diameter of follicles were not influenced ($P = 0.17$ to 1.0) by dietary treatment. Treatment did not influence hypophyseal GnRH receptors ($P = 0.42$; 2.7 # 10^{-14} and 2.2 # 10^{-14} M/mg of protein for Control and Linoleate, respectively) or concentrations of LH ($P = 0.14$; 700 96.9 ng/mg) in the anterior pituitary gland. Conversely, concentrations of FSH in the anterior pituitary gland were greater ($P = 0.02$) for Linoleate (1100.6 ng/mg) than Control (805.1 ng/mg) cows. Fat supplementation enhanced stores of FSH in the anterior pituitary gland; however, increased hypophyseal FSH storage was not accompanied by increased ovarian follicular development. Overall, dietary fats high in linoleic acid do not improve development of ovarian follicles of primiparous cows early in the postpartum period either because of insufficient hypophyseal FSH secretion or decreased ovarian responsiveness to FSH.

Key Words: Beef cattle, Fat supplementation, Gonadotropin

T2 Reproductive effects of feeding lambs high-oleate or high-linoleate safflower seeds. Z. Kiyma*, B. W. Hess, M. R. Bolte, E. A. Van Kirk, and G. E. Moss, *University of Wyoming, Laramie*.

The objective of this project was to evaluate potential reproductive effects of feeding high-oleate or high-linoleate safflower seeds to ewe lambs. White-faced ewe lambs (BW = 34 ± 0.4 kg; n = 36) were fed a beet pulp, oat hay and soybean meal basal diet (CON). Safflower seeds were fed as isocaloric and isonitrogenous replacement in the basal diet so that Oleate (OLE) and Lineolate (LIN) diets contained 5% additional fat. Lambs were slaughtered when they reached a final BW of 61.3 ± 0.9 kg. Based on serum progesterone or the presence of a corpus luteum (CL), 6, 5 and 2 lambs reached puberty prior to slaughter in LIN, OLE and CON groups, respectively. Lambs fed LIN had more ($P = 0.02$) and OLE tended ($P = 0.10$) to have more CLs than CON lambs. No treatment effects were detected ($P \geq 0.18$) for any other characteristics. Subsequently, data from only prepubertal lambs were re-analyzed. Within the prepubertal population, treatment did not influence ($P \geq 0.38$) hypothalamic contents of GnRH, hypophyseal GnRH-receptors, ovarian weights, or number of large follicles. Hypophyseal concentrations of LH ($P = 0.04$) were, and FSH tended ($P = 0.10$) to be influenced by treatment. Concentrations of LH ($P = 0.01$) and FSH ($P = 0.04$) were the greater in OLE than CON, and intermediate ($P \geq 0.24$) in LIN lambs. Uterine weight ($P = 0.09$) and number of small follicles ($P = 0.10$) tended to be influenced by treatment. Uteri from CON were heavier ($P = 0.03$) than those of OLE and were intermediate ($P = 0.13$) in LIN lambs. Similarly, numbers of small ovarian follicles were greater ($P = 0.05$) in CON than OLE and LIN lambs were intermediate ($P = 0.11$). Dietary fat supplied by safflower seeds may potentiate the onset of puberty in ewe lambs. It appears the response may be unique to the fatty acid composition of the supplement, but actions of other potential constituents of safflower seeds remains to be determined.

Key Words: Dietary fat, Lambs, Puberty

T3 Feed intake, serum leptin, and puberty in Brangus heifers sired by bulls with differing EPDs for growth and scrotal circumference. K. L. Shirley*[1], M. G. Thomas[1], D. H. Keisler[2], D. M. Hallford[1], D. M. Montrose[1], G. A. Silver[1], M. D. Garcia[1], and L. A. Narro[1], [1]*New Mexico State University, Las Crucs,* [2]*University of Missouri, Columbia*.

Spring-born Brangus heifers sired by bulls with differing EPDs for growth and scrotal circumference were evaluated for growth, level of feed intake, serum concentrations of leptin, and puberty from 12.5 to 15.5 months of age. Sire EPD and accuracy for weaning weight, yearling weight, and scrotal circumference were 36.2 (0.61), 61.0 (0.54), and 0.1 (0.42) for a large growth-moderate scrotal circumference sire (LG-MSC;

n = 7 heifers), 29.5 (0.66), 36.3 (0.59), and 0.9 (0.47) for a moderate growth-large scrotal circumference sire (MG-LSC; n = 8 heifers), and 25.9 (0.61), 39.3 (0.54), and 0.4 (0.37) for a sire with Balanced EPD values (n = 8 heifers). Heifers were weaned, trained to a Calan® gate system, and fed a diet of 11.6% CP and 79.4% TDN. Individual feed intake was measured daily and body weight was measured every two wk. Blood samples were collected twice weekly to evaluate serum concentrations of leptin and progesterone with RIA, and two consecutive samples of progesterone > 1 ng/mL was considered as day of puberty. Heifers were exposed to breeding for 90-d beginning at 14.3 months of age. Adjusted 205- and 365-d weight and ADG were similar ($P > 0.10$) in heifers from these sires, but feed intake was greater ($P < 0.01$) in heifers from the LG-MSC and MG-LSC sire groups relative to heifers from the Balanced EPD sire group (1.07 and 1.05 > 0.89 0.09 kg of feed consumed/100 kg of BW). Serum concentrations of leptin increased linearly ($P < 0.01$, slope = 0.02 ng/mL/d) in all heifers, but were similar ($P > 0.47$) among sire groups. Age of puberty was earlier ($P < 0.02$) in heifers from the Balanced EPD sire relative to heifers from the LG-MSC and MG-LSC EPD sires (13.7 < 15.1 = 15.5 0.4, d), however, pregnancy percentage was similar among sire groups (87.5% = 71.4% = 75.0%, $\chi^2 = 0.72$). Data suggest that Brangus heifers from a sire with balanced EPDs for growth and scrotal circumference achieve reproductive competency earlier than heifers from a sire with EPDs for either large growth-moderate scrotal circumference or moderate growth-large scrotal circumference. This relationship may be related to differences in mechanisms which influence feed intake, but appears to be independent of serum concentrations of leptin among the sires groups.

Key Words: Brangus, Puberty, Leptin

T4 Intracerebroventricular infusion of Neuropeptide Y and leptin differentially influence the episodic secretion patterns of GH in well-fed ovariectomized cows. L. A. Narro*[1], M. G. Thomas[1], M. D. Garcia[1], D. H. Keisler[2], M. Amstalden[3], G. L. Williams[3], and D. M. Hallford[1], [1]*New Mexico State University, Las Cruces,* [2]*University of Missouri, Columbia,* [3]*Texas A&M Unversity Agricultural Research Station, Beeville.*

Anterior pituitary secretion of GH is regulated by hypothalamic secretion of somatostatin and GHRH. There are also appetite-regulating signals that modulate this axis at the level of the hypothalamus; however, these data are limited in cattle. Objectives of this study were to further evaluate the central effects of the orexigenic and anti-orexigenic peptides, neuropeptide Y (NPY) and leptin, on pituitary secretion of GH in cattle. Six *Bos taurus* x *Bos indicus* crossed cows were ovariectomized by paralumbar laparotomy and then surgically fitted with a third cerebroventricle cannula at least 3 wk before the start of the sampling period. Cows were fed a diet of hay and concentrate to maintain BW and condition. Body condition scores were 5.6 0.3 (i.e., scale of 1 = emaciated to 9 = obese) throughout the experiment. Cows were randomly assigned to receive infusions of Control (200 l of 0.3% BSA, 0.9% NaCl), NPY (500 μg of pNPY dissolved in 200 l of 0.3% BSA, 0.9% NaCl) or Leptin (600 μg oleptin dissolved in 200 l of 0.3% BSA, 0.9% NaCl) solutions into the third cerebroventricle in a replicated 3 x 3 latin square arrangement. At least 1 d of rest occurred between sampling periods. Ten milliliters of blood were collected immediately before infusion and every 10 min thereafter for 4 h. Blood plasma was analyzed for concentrations of GH with RIA. Mean concentrations of GH, frequency and amplitude of GH pulses, and area under the response curve were estimated using CLUSTER®. No differences were detected among Control, Leptin, and NPY treatments in mean concentrations of GH (19.0 = 19.6 = 23.4 3 ng/mL, $P > 0.18$), area under the response curve (4545 = 4733 = 5648 747, $P > 0.17$), or frequency of GH pulses (1.6 = 1.2 = 1.7 0.4 per 4 h, $P > 0.17$). However, amplitude of GH pulses were greater (42.5 > 25.8 4.4 ng/mL, $P = 0.05$) in cows treated with NPY than Control, while leptin-treated cows did not respond differently ($P > 0.10$) from Control or NPY-treated cows. Results suggest that in well-fed mature cows, acute intracerebroventricular administration of NPY modulates pituitary secretion of GH by increasing the amplitude of GH pulses, but pituitary secretion of GH does not appear to be influenced by central administration of leptin.

Key Words: Neuropeptide Y, Leptin, Growth hormone

T5 Concentrations of antigonadatropic decapeptide in ovine tisses. S. N. Sandstede*, M. E. Wise, and D. M. Hallford, *New Mexico State University, Las Cruces, NM/USA.*

Antigonadatropic decapeptide (AGD) has been shown to inhibit secretion of GnRH and LH in several species. The mechanism of action of AGD is unknown but appears to be integral to the GnRH secretory process. The objectives of this study were to 1) develop a RIA to measure tissue concentrations of AGD and 2) determine which ovine tissues contained AGD. The AGD double antibody RIA utilized rabbit antiserum against AGD conjugated to KLH (Covance Res. Prod.) and synthetic AGD (Princeton Biomolecules) as the standard. The 125I-AGD was produced using chloramine T and purified using sephadex G-10 chromatography. No cross reactivity was detected for the following peptides: oxytocin, CRH, GHRH, TRH, ADH, SRIF, GnRH, and NPY. Detection limit was 0.3 ng, recovery of added AGD to tissue extracts was 108%, and the assay CV was 3%. Liver, kidney, skeletal muscle, and brain tissues were collected from six ewes, immediately frozen at -80°C, and subsequently homogenized in PBS. Tissues (0.02 to 1.0 g) were vortexed for 2 min using 3 mL of acid methanol (12% 2N HCl: 88% methanol; vol: vol) followed by centrifugation at 4100 x g for 10 min and dried at 40°C for 30 min. Using this procedure, an average of 82 ± 1.2% of added 125I-AGD was recovered. The dried extract was resuspended in 0.5 mL of PBS containing 1% BSA which was then assayed in duplicate for AGD. No AGD was detected in control tissues (liver, kidney, and skeletal muscle). Likewise, the decapeptide was not detected in brainstem, cortex, pituitary, anterior or posterior hypothalamus. The pineal gland averaged 8.0 ± 3.0 ng AGD/g tissue while the greatest concentration of AGD was detected in the median eminence (69.0 ± 19.0 ng/g). These data demonstrate development of a sensitive AGD RIA. This RIA reveals the presence of substantial concentrations of AGD in the ovine median eminence and pineal gland.

Key Words: Antigonadatropic decapeptide, Radioimmunoassay, Neuropeptide

T6 Pituitary expression of ghrelin mRNA during the luteal phase of the bovine estrous cycle. H. C. Moore*, P. C. Gentry, R. J. Collier, and A. M. Turzillo, *University of Arizona, Tucson, AZ.*

Ghrelin, an endogenous growth hormone (GH) secretagogue, has been implicated as a regulator of metabolism and growth. Although predominantly secreted by the stomach, ghrelin expression was recently reported in somatotropes, lactotropes, gonadotropes, and corticotropes of the human pituitary gland. The presence of ghrelin mRNA in various pituitary cell types indicates that ghrelin may modulate the release of pituitary hormones other than GH. The potential influence of ghrelin on synthesis and secretion of gonadotropins as well as potential feedback effects of steroid hormones on ghrelin actions are yet to be determined. The objectives of this study were to determine 1) if the ghrelin gene is expressed in the bovine pituitary gland, and 2) if pituitary ghrelin mRNA expression is modulated by progesterone (P4) during the luteal phase of the estrous cycle. Following estrous synchronization, ovarian follicular dynamics in beef heifers were monitored with ultrasound and pituitary glands were harvested on days 2, 4, 6, 8, and 10 (n=6) after initiation of the first follicular wave following ovulation. Blood samples were collected daily and serum concentrations of P4 were determined by RIA. As expected, concentrations of P4 increased from day 2 to day 10 (0.7, 1.9, 3.3, 5.7, and 7.3 ng/ml on days 2, 4, 6, 8 and 10, respectively) and were correlated with luteal development. Total cellular RNA was reverse transcribed and primers spanning bases 40-481 of bovine ghrelin were used to amplify ghrelin cDNA by PCR. Representative cDNA products were sequenced to verify identity. Ghrelin gene expression was detected in pituitary glands on days 2-10. However, preliminary analysis indicated that pituitary ghrelin expression does not change during the luteal phase of the estrous cycle. We conclude that pituitary expression of ghrelin is not regulated in an endocrine fashion by P4. Studies are underway to determine cellular sites of ghrelin expression in the bovine pituitary gland.

Key Words: Ghrelin, Pituitary, Bovine

T7 Effects of short-term fasting on reproductive function in beef cows. A. Ramos III*[1], K. K. Kane[1], D. E. Hawkins[1], W. D. Bryant[1], D. M. Hallford[1], G. E. Moss[2], and R. S. Kelling[1], [1]*New Mexico State University,* [2]*University of Wyoming.*

To determine the influence of short-term fasting on reproductive function, normally cycling, crossbred cows were randomly assigned to one of three treatments: control (CONT; n = 8), CIDR (n = 9), or fasted (FAST; n = 9). CONT and CIDR cows were fed ad libitum while the FAST cows were not fed from d 10 through 14 (d 0 = estrus). CIDR cows received an intravaginal CIDR (InterAg, Hamilton, NZ; 1.38 g progesterone (P4)) on d 11. On d 15, cows received PGF2α (Lutalyse®, 25 mg, i.m.) at 0600 h and CIDRs were removed at 1800 h. Body weights were obtained on d 10 and 15 at 0600 h. Blood samples were collected d 10 through 16 for determination of P4. To evaluate serum LH, samples were collected every 15 min for 4 h on d 10 and 14 and every 4 h on d 17 through ovulation. Ultrasonography was performed daily from d 0 through d of ovulation. On d 15, BW loss of FAST cows was greater (-29 kg) than CONT (-1 kg) and CIDR cows (0 $\pm$ 4 kg.; P $\leq$ 0.001). Mean P4 from d 10 through 14 did not differ among treatments (7.1, 7.1, 6.3 $\pm$ 0.5 ng/mL, CONT, CIDR, and FAST, respectively; P $\geq$ 0.05). Concentration of LH within treatments was similar between d 10 and 14 (CONT: 4.9 vs 4.2 $\pm$ 1.3 ng/mL; CIDR: 1.3 vs 1.8 $\pm$ 0.5 ng/mL; FAST: 3.5 vs 2.9 $\pm$ 0.6 ng/mL, d 10 and d 14, respectively; P $\geq$ 0.05). Time from PGF2α to P4 $\leq$ 1 ng/mL did not differ among treatments (30.0, 33.3, 26.2 $\pm$ 3.3 h, CONT, CIDR, and FAST, respectively; P $\geq$ 0.05). No differences were observed in times from PGF2α to peak LH (79.7, 84.6, 127.7 $\pm$ 26.7 h, CONT, CIDR, and FAST, respectively; P $\geq$ 0.05) and peak LH to ovulation (24.0, 16.0, 41.1 $\pm$ 9.8 h, CONT, CIDR, and FAST, respectively; P $\geq$ 0.05). Time from PGF2α to ovulation was greater in FAST (255 h) than CONT (96 h) and CIDR (101 $\pm$ 55.3 h, P $\leq$ 0.05). Short-term fasting did not affect serum P4 or LH during the luteal phase, P4 disappearance following PGF2α, or timing of the LH surge. However, short-term fasting increased BW loss and time from PGF2α to ovulation, suggesting an influence of short-term fasting on time of ovulation.

Key Words: Fasting, Ovulation, Reproduction

T8 Reproductive Performance of Dairy cows under the Pasture Production System of New Zealand. Z. Z. Xu, L. J. Burton, and D. L. Johnson, *Livestock Improvement Corporation Ltd, Hamilton, New Zealand.*

Reproductive performance is a key determinant of the efficiency of dairy production, especially for seasonal dairy production systems based on pasture. Studies in several countries have shown a gradual decline in reproductive performance. The objectives of this study were to benchmark current reproductive performance of dairy cows in New Zealand and to quantify the effects of various factors on reproductive performance. Data were collected from 101,185 cows over a 3-year period (414 herd-year groups). Pregnancy status was determined either by palpation per rectum and/or from calving information in the following calving season. The overall conception rate to first AI (CR1) for all cows was 53.0% (n=89,367) with a large variation among herds. The average CR1 for herds in the top and bottom quartiles were 62.3% and 43.4%, respectively. The conception rate to AI after a natural estrus was 55.3% compared with 38.6% to AI after an estrus induced with hormonal treatment.

Data were analyzed using the MIXED procedure of SAS and herd-year was included as a random factor. All following results are least squares means produced by the model. CR1 increased with age from 2 (53.5%) to 4 years (59.2%) and then decreased with age to 46.7% in cows aged $\geq$10 years. Jersey cows had a lower CR1 (53.3%, P<0.0001) than Holstein-Friesian (56.1%) or crossbred cows (56.4%). Cows giving birth to twins had lower CR1 (47.0%, P<0.0001) than cows giving birth to a single (55.8%). Cows that had calving difficulty had a lower conception rate (50.3%, P<0.001) than cows that had no calving difficulty (55.8%). The relationship between the interval from calving to first AI and CR1 was curvilinear, with the linear (1.51), quadratic (-0.011) and cubic (0.000027) terms all being significant (P<0.01). The day of AI relative to the start of the breeding season also had a curvilinear relationship with CR1, with significant (P<0.01) linear (0.24), quadratic (-0.015) and cubic (0.000106) terms. These results show that the conception rate of dairy cows in New Zealand is higher than that reported in many other countries. The large variation among herds in conception rate suggests tremendous scope for improving reproductive performance through management. (Supported by the Dairy Global Program)

Key Words: Reproductive performance, Conception rate, Risk factors

T9 Effect of genetic potential for milk yield on the onset of reproductive activity and corpus luteum function in Holstein cows. W. J. Weber*[1], S. J. Kolath[2], M. C. Lucy[2], H. Chester-Jones[1], L. B. Hansen[1], and B. A. Crooker[1], [1]*University of Minnesota, St. Paul,* [2]*University of Missouri, Columbia. USA.*

Holsteins from a breeding project initiated in 1964 to develop a stable control line (CL) that represents US breed average in 1964 and a select line (SL) that represents contemporary US Holsteins were used to determine effects of selection on corpus luteum function. Management of heifers (25 CL, 30 SL) and cows (13 CL primiparous (CL-P), 28 CL multiparous (CL-M), 25 SL-P, 38 SL-M) was identical for both lines. Blood samples were obtained weekly from heifers from 240 d of age until first observed estrus and 3X weekly for 6 wk from the later of first estrus or 12 mo of age and weekly from cows during the first 10 wk postpartum (PP). Blood from heifers and cows was collected 10, 28 $\pm$ 3 and 42 $\pm$ 3 d post-insemination (AI), unless a subsequent estrus was observed. Post-AI sampling was repeated prior to 730 d of age (heifers) or 200 d PP (cows) until conception. Growth and production variables were determined. Growth rate, production data, day of first plasma progesterone (P4) greater than 1.0 ng/ml, estrous cycle length, and area under the estrous cycle P4 curve (AUC) were analyzed using PROC MIXED and body measures and post-AI P4 as repeated measures using PROC MIXED of SAS. Means differed when $P < 0.05$. From 8 to 18 mo of age, growth rate was greater (800 vs. 730 g/d) but BCS consistently less (3.8 vs. 4.0 at 18 mo) in SL heifers. Daily 3.5% FCM yield through 17 wk PP was greater in SL-P (31.1 vs. 20.6 kg) and SL-M (43.8 vs. 29.7 kg) cows. Age at first P4 rise (291 vs. 302 8.0 d), cycle length (19.0 vs. 19.6 0.5 d), or AUC (85.3 vs. 82.6 4.4 ng/ml/d) were not affected by line. First P4 rise PP was delayed for SL cows (38.5 vs. 28.5 $\pm$ 2.3 d) and not altered by parity. Plasma P4 increased from 10 to 42 d post-AI (5.6, 8.8, 9.3 $\pm$ 0.2 ng/ml) but did not differ between lines. Corpus luteum function was not affected by greater growth rate of SL calves but PP alterations contribute to an increased interval of anestrus in SL cows.

Key Words: Selection, Progesterone

T10 Comparison of artificial insemination (AI) versus embryo transfer (ET) in lactating dairy cows. R. Sartori*, A. Gümen, J. N. Guenther, A. H. Souza, and M. C. Wiltbank, *University of Wisconsin-Madison.*

Based on the idea that oocyte integrity and early embryonic development are compromised in dairy cows, we tested the hypothesis that conception rate (CR) can be improved by ET compared with AI. During 365 d, 550 potential breedings were used from 243 lactating Holstein cows with average milk production of 34.9 kg/d. Cows were synchronized with a modified Ovsynch protocol (GnRH-7d-PGF2α-3d-GnRH) and were randomly assigned to receive AI immediately after the second GnRH injection (d 0) or to receive transfer of one embryo 7 d later (21.5 and 78.5% fresh and frozen embryos, respectively). Circulating progesterone and follicular and luteal size (by ultrasound) were determined on d 0 and 7. Cows with circulating progesterone $\geq$ 0.5 ng/ml on d 0 (n = 66; 12.0%), < 0.5 ng/ml on d 7 (n = 9; 1.6%), or without a responsive follicle to GnRH on d 0 (n = 76; 13.8%) were considered not synchronized. Pregnancy diagnosis was performed by ultrasonography on d 25 or 32, and pregnant cows were reevaluated on d 60-66. Synchronized cows with single ovulation had similar (P > 0.30) CR on d 25-32 with ET (n = 176; 40.3%) and AI (n = 160; 35.6%). Pregnancy loss between d 25-32 and 60-66 also did not differ (P > 0.20) between ET (26.2%) and AI (18.6%) cows. When single (n = 336) and multiple (n = 57) ovulators were compared, independent of treatment, multiple ovulators had greater (P < 0.001) circulating progesterone on d 7 than single ovulators (2.7 vs. 1.9 ng/ml) and there was a tendency (P = 0.07) for a greater CR for multiple ovulators (50.9% vs. 38.1%). However, there was no difference in CR between AI and ET cows with multiple ovulation (50.0% vs. 51.7%). The CR tended to be lower for AI than ET in single-ovulatory cows ovulating smaller ($\leq$ 15mm; 23.7 vs. 42.3%; P = 0.11) or larger ($\geq$ 20mm; 34.3 vs. 51.0%; P = 0.13) follicles but not average ovulatory sized follicles (16-19 mm; 41.2 vs. 37.3%; P = 0.69). Thus, ET did not

improve overall CR in lactating cows but size and number of ovulating follicles may determine success with these procedures.

Key Words: Embryo transfer, Dairy cattle, Pregnancy

T11 Effects of varying dry period length and prepartum diet on reproduction in dairy cattle. A. Gümen, R. R. Rastani, R. R. Grummer, and M. C. Wiltbank, *University of Wisconsin-Madison*.

The effect of dry period length on reproductive performance of lactating dairy cows has not been previously evaluated. Sixty Holstein cows were assigned in a randomized block design to one of three treatments: 1) Traditional (T) dry period (56 d) with dry cows fed 28 d on low energy followed by 28 d on a moderate energy diet, 2) Shortened (S) dry period (28 d) with cows continuously fed a high energy diet, or 3) Zero (Z) dry period with cows continuously fed a high energy diet. Cows had ovaries evaluated by ultrasound and blood samples collected 3 times per week beginning from d 6 or 7 postpartum (PP) until 7 d after second ovulation. Average d from calving until the first 10 mm follicle were fewer ($P < 0.05$) in Z (8.1 d) and S (9.0 d) than T (10.5 d). Time from calving to first ovulation was earlier ($P < 0.01$) in Z (14.5 d) than T (28.9 d) with S (21.5 d) intermediate. A follicle of the first follicular wave ovulated in more ($P < 0.01$) Z (84%; 16/19) than T (43%; 9/21) with S (65%; 13/20) intermediate. Double ovulation rate at the first ovulation was greater ($P < 0.02$) in T (62%) than Z (21%) with S (35%) intermediate. However, there was no difference in double ovulation rate at second ovulation (15/60). There were no differences among treatments in size and volume of the ovulatory follicle or in luteal volume and serum progesterone concentrations on day 7 after ovulation for cows with single or double ovulation. Number of cows with persistent CL (>30 d; 18/60) was not different among groups; however, short luteal phases were greater ($P < 0.05$) in Z (21%; 4/19) than S (0%; 0/20). Days to first AI were shorter ($P < 0.06$) in Z (68.7 d) and S (68.0 d) than T (75.4 d). First service conception rate was greater ($P < 0.06$) in Z (58%; 11/19) than T (25%; 5/20) with S (29%; 6/21) being intermediate. Days open in pregnant cows were fewer ($P < 0.05$) in Z (80.7 d) than S (121.1 d) or T (114.4 d). Thus, shortening or eliminating the dry period leads to earlier PP ovulation and may improve reproduction in lactating dairy cows.

Key Words: Dry Period, Reproduction

T12 Relationship between milk production and estrous behavior of lactating dairy cows. H. Lopez*[1], L. D. Satter[1,2], and M. C. Wiltbank[1], [1]*Dairy Science Department, University of Wisconsin,* [2]*US Dairy Forrage Research Center, USDA-ARS, Madison, WI*.

The objective of this study was to evaluate the association between level of milk production and duration of estrus as determined by mounting activity recorded by a radiotelemetry system. Holstein cows (n=267;50 DIM) were fitted with a transmitter that allowed 24h/d recording of mounting activity. Cows were housed in a free-stall barn with concrete flooring and milked twice daily with milk weights recorded. Ovulation was confirmed for all estruses (n=323) by ultrasonography. Average milk production for 10d before the day of estrus was used to classify cows as low (<39.5kg/d) or high (≥39.5kg/d) producers at the time of estrous expression. Follicle diameter and serum estradiol (E2) concentrations were determined in a subset of single-ovulating cows (n=71) on the day of estrus. Duration (6.2±0.5 vs. 10.9±0.7h; P<0.0001), mounts (6.3±0.4 vs. 8.8±0.6; P=0.001), and mounting time (21.7±1.3 vs. 28.2±1.9s; P=0.007) were shorter for estruses from high (46.4±0.4kg/d; 91±3DIM; n=146) than low producers (33.5±0.3Kg/d; 96±3DIM; n=177). The effect of milk production on estrous duration was similar in primiparous (5.7±0.8h for high [45.9±0.8kg/d; n=49] vs. 10.7±0.8h for low [33.7±0.3kg/d; n=135] producers; P<0.0001) and multiparous (6.4±0.6h for high [46.6±0.5kg/d; n=98] vs. 11.9±1.4h for low [33.0±0.6kg/d; n=41] producers; P<0.0001) cows. Milk production for 10d before the day of estrus was correlated with estrous duration for primiparous (r=-0.54; P<0.0001) and multiparous (r=-0.48; P<0.0001) cows. E2 concentrations were lower (6.8±0.5; n=31 vs. 8.6±0.5pg/ml; n=40; P=0.01) for high than low producing cows in spite of larger preovulatory follicle diameter (18.6±0.3; n=31 vs. 17.4±0.2mm; n=40; P=0.004). Level of milk production was correlated with E2 concentrations (r=-0.56; P<0.0001) and diameter of the preovulatory follicle (r=0.44; P<0.0001). Thus, high level of milk production decreases duration of estrus probably due to decreased concentrations of E2 at estrus.

Key Words: Dairy cow, Estrous behavior, Milk production

T13 Milk urea nitrogen and conception rate: a population study using test-day records. J. E. Vallimont[1], G. W. Rogers*[2], L. A. Holden[1], M. L. O'Connor[1], J. B. Cooper[2], C. D. Dechow[2], and J. S. Clay[3], [1]*Penn State University,* [2]*University of Tennessee,* [3]*Dairy Records Management Systems*.

Reproductive failure is costly to dairy producers, and high milk urea nitrogen (**MUN**) levels are known to affect reproduction. Dairy Records Management Systems, Raleigh, NC, provided records for 15,191 test days with a first service within 30 d of a MUN test to determine the relationship between MUN and conception rate (**CR**) in Holstein cows. Conception rate data were included from October 1998 to December 2000; seasons were summer (April to September) and winter (October to March). Days to first service (**DFS**) was limited to 25 to 200 d. Herds were required to have a first service CR between 10% to 65%. Data were analyzed with SAS using the PROBIT model of PROC LOGISTIC. Analyses included wet chemistry alone (**WC**) and WC plus infrared (**ALL**). Variables in the final model were herd, year-season of insemination, parity group (1, 2, and 3+), and MUN as a continuous variable or MUN grouped (<6, 6 to 7, 8 to 9, 10 to 14, 15 to 16, 17 to 18, and >18 mg/dl). Milk yield did not change the impact of MUN on CR, and DFS was not significant. Milk urea nitrogen approached significance at the 0.10 level. Cows were 22% more likely to conceive if they had a WC MUN of 8 to 9 mg/dl (n=181) in the period of the week preceding or following a service compared to MUN of 10 to 14 mg/dl (n=1690, $P<0.08$). Cows with WC MUN 6 to 7 mg/dl (n=57) had a 22% better likelihood of conception than those with MUN 10 to 14 mg/dl (n=1638) when inseminated within a two-wk period after MUN test ($P<0.09$); cows with WC MUN <6 mg/dl or >18 mg/dl (n=14, n=621) were 27% and 13% less likely to conceive than those with MUN 10 to 14 mg/dl for the same period ($P<0.09$). The continuous MUN variable in WC and ALL models predicted pregnancy outcome for services within two wk after MUN test, but was not significant for services within two wk before MUN sample date ($P<0.06$). Lower MUNs, with the exception of <6 mg/dl, at the time of insemination were associated with improved CR.

Key Words: Milk urea nitrogen, Conception rate

T14 The effect of daily drenching with propylene glycol during the transition period on LH pulsatility and the fate of the first follicle wave in dairy cows. S. T. Butler* and W. R. Butler, *Cornell University*.

The early postpartum period in high producing dairy cows is characterized by chronic severe negative energy balance, hypoinsulinemia, hypoglycemia, and inadequate LH pulse frequency resulting in a varying duration of anovulation. This experiment was carried out to determine if a daily transient elevation in insulin and glucose could ameliorate the detrimental effects of negative energy balance on LH pulsatility and the fate of the first follicle wave. Mature Holstein cows were drenched with either 500 ml of propylene glycol (PG; n=30) or water (CTL; n=29) daily from day -10 prior to parturition until day 25 postpartum. Transrectal ultrasound examinations of ovarian follicle development were carried out on 3 days per week from day 10 until day 30. Frequent blood samples (every 30 minutes) were collected via indwelling jugular catheters from a sample of 10 cows from each treatment group on day -10, 2, and 25 to assess the glucose and insulin response to the treatments. In addition, on day 10 postpartum blood samples were collected at 10 min intervals for 12 hours to determine treatment effects on LH pulse profiles. Both insulin and glucose were elevated on day -10, 2, 10 and 25 following PG administration (treatment by time, P<0.01). On day 10 postpartum the number of LH pulses (7.8 ± 0.5 vs. 7.1 ± 0.5 pulses per 12 hours; P>0.1), mean LH (0.56 ± 0.05 vs. 0.46 ± 0.05 ng/ml; P>0.1) and pulse amplitude (0.56 ± 0.07 vs. 0.50 ± 0.7 ng/ml [peak # base]; P>0.1) were not different between CTL and PG cows respectively. The proportion of dominant follicles that became ovulatory (10/29 vs. 11/30), non-ovulatory (13/29 vs. 15/30) and cystic (6/29 vs. 4/30) between day 10 and 30 postpartum were not different between CTL and PG cows respectively. The results indicate that daily drenching from day -10 to

25 relative to parturition with propylene glycol had little effect on LH pulsatility or on the outcome of the first follicle wave.

Key Words: LH, Ovary, Propylene glycol

T15 Reproductive and metabolic parameters associated with low postovulatory progesterone secretion in lactating dairy cows. G. E. Mann*[1], L. M. Hicking[1], and D. Blache[2], [1]*University of Nottingham,Sutton Bonington,UK,* [2]*University of Western Australia, Nedlands, Australia.*

In dairy cows, inadequate progesterone secretion following mating is an important cause of early pregnancy loss though the reasons for this reduced secretion of progesterone are not known. The aim of this study was to determine the reproductive consequences of low postovulatory progesterone secretion and to identify parameters associated with this problem. Milk progesterone concentrations were determined on day 5 following first insemination in 96 lactating Holstein Friesian dairy cows. Low progesterone was empirically defined as a milk progesterone concentration of <3ng/ml while high progesterone was defined as any concentration greater than this value. Of the 96 cows sampled, 15 (15.6%) had low milk progesterone concentrations (<3ng/ml) and 81 cows (84.4%) had high milk progesterone. Mean milk progesterone concentration was 1.9±0.2ng/ml in the low group and 6.8±0.3ng/ml in the high group. Conception rate in the low progesterone group (13.3%) was significantly lower (P<0.01) than in the high progesterone group (58.8%). However, there was no difference between low and high progesterone cows in the days from calving to first insemination or in the day of initiation of first luteal activity. Milk yield in the low progesterone group (36.9±1.5 l/d) was not significantly different to that in high progesterone group (34.9±0.9 l/d). Body condition score (0 to 5 scale) in the low progesterone group (1.4±0.1) was significantly lower (P<0.01) than in the high progesterone group (1.8±0.1) as was plasma leptin concentration (1.4±0.2 vs 2.2±0.2 ng/ml; P<0.05). There were no significant differences in plasma concentrations of urea, beta hydroxybutyrate or glucose between the low and high progesterone groups. In conclusion, low day 5 progesterone resulted in a severely reduced pregnancy rate and was associated with reduced condition score and plasma leptin concentration but was not associated with increased milk yield or altered blood metabolites.

Key Words: Milk progesterone, Cow, Pregnancy

T16 Effect of gossypol intake on plasma and uterine gossypol concentrations and on embryo development and viability in vivo and in vitro. M. Villaseñor*, A. C. Coscioni, K. N. Galvao, S. O. Juchem, J.E.P. Santos, and B. Puschner, *University of California - Davis.*

Forty-eight postpubertal Holstein heifers (13 mo; 380 kg of BW) were blocked by age and BW and randomly assigned to one of three isocaloric and isonitrogenous diets differing in their free gossypol (FG) content: control (C; 0 mg of FG/kg of BW); medium (M; 20 mg of FG/kg of BW); and high (H; 40 mg of FG/kg of BW). Cracked Pima cottonseed was used as a source of gossypol. Heifers were fed diets for 70 d prior to superovulation and embryo collection. Heifers were flushed on d 5.5 after the initial AI and embryos were evaluated. Plasma gossypol concentrations were measured 1 d prior to uterine flush. Embryos with grades 1 to 3 were either stained, to determine the number and proportion of live and dead cells, or randomly assigned to culture in vitro for 96h in a medium containing either 0 (MC) or 10 μg/ml (MG) of gossypol acetic acid (GAA). Continuous, binomial, and count data were analyzed by the GLM, LOGISTIC, and GENMOD procedures of the SAS (2001) program. Number of embryos grades 1 and 2 was similar for C, M, and H and averaged 3.3 (P=0.29), but number of unfertilized oocytes, grade 3 and degenerated embryos was higher for H than C and M (5.6 vs 2.9 vs 0.5; P<0.01). Total number of cells in fresh stained embryos were similar for C, M, and H (16.6 vs 14.8 vs 16.4; P=0.40). However number of live cells was higher for C compared to M, but did not differ from H (13.5 vs 10.4 vs 12.2; P=0.05). Similarly, percent of total live cells was higher for C compared to M, but did not differ from H (80.2 vs 72.2 vs 78.1; P=0.02). Hours of development in in vitro cultured embryos was reduced by GAA (77.1 vs 64.9h; P=0.05), but no interaction between heifer diet and culture medium was observed (P=0.50). An interaction between heifer diet and culture medium was observed for the proportion of live embryos after 96h of culture (P=0.10). Number of cells after culture was higher for C than M and H (23.1 vs 20.3 vs 14.6; P<0.01), but culture medium did not influence cell numbers (P=0.50). High gossypol diet and GAA in the medium influenced negatively embryo quality and development.

Key Words: Gossypol, Embryo, Heifers

T17 Effect of gossypol intake and plasma gossypol concentrations on follicle development and luteal function in dairy heifers. A. C. Coscioni*[1], K. N. Galvao[1], M. Villaseñor[1], J.E.P. Santos[1], B. Puschner[1], and L.M.C. Pegoraro[2], [1]*University of California - Davis,* [2]*EMBRAPA - Brazil.*

Twenty-seven postpubertal Holstein heifers (13 mo; 380 kg of BW) were blocked by age and BW and randomly assigned to one of three isocaloric and isonitrogenous diets differing in their free gossypol (FG) content: Control (C; 0 mg of FG/kg of BW, N=8); medium (M; 20 mg of FG/kg of BW; N=9); and high (H; 40 mg of FG/kg of BW; N=10). Cracked Pima cottonseed was used as a source of gossypol. Heifers were fed diets for 30 d and then estrus was synchronized with an injection of GnRH (Cystorelin- Merial Ltda) and insertion of a progesterone implant (CIDR- Pharmacia Animal Health), followed 7 d later by an injection of PGF2a (Lutalyse-Pharmacia Animal Health). Heifers were ultrasounded every 24 h during an entire estrous cycle. Follicle and CL development, and plasma progesterone concentrations were evaluated daily, and plasma gossypol concentrations were evaluated once at the end of the cycle. Continuous data were analyzed by the GLM procedure of SAS (2001) and repeated measurements over time were analyzed by the MIXED procedure of SAS (2001). Emergence of first and second follicular waves (FW) were similar (P>0.15) for C (1.1 and 9.1 d), M (1.0 and 8.9 d), and H (1.9 and 8.8 d). Deviation of the dominant follicle (DF) after emergence for the first (C=3.5 vs M=3.5 vs H=3.4; P=0.99) and second FW (C=4.0 vs M=4.6 vs H=4.5; P=0.61) was not affected by treatments. Treatment had no effect on CL growth throughout the estrous cycle (P=0.68). Estrous cycle length, maximum follicle diameter for the DF of the first and second FW, period of follicle dominance for the DF of the first and second FW, and diameter of ovulatory follicle were not influenced by dietary gossypol intake. Results indicate that consumption of up to 40 mg of FG/kg of BW does not influence follicle and CL development in dairy heifers. A.C. Coscioni: Supported by CAPES, Brazil

Key Words: Gossypol, Heifer, Follicle development

T18 Effect of gossypol intake on plasma and uterine gossypol concentrations and on embryo quality and development in superovulated Holstein dairy heifers. A. C. Coscioni*[1], M. Villaseñor[1], K. N. Galvao[1], R. C. Chebel[1], J.E.P. Santos[1], J. H. Kirk[1], B. Puschner[1], and L.M.C. Pegoraro[2], [1]*University of California - Davis,* [2]*EMBRAPA - Brazil.*

Seventy-four postpubertal Holstein heifers (13 mo; 380 kg of BW) were blocked by age and BW and randomly assigned to one of three isocaloric and isonitrogenous diets differing in their free gossypol (FG) content: Control (C; 0 mg of FG/kg of BW, N=23); medium (M; 20 mg of FG/kg of BW; N=26); and high (H; 40 mg of FG/kg of BW; N=25). Cracked Pima cottonseed was used as a source of gossypol. Heifers were fed diets for 60 d prior to superovulation. Superovulatory treatment with 8 decreasing doses of FSH started on d 9 of the estrous cycle. Heifers were inseminated twice, 12 h apart, with the first insemination when estrus was first detected. Heifers were flushed on d 7.0 after the initial AI and embryos evaluated. Blood and uterine flush samples were collected and evaluated for the gossypol concentration. Embryos graded as 1 to 3 were frozen and evaluated again after thawing. Continuous, binomial, and count data were analyzed by the GLM, LOGISTIC and GENMOD procedures of SAS (2001), respectively, and heifer was the experimental unit for analyses. Number of structures collected per heifer were, respectively, 9.4, 8.4, and 8.8 for C, M, and H (P=0.88). Number of embryos grades 1 and 2 were similar for all treatments (P=0.87), and averaged 3.5, 3.6, and 3.3 for C, M, and H, respectively. However, heifers receiving the H diet (5.8) had higher number (P<0.01) of grade 3 and degenerated embryos than those receiving the C (3.6) and M (3.2) diets. Number of unfertilized oocytes were higher (P<0.01) for M (2.4) than C (2.0) and H (1.0). Heifers fed C and M had a lower proportion of embryos classified as Morula than those fed H (33.3 vs 20.2 vs 47.7%; P<0.02). Feeding a diet with 40 mg of FG/kg of BW increased the number of degenerated embryos and hindered embryo development by day 7 after AI.

A.C. Coscioni: supported by CAPES, Brazil.

Key Words: Gossypol, Embryo quality, Heifer

T19 Enhancing ability of bovine sperm to survive cryopreservation with cyclodextrin and cholesterol. A. Kaya*[1,2] and J. J. Parrish[1], [1] *University of Wisconsin Madison, Wisconsin,* [2] *University of Selçuk Konya, Turkey.*

Protection of plasma membrane integrity during cryopreservation of spermatozoa is important for their fertilizing ability. The objective of this study was to determine the optimal dose of cholesterol-loaded cyclodextrin (CLC) resulting in an increase in the post-thaw characteristics of bull sperm. Semen was initially diluted to 120 x 10^6 sperm/ml in a Na citrate buffer composed of 63 mM Na citrate, 55 mM glucose and at PH = 7.0. The CLC was dissolved in TALP medium containing 3 mg/ml of BSA. The solution was added to the sperm suspension at various doses of CLC (0, 1.25, 2.5, 3.75, 5 and 7.5 mg/120x10^6 sperm /ml) and incubated 15 min at room temperature. The sample was then processed by standard freezing procedures. Post-thaw sperm characteristics were evaluated for motility using time-lapse photography of fluorescently labeled sperm nuclei, sperm with intact acrosomes (wet mount, DIC) capacitation status in response to lysophatidlcholine (LPC), sperm viability assessment using SYBR-14 and propidium iodide (PI) and functional integrity of sperm membrane using hypoosmotic swelling (HOS) test. The CLC addition to the extender did not differ significantly in sperm motility, intact acrosome and capacitated sperm rates (P>0.05). However sperm treated with 1.25 and 2.5 mg CLC had improved sperm viability (69.0 and 69.2 % vs. 58.5 %) and membrane functional integrity (59.8 and 51.8 % vs. 36.5 %) compared to control, respectively (P < 0.01). Additionally, 3.5 mg of CLC also resulted in an increase in the response to the HOS test (47.8 % vs. 36.5 %; P < 0.05). These results indicate that sperm treated with the lower doses of cholesterol-loaded cyclodextrin could modify sperm plasma membranes resulting in an increase post-thaw viability and osmotic responsiveness. Supported by State of Wisconsin and American Breeders Service Global.

Key Words: Cholesterol, Cyclodextrin, Semen freezing

T20 Wisconsin avian extender yields better post-thaw motility for rooster semen than Minnesota avian extender after cryopreservation. L. E. Enwall*[1], A. Kaya[2], L. N. Geiger[1], and J. J. Parrish[1], [1] *University of Wisconsin Madison, Wisconsin,* [2] *Selçuk University Konya, Turkey.*

Reliable and consistent protocols for the successful freezing of avian sperm remain somewhat elusive especially in comparison to the success enjoyed by the bovine industry. We developed an extender, Wisconsin avian extender (WISA) and compared it to Minnesota avian extender (MNA) with differing final concentrations (6%, 11%, 14%, and 19%) of glycerol. WISA is a modification of a Tyrode's based medium used to incubate bovine sperm in an air atmosphere. Semen was pooled from 4-12 roosters, diluted 1:2 with extender, frozen in 0.5 ml straws over static nitrogen vapor, and then immersed in liquid nitrogen. Straws were thawed at 35C for 1 minute and then semen diluted 1:20 into the same base extender, either WISA or MNA. Two separate operators assessed motility of thawed semen visually. Sperm frozen without glycerol did not survive. At the lowest final concentration of glycerol, 6%, neither treatment yielded greater than 15% average motility and were not statistically different from one another although both were different from the WISA at 11%, 14%, and 19% glycerol concentrations (p<.001). At final glycerol concentrations of 11%, 14%, and 19%, WISA demonstrated a far more significant (p<.001) advantage in preserving sperm motility after thawing. None of the 11%, 14%, and 19% MNA/glycerol treatments exceeded 10% average motility while the comparable WISA treatments exceeded 30%, 40% and 40% motility respectively. Although motility is not necessarily indicative of fertility, these results indicate that WISA is a strong candidate for the cryopreservation of rooster sperm.

Key Words: Cryopreservation, Semen, Rooster

T21 The effect of time and fluid volume on the rate of boar sperm settling using a commercial extender. K. L. Willenburg*, K. J. Rozeboom, B. R. Lindsey, and M. E. Wilson, *Minitube of America, Verona, WI.USA.*

The objective of the study was to evaluate the effect of time and fluid volume on the rate of sperm settling using a commercial extender with special interest in uniform concentration distribution during semen dose preparation. To analyze sperm settling rate, three extended semen volumes (10, 80, and 1000 ml) contained in each of six 15 ml conical tubes, each of six 100 ml AI tube, and a 1000 ml glass beaker, respectively, were sampled from three areas of each container (top, middle, and bottom). Samples (0.5 ml) were drawn from each container at each of the three levels and each time point using a glass pipette. Samples contained 3.75 x 10^8 spermatozoa/ml from a pool of two boars of known fertility. Sperm concentration was determined with Sperm Vision, which was verified in an earlier study with a hemacytometer. Samples were taken at 0, 5, 10, 20, 40, and 80 minutes. However for statistical analysis, times were blocked into three groups, T1 = 0 and 5 m, T2 = 10 and 20 m, T3 = 40 and 80 m. Initial sperm concentration was similar among the three treatment volumes. Furthermore, settling rate by volume interactions, as measured by sampling the top, middle, and bottom, areas was not present (P>0.1). However, semen concentration over time varied among the three areas sampled (p<.01). Top, middle, and bottom concentrations were similar for T1, however, for T2, more sperm were recovered from the bottom than from the top (3.1 vs 3.3 x10^6, respectively, p<.01). Similarly, sperm numbers were different at T3 for the top, middle, and bottom (2.5 vs. 2.9 vs. 5.1x10^6, respectively, p<.01). In summary, sperm settling appears to depend upon time, but not necessarily volume. Based upon these conditions, settling occurred between 10 and 20 minutes regardless of volume. The results of this experiment show that extended semen should be remixed before dose distribution if the semen is left undisturbed for more than 10 minutes.

Key Words: AI, Boar, Sperm concentration

T22 Boar seminal plasma effects on AI outcomes. A.L. Ruiz-Sanchez*, R. O'Donoghue, and G. Foxcroft, *University of Alberta, Edmonton, Alberta, Canada.*

Rozeboom et al. (Swine AI News Bulletin vol. IX. 2000) suggested a minimum requirement of 10 to 12% seminal plasma (SP) in semen diluted for AI use to maintain high fertility. As part of an ongoing study of ejaculate quality and boar fertility, the impact of differing percentages and absolute amounts of seminal plasma on fertility outcomes was examined. The first sperm rich fraction of ejaculates collected from nine boars twice weekly over 7- to 8-month periods was diluted to 1.5 billion morphologically normal sperm in 50 mL BTS extender, and used to breed at least 55 gilts. Boars differed consistently for pregnancy rate (73 to 98%; P < 0.0003) and farrowing rate (71 to 98%; P < 0.0003) and two boars (G1, R1) were identified as being less fertile. Total born was affected by both boar (8.8 to 12.0; P < 0.001) and time (9.5 to 11.1; P = 0.038), with no boar x time interaction. In contrast, a boar x time interaction (P < 0.0001) existed for percentage of SP (range 4.9 to 20.7%) and total volume of SP (range 2.5 to 10.3 mL) per AI dose, and a lack of significant correlations between SP inclusion and proven fertility suggests that even at low sperm numbers, the amount of SP per AI dose did not critically affect fertility. Unpublished data in the boar and other domestic species suggest that specific boar SP proteins make be related to differences in boar fertility. Our initial results indicate that although total protein concentration in raw semen SP was different among boars (19.13 to 37.97 mg/mL; P = 0.029), total SP protein in diluted semen did not differ among boars or times, and hence showed no meaningful correlations with proven differences in boar fertility. Associations with specific SP proteins are presently being evaluated.

Key Words: Seminal plasma, AI, Boar Fertility

T23 Evaluation of post-thaw boar semen characteristics of two genotypes using three extenders. H. D. Blackburn*, *USDA-ARS-National Animal Germplasm Program.*

The National Animal Germplasm Program's (NAGP) charge is to develop cryopreserved collections of animal genetic resources. Effective implementation of swine cryopreservation in the program requires freezing protocols that can be employed across genotypes. Therefore, semen was collected from Yorkshire (YK, n=4) and Composite (CP, n=5)

boars to evaluate three extenders: BF5, LEY and BF5 containing 2-hydroxypropyl-beta-cyclodextrin added (BF5CD). The literature has suggested adding cyclodextrin to boar semen extenders improves post-thaw viability. Post-thaw measurements were performed with computer assisted sperm analysis (CASA) for motility (MOT), cell area, track speed (VCL) and straightness of cell movement (STR). CASA readings were taken on each extender breed combination from post-thaw time 0 (T-0) and a subsequent reading at 105 minutes (T-105). Post-thaw CASA characteristics were evaluated using a mixed model (SAS, 2002). Model main effects were: extender, breed and extender*breed as fixed effects, while boar nested within breed was random. For evaluating pre-freeze and post-thaw cell area the inverse of cell area was used to normalize the data. The effect of extender*breed for MOT and VCL were highly significant at T-0. The YK-BF5 combination caused the interaction by increasing MOT to 52.3% vs. 30.6% and VCL to 145.6 vs. 121.3 the mean for all other extender breed combinations. For the response variables STR and cell area the BF5 extender yielded better post-thaw performance (P<. 01). Boar nested within breed was found to be significant at T-0, with MOT ranging from 4 to 70%. However, by T-105 boar within breed was not significant for any of the traits measured. At T-105 BF5 held a significant advantage over LEY and BF5CD. These results do not support previous work showing BF5CD as affording better cryoprotection when compared to BF5. Given these results the extender of choice for preserving boar semen in the NAGP repository is BF5. As new extenders become available additional testing of genotypes and extenders will be performed.

Key Words: Cryopreservation, Boars, Genetic conservation

T24 Effect of fetal bovine serum on the development of in vitro produced porcine embryos. J. N. Caamano*[1], J. Mao[1], T. C. Cantley[1], A. R. Rieke[1], R. Farwell[1], C. Murphy[1], B. A. Didion[2], and B. N. Day[1], [1]*Univeristy of Missouri, Columbia MO,* [2]*Monsanto, St. Louis, MO.*

The objective of the experiments was to assess the effect of adding Fetal Bovine Serum (FBS) to the embryo culture medium (NCSU-23) on days 3, 4 or 5 after in vitro fertilization (IVF) on embryo development of in vitro produced porcine embryos. In vitro maturation, fertilization and embryo culture were performed following established procedure (Abeydeera et al., 2000; Theriogenology 54:787-797) in our laboratory. In Experiment 1, embryos were selected and placed in a well after 72 h in culture. From this pool, embryos were randomly allocated to treatment groups. Groups of embryos were placed on day 3, 4 or 5 after IVF in NCSU-23 medium with the addition of 0.4% BSA or 10 % FBS. Blastocyst formation was assessed on day 6 to 9 after IVF. Only excellent/good quality blastocysts were included in the analysis. Results are presented in Table 1. There was an advantage for FBS when added on day 4 or 5 to the culture medium but not when was added on day 3 after IVF. In Experiment 2, FBS/BSA were added on day 4 and blastocyst cell number was assessed on day 6 after IVF. Average embryonic cell number was higher (P<.05) in embryos cultured in the presence of FBS (41.6 2.1) than in the presence of BSA (35.4 2.2). It was concluded that FBS could exert a differential effect on embryo development depending on the day that it was included in the culture medium. Table 1: Embryo development of in vitro produced embryos in NCSU-23 with the addition of Fetal Bovine Serum or BSA

Media	Day	No.	Day 6* %Total Blast. x±SEM
NCSU-BSA	3	57	52.0 ± 6.4^{ab}
NCSU-BSA	4	57	57.9 ± 6.4^{ab}
NCSU-BSA	5	46	49.1 ± 6.4^{ab}
NCSU-FBS	3	57	33.2 ± 6.4^{a}
NCSU-FBS	4	57	67.3 ± 6.4^{b}
NCSU-FBS	5	55	65.3 ± 6.4^{b}

Day 6* %Hatched Blast x ± SEM	Day 7* %Total Blast. x ± SEM	Day 7* %Hatched Blast x ± SEM	Day 8 % Total Blast x ± SEM
0	46.9 ± 6.7^{cd}	0.0 ± 2.7^{e}	41.3 ± 8.8^{gh}
0	60.3 ± 6.7^{cd}	0.0 ± 2.7^{e}	27.2 ± 8.8^{f}
0	50.2 ± 6.7^{cd}	0.0 ± 2.7^{e}	31.1 ± 8.8^{gh}
0	33.2 ± 6.7^{c}	0.0 ± 2.7^{e}	33.7 ± 8.8^{gh}
0	68.7 ± 6.7^{d}	18.6 ± 2.7^{f}	66.4 ± 8.8^{h}
0	67.6 ± 6.7^{d}	3.1 ± 2.7^{d}	67.6 ± 8.8^{h}

Day 8 % Hatched Blast** x ± SEM	Day 9 % Total Blast* x ± SEM	Day 9 % Hatched Blast** x ± SEM
0.0 ± 3.2^{i}	13.0 ± 7.3^{l}	0.0 ± 3.1^{n}
0.0 ± 3.2^{i}	12.2 ± 7.3^{l}	0.0 ± 3.1^{n}
0.0 ± 3.2^{i}	9.9 ± 7.3^{l}	0.0 ± 3.1^{n}
5.1 ± 3.2^{ik}	32.8 ± 7.3^{l}	6.4 ± 3.1^{n}
28.1 ± 3.2^{j}	66.4 ± 7.3^{m}	35.4 ± 3.1^{o}
16.5 ± 3.2^{jk}	66.6 ± 7.3^{m}	33.6 ± 3.1^{o}

*Within columns, Least Squares Means without a superscript in common are different (P<.05). ** Within columns, Least Squares Means without a superscript in common are different (P<.01).

Key Words: Embryo culture, Porcine embryos, Fetal bovine serum

T25 Effect of follicular size on developmental competence of porcine oocytes in vitro. J. Mao*, J. N. Caamano, T. C. Cantely, R. Farwell, A. R. Rieke, M. F. Smith, and B. N. Day, *University of Missouri-Columbia.*

The developmental competence of the oocyte is acquired progressively during late follicular growth. In conventional in vitro porcine oocyte maturation and fertilization procedures, immature oocytes are aspirated from 2- to 6- mm follicles. This experiment was conducted to test the hypothesis that the developmental potential of oocytes collected from different-sized follicles was different. Prepubertal gilt ovaries were obtained from a local abattoir. Oocytes were aspirated from three groups of follicles: 2.0-3.0 (small), 3.1-5.0 (medium), and 5.1-7.0 mm (large) in diameter. Oocytes were cultured in basic maturation medium (TCM199) supplemented with 0.5 μg/ml FSH and 0.5 μg/ml LH for 22 h, then transferred to TCM199 without hormones and cultured for another 22 h. After culture, oocytes were stripped of cumulus cells and fertilized with cryopreserved ejaculated spermatozoa for 6 h. In part 1 of the experiment, oocytes were cultured until day 6 post fertilization. Cleavage rate at 48 h and the percentage of blastocysts on day 6 was determined. Data were analyzed using SAS general linear model. The cleavage rate and proportion of oocytes developed to blastocyst stage on day 6 were 55.1 2.5% (n = 290), 50.4 1.5% (n = 969), and 44.2 3.9% (n = 188); 33.4 2.7%, 26.3 1.6%, and 13.8 4.2% for the large, medium and small follicle groups, respectively. Cleavage rate in the large follicle group was higher than that in the small follicle group (P<0.05). The percentage of oocytes developed to blastocyst in large and medium follicle groups were higher than the small follicle group (P<0.05). Blastocyst cell numbers in the large and medium follicle groups were also higher than those in the small follicle group (35.1 4.1 and 38.3 3.2, vs 25.2 4.2, P<0.05). In part 2 of the experiment, 12 h post in vitro fertilization, oocytes were fixed in 25% acetic alcohol for 48-72 h and the number of pronuclei was determined. The polyspermic fertilization rate (3 or more pronuclei in the oocyte) was 42.9, 40.0 and 48.8% for the large, medium and small follicle groups (P>0.05). It was concluded that oocytes aspirated from medium- and large-size follicles are more competent compared those collected from 2-3 mm follicles. However, the incidence of polyspermic fertilization is not different among them.

Key Words: In vitro maturation, Follicular size, Porcine

T26 Effects of bovine somatotropin (bST) on IGF-I and IGF-binding proteins in non-lactating cyclic and pregnant Holstein cows on day 17 after estrus. . T. R. Bilby*, A. Guzeloglu, S. Kamimura, F. Michel, and W. W. Thatcher, *University of Florida, Gainesville, FL, USA*.

Non-lactating cows were used to examine effects of bST on uterine proteins and gene transcripts encoding components of the IGF system. Cows (n=85) were injected on dV10 (d0 = timed insemination [TI]) with GnRH (100μg) followed 7d later (d-3) by $PGF_{2\alpha}$ (25 mg). At 48h after injection of $PGF_{2\alpha}$, GnRH (d-1) was administered, and 16 h later (d0) 55 cows were TI and 29 cows were not TI (cycling). On d0 and d11, cows received either bST (500 mg, n=52) or no bST (n=33). A follicular cyst was detected on d0 in 7 cows and on d 7 in 5 cows. CL regression prior to d16 was observed in 2 cows. These 14 cows were not slaughtered; 22 cyclic and 49 TI cows were slaughtered on d17. Uteri were flushed with 40 ml of PBS to recover uterine flushings and verify presence of a conceptus. Ligand Blot analyses for IGFBPs in uterine flushings were done on 19 cyclic and 18 pregnant cows. Endometrial tissues were collected from 14 cyclic and 16 pregnant cows for Northern blot analyses. Ligand blots revealed IGFBP-3, 4, 5 and molecular weight protein 28-29 in flushings from all cows. IGF-binding protein-3 (IGFBP-3) was higher in bST treated pregnant cows ($P< 0.05$) compared to pregnant control cows. The IGFBP-4, IGFBP-5 and molecular weight 28-29 proteins were higher in cyclic versus pregnant cows ($P<0.001$). Northern blot analyses detected IGF-I, IGFBP-3, IGF-II and IGFBP-2 mRNAs in endometrial tissues from all cows. However, growth hormone receptor (GHr-1a) mRNA was undetectable in all cows. Interactions between status and bST ($P< 0.01$) were detected for the mRNAs encoding IGF-I, IGFBP-3, IGF-II and IGFBP-2. The mRNAs for IGF-I, IGFBP-3, IGF-II and IGFBP-2 increased in bST treated cyclic cows; furthermore, pregnancy increased IGF-II and IGFBP-2 in control cows. In conclusion, differential uterine responses were detected in response to bST and pregnancy status in non-lactating Holstein cows.

Key Words: Cycle-pregnancy, bST, IGF-family

T27 Molecular characterization and endometrial expression of porcine Smad1. J. G. Kim*, J. L. Vallet, D. Nonneman, G. A. Rohrer, and R. K. Christenson, [1]*USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE*.

Uterine capacity contributes to litter size in swine. Previous gene mapping analyses revealed a quantitative trait locus (QTL) for uterine capacity on chromosome 8. Comparison of porcine and human genetic maps suggests that the Smad1 gene is located near this region. Smad1 mediates signal transduction from TGF-β family ligands, including TGF-β and bone morphogenetic proteins. In addition, Smad1 mutation in mice causes defects in allantois formation. To further explore Smad1 as a candidate gene for the uterine capacity QTL, we 1) cloned and sequenced the full coding region for Smad1, 2) examined endometrial expression of Smad1 during the estrous cycle and early pregnancy, and 3) mapped the Smad1 gene. By iterative screening of a porcine expressed sequence tag library, we obtained 2161 and 2077 bp cDNA clones containing the full coding region of Smad1. The two clones differed in their 5′ untranslated regions while their coding regions were identical, suggesting differential splicing. The inferred amino acid sequence of porcine Smad1 was 99.8% identical to human Smad1. Endometrial expression of Smad1 mRNA in White composite gilts (n = 3 to 4) was determined by Northern blotting using total RNA from d 10, 13 and 15 cyclic and from d 10, 13, 15, 20, 30 and 40 pregnant gilts, followed by densitometry. Endometrial expression of Smad1 mRNA was greater ($P < 0.05$) on d 10 (47.6 ± 3.8 arbitrary units) of pregnancy than d 10 (36.2 ± 3.8) of the estrous cycle. In both pregnant and cyclic gilts, endometrial expression of Smad1 mRNA was lower ($P = 0.03$) on d 15 (33.8 ± 3.8, 40.2 ± 3.8) than d 13 (44.0 ± 3.8, 48.4 ± 4.4), respectively. The Smad1 gene was mapped to chromosome 8, position 78 cM, near the peak of the uterine capacity QTL (71 cM). Elevated endometrial expression of Smad1 mRNA on d 10 of pregnancy suggests a role for Smad1 in signal transduction in endometrium during this period and the location of the Smad1 gene in the porcine genome is consistent with it being a candidate gene for the uterine capacity QTL.

Key Words: Uterine capacity, Coding region, Mapping

T28 Relative amounts of mRNA encoding endothelial and inducible nitric oxide synthase in the bovine corpus luteum. W. D. Bryant*, K. K. Kane, J. S. Nelson, A. Ramos III, and D. E. Hawkins, *New Mexico State University*.

Nitric oxide (NO) has emerged as a molecular messenger that mediates biological processes in several mammalian tissues. Nitric oxide is synthesized from L-arginine by one of three different NO synthase (NOS) isoforms, two constitutively expressed, endothelial (eNOS) and neuronal nitric oxide synthase, and one inducible (iNOS). Nitric oxide has been implicated in the regression of the corpus luteum (CL). Therefore, relative amounts of mRNA encoding eNOS and iNOS were examined in the bovine CL by real-time RT-PCR during the early- and mid-luteal stages and in response to PGF2α. Twenty cows were synchronized with 25 mg PGF2α (i.m., Lutalyse®) and randomly assigned to one of four treatments (estrus = d 0). Corpora lutea (n = 5/treatment) were collected via ovariectomy during early-luteal (d 5; early), mid-luteal (d 12; mid), mid-luteal, 6 h after PGF2α injection on d 12 (mid-6), and mid-luteal, 24 h after PGF2α injection on d 12 (mid-24). Immediately after collection, CL were snap frozen in liquid nitrogen and stored at -80°C. Total RNA was extracted from each CL and amplified in duplicate by real-time RT-PCR. Corpora lutea collected in the early-luteal stage tended to have less mRNA encoding eNOS than those from mid-luteal stage cows (0.07 vs 0.22 ± 0.05 arbitrary units, early and mid, respectively; $P = 0.09$) whereas early and mid mRNA encoding iNOS did not differ ($P = 0.90$). When the CL in mid, mid-6, and mid-24 were compared for mRNA encoding iNOS, mid and mid-24 were greater than mid-6 (0.45, 0.14, 0.47 ± 0.09 arbitrary units, mid, mid-6, and mid-24, respectively; $P = 0.03$). A similar trend was also observed for eNOS (0.22, 0.02, 0.27 ± 0.09 arbitrary units, mid, mid-6, and mid-24, respectively; $P = 0.14$). Relative amounts of mRNA encoding iNOS were similar whereas mRNA encoding eNOS tended to differ in the early and mid-luteal bovine CL. Moreover, mRNA encoding iNOS differed, and eNOS tended to be altered, in response to PGF2α, suggesting that PGF2α may regulate amounts of mRNA encoding NOS in the bovine CL.

Key Words: Nitric oxide synthase, Bovine, Corpus luteum

T29 Factors affecting postpartum placental blood volume. A. L. Riddle* and H. D. Tyler, *Iowa State University, Ames, IA*.

The objective of this study was to determine factors affecting the volume of blood retained in the placenta following delivery of the calf. In addition, we developed a technique for accurately measuring the volume of blood retained in the placenta following delivery. Optimal delivery conditions can improve both the short term and long term health status of the calf. Fifteen Holstein cows and heifers were placed in a maternity barn approximately 3-4 d prior to their estimated delivery date. An electronic birth monitoring system was used to determine the initiation of stage 2 labor. The umbilical cord was clamped during the delivery process. Calves were separated into two groups: those with cords clamped prior to the first breath or simultaneous with the first breath (n=7) and those with cords clamped approximately one-minute after the first breath (n=8). The first breath was considered as the first inspiration (gasp) of air. Blood samples were collected from the jugular vein of the calf immediately after birth to determine hemoglobin concentrations. Placentae were evaluated within 12 h after expulsion. Cotyledon color, cotyledon number, hemoglobin concentration from all cotyledons, placental weight, and cotyledon weight were recorded. Blood remaining within the placenta was calculated using an algorithm that included cotyledonary weight, cotyledonary [Hb], and calf blood [Hb]. Multiple regression analysis was used to identify explanatory variables associated with each response variable. Response variables included placental blood volume and placental expulsion time. Factors that affected placental blood volume included cotyledon hemoglobin concentration ($P < 0.001$), placental weight ($P < 0.01$), and calf hemoglobin concentration ($P < 0.01$). The only factor that significantly affected placental expulsion time was the weight of the placenta ($P < 0.01$). These data suggest that placental blood transfer does not appear to affect placental expulsion time in cattle.

Key Words: Placenta, Placental blood volume

T30 Expression of leptin and leptin receptor messenger RNA during mammary gland development in mice. J. L. Smith* and L. G. Sheffield, *University of Wisconsin, Madison.*

Previously, leptin and leptin receptor have been identified in the mammary gland and in mammary epithelial cells. To further investigate the developmental regulation of leptin and its receptor, quantitative real time polymerase chain reaction was used. Primers specific to leptin, long form leptin receptor, short form leptin receptor or glyceraldehyde-3-phosphate dehydrogenase (GAPDH, internal control) were synthesized. Female C57BL/6J mice were mated and mammary tissue excised at various stages of pregnancy or lactation. mRNA was extracted from mammary tissue, reverse transcribed and amplified in the presence of SYBR Green dye. Fluorescence was monitored each cycle and change in leptin, short form leptin receptor or long form leptin receptor assessed relative to GAPDH internal control. Leptin expression increased during early to mid pregnancy, reaching a maximum of 1.90.08 times non-pregnant control on day 15 of pregnancy. Leptin expression then declined during late pregnancy and was 1.10.08 at the initiation of lactation. Short form leptin receptor expression increased during early to mid pregnancy, reaching a maximum of 1.20.05 on day 15 of pregnancy, while a decline during late pregnancy was observed and was 0.80.05 at the initiation of lactation. Long form leptin receptor expression increased during mid to late pregnancy with a maximum of 1.40.1 on day 15 of pregnancy, with a resulting decline of expression at the initiation of lactation of 0.90.07. These results indicate that the expression of leptin and leptin receptor were altered during pregnancy, with the highest expression of each during mid pregnancy.

Key Words: Leptin, Leptin receptor, Mammary gland

T31 Impact of growth factors on expression of leptin and leptin receptor in cultured mammary epithelial cells. J. L. Smith and L. G. Sheffield*, *University of Wisconsin, Madison.*

To determine the impact of various growth factors on expression of leptin and leptin receptor in mammary epithelial cells, cultured murine mammary epithelial cells (NMuMG line) were serum deprived for 24 hours and treated with insulin, IGF-I or epidermal growth factor (EGF). mRNA was extracted, reverse transcribed and used for real time quantitative polymerase chain reaction. Primers specific for leptin, long form leptin receptor or short form leptin receptor were used to amplify their respective mRNAs, which were then compared to a glyceraldehyde-3-phosphate dehydrogenase (GAPDH) internal control. Maximum expression of leptin to insulin was 4.00.3 fold over control with 1 ng/ml at 3 hours. Maximum response of leptin expression to IGF-I at 3 hours was 5.40.5 fold over control with 10 ng/ml. Maximum response of leptin expression to EGF at 0.5 hours was 6.90.7 fold over control with 1 ng/ml. Short form leptin receptor mRNA expression was maximized in response to 1 ng/ml insulin at 1 hour after treatment (3.20.2 fold over control). Maximum response of short form leptin receptor to IGF-I was with 10 ng/ml at 1 hour (4.30.2 fold increase). Maximum response of short form leptin receptor to EGF was with 1 ng/ml at 6 hours (10.70.5 fold increase). Changes in long form leptin receptor were not as dramatic as leptin or short form leptin receptor, but were detectable. Insulin dose response studies indicated maximum response of a 1.40.3 fold change with 10 ng/ml at 6 hours after treatment. IGF-I at 100 ng/ml gave a 1.40.2 fold increase at 1 hour after treatment, while EGF at 10 ng/ml gave a 5.10.4 fold increase at 0.5 hours. These studies indicate that leptin expression in the mammary gland is regulated by factors known to alter mammary development. Furthermore, they indicate that both long and short forms of the leptin receptor are regulated in mammary epithelial cells, although to a different extent.

Key Words: Leptin, Leptin receptor, Mammary gland

T32 Local ablation of leptin receptor inhibits mammary alveolar development. J. L. Smith* and L. G. Sheffield, *University of Wisconsin, Madison.*

Previously, mice lacking leptin and leptin receptor have been shown to have impaired mammary development and lactation. However, whether this defect is due to leptin requirements within the mammary gland or to alterations in systemic physiology is unclear. To determine if leptin receptor deficiency within the mammary gland but in the context of otherwise normal physiology impacts mammary development, mammary epithelium was transplanted from wild-type (Lepr+/+) or leptin receptor deficient (Lepr-/-) donors into gland-free mammary fat pads of 3 week old syngenic (C57BL/6J) mice. After 7 weeks recovery, mice were mated and euthanized at various stages of pregnancy. Mammary gland development was assessed by whole mount. Basal development of the non-pregnant mammary gland was not different between Lepr+/+ and Lepr-/- mice. Subsequent duct development did not appear to be impaired in Lepr-/- mammary glands. However, alveolar development was dramatically inhibited. By day 15 of pregnancy, Lepr+/+ epithelium had extensive alveolar development, as would be expected at this stage of pregnancy in the mouse mammary gland. However, alveolar development was essentially absent in glands containing epithelium from Lepr-/- donors. Since the only tissue lacking leptin receptor was the mammary epithelium, this suggests that failure of mammary development in Lep-/- and Lepr-/- mice is due at least in part to a leptin requirement by the mammary epithelial cells. Specifically, these results suggest a role for leptin in alveolar development.

Key Words: Leptin, Leptin receptor, Mammary gland

T33 Evidence for shifts in prolactin sensitivity in cows exposed to long or short day photoperiod during the dry period. A. G. Rius*[1], T. L. Auchtung[1], P. E. Kendall[1], T. B. McFadden[2], and G. E. Dahl[1], [1]*University of Illinois,* [2]*University of Vermont.*

Galactopoietic effects of photoperiod are well established in dairy cattle. Long day photoperiod (LDPP) increases milk production in lactating cattle, whereas dry cows exposed to short day photoperiod (SDPP) produce more milk in their subsequent lactation. Photoperiod also affects circulating prolactin (PRL); LDPP increases, whereas SDPP decreases PRL. While PRL effects are likely not involved in the lactation response, we hypothesize that PRL effects are critical to the dry cow response to photoperiod. The objective of this study was to characterize the effect of photoperiod on PRL and PRL- receptor (PRL-r) mRNA expression during the dry period as an index of PRL sensitivity during the transition to lactation. Multiparous Holstein cows were dried off 62 days before expected calving and assigned to either LDPP (16L:8D; n = 19) or SDPP (8L:16D; n = 17). After parturition cows were exposed to ambient lighting conditions. Jugular blood samples were collected and immediately processed for PRL and PRL- r mRNA (in lymphocytes). With regard to production, milk yield was consistently greater in SDPP relative to LDPP cows for the initial 16 weeks of lactation (34.9 vs. 32.5 kg/d) and the difference was significant ($P< 0.09$) from week 3 to 8. Compared to LDPP, dry matter intake was greater ($P< 0.06$) in SDPP cows during the dry period (11.7 vs. 9.9 kg/d). Concentrations of PRL did not differ between groups at dry off (LDPP = 21.2 ng/ml; SDPP = 20.5 ng/ml), but were higher ($P < 0.05$) in LDPP cows at days 30 and 60 compared to SDPP cows (14.9 vs. 8.3 ng/ml). Long and short forms of PRL-r mRNA did not differ between groups at dry off but were higher ($P< 0.06$) in SDPP cows at days 30 and 60 compared with LDPP cows. In summary, SDPP exposure during the dry period increased PRL-r mRNA expression but decreased PRL relative to LDPP. These data support the concept that greater PRL sensitivity during the transition to lactation may result in the observed increase in subsequent milk yield.

Key Words: Photoperiod, Prolactin, Milk yield

T34 Short day photoperiod during the dry period improves immune cell response of dairy cattle. T. L. Auchtung*, D. E. Morin, C. C. Mallard, J. L. Salak-Johnson, and G. E. Dahl, *University of Illinois, Urbana.*

Photoperiod has practical use on dairy farms as its manipulation can increase milk production in dairy cows. Cows on long day photoperiod (LD; 16h light: 8h dark) during their lactation have an increase in milk yield compared with cows on natural photoperiod. Studies have also shown that short day photoperiod (SD; 8L: 16D) during the dry period increases milk yield of cows in the subsequent lactation. Interestingly, recent studies in hamsters have shown that immune function can be

influenced by photoperiod. The objective of this experiment was to determine if SD during the dry period alters immune function in cows. Multiparous Holstein cows (n = 40) started the experiment an average of 62 d prior to calving. After baseline blood samples were collected, cows were dried off and exposed to LD or SD until parturition. On d 0, 28, and 56 relative to dry off, and d 2 post-calving, samples were processed for neutrophil chemotaxis and lymphocyte proliferation. Blood samples were collected twice daily from 5 d prior to, until 2 d after calving to assess the periparturient prolactin (PRL) profile. The periparturient PRL surge was greater ($P < 0.05$) in LD animals relative to SD. Neutrophil chemotaxis was not different prior to treatment ($P = 0.29$) but subsequently differed ($P < 0.05$) at all time points measured, with cows on SD having greater chemotaxis than LD cows. Lymphocyte proliferation was not different between the treatments at dry off ($P > 0.20$) but was greater ($P < 0.05$) in SD cows, compared to LD, at all subsequent time points. In conclusion, dairy cows subjected to SD when dry have a reduced periparturient PRL surge compared to LD cows. Neutrophil chemotaxis and lymphocyte proliferation were greater in SD cows compared to LD, suggesting an enhanced immune system in cows on SD when dry. Because the periparturient period is a time of increased risk for mastitis, the potential implications for dairy management merits further investigation.

Key Words: Cattle, Immune function, Photoperiod

T35 Milk fat decreases when lactating mice are fed selected *trans* fatty acid containing diets. B. B. Teter*[1], J. Sampugna[1], R. A. Erdman[1], P. Yurawecz[2], and D. Luchini[3], [1]*University of Maryland, College Park, MD/USA,* [2]*Center for Food Safety and Applied Nutrition, FDA, College Park, MD/USA,* [3]*Bioproducts, Inc. Fairlawn, OH/USA.*

Lactating mice were used as a model to test the effects of *trans* fatty acid containing diets on milk fat and pup body weight. Diets were formulated based on the AIN-76 diet with fat at 20 % of energy. The control diet (C-9) oil contained cocoa butter, corn oil, olive oil and oleic acid. The test diets used the same mixture but some of the oleic acid was replaced by the isomers to be tested. Five isomer diets were formulated to include up to 5% of energy as the test isomer or isomer mixtures. The five diets were: *trans*-9-18:1 (t-9), *trans*-10-18:1 (t-10), mixed isomers from a commercial shortening (Sh), calcium salts of *trans* fatty acids (Ca-tFA), and calcium salts of conjugated linoleic acids (Ca-CLA). Groups of five C57/Bl6J mice were maintained on control diets until day six of lactation and then switched to an isomer diet for the remainder of the study. A control group was maintained on the C-9 diet throughout. Mice were milked on d6 of lactation, before the diet changes, and again at d10 of lactation. Body weights of the dams and pups were recorded after each milking and were not different compared to controls at either milking. Also the pup weights were not different by diet. Milk fat was determined at each milking and did not differ among groups at day six. At d10 the milk fat values of the control group did not differ from those at d6, but the values from all treatment groups were lower. The milk fat was significantly lower ($P<0.01$) on d10 compared to d6 in all groups fed the test diets. The t-9, t-10, Sh, Ca-tFA, Ca-CLA diets decreased milk fat by 5, 9, 14, 19, and 23 %, respectively, suggesting that the diets were not equivalent in their ability to decrease milk fat.

Key Words: Trans fatty acids, Conjugated linoleic acids, Mouse milk

T36 Effects of milk yield and milk fat production on milk *cis*-9, *trans*-11 CLA and Δ9-desaturase enzyme activity. A. L. Lock*[1,2], D. E. Bauman[2], and P. C. Garnsworthy[1], [1]*University of Nottingham, UK,* [2]*Cornell University, Ithaca, USA.*

The potential health benefits of conjugated linoleic acids (CLA) have been well documented. Although there have been numerous studies investigating the effect of nutrition of dairy cows on milk CLA levels, there has been no report of any relationship between the CLA content of milk and milk yield or milk fat production. The *cis*-9, *trans*-11 isomer of CLA is the predominant isomer found in dairy products and this isomer is principally produced in the mammary gland via the enzyme Δ9-desaturase. A desaturase index using the ratio of C14:1 to C14:0 fatty acids in milk can be used as an estimate of Δ9-desaturase enzyme. Using the data set from Lock & Garnsworthy, 2003 (Livestock Production Science 79: 47-59), the objective of the current analysis was to examine the effects of milk yield and milk fat production on the *cis*-9, *trans*-11 CLA content of milk and desaturase index. A total of 433 samples were collected from cows fed on a commercial TMR in winter and grazing in summer. Milk yield ranged from 8.8 to 55.2 kg/d, milk fat content ranged from 12.3 to 68.7 g/kg and milk fat yield ranged from 347 to 2559 g/d. The *cis*-9, *trans*-11 CLA content of milk ranged from 0.10 to 3.15 g/100 g fatty acids and the desaturase index from 0.033 to 0.166. Milk yield, milk fat content and milk fat yield had little or no effect on the *cis*-9, *trans*-11 CLA content of milk. R^2 values for the relationships between *cis*-9, *trans*-11 CLA and milk yield, milk fat content and milk fat yield were <0.01, 0.01 and 0.01 respectively. Similarly, there was no relationship between desaturase index and these variables (all R^2 values were <0.01). It may be possible to formulate diets that manipulate *cis*-9, *trans*-11 CLA, milk yield and milk fat concurrently. However, the current study clearly shows that, under normal conditions, the *cis*-9, *trans*-11 CLA content of milk and Δ9-desaturase activity in the mammary gland are independent of milk yield, milk fat content and milk fat yield.

Key Words: Dairy cow, Conjugated linoleic acid, Milk synthesis

T37 Abomasal infusion of a mixture of conjugated linolenic acid (C18:3) isomers had no effect on milk fat synthesis. A. Siæbo[1], J. W. Perfield*[2], and D. E. Bauman[2], [1]*Natural ASA, Hovdebygda, Norway,* [2]*Cornell Univ., Ithaca, NY.*

Trans-10, *cis*-12 conjugated linoleic acid (CLA) is a potent inhibitor of milk fat synthesis. Eicosanoid metabolites of this isomer formed by activity of tissue desaturases may be responsible for its activity. Additional unique fatty acids such as conjugated linolenic acid (C18:3) isomers, formed during rumen biohydrogenation of linolenic acid, may also affect milk fat synthesis. This study investigated the effects of a mixture of C18:3 conjugated triene isomers on milk fat synthesis. Three rumen fistulated Holstein cows (210±8 DIM) were randomly assigned in a 3 X 3 Latin square experiment. Treatments were 1) control, 2) *trans*-10, *cis*-12 CLA supplement (2.1 g/d; positive control), 3) supplement enrichment containing a mixture of C18:3 conjugated trienes (6.6 g/d; equal proportions of *cis*-6, *trans*-8, *cis*-12 and *cis*-6, *trans*-10, *cis*-12) and *trans*-10, *cis*-12 CLA (2.1 g/d). Conjugated fatty acid isomers were dissolved in ethanol and control treatment was ethanol only. Daily doses were abomasally infused with equal amounts given at 4 h intervals and treatment periods were 5 d with a 7 d interval between periods. Milk yield, DMI and milk protein yield were unaffected by treatments. In contrast, the trans-10, cis-12 CLA supplement reduced milk fat yield by 27% ($P<0.01$), whereas the supplement enrichment containing C18:3 conjugated trienes (treatment 3) had no effect on milk fat yield beyond that attributable to its *trans*-10, *cis*-12 CLA content. Abomasally infused *trans*-10, *cis*-12 CLA was transferred to milk fat with concentrations averaging 1.1 and 1.0 mg/g fatty acids for treatments 2 and 3, respectively. Abomasally infused C18:3 conjugated trienes were also transferred to milk fat, the concentration averaging 4.9 mg/g fatty acids for treatment 3 vs. trace amount in treatments 1 and 2 (<0.1 mg/g fatty acids; $P<0.001$). Overall short-term abomasal infusion of C18:3 conjugated triene isomers (*cis*-6, *trans*-8, *cis*-12 and *cis*-6, *trans*-10, *cis*-12) had no effect on milk fat synthesis or other production parameters.

Key Words: CLA, Milk fat depression, Milk fat

T38 Feeding increasing amounts of conjugated linoleic acid (CLA) progressively reduces milk fat synthesis immediately postpartum. C. E. Moore*[1], H. C. Hafliger III[1], O. B. Mendivil[1], D. Luchini[2], D. E. Bauman[3], and L. H. Baumgard[1], [1]*The University of Arizona,* [2]*BioProducts, Inc., Fairlawn, OH,* [3]*Cornell University, Ithaca, NY.*

CLA decreases milk fat synthesis in later lactation, but the ability of CLA to cause milk fat depression (MFD) immediately postpartum remains questionable. Multiparous Holstein cows (n = 16) were randomly assigned to one of four rumen-protected (RP) CLA doses (0, 200, 400 and 600 g/d) with each dose providing equal amounts of fatty acids by replacing and balancing treatments with EnerGII® (a RP supplement of palm oil). Doses provided a total of 468 g fatty acids/d and either 0, 74, 148 or 222 g CLA/d, respectively. The CLA supplement contained a variety of CLA isomers as previously described. Each group received treatments from -10 to 21 d relative to calving. To improve palatability and to ensure complete consumption, doses were mixed with equal amounts of steam-flaked corn and dried molasses and half the supplement was fed at 0600 and the remaining at 1800 hr. Milk yield and feed

intake were recorded daily, and milk samples obtained from each cow every second day (at both milkings) starting on d 1. There were no overall differences in DMI (20.5 kg/d), milk yield (34.1 kg/d), protein% (3.75), lactose% (4.62) or yield of these milk components. CLA supplementation decreased overall milk fat% in a dose responsive manner (4.58, 3.98, 3.43 and 3.11, respectively) and milk fat yield showed the same linear pattern. The milk fat% dose response was evident during wk 1 (P=0.15) and became highly significant during wks 2 and 3 (4.51, 3.79, 3.03, 2.81 and 3.89, 3.17, 2.77, 2.31% for wk and dose, respectively). The milk fat yield response pattern was similar with the highest CLA dose decreasing fat yield by 46% in wk 3. On d 21 the highest dose decreased milk fat% and yield by 49 and 56%, respectively. These data clearly indicate RP CLA can markedly (40-50%) induce MFD immediately postpartum without negatively affecting other production parameters and demonstrates the possibility of improving energy balance during the transition period.

Key Words: CLA, Milk Fat

Animal Health

T39 Differences in production traits between scrapie resistant and scrapie susceptible ewes. B. M. Alexander*[1], R. H. Stobart[1], W. C. Russell[1], K. I. O'Rourke[2], and G. E. Moss[1], [1]*University of Wyoming,* [2]*USDA-ARS.*

Scrapie is one of several transmissible spongiform encephalopathies (TSE) including bovine spongiform encephalopathy (BSE). The apparent transmission of BSE to humans in the United Kingdom resulted in a call for eradication of all TSEs in food producing animals. In the United States, scrapie has been detected only in sheep possessing alleles of the prion protein with glutamine (Q) or histidine (H) at codon 171, both reported as Q. Incidence of scrapie infection is rare when animals possess at least one allele for arginine (R) at 171. The objective of the present study was to determine if production traits differed between scrapie resistant (QR and RR) and scrapie susceptible (QQ) animals. Historic records of the Univ. of Wyoming purebred ewe flock were analyzed for evidence of production advantage to scrapie susceptible ewes. Lambing records from purebred Columbia (n=240), Hampshire (n=325), Rambouillet (n=227), and Suffolk (n=277) ewes with known genotype at codon 171 were analyzed for differences in birth-type, birth weight, adjusted weaning weight and total kg of lambs weaned per ewe lambing. In addition, influence of lamb genotype on birth weights and adjusted weaning weights was determined from the 2002 lamb crop (n=356). Suffolk ewes with QQ genotype gave birth to more ($P<0.001$) lambs than QR ewes (1.8 ± .06 vs 1.2 ± .13, respectively). However, QQ Suffolk ewes weaned less ($P=0.07$) total kg of lamb than QR ewes (63.2 ± 1.1 vs 70.2 ± 2.7, respectively). Although, birth weights from Rambouillet ewes tended ($P=0.09$) to be influenced by ewe genotype, differences were not noted at weaning or in total kg of lambs weaned. Production traits of Columbia and Hampshire ewes did not differ by ewe genotype. There was no influence of lamb genotype ($P\geq0.34$) on birth weight or adjusted weaning weight for any of the breeds analyzed. In conclusion, the scrapie resistance status of the ewe may influence birth-type and weight, but these differences do not appear to influence ultimate lamb production.

Key Words: Genotype, Scrapie, Sheep

T40 Effect of calving season on colostrum quality and growth of dairy calves in a hot arid region. J S. Saucedo*[1], L. Avendaño[1], F. D. Alvarez[1], T. B. Rentería[1], J. F. Moreno[1], M. F. Montaño[1], and M. P. Gallegos[2], [1]*Universidad Autónoma de Baja California, Mexicali, Baja California, México,* [2]*Universidad Juárez del Estado de Durango, Durango, México.*

The objective of the present study was to determine the effect of calving season on colostral immunoglobulin levels (CIL), colostral immunoglobulin transfer (CIT), calf birth weight (CBW), weight at 60 d (W60) and daily weight gain from birth to 60 d of age (DWG) of Holstein calves in a dairy herd located in a desert region of Baja California, Mexico. Calving season was grouped in summer (n=12), autumn (n=24), and winter (n=36). The CIL levels were measured using a colostrometer during the first four milkings postpartum. Blood samples were taken from the jugular vein of calves at birth, 24 and 48 h after partum in order to measure CIT using the ELISA procedure. Calves consumed 2 L of colostrum at 6 and 12 h of age and then 4 L of whole milk until 60 d of age. Calf starter was offered to all calves from the first week of age. Statistical analyses were performed using linear models through analysis of variance in SAS. In the first milking, cows calved during winter had higher (P<.05) CIL than those calved during summer and autumn (99.2 ± 6.98 vs 85.2 ± 5.33 and 89.28 ± 4.93 mg/ml, respectively). During the following three milkings, CIL was higher for cows calved in winter and autumn than the cows calved during summer (47.5 ± 4.4; 20.0 ± 2.9; 5.83 ± 2.9 mg/ml, in three milkings, respectively). The CBW were higher (P<.05) in cows calved during winter (35.6 ± 1.9 kg) than those calved during summer (29.6 ± 1.6), but similar (P>.05) to those cows calved in autumn (32.8 ± 1.3 kg). Weights of calves at 60 d were similar (P>.05) during summer (65.3 ± 2.91 kg), autumn (64.3 ± 2.32 kg) and winter (67.6 ± 3.36 kg). The DWG were also similar during summer, autumn and winter (0.593 ± 0.03, 0.524 ± 0.02 and 0.534 ± 0.04 kg, respectively). These results indicate that there is a significant effect of hot environmental temperatures on colostral quality and calf birth weight. However, no significant effect of calving season was observed in daily weight gain and weights at 60 d of age.

Key Words: Calves, Colostral immunoglobulin, Growth

T41 Effect of batch and high-temperature-short-time pasteurization on IgG concentrations in colostrum. L. Green*, S. Godden, and J. Feirtag, *University of Minnesota, St. Paul, MN.*

The objectives of this study were to determine the loss of IgG 1) during pasteurization of the colostrum in both a batch/vat (B/V) and a high-temperature short-time (HTST) pasteurizer; 2) with different volumes of colostrum pasteurized in a batch pasteurizer unit; 3) when different cooling treatments were applied post-pasteurization; and 4) when colostrum was frozen after pasteurization and thawed. The B/V and HTST pasteurizers used in this study were made for on-farm commercial use. A small laboratory-scale B/V pasteurizer (1 gallon aliquots) and a large scale on-farm commercial B/V pasteurization unit (8 gallon aliquots) were used to determine the effect of volume. Three cooling treatments (ice bath, cooler and room temperature) were applied to pasteurized colostrum in the laboratory-scale batch pasteurizer. Pasteurized colostrum samples were frozen immediately after pasteurization. The samples were thawed and re-tested for the impact of freezing on the available IgG concentration in the colostrum. IgG concentrations were quantified in both the pre- and post-pasteurized samples using a radial immunodiffusion assay. Pasteurization caused an average decrease in the IgG for the laboratory-scale batch pasteurizer, commercial on-farm batch pasteurizer and the HTST pasteurizer of 25%, 31%, and 29%, respectively. Pasteurization of different volumes did not appear to have an effect on the final concentration of IgG. A 24.4%, 12.6% and 20.9% decrease in colostral IgG from pre- to post-pasteurized samples was observed when the ice bath, cooler and room temperature cooling treatments were applied, respectively. No significant differences in IgG concentrations were detected in the pasteurized colostrum after being frozen and thawed. Results from this study have demonstrated that on-farm commercial batch pasteurization units can consistently produce a product of normal consistency which can easily be fed to calves.

Key Words: Colostrum, IgG, Pasteurization

T42 The absorption of immunoglobulins from a plasma-based IgG supplement. A. L. Riddle*[1], H. D. Tyler[1], M. L. O'Brien[2], K. J. Touchette[2], and J. A. Coalson[2], [1]*Iowa State University, Ames, IA,* [2]*Merrick's Inc., Union Center, WI.*

Calves that fail to absorb adequate amounts of antibodies within the first 24 h after birth have increased susceptibility to infectious diseases and increased mortality rates. Colostrum supplements, such as plasma-based IgG supplements, are useful when colostrum is unavailable, of poor quality, or a potential disease vector. A plasma-based IgG supplement may provide adequate levels of passive immunity to the neonatal calf. The objective of this experiment was to compare the efficiency of uptake of immunoglobulins from three different sources; a plasma-based IgG supplement, the same plasma-based IgG supplement with

an added emulsifying agent, and from colostrum. Twenty colostrum-deprived newborn calves were used for this trial. Immediately following parturition, each calf was fed one of three treatments (colostrum (n=7), plasma-based IgG supplement (n=7), or plasma-based IgG supplement with added emulsifiers (n=6)). Blood samples were collected at 1 h, 6 h, 12 h, 18 h, 24 h, 36 h, 48 h, 60 h, and 72 h after birth to determine efficiency of antibody absorption. Calves were monitored for visual signs of illness including refusal of milk, body temperature, and scour scores. All 24 h blood samples were tested for IgG concentration. Peak concentrations of IgG were not different ($P > 0.05$) between treatments, although apparent efficiency of absorption was higher for the plasma-based products than for colostrum ($P < 0.05$). Although the emulsifying agent did not further enhance the uptake of immunoglobulins from this product, these data reinforce the value of plasma-based IgG products as a source of supplemental IgG for neonatal calves.

Key Words: Calf, Colostrum, Passive immunity

T43 Practical considerations related to installation and use of commercial pasteurization units for on-farm pasteurizing of milk and colostrum. L. Green, S. Godden, and J. Feirtag*, *University of Minnesota*.

The objectives of this study were to utilize in-lab experience and self-reported survey data to determine the issues and concerns of implementation and use of two commercial pasteurization units (batch/vat and high-temperature short-time) for on-farm pasteurization of waste milk and colostrum. In-lab experiments, conducted at the University of Minnesota pilot plant, involved pasteurizing milk and colostrum in both a fully automated commercial batch pasteurizer and a manual commercial high-temperature short-time pasteurizer. Several issues arose when initially using both of the commercial pasteurization units. These issues included special set-up requirements with respect to water and electrical requirements, their ease in use of pasteurization of milk and colostrum and cleanability of the units. Both of the units were successful at pasteurizing milk, while the batch unit had a higher success rate when pasteurizing colostrum. Our study is one of a few studies reporting on whether agglutination is a concern if pasteurizing colostrum in these new commercially available pasteurizers. A 33-question survey was mailed to dairy producers who have implemented either a commercial or home-made pasteurization unit in their operation for the purpose of collecting information on their experiences and degree of satisfaction in installation and day-to-day use of this technology. The questions focused on issues such as pasteurizer design, cost, set-up requirements, service, pasteurizing and feeding milk, and effects on calf health and performance. Twenty-two out of 51 (43%) of the surveys sent to dairy producers implementing pasteurizer units were completed and mailed back. Six farms had a batch/vat unit while 14 farms had a high-temperature short-time (HTST) unit. Overall, 91% (20/22) of the farms felt that they made a good decision in purchasing this technology and feeding pasteurized milk to their dairy calves.

Key Words: On-farm pasteurization, Batch pasteurizer, HTST pasteurizer

T44 Destruction of *Mycobacterium paratuberculosis*, *Salmonella* sp., and *Mycoplasma* sp. in raw milk by a commercial on-farm high-temperature, short- time pasteurizer. J. R. Stabel*[1], S. Hurd[1], L. Calvente[2], and R. F. Rosenbusch[2], [1]*USDA-ARS-National Animal Disease Center, Ames, IA,* [2]*Iowa State University, Ames, IA*.

The 2002 NAHM's Dairy Survey indicated that 87.2% of dairy farms feed waste milk to their neonatal calves. Although cost-effective, this practice can lead to increased calf morbidity and mortality due to ingestion of pathogenic agents. In an effort to reduce the risk of infection, dairy producers are implementing on-farm pasteurization of the waste milk as a control procedure before feeding the milk to calves. We previously demonstrated the efficacy of an on-farm batch pasteurizer unit for the destruction of *M. paratuberculosis* in waste milk. However, the batch pasteurizer requires a hold time of 30 minutes for adequate killing. Commercial HTST pasteurizer units are now available for on-farm use and these units operate at a higher temperature for a much shorter hold time (15 sec). In the present study we evaluated the efficacy of a commercial HTST on-farm pasteurizer unit to destroy *M. paratuberculosis*, *Salmonella*, and *Mycoplasma* in raw milk. Replicate experiments were run for 3 isolates of *M. paratuberculosis*, 3 strains of *Salmonella* (derby, dublin, typhimurium); and 4 strains of *Mycoplasma* (bovis, californicum, canadense, serogroup 7) at two different levels of experimental inoculation. After culture of the pasteurized milk samples, no viable organisms were recovered. These results suggest that HTST pasteurization of waste milk contaminated with these pathogens is effective at generating a clean product to feed to young calves.

Key Words: Pasteurization, Neonatal calves, Pathogens

T45 Factors associated with transition cow ketosis incidence in selected New England herds. W. S. Burhans*[1], A. W. Bell[1], R. Nadeau[2], and J. R. Knapp[2], [1]*Cornell University, Ithaca, NY,* [2]*University of Vermont, Burlington, VT*.

We conducted an observational field study of diet, facility, and management factors associated with transition disorders in 28 dairy herds in New England. From January to April 2002 dry cows (n=657) from a convenience sample of both Holstein (n=22) and Jersey (n=6) herds were enrolled either at entry into the close up dry group (CUD) or at 3 weeks before expected calving. Health events (incidences of clinical disorders and all preventive, therapeutic, and routine interventions or treatments) were diagnosed and recorded by farm personnel. Data on health, management, diets, and facilities during the CUD and FRESH (calving to 30 days postcalving) periods were collected at biweekly herd visits. Random effect (RE=farm) logistic regression and likelihood ratio tests were used to assess factor odds ratios (OR) for ketosis. Associations with ketosis were assessed separately for Diet and Facility by CUD and FRESH period to minimize collinearity. Reference groups were facilities with fixed opening to outside, without headlocks, and with trough waterers. Overall transition period health disorder incidence (any type) was 42.4%, and not different by breed. Ketosis incidence (unadjusted) was greater (P=0.036) in Holsteins (14.2%) than Jerseys (7.9%). Increasing NFC %DM and eNDF %DM was protective in both CUD and FRESH diets. CUD diet increases in metabolizable Lysine were protective (OR=0.48, P=0.002); increasing CUD degradable protein raised OR, (1.65, P=0.016). Selected factors tabled below may increase odds by affecting intake. Additional factors associated with ketosis occurrence will be presented.

	CUD PERIOD			FRESH PERIOD		
	Odds Ratio	*P*	90%CI	Odds Ratio	*P*	90%CI
Factors						
Barn Type Enclosed Barn	10.35	0.001	3.09-34.72	21.66	0.012	2.89-162.37
Curtained Barn	6.03	0.017	1.75-20.80	11.70	<0.001	4.07-33.7
Headlocks present	2.53	0.064	1.11-5.81			
Waterer Type Ball Waterers	49.42	<0.001	11.37-214.84			
Waterbowls	5.08	0.036	1.41-18.25	0.18	0.112	0.03-1.06
Breed (Adjusted) Jersey	2.82	0.073	1.09-7.31			

Key Words: Ketosis, Health

T46 Prevalence of subclinical hypocalcemia in U.S. dairy operations. R. L. Horst*[1], J. P. Goff[1], and B. J. McCluskey[2], [1]*USDA-ARS-National Animal Disease Center, Ames, IA,,* [2]*Centers for Epidemiology and Animal Health, Fort Collins, CO*.

Cows developing clinical hypocalcemia are known to experience biochemical and physiologic changes that predispose them to other diseases such as mastitis, retained placenta, displaced abomasum, and ketosis. For example, severe hypocalcemia results in higher plasma cortisol which may exacerbate the immunosuppression ordinarily present at calving; a greater decline in feed intake after calving exacerbating the negative energy balance; decreased secretion of insulin, preventing tissue uptake of glucose, and increasing lipid mobilization. Although milk fever is the clinical manifestation of severe hypocalcemia, an emerging concern is subclinical hypocalcemia. Cows suffering from subclinical hypocalcemia

have few overt clinical signs. However, they may be more susceptible to secondary problems than normocalcemic cows. The objective of this study was to determine the occurrence of subclinical hypocalcemia in U.S. dairy operations. As part of the USDA's National Animal Health Monitoring System (NAHMS) Dairy 2002 study, blood samples were taken from 1,446 cows within 48 hours of parturition, representing 480 dairy operations in 21 states. Serum was harvested and frozen within 24 hours of collection. The samples were divided in three groups: 1st lactation (n=442); 2nd lactation (n=424); >=3rd lactation (n=580). Subclinical hypocalcemia was defined as serum calcium <8.0 mg/dl. Subclinical hypocalcemia increased with advancing age and represented 25.3%, 43.9%, and 57.8% of 1st, 2nd and >=3rd lactation cows, respectively. Specific management data was also evaluated for association with hypocalcemia. In this study, 38.7% of the animals were identified as being on a DCAD program. Animals on the DCAD program suffered a significantly (P<0.01) lower incidence of subclinical hypocalcemia than those not being offered a DCAD program, with the biggest difference observed in the >=3rd lactation group. Animals with calcium values of >=8 mg/dl also had lower serum NEFAs than those that were <8 mg/dl, indicating that normocalcemic animals were in better energy status than those suffering from hypocalcemia. Subclinical hypocalcemia can induce some of the same secondary disease problems as clinical milk fever and should be viewed as an impediment to the health of a cow.

Key Words: Subclinical hypocalcemia, Anionic diets, Milk fever

T47 The relationship between disease occurrence, feeding management and return over feed. C. J. McLaren*[1], K. D. Lissemore[1], K. E. Leslie[1], T. F. Duffield[1], D. F. Kelton[1], and B. Grexton[2], [1]*University of Guelph, Department of Population Medicine,* [2]*Ontario Dairy Herd Improvement Corporation.*

Dairy producers of many countries throughout the world are becoming increasingly concerned with global competition. Therefore, it has become important to examine the many management factors that effect profitability of the dairy enterprise. The objective of this research is to examine the relationship between profitability as measured by The Ontario Dairy Herd Corporation's (DHI) Return over Feed (ROF) index, and herd characteristics (herd size, TMR use, monensin use, facility type, dry cow therapy, and disease prevention). Producers (n=148) were identified through the DHI ROF and Management Club groups. The ROF was calculated from the difference between monthly milk revenue and feed cost. Percent dry matters were taken from provincial averages and herd average cow dry matter intakes were calculated. These intakes were multiplied by fixed market prices to generate feed costs per cow per day. Revenue was calculated based on the Dairy Farmers of Ontario multiple component pricing formula for milk. Herd management information was generated through a phone survey of all participants. In previous studies milk production was determined to have a significant effect on the ROF. However, this current research is focused on management factors of dairy enterprises. Total herd size, facility type and monensin use, both as a feed supplement and a controlled release capsule were determined to have no significant effect on the ROF index. There are many management factors that can affect the profitability of dairy operations. Currently, there are few studies that have examined management factors and profitability as measured by the Return Over Feed index.

Management Factors		Coefficient	p-value
Dry Cow Intramammary Antibiotic[1]	Selective	-0.7531	0.032
	None	-1.2767	0.033
TMR Feeding		0.5923	0.058
3X Milking		1.1977	<0.001
E.coli Vaccination		0.6712	0.003
Preventive Periparturient Therapy		0.5219	0.016

[1]dry cow therapy to all cows as referent, r^2=0.30

Key Words: Return over feed, Management, Disease

T48 Effects of intravenous infusion of triglyceride emulsions varying in lipid source on development of bovine fatty liver. D. G. Mashek*, S. J. Bertics, and R. R. Grummer, *University of Wisconsin, Madison.*

Previous research from our laboratory has shown that individual long chain fatty acids influence hepatic lipid and glucose metabolism in vitro, however, little is known about the effects of different fatty acids in vivo. Therefore, our objective was to test the effects of intravenous infusion of triglyceride (TG) emulsions derived from different lipid sources on plasma indicators of energy metabolism and hepatic TG accumulation during a period of fatty liver induction. Six multiparous, non-pregnant, non-lactating Holstein cows were used in a replicated 3x3 Latin Square design. For 4 d, cows were fasted and infused intravenously with a 20% TG emulsion derived from tallow, linseed oil, or fish oil. The emulsions were administered for 20 to 30 min every 4 h throughout the 4 d fast at a rate of 0.54 g TG/kg BW/d. Blood samples were taken every 8 h during the fast and liver biopsies were taken prior to and immediately following the 4 d fast. Cows were fed ad libitum for 24 d between the fasts. Infusion of linseed oil emulsion decreased plasma TG concentrations ($P < 0.01$) compared to tallow and fish oil treatments, which were similar ($P > 0.10$). There was no effect of treatment on plasma glycerol or glucose concentrations ($P > 0.10$). The infusion derived from linseed oil decreased plasma non-esterified fatty acid (NEFA) and β-hydroxybutyric acid concentrations ($P < 0.05$) compared to tallow and fish oil, which were not significantly different from each other ($P > 0.10$). Overall, plasma NEFA concentrations increased from approximately 100 uM at the start to 700 uM at the end of the fast ($P < 0.001$). Liver TG content increased 29.9, 16.3, and 44.1 ug/ug DNA during the fast for tallow, linseed oil, and fish oil treatments, respectively; all treatments were different from each other ($P < 0.05$). In summary, intravenous infusion of a linseed oil emulsion resulted in the lowest hepatic TG accumulation during a 4 day fast, which in part may have been due to lower plasma NEFA concentrations.

Key Words: Fatty liver, Fatty acids, Bovine

T49 Anti-diabetic potentials of *Momordica charanta* and *Andrographis paniculata* and their effects on estrus cyclicity of Alloxan-induced diabetic rats. B. Reyes[1], N. Bautista[2], R. Magtoto*[2], N. Tanquilut*[2], A. Leung[2], Z. Battad[2], G. Sanchez[2], R. V. Anunciado[4], H. Tsukamura[5], and K.-I. Maeda[5], [1]*Thomas Jefferson University, Philadelphia, Penn.,* [2]*Pampanga Agricultural College, Magalang, Pampanga, Philippines,* [3]*Iowa State University, Ames Iowa,* [4]*University of the Philippines, Los Banos, Philippines,* [5]*Nagoya University, Nagoya, Japan.*

Momordica charanta and Andrographis paniculata are commonly used herbs by the diabetic folks in Pampanga, Philippines. While the anti-diabetic potential of M. charanta is well established, it is not known whether A. paniculata possesses anti-diabetic property. Moreover, the effects of these herbs on estrous cyclicity of diabetic rats are not known. Thus, in this experiment, we determined the anti-diabetic potentials of M. charanta and A. paniculata and their abilities to restore estrous cyle in Alloxan-induced diabetic rats. Extract and decoction of M. charanta and A. paniculata, respectively, were administered orally to Alloxan-induced diabetic rats from the day they showed diabetes through the blood and urinary glucose levels until the last day of the experiment. There were two groups of rats that served as positive (untreated Alloxan-induced diabetes) and negative controls. Rats treated with M. charanta and A. paniculata had higher body weight (BW) and lower feed and water intake compared with positive control starting from day 16 (D16) to D26 (P<0.05), though lower BW and higher feed and water intake compared with negative controls (P<0.05). Urinary glucose could not be detected in the M. charanta-and A. paniculata-treated rats from D11 to D26. The blood glucose levels in M. charanta-and A. paniculata-treated rats were significantly reduced from D11 to D26 compared with positive controls (P<0.05) and comparable with negative controls (P<0.05). M. charanta and A. paniculata demonstrated potentials in the restoration of estrous cyclicity at about 8.4 days from the day it was disrupted. The reduction of blood glucose levels and restoration of estrous cycle in Alloxan-induced diabetic rats treated with M. charanta-and A. paniculata indicate that the herbs possess anti-diabetic potentials that could restore impaired estrous cycle.

Key Words: Diabetic, Herbs, Estrus

T50 Induction of apoptosis by butyrate correlates with increasing level of protein ubiquitination in bovine kidney epithelial cells (MDBK). C. Li* and T. Elsasser, [1] *USDA-ARS, Beltsville, MD.*

While butyrate (BT) is largely regarded as the minor short-chain fatty acid ([butyrate]< [acetate] or [proiponate]) formed during microbial fermatation in ruminants, an increasing body of evidence has clearly shown effects beyond those attributable to its function in nutrition. BT modulates cell differentiation, cell invasion, proteolysis, adhesion, proliferation, motility and in particular apoptosis. The body of information in the literature on these effects have concentrated on established cancer cell lines and on the epigenetic effects of physiologic concentrations of BT and other short-chain fatty acid. Effects of BT at the cellular and molecular level in normal bovine cells have not been studied thus far. The aim of this study was to investigate the effects of BT on the established bovine kidney epithelial cell line (MDBK) as a possible model for cell apoptosis. We also compared the effects of BT to those of a known inducer of apoptosis, the histone deacetylase inhibitor, trichostatin A (TSA). MDBK cells were obtained from the ATCC, grown in standard DMEM + 5% serum medium , passaged once every 3 days in a 1:10 split, and used at 50 % confluence. BT (0 to 10 mM) and TSA (0 to 200ng/ml) were added for an overnight incubation and cells were harvested for asessment of DNA fragmentation (agarose electrophoresis) and protein ubiquitination (western blot). Our results indicated that both BT and TSA induce apoptosis in MDBK cells in a dose-dependent maner ($P<0.02$, quadratic effect). Increased protein ubiquitination ($P<0.05$, linear) was detected in whole cell lysates from MDBK cells treated with BT and TSA suggesting a possible pathway through which cell apoptosis may be operating. These results indicate that the MDBK cell line is a useful in vitro model to study factors that impact apoptosis in the ruminant. The cells are responsive to butyrate in terms of both apoptosis and ubiquitination.

Key Words: Apoptosis, Butyrate, Epithelial cells

T51 Anthelmintic efficacy in a Maryland small ruminant flock. C. M. Fletcher*, D. J. Jackson, and N. C. Whitley, *University of Maryland Eastern Shore.*

It was the objective of two EXP to determine anthelmintic efficacy in a flock of meat goats and hair sheep in Maryland. On d0 of EXP1, kids (n=27) and lambs (n=18) 112.9 ± 15.8 days of age were orally administered (n=15/treatment) two times the labeled sheep dosage of Ivomec (IVM), Tramisol (TRA), or Valbazen (VAL) and fecal samples were taken for determination of fecal egg counts (FEC). On d7, fecal samples were taken to determine percentage fecal egg count reduction (FECR). In EXP2, mature does (n=69) and ewes (n=47) were orally administered either the labeled dosage (ewes and all does treated with Cydectin; CYD; n=33) or two times the labeled dosage (does) of Safeguard (SGD; n=31) or Levasole (LVS; n=33) and fecal samples were collected as for EXP1 (d0). On d10, fecal samples were collected to determine FECR. Overall in EXP1, IVM, TRA, and VAL was effective (> 95% egg reduction) in 33.3, 13.3, and 40.0% of the treated animals, respectively with no differences among treatments, indicating overall reduced drug efficacy. FECR for all animals averaged 66.6 ± 7.6%. Moreover, there was an effect of species in which pre-treatment FEC was higher ($p<.04$) for goats (3532.2 ± 974.3 EPG) than for sheep (189.7 ± 1217.9 EPG), but there was no effect of species on FECR averaging 71.3 ± 9.4% for goats and 57.4 ± 13.3% for sheep. In EXP2, CYD (71.2 ± 7.7%) was effective in more animals ($p<.001$) than LVS and SGD (29.8 ± 7.9% and 30.2 ± 7.7%, respectively) indicating reduced drug efficacy. In addition, FECR was greater ($p<.006$) for CYD (92.7 ± 12.3%) than LVS (44.5 ± 12.6%) or SGD (38.3 ± 12.3%). FECR was less ($p<.001$) for goats (37.4 ± 8.4%) than sheep (79.7 ± 12.9%). Also, deworming was effective in more sheep (63.9 ± 8.1%; $p<.0001$) than goats (23.5 ± 5.3%). Results indicate parasite resistance to anthlemintics in this Maryland small ruminant flock as has been noted in other areas of the world. In addition, hair sheep were more resistant to parasite infection than meat goats under these grazing conditions.

Key Words: parasite, anthelmintic resistance, small ruminants

T52 Field trial evaluation of selected topical parasiticides in stocker cattle. T. A. Yazwinski*, C. A. Tucker, D. Hubbell, J. Robins, and Z. B. Johnson, *University of Arkansas, Department of Animal Science.*

According to a 1999- 2000 survey of cow/calf farmers in Arkansas, the majority of weaned calves are either not treated for internal parasites (30%), or given a broad-spectrum, topical parasiticide (32%). The remainder of the animals are administered an injectable (22%) or oral (16%) preparation. The current study was conducted to investigate the ramifications of the most popular practices, i.e. no treatment or topical endectocide. Crossbred weaned calves were grazed on replicated pastures of two herbage types (fescue and bermuda) over a 119-day post treatment period (4 treatment groups x 2 herbage types x 2 pastures x 5 animals). The pastures were adjoining, and except for herbage characteristics, all were equivalent in regard to prior contamination, maintenance and size (1.6 hectares). The topicals used in the study were those which contained ivermectin (Ivomec®Merial), doramectin (Dectomax®Pfizer) and eprinomectin (Eprinex®Merial). In regard to fecal, Trichostrongyle egg counts; (1) both doramectin and eprinomectin treatments provided significant reductions ($P < 0.05$) from control calf levels through day 119 for animals on bermuda grass, (2), ivermectin provided significant reduction only through day 82 when the animals were on bermuda grass and (3), regardless of parasiticide, egg count reductions for fescue-grazed cattle were significant only through day 42. Fecal egg counts were higher for fescue than for bermuda-grazed calves, with Cooperia and Ostertagia spp accounting for the difference. Contrastingly, Haemonchus placei eggs were of greater abundance from bermuda than from fescue-grazed calves. For each herbage type X parasiticide combination, average daily gains for the 119 day trial were improved from control levels, albeit not significantly ($P < 0.09$).

Key Words: Parasiticides, Cattle

T53 The impact of tunnel ventilation cooling and brown mid-rib (BMR) corn silage on heat stress in lactating dairy cows. R. J. Williams*[1], A. M. Chapa[1], T. O. Riley[2], D. O. Pouge[2], S. T. Willard[1], and T. R. Smith[1], [1] *Department of Animal and Dairy Sciences, Mississippi State University,* [2] *North Mississippi Branch Experiment Station, Holly Springs, MS.*

Four groups of 10 lactating Holsteins were used to measure the effects of tunnel ventilation cooling and diet on feed intake, milk production and the incidence of mastitis during periods of heat stress. Two groups were housed in a freestall barn equipped with tunnel ventilation cooling. The remaining two groups were housed in an outside freestall barn, cooled with fans and sprinklers. The maximum daytime temperature in the tunnel barn averaged 6 °C below that of outside freestall barns. Average exposure time to conditions of moderate heat stress (temperature-humidity index (THI) of 80-90) was reduced 6.75 h/day for cows housed in the tunnel ventilation barn. Maximal daytime rectal temperatures for cows housed inside averaged 0.28°C below ($P<0.0001$) those for cows housed outside. Furthermore, the maximal daytime respiration rate averaged 6.0 breaths/min lower ($P<0.0001$) for cows housed inside the tunnel barn than for cows housed outside. There were no significant differences in milk production, milk composition or the incidence of mastitis between housing units. To measure the effect of diet on dry matter intake (DMI) during periods of heat stress, one group in each barn received a diet based on BMR corn silage and the other group received a standard corn silage-based diet (Controls). DMI averaged 21.4 kg/hd/day and did not differ between the 2 dietary treatments. Cows fed the BMR silage averaged 0.5 kg/hd/day more milk than those fed the control silage, but the difference was not significant. Similarly, milk fat production was not affected by diet; However, milk fat percentage averaged 0.238 units lower ($P<0.0001$) in BMR fed cows than in controls, suggesting the improved milk production of BMR fed cows was real. These results suggest that tunnel ventilation cooling can be helpful in reducing the severity of heat stress on dairy cows in the southeastern U.S. BMR may be helpful to maintain production in heat stressed cows, however the BMR diet used in this study did not reduce the symptoms of heat stress.

Key Words: Heat stress, Tunnel ventilation cooling, Brown mid-rib corn

T54 The effect of biotin supplementation on milk yield, reproduction and lameness in dairy cattle. J. K. Margerison*[1], B. Winkler[1], G. Penny[1], and A. Packington[2], [1]*University of Plymouth, UK,* [2]*Roche Vitamins, UK.*

This study determined the effect of dietary biotin supplementation (0 or 22 2 mg/d) on the performance of Holstein-Friesian (n = 36) multiparoius cows, with 18 supplemented with biotin (SB) and 18 cows not supplemented with biotin (NSB). Treatment diets were fed from 14 d prepartum and continued until 120 d in milk (DIM). Total dry matter intake (kg/d) was not significantly different between treatment groups, NBS 24.35 and BS 24.34 (sem 0.510) cows. Biotin supplementation significantly increased (P<0.001) milk yield (kg/d) NBS 37.2, BS 39.2 (sem 0.32), fat corrected milk yield (kg/d) NBS 37.0, BS 39.4 (sem 0.32) and total milk fat yield (kg/d) NBS 1.48, BS 1.58 (sem 0.003). While milk fat content (g/kg) NBS 39.8, BS 40.2 (sem 0.50), protein content (g/kg) NBS 33.0, BS 33.0 (sem 0.20), total protein yield (kg/d) NBS 1.23, BS 1.2 (sem 0.003) were not significantly different between treatment diet. Biotin supplementation had no significant effect on postpartum interval (PPI) to first ovulation (d), NBS 41.7, BS 38.8 (sem 2.26), but first inter ovulation period (d) NBS 21.2, BS 24.5 (sem 0.73) and mean inter-ovulation period, NBS 21.3, BS 23.7 (sem 0.53) were significantly greater in cows supplemented with biotin. PPI to first insemination (d) NBS, 64.2, BS 73.4 (sem 3.61) or PPI to conception (d) NBS 68.7, BS 76.6 (sem 5.32) were not different between treatment diets. Sole lesion score sole at 150d pp was significantly (P0.05) lower in cows supplemented with biotin, NBS 3.06, BS 2.95 (0.04). Biotin had no significant effect on either weekly change in body live weight or condition score.

Key Words: Dairy, Biotin, Reproduction

T55 Influence of a biogenic substance on growth, health, and meat quality in pigs[1]. O. Bellmann*, E. Kanitz, M. Tuchscherer, and K. Ender, *Research Institute for the Biology of Farm Animals, Dummertsorf.*

Growth potential, animal health, and meat quality are important parameters to describe the pork quality. Especially regarding the consumer expectation on production systems, animal health, welfare, and product quality makes it necessary to minimize the use of pharmacological active substances and replace them by biogenic substances as homeopathic substances are. We selected Engystol® (Heel GmbH, Germany) as a product known to improve health status and reduce stress fragility in animals. Pigs of the German Landrace were kept in four groups, two with a maximal number of pigs per pen concerning the German law (between 0.4 and 1 sqm. per pig depending on live weight), two groups below that density. One subgroup of each of them was treated with the biogenic substance Engystol® twice a week provided by drinking water for ten weeks. The trial started when pigs were 70 days old. The pigs were kept in a controlled environment piggery with partly slatted floor. Once a week the animals were weighted and a sample of saliva was taken. At the beginning and at the end of the treatment a blood sample of each animal was taken. With an age of about 170 days the animals were slaughtered and parameters of meat quality were determined. Differences between treated and not treated animals were found especially in the sub-groups with high population density. The not treated animals started tail biting after three weeks, the daily weight gain was reduced and the live weight was lower the in the treated sub-group. The carcass did show pleural and pulmonal alteration. No differences were found in the meat quality. Cortisol concentration in the saliva was higher in the control group of the highly occupied group compared to the treated highly occupied group. No differences were seen in the plasma cortisol concentration. The use of biogenic substances is one to improve animal health and welfare in a prophylactic or metaphylactic manner especially under conditions which are less suitable for animal (for instance high occupation density).

[1] supported by HEEL GmbH, Baden-Baden, Germany

Key Words: Meat quality, Homeopathic substance, Pork

T56 Effects of pretransit supranutritional levels of dietary selenium and D-α-tocopherol acetate on selenium content of specific tissues in wether lambs. J. B. Taylor*[1], N. K. Chirase[2,3], and T. Thelen[1], [1]*Agriculture Research Service, Dubois, ID,* [2]*Texas Agriculture Experiment Station, Amarillo,* [3]*West Texas A&M University, Canyon.*

Twenty-nine wether lambs (BW = 27.1 kg ± 0.36) were utilized to assess the effects of pretransit supranutritional levels of dietary selenium (Se) and D-α-tocopherol acetate (TOCO) on Se concentrations of specific tissues. Wethers were assigned to one of four treatments: adequate Se and no TOCO (CON; n = 9); high Se (HSE; n = 9); TOCO (HVE; n = 5); high Se and TOCO (SEVE; n = 6). Selenium was provided as high Se wheat (6.1 ppm) delivering 110 μg/kg BW, and TOCO was provided as a daily bolus delivering 3.8 IU/kg BW. Wethers were weaned (d 0), fed treatment diets from d 0 to 20, subjected to transit stress on d 21, and received a common diet similar in nutrient composition to CON for an additional 20 d (d 22–42). Four wethers from CON and HSE were withheld from the transit stress, euthanized (d 21), and blood, skeletal muscle and liver were collected. Likewise, at the end of the receiving period (d 42), all other wethers were euthanized and tissues collected. Pretransit dietary Se resulted in HSE having 66%, 80% and 42% higher ($P < 0.001$) Se concentration in muscle, liver and serum, respectively, than CON. However, this gain for HSE was followed by a 30%, 51% and 34% decrease (d 21 vs. d 42; $P < 0.001$), respectively, during the receiving period. When fed alone (HVE), TOCO had no effect ($P > 0.05$) on tissue Se concentration; however, in combination with high Se (SEVE), TOCO decreased ($P < 0.03$) Se concentration in liver, but increased ($P < 0.04$) Se in the skeletal muscle. Both HSE and SEVE had higher ($P < 0.0001$) concentrations of Se in liver, skeletal muscle, and serum than HVE and CON treatments. Feeding high Se wheat resulted in higher Se tissue concentrations both pretransit and post-receiving. D-α-tocopherol acetate seemed to affect level of Se incorporated and(or) retained in liver and muscle tissue.

Key Words: Selenium, Transit stress, α-Tocopherol

T57 Silymarin PHYTOSOME* against AFB1 in broilers. D. Tedesco*[1], S. Galletti[1], S. Steidler[1], M. Tameni[1], O. Sonzogni[1], and P. Morazzoni[2], [1]*Department VSA, University of Milan, Italy,* [2]*Indena S.p.A., Milan, Italy.*

Silymarin, the bioactive extract of *Silybum marianum*, is used as a natural hepatoprotector in man and is a potent anti-hepatotoxic agent. This study focused on determining the effect of silymarin PHYTOSOME *, a silymarin complexed form with phospholipids from soy, on reducing the toxic effects of aflatoxin B_1 (AFB_1) in broiler chickens. Toxic effects of AFB_1 were studied in a batch of 28 male broiler chickens during their complete commercial growth cycle (from day 14 to day 51). Chickens were randomly allotted in four groups and treated as follows: group C) control group fed on a basal diet alone; group B_1) AFB_1 at 0.8mg/kg of feed; group B_1+Sil) AFB_1 at of 0.8mg/kg of feed plus silymarin at 200 mg/kg body weight; group B_1+Phyt) AFB_1 at of 0.8mg/kg of feed plus silymarin PHYTOSOME* at 600 mg/kg body weight. Chicks were weighed individually every week. Feed intake was recorded daily in the last two weeks of experimental period. At necropsy, liver weight was recorded for each animal and two animals for each group were randomly selected for histological studies on liver tissue. Considering the whole growth cycle, body weight gain and feed intake were significantly decreased in AFB_1 treated animals with respect to control (P<.05). On the contrary, animals receiving AFB_1 plus silymarin PHYTOSOME or silymarin grew at the same rate of the control animals and their body weight gain and feed intake were significantly different with respect to AFB_1 treated animals (P<.05). No differences were noted on the weight or on macroscopic observations of the liver between groups. Histological liver sections of AFB_1-treated animals showed multifocal portal infiltration and necrosis in zone 1. Those changes were less severe in silymarin PHYTOSOME and silymarin treated groups. In conclusion, our results suggest that silymarin PHYTOSOME can provide a protection against the negative repercussion of AFB_1 on performance of broiler chicks. * PHYTOSOME is a trademark of Indena S.p.A.

Key Words: Aflatoxin B1, Silymarin PHYTOSOME, Broiler

T58 Inhibition of fungal growth with OmniGen-AF: a new anti-fungal feed additive. Y. Wang*, S. Puntenney, and N. Forsberg, *Oregon State University*.

Commercial livestock production is adversely affected by mycotic infection of feed and gastrointestinal tract and via invasive mycoses. Mycotic infections have potential to reduce performance, to potentiate disease, to adversely affect reproduction and to cause death. The goal of this study was to test the hypothesis that a new commercial feed supplement (OmniGen-AF), consisting of "GRAS products", inhibited fungal growth and thereby had potential as an anti-mycotic. A mixed fungal culture containing both *Aspergillus fumigatus* and *A. flavus* was obtained from a sample of mill run on a dairy farm which had experienced incidence of hemorrhagic bowel syndrome (HBS; also known as jejunal hemorrhage syndrome). The antifungal properties of OmniGen-AF were tested in four different experiments. In the first experiment, the fungi were cultured on a Sabouraud agar plate (with chloramphenicol and gentimycin present). Drops of the OmniGen-AF product were added directly to the fungal streaks and growth was observed over the next 48 hr. Addition of the product to the fungal streaks inhibited growth. In a second experiment, fungi were grown in Sabouraud liquid medium at 27 degrees C in the presence and absence of OmniGen-AF. Logrithmic growth was noted beginning at 20-24 hr post-inoculation and maximal culture density was reached within 30-34 hours post-inoculation. Addition of OmniGen-AF directly to the culture delayed entry into log-phase growth by 4-6 hr; however, it did not prevent later fungal growth. In a third study, the OmniGen-AF product was added to a broiler feed and moisture content of the feed was increased to 20%. Temperature of the feed was monitored over 1-month. The untreated feed increased in temperature (an index of fungal respiration) to 37 degrees C within 1 week whereas the OmniGen-AF-treated feed did not change in temperature until 1-month. Untreated feed accumulated clumps of *A. fumigatus* and *A. flavus*. Finally, efficacy of the product on clearance of a mycotic infection was evaluated in steers intentionally infected with *A. fumigatus*. Steers treated with OmniGen-AF product cleared *A. fumigatus* from blood more rapidly than untreated steers. Our data indicate that this product has potential to prevent mycotic growth in feed, in liquid culture and *in vivo*.

Key Words: Mycotic infections, Aspergillus fumigatus, Aspergillus flavus

T59 Effects of swainsonine on digestion in wethers consuming locoweed. M. M. Reed[1], B. S. Obeidat*[1], J. R. Strickland[1], C. R. Krehbiel[2], J. B. Taylor[3], C. A. Loest[1], G. S. Bell[1], W. D. Bryant[1], J. D. Rivera[1], and J. L. Jim[1], [1]*New Mexico State University,* [2]*Oklahoma State University,* [3]*USDA, ARS, USSES*.

A trial was conducted to study the effects of swainsonine (SW) on digestion. Mixed breed wethers were assigned to one of three treatments. Wethers received blue grama hay plus 1.6 mg SW/kg BW (n=5), 0.2 mg SW/kg BW (n=6), or no SW (control; n=6). Swainsonine was administered by feeding locoweed (428 ug SW/g dry matter). Blood was collected via jugular venipuncture at 12 h intervals on d #1, 8, 11, 14, and 18 to determine serum SW, alkaline phosphatase, and aspartate-amino transferase activity. Rises ($P< 0.05$) in alkaline phosphatase and aspartate amino transferase activity indicated subclinical toxicity in treated wethers. Rumen samples were collected from 0 to 48 h in 8 h intervals to determine effects on ammonia and volatile fatty acid concentrations. Ammonia concentrations were lower ($P <0.05$) for controls than treated animals at 8 h and higher ($P<0.05$) at 24 and 48 h. Volatile fatty acid (VFA) concentrations essentially were not affected ($P>0.08$) showing no time by treatment effect for all VFA except valerate. Valerate concentrations increased ($P<0.05$) at h 8 in 1.6 mg SW/ kg BW wethers. In situ samples contained 5 g of treatment diets and placed into the rumen representing h 0, 3, 6, 9, 12, 24, and 48. Treatments were 0.2 mg SW/kg BW (n=4), 1.6 mg SW/kg BW (subacute exposure; n=4), 0@1.6 mg SW/kg BW (acute exposure; n=3), or no SW (n=3). Dry matter digestion was greatest ($P<0.05$) for both the 1.6 mg SW/kg BW and 0@1.6 mg SWkg BW treatments. Organic matter, NDF, ADF, and CP showed no effects ($P>0.1$) on digestion. Duodenal and fecal flow rates were apparently unaffected ($P>.09$). Enzyme and swainsonine activity levels in serum indicated subclinical toxicity. However, lack of consistent results in digestive parameters indicates limited effects of swainsonine on digestive processes.

Key Words: Swainsonine, Locoweed, Digestion

T60 Development of quantitative diagnostic assays for assessment of mycotic infections. N. Forsberg*, S. Puntenney, and Y. Wang, *Oregon State University*.

The goal of this research was to develop a quantitative PCR-based assay for the detection of fungal genomic DNA in tissues and blood of domestic animal species. We based our assay on published ITS-1 and -2 fungal genomic sequences which lie between the fungal 18S, 5.8S and 28S ribosomal genes. The ITS-1 and -2 sequences have shown sufficient variation across species that specific PCR methods may be used to detect individual species. Methods for two particularly pathogenic fungal species *A. fumigatus* and *A. flavus* were developed. Forward and reverse primers, which generated 62 bp and 55 bp products, were developed and used in a Sybr Green real-time quantitative PCR assay. An ABI7700 thermocycler was used in all assays. Samples of DNA were extracted from blood and tissues using the Qiagen "tissue" method. Standard curves for both *A. fumigatus* and *A. flavus* were developed using purified genomic template DNA samples which were obtained from a commercial source in Belgium (Dr. F. Symoens). Following completion of thermocycling, the melting temperatures of the PCR products were examined. The melting temperatures of the *A. fumigatus* and *A. flavus* PCR products were 84 degrees C and 76 degrees C, respectively. Examination of the melt temperatures of individual reactions thereby allowed us to ensure reactions were specific. Both assays were very sensitive and specific. The assays were capable of detecting as little as 10 femtograms of *Aspergillus* genomic DNA in a 25 ul sample of blood or 25 ug sample of tissue. Furthermore, the assays were species-specific. The *A. fumigatus* primers did not generate a PCR product using *A. flavus* or *A. niger* genomic templates. Similarly, the *A. flavus* primers did not generate a PCR product from the *A. fumigatus* or *A. niger* genomic templates. These methods may be used to assess mycotic infection and efficacy of anti-fungal treatments in livestock.

Key Words: Mycotic infection, Aspergillus fumigatus, Aspergillus flavus

T61 The impact of tunnel ventilation cooling and brown mid-rib (BMR) corn silage on heat stress in lactating dairy cows. R. J. Williams*[1], A. M. Chapa[1], T. O. Riley[2], D. O. Pouge[2], S. T. Willard[1], and T. R. Smith[1], [1]*Department of Animal and Dairy Sciences, Mississippi State University,* [2]*North Mississippi Branch Experiment Station, Holly Springs, MS*.

Four groups of 10 lactating Holsteins were used to measure the effects of tunnel ventilation cooling and diet on feed intake, milk production and the incidence of mastitis during periods of heat stress. Two groups were housed in a freestall barn equipped with tunnel ventilation cooling. The remaining two groups were housed in an outside freestall barn, cooled with fans and sprinklers. The maximum daytime temperature in the tunnel barn averaged 6 °C below that of outside freestall barns. Average exposure time to conditions of moderate heat stress (temperature-humidity index (THI) of 80-90) was reduced 6.75 h/day for cows housed in the tunnel ventilation barn. Maximal daytime rectal temperatures for cows housed inside averaged 0.28°C below ($P<0.0001$) those for cows housed outside. Furthermore, the maximal daytime respiration rate averaged 6.0 breaths/min lower ($P<0.0001$) for cows housed inside the tunnel barn than for cows housed outside. There were no significant differences in milk production, milk composition or the incidence of mastitis between housing units. To measure the effect of diet on dry matter intake (DMI) during periods of heat stress, one group in each barn received a diet based on BMR corn silage and the other group received a standard corn silage-based diet (Controls). DMI averaged 21.4 kg/hd/day and did not differ between the 2 dietary treatments. Cows fed the BMR silage averaged 0.5 kg/hd/day more milk than those fed the control silage, but the difference was not significant. Similarly, milk fat production was not affected by diet; However, milk fat percentage averaged 0.238 units lower ($P<0.0001$) in BMR fed cows than in controls, suggesting the improved milk production of BMR fed cows was real. These results suggest that tunnel ventilation cooling can be helpful in reducing the severity of heat stress on dairy cows in the southeastern U.S. BMR may be helpful to maintain production in heat stressed cows, however the BMR diet used in this study did not reduce the symptoms of heat stress.

Key Words: Heat stress, Tunnel ventilation cooling, Brown mid-rib corn

T62 Meta-analysis to detect QTL in two connected F2 swine populations using simulation. B. R. Southey* and S. L. Rodriguez-Zas, *University of Illinois Champaign-Urbana, Urbana, IL.*

All F2 inbred or outbred populations developed to detect quantitative trait loci (QTL) use parental crosses between two breeds or lines. Although many populations share one of the breeds and may have common ancestors, most studies assume independent populations and use models that do not combine the information. The benefits of combining the data from related F2 populations and using more complex models was evaluated in a simulation study. Different breed and genetic effect compositions were simulated on three grandsires mated to two groups of 18 granddams. Each population consisted of nine F1 sires, 36 F1 dams and 720 offspring. A single chromosome with 10 markers spaced 10 cM apart and one QTL fixed for different alleles in each grandparental breed was simulated. The markers have varying polymorphic information content with the frequency of the allele corresponding to the breed equal to 80% and the rest distributed among the other allele(s). Different scenarios, characterized by the total QTL effect and breed-specific allelic effects of the QTL were evaluated. A total of 1000 replicates per scenario were generated using PEDSIM (Mattis et al., 1998). The additive and dominance coefficients were computed every 1 cM using the procedure of Haley et al. (1996). Estimates of the QTL location and effect were estimated using models that contain or excluded breed differences. The statistical power to detect the QTL depended on the model considered, the magnitude of the QTL and the breed specific effects. The extended data and model permitted the accurate and precise location of QTL accounting for 5% or more of the phenotypic variance. Results from a model that excluded breed effect failed to detect QTL of any magnitude when the effect of the QTL allele of the sire breed was intermediate between those of the dam breeds. These results demonstrate the impact of the population stratification and model on the power to accurately map QTL.

Key Words: QTL, Simulation, Swine

T63 Detection of SNPs on the ovine skeletal muscle specific calpain gene using PCR-SSCP analysis. H. Chung*[1], S. Chen[1], D. Yoon[1], I. Cheong[1], S. Lee[1], M. Davis[2], and C. Hines[2], [1]*National Livestock Research Institute, Suwon, Korea,* [2]*The Ohio State University, Columbus, USA.*

The ovine skeletal muscle specific gene, which is n-calpain or calpain 3, was screened with primers. The primer sequences were selected based on the bovine cDNA sequence (GenBank accession No. AF115744B). The forward and reverse primers were selected from exons 10 and 11 (CAPN31011), and exons 11 and 12 (CAPN31112). Approximately 55 purebred Polypay, 52 purebred Targhee, and 55 mixed breed sheep (Polypay, Targhee, Hampshire, Rambioullet, Dorset, and Suffolk) from the Ohio Agricultural Research and Development Center (OARDC) were used. Allele frequencies (A and B) were calculated as 0.53 and 0.47 for CAPN31011, and 0.69 and 0.31 for CAPN31112, respectively. Analysis of variance was conducted to investigate effects of the genotypes on weight traits including birth weight (BW) and weaning weight (WW). A total of 162 animals were examined. Calpain genotypes of the CAPN31011 (P=0.01) and CAPN31112 (P=0.02) segment were associated with BW. No significant influence of CAPN31011 and CAPN31112 genotypes on WW was observed.

Key Words: Calpain, Ovine, Weight

T64 Relationships between DGAT1 and Pit-1 genes polymorphism and milk yield in Holstein cattle. S. Hori-Oshima and A. Barreras-Serrano*, *Universidad Autnoma de Baja California, Mexicali, B.C. Mxico.*

The objective of this study was to determine the relationships between diacylglycerol O-acyltransferase homolog 1 (DGAT1) gene and the growth hormone regulator gene Pit-1 with milk production. Moreover, genotypes and allele frequencies of them were determined in the population. Because our previous work showed the positive effect of genotypes of α_{s1}-casein on total milk yield (BC>BB), we put as secondary objective to examine the effect of that in joint with DGAT1 and Pit-1 genotypes on milk production in the statistical analysis. 196 Holstein first lactation cows located in Tijuana B.C. with the known genotype of a_{s1}-casein were used. The detection of the polymorphisms was by standard PCR and RFLP method. Cleavage resistance to CfrI and HinfI represent the lysine-232/alanine substitution (K232A) for DGAT1 and the A allele for Pit-1, respectively. Data was analyzed using procedures of SAS software. The frequencies of AA, AK, and KK genotypes for DGAT1 were .661, .318, and .021, respectively. Also, the frequencies of AA, AB, and BB genotypes for Pit-1 were .026, .257, and .717, respectively. Allelic frequencies for A in DGAT1and Pit-1 were .82 and .155 respectively. AA genotype of PIT1 had significant effect on the total milk yield. Statistical analysis showed that interaction between DGAT1 and Pit-1 genes had significant effect on milk yield, with a positive and conditional effect of K allele in DGAT1. Substitution of A for K allele at DGAT1 locus resulted in an increase of 263.22 kg in milk production. The substitution effect was additive significantly on milk yield in animals with AA genotype for Pit-1 gene (296.28 kg). By contrast, no important effect of substitution of K allele in DGAT1 in the AB or BB genotypes at Pit-1 locus was observed. Additionally, BC genotype at α_{s1}-casein showed the tendency of high milk yield in animals with both AA and AK genotypes at Pit-1 and at DGAT1, respectively. These results suggest in genetic improvement program of milk yield to selection animals with AA genotypes at Pit-1, which can also obtain the positive effect of DGAT1 in preference to increase in the population, animals with K allele.

Key Words: DGAT1, Polymorphism, Milk yield

T65 Use of intra-ruminal monensin capsules in dairy cows under alfalfa grazing conditions. II. Reproductive performance. A. A. Abdala[1], M. G. Maciel[1], M. R. Gallardo[1], M. E. Castelli[1], A. Quatrin[1], D. Lettieri[1], S. P. Allassia[1], N. Zanoni[1], and A. R. Castillo*[2], [1]*Experimental Station Rafaela, INTA, Argentina,* [2]*UC Davis Cooperative Extension, USA.*

The objective of this experiment was to evaluate the effects of intra-ruminal capsules of monensin on reproductive performance and some blood parameters in dairy cows under alfalfa grazing. Fifty-six Holstein dairy cows (46 multiparous and 10 primiparous) were blocked in pairs (calving date; previous milk yield, body weight and lactation number) in a repeated measures randomized design and assigned to one of two treatments: Control and Monensin. Treated cows received the intra-ruminal capsules 30 days before the expecting calving date and 60 days after calving. All the cows were fed with the same diet, during the dry period a TMR and after calving, alfalfa pasture and supplemented with TMR. Corn silage, alfalfa hay, corn grain, cottonseed, mineral and vitamins composed the TMR. Mean quality of the diet pre and postpartum were: 57.8 and 45.6%; 12.7 and 18.8%; 1.51 and 1.65 Mcal/kgDM; 52.1 and 35.8% for DM; CP; NEl; and NDF respectively. The body condition score (BCS) evaluations were carried out a week before the treatment start and a two weeks intervals. All the cows were blood sampled at 21 days pre-calving, at calving and at 21 day post-calving to determine the concentration of glucose, non-esterified fatty acids (NEFA) and blood urea nitrogen (BUN). The reproductive performance was closely monitored during the experiment. Monensin treatment significantly (P<0.05) improved body condition score and reproductive performance in dairy cows grazing alfalfa. In addition, NEFA were lower and BUN was increased with no effect on blood glucose.

	Control	Monensin	Dif.	
Blood parameters				
Glucose (mg/%)	59.34	61.10	1.76	
BUN (mg/%)	18.14	20.43	2.29	*
NEFA (meq/L)	0.54	0.47	-0.07	#
Reproductive performance				
% P 1st AI	20.69	44.83	24.14	*
% P 6 weeks	41.38	55.17	13.78	
% P 12 weeks	55.17	75.86	20.69	#
BCS#	2.82	2.92	0.10	**

P = pregnancy, AI = artificial insemination, # = five point scale, # P<0.10, * P<0.05, ** P<0.01

Key Words: Monensin capsules, Dairy cows, Reproductive performance

T66 Estimation of additive and nonadditive genetic parameters in the Chilean multibreed dairy cattle population using restricted maximum likelihood procedures. M. A. Elzo*[1], A. Jara[2], and N. Barria[2], [1]*University of Florida, Gainesville,* [2]*University of Chile, Santiago, Chile.*

Chile has imported Holstein semen from various countries (Canada, New Zealand, USA) for over 20 years. Most of the semen came from the USA. Chilean breeders have made a concerted effort to upgrade the original European Friesian cattle population to Holstein of US origin. This mating strategy created a complex multibreed population with more than 10 breed x country combinations. The objective here was to estimate heritabilities, interactibilities (ratios of nonadditive to phenotypic variances), and correlations (genetic, environmental, phenotypic) among 305-d ME milk yield (M), fat yield (F), and protein yield (P) from 54,035 first lactation records collected between 1990 and 2000. For simplicity, only two base breeds were defined: US Holstein (H) and Other Breeds (O). Fixed effects in the multibreed model were herd-year-season, and regression intrabreed additive and interbreed nonadditive group genetic effects. Random effects were sire and maternal grandsire additive genetic, regression intra and interbreed sire and maternal grandsire nonadditive genetic, and residual effects. Estimates of heritabilities for M, F, and P were lower for H (0.07, 0.12, and 0.26) than for O (0.17, 0.32, and 0.12), and had intermediate values for crossbred groups. Interactibility estimates were generally larger than heritabilities (0.12, 0.68, and 0.40 for H and 0.19, 0.59, and 0.12 for O). Additive correlations among the three traits were higher (0.7 to 1.0) than nonadditive correlations (0.4 to 0.8) and similar across breed groups. Environmental and phenotypic correlations tended to be lower than genetic correlations, and they were higher for H (0.84 to 0.96) than for O (0.11 to 0.92). The incompleteness of the diallel structure of the Chilean dataset produced multicollinearity not only among fixed effects, but also between random additive and nonadditive genetic effects. Thus, covariance estimates reported here should be considered as first approximations, particularly those for nonadditive genetic effects.

Key Words: Cattle, Milk, Heritability

T67 Estimation of genetic trend for milk yield in two dairy herds involving inheritance of holstein cows in baja california, mexico. A. Perez*[1], J. Ponce[1], A. Correa[1], M. Montaño[1], J. Guerrero[2], and S. Cobos[1], [1]*Universidad Autónoma de Baja California, Mexicali, Baja California, Mexico,* [2]*University of California, Holville CA. USA.*

The most accurate method of estimating genetic trend would be to predict the genetic value of all animals in the population and obtain the average for each year. Earlier evaluation procedures with varying bases and unspecified properties were no suitable. 1351 records of first, second and third complete lactations for milk yield of Holstein cows, daughters of 44 Holstein sires were analyzed by using a sire model. The objective was to estimate genetic trend for milk yield in two dairy herds involving inheritance of Hostein in Baja California, Mxico. The average milk yield values 305 2X in the two herds were 8862 and 8312 kg, respectively. The average values for milk yield were 81461310.90, 82461324.16 and 88961125.37, and 86901275.27, 92391173.33 and 95221142.91kg to first, second and third complete lactations in herds 1 and 2 respectively. The average values of age at parturition were 24.9, 40 and 64.50, and 25.20, 39.60 and 73.70 month for cows of first, second and third complete lactations, in herds 1 and 2, respectively. The generational interval was 4.3 years. The average phenotypic mean values for milk yield and the projected milk yield to mature equivalent ME were 8587 and 10,838.64 kg, respectively. The estimates correlation of milk yield of first lactations cows to mature equivalent was (r_{xy}=0.87).The estimates for annual genetic progress was 80.85 kg for milk yield, the estimated breeding value for milk yield was 421 kg. To increase actual progress to levels closer to optimum will require strict adherence to basic rules of selection, the most accurate methods of genetic evaluation and intense selection.

Key Words: Generic trend, Progeny test, Selection

T68 Genetic evaluation of male and female fertility using longitudinal binary data. T. Averill* and R. Rekaya, *The University of Georgia.*

Long time selection for production responses has deteriorated some secondary traits such as fertility or health conditions. It is important to estimate male and female fertility simultaneously, such that both components are inferred correctly. With the current methodology such objective is not fulfill. Not accounting properly for male fertility will bias the genetic evaluation of female fertility and compromises the improvement of reproduction performances. Furthermore, existing methodologies do not make use of all available information leading to less precise prediction. Often, cows need more than one insemination per conception and at best, it is possible to account for only one of service bulls. Another issue of interest is the sequence of mate bulls used for cows having more than one insemination. For two cows having the same number of inseminations and sired by the same bulls but in different order is not accounted for with actual models, which may bias fertility estimation. A simulation study was carried out. The data set consisted of 6918 binary responses from 2780 cows. The pedigree file included 3100 animals. The simulation model at the liability scale included one systematic effect of 50 classes, one covariate on days between calving and insemination, service bull effect (30 bulls), cow effect and permanent effect. The correlation between true and predicted breeding values was 0.98 and greater than 0.99 between true and estimated service bull effects. No significant differences were noted between the true and estimated genetic parameters. To compare the proposed model with the actual methodology used for male and female fertility estimation, only first insemination records from the simulated data set were used. The correlation between the true and predicted breeding values from the second analysis was 0.82 and 0.84 between true and estimated service sire effects. These results indicate the incapacity of the actual methodology in estimating correctly both male and female fertility. The proposed methodology is being evaluated using real data.

Key Words: Male fertility, Longitudinal, Binary responses

T69 Genetic relationships between ewe mature size and measures of lamb feed efficiency and postweaning growth in Targhee sheep. B. W. Woodward*[1] and G. D. Snowder[2], [1]*USDA-ARS, US Sheep Experiment Station, Dubois, ID,* [2]*USDA-ARS, US Meat Animal Research Center, Clay Center, NE.*

The purpose of this study was to estimate the genetic relationships between ewe mature size and measures of lamb feed efficiency and postweaning growth in Targhee sheep. Mature size (weight) was the average fall weight after weaning for ewes with records from age 3 to 6 yr born between 1977 and 1983 (n = 373). Overall average mature weight was 69.3 ± 0.39 kg. Ram and ewe lamb data collected from 1978 to 1984 were used to estimate residual and total feed intake, gain to feed ratio (952 records), and postweaning ADG (1,047 records). Approximately 21 d after weaning, lambs were group fed for 4 wk, and then individually fed for 6 wk before returning to group feeding for another 4 wk. Overall average total feed intake, gain to feed ratio, and ADG were 89.5 ± 0.5 kg, 0.116 ± 0.001, and 0.250 ± 0.002 kg/d, respectively. Estimates of heritabilities and correlations were obtained by running two-trait animal models using REML. The single-trait model heritability estimate for mature weight was 0.66, which was similar to two-trait model estimates (0.60 to 0.66). Genetic correlations of mature weight with residual feed

intake, total feed intake, gain to feed ratio, and ADG were 0.22, 0.53, 0.50, and 0.63, respectively. Heritability estimates for these same traits from the two-trait models were 0.28, 0.32, 0.11, and 0.38, respectively. Environmental correlations were low (-0.23 to 0.14). Estimated genetic parameters suggest selection could improve feed efficiency and postweaning growth, with associated changes in mature size. Selection against residual or total feed intake would be accompanied by a corresponding decrease in mature size. Conversely, selection for increased gain to feed ratio and ADG would indirectly increase mature size. Appropriate use of selection pressure through a selection index, for example, could result in increased feed efficiency and postweaning growth, while maintaining mature size and(or) moderating the amount of change in mature size.

Key Words: Mature size, Feed efficiency, Genetic parameters

T70 Estimates of genetic parameters for reproduction and weight in the progeny of Nubian, French Alpine, Saanen, Toggenburgh, and Spanish goats mated to Boer sires. A. Perez*[1], J. Ponce[1], A. Correa[1], M. Montaño[1], and J. Guerrero[2], [1]*Universidad Autónoma de Baja California, Mexicali, Baja California, Mexico,* [2]*University of California, Holville CA. USA.*

Data came from a commercial goat stud at Imperial Valley California. The objectives were to compare the performance of the progeny of dams involving inheritance of Nubian(N), French Alpine (A), Saanen (S) Toggenburgh (T), and Spanish (P) genotypes (n=160) and to estimate genetic parameters of growth traits. Traits analyzed were prolificacy (P), weight at birth (BWT) and weaning (WWT), and average daily gain (ADG) from birth to weaning. Separate analysis for each trait used least squares mixed model SAS (1992). The analytical model included: breed of dam, age of dam, sex of the kid, season of parturition as fixed effects; sire, sire x breed of dam interaction and the residual as random components. The overall mean for prolificacy was 1.310.72). The average values for prolificacy of dams were (1.270.71, 1.280.72, 1.330.74, 1.360.69, and 1.290.73) for N, A, S, T and P, respectively. The overall mean values for weight at birth and weaning were: 1.99 and 12.89 kg, respectively. The average values for weight at birth were (2.12.0.07, 2.11 .06, 2.04.05, 1.95.06, 2.10.05 and 1.98.07, 1.97.06, 1.93.05, 1.83.05, 1.96.06) for males and females kids respectively. The average values for weaning weights were (13.990.37, 13.29 .0.33, 13.250.34, 12.670.31 and 13.510.43, and 12.500.29, 12.48 0.30, 11.98 0.29, 12.68 0.41 and 12.600.32 kg) for male and female kids, respectively. The estimated average daily gain from birth to weaning was 2200.32 g. The average values for daily gain were: 1360.36 and 127 0.43 g for male and female kids, respectively. The unadjusted survival rate at birth and weaning was (87.37 and 64.97%) respectively. Estimates of heritability direct values were (h^2= 0.070.04, h^2= 0.200.03, h^2= 0.15 0.03 and h^2=0.250.05) to prolificacy, weight at birth, weaning and average daily gain, respectively.

Key Words: Genetic parameters, Reproduction, Boer goat

T71 Relationships among measures of body weight, thoracic diameter and age to scrotal circumferences of boer goat. A. Perez*[1], J. Ponce[1], A. Correa[1], M. Montaño[1], and J. Guerrero[2], [1]*Universidad Autónoma de Baja California, Mexicali, Baja California, Mexico,* [2]*University of California, Holville CA. USA.*

The lack of effective means for selecting males with superior fertility is due primarily to two factors: i) the lack of information on basic measurable traits of male reproduction that are related to fertility, and ii) the cost and difficulty of obtained accurate fertility on individual sires. If testicular size is to be considered in selection programs for breed differences, heritabilities and relationships of testicular measurements to age and body weight must be established for young beef bucks. Data came from a goat stud in Imperial Valley California, under an irrigated grazing system during May to October, and total confinement from November to April. The objectives of this study were to estimate the average scrotal circumferences of (n= 31) Boer bucks, and to estimate correlations among measures of body weight, thoracic diameter and age to scrotal circumferences of Boer bucks. Data was analyzed by SAS, 1992, by using PROC MEANS. The estimated average values 25.595.40 and 90.7118.38 cm corresponded to scrotal circumferences, and thoracic diameter, respectively. The unadjusted average values were: 64.5916.90 kg and 45.8014.51 month for weight and age of bucks at time to take the measurements, and age of bucks, respectively. The estimates of correlations among thoracic diameter and weight to scrotal circumference were highly significant (P<0.01) and positive (r_{xy}=0.56 and r_{xy}=0.52) respectively. The estimates of correlation between age and scrotal circumference diameter was positive (r_{xy}=0.14) but non significant (P>0.05). A large range in testis size was observed within bucks.

Key Words: Escrotal circumferences, Correlations, Boer goat

T72 Calving ease of heifers bred to Angus and Simmental sires selected for decreased dystocia. H. C. Van Wagoner[1], R. P. Ansotegui*[1], M. D. Ropp[2], and R. J. Lipsey[2], [1]*Montana State University,* [2]*American Simmental Association.*

The objective of this study was to compare birth weight, gestation length, and percent assisted births of calving ease Simmental and low birth weight Angus sires. Angus yearling heifers were bred in two consecutive years (1999 and 2000) at four locations by AI using semen collected from Simmental (n = 20) and Angus (n = 27) sires. Birth weights, gestation lengths, and calving ease scores (1 = unassisted, 2 to 4 = various levels of assistance) of 1,039 births in 2000 and 2001were analyzed to determine sire breed effect. Calving ease scores were recorded so that the percentage of assisted births could be calculated. The statistical model included the fixed effects of year of birth, sire breed, calf sex, ranch, two-way, and three-way interaction. Sire breed affected (P < 0.01) birth weight, gestation length, and percent assisted. Simmental sired calves were 2.13 ± 0.37 kg heavier at birth, 2.90 ± 0.48 days longer in gestation length, and assisted 1.44 more times than Angus sired calves. Calf sex affected (P < 0.01) birth weight and gestation length. Bull calves were 2.77 ± 0.25 kg heavier at birth and 1.30 ± 0.27 days longer in gestation length than heifer calves. Furthermore, bull calves were assisted 2.51 and 1.36 times more than heifer calves, 2000 and 2001, respectively. In this study calf sex was the leading cause of dystocia, followed by sire breed.

Key Words: Dystocia, Angus, Simmental

T73 Odds ratios for failure to calve and wean for Senepol- and Tuli-Angus cows compared to Brahman-Angus cows. D. G. Riley*[1], K. S. Barling[2], C. C. Chase, Jr.[1], T. A. Olson[3], A. C. Hammond[4], and S. W. Coleman[1], [1]*USDA, ARS, STARS, Brooksville, FL,* [2]*Texas A&M University, College Station,* [3]*University of Florida, Gainesville,* [4]*USDA, ARS, SAA, Athens, GA.*

The objective of this study was to compare reproductive performance of F_1 Senepol- and Tuli-Angus cows to that of F_1 Brahman-Angus cows (bred to Charolais bulls) using calving (n = 640) and weaning (n = 633) records from 1996 to 2001. Traits evaluated were 1) failure to calve, and 2) failure to wean a calf. Cows failing to calve or to wean a calf in a given year were coded 1; otherwise they were coded 0. Traits were modeled as binomially-distributed using repeated measures, generalized estimating equations, and a logit link function to an assumed underlying normal distribution. Effects investigated included breed, year, cow age, cow birth year, and sire of cow. Clustering associated with cow age was modeled using repeated measures analysis with an unstructured covariance matrix. Odds ratios (OR) and 95% confidence intervals (CI) were generated to compare breeds. Cow breed, year, cow birth year, and breed × year interaction were highly significant in all analyses. Sire of cow ($P > 0.25$) was excluded from final models. Senepol F_1s had significantly greater odds of failure to calve than Brahman F_1s in 1997, 1998, 2000, and 2001, as indicated by OR (CI) of 1.87 (1.09, 3.2), 3.81 (1.01, 14.32), 2.88 (2.47, 3.36), and 11.69 (9.49, 14.4), respectively. Senepol F_1s had greater odds of failure to wean a calf than Brahman F_1s in 1997, 1998, 2000, and 2001, as indicated by OR (CI) of 2.29 (1.66, 3.16), 4.88 (1.2, 19.82), 2.81 (2.3, 3.42), and 9.18 (3.41, 24.71), respectively. In contrast, Tuli F_1s were similar to Brahman F_1s, but had lower odds of failure to calve (OR = 0.09; CI = 0.04, 0.2) or wean (OR = 0.19; CI = 0.06, 0.58) than Brahman F_1s in 1999 and greater odds of failure to wean a calf than Brahman F_1s in 2000 (OR = 2.64; CI = 2.22, 3.13). Results indicate that the Tuli breed may be a viable source of non-Zebu adaptation to the subtropics.

Key Words: Brahman, Senepol, Tuli

T74 Divergent selection for blood serum insulin-like growth factor I concentration does not change age of Angus heifers at puberty. A. Yilmaz[1], M. E. Davis*[1], and R. C. M. Simmen[2], [1]*Department of Animal Sciences, The Ohio State University,* [2]*Department of Animal Science, University of Florida.*

The objective of this study was to determine effects of divergent selection for blood serum insulin-like growth factor I **(IGF-I)** concentration on age of heifers at puberty. Data were obtained from an ongoing divergent selection experiment involving Angus beef cattle at the Eastern Ohio Resource Development Center. Selection was based on the mean IGF-I concentration of three blood samples taken at d 28, 42, and 56 of the 140-d postweaning test, which were abbreviated as **IGF28**, **IGF42**, and **IGF56**, respectively. Data were analyzed using SAS. All models used in the analysis included line-season and the random effect of sire nested within line-season. Age of dam and on-test age of calf were added to the models as a fixed effect and a covariate, respectively. Blood samples were collected weekly for 17 wk from 61 heifers in each of the fall- and spring-calving groups during the postweaning test period. Mean on-test age of heifers in the spring- and fall-calving groups were 260 and 265 d, respectively. Progesterone concentration was determined using RIA. Puberty was assumed attained if the progesterone concentration exceeded 2 ng/mL in a single or 1 ng/mL in two consecutive blood samples. Age at puberty was obtained by subtracting 7 d from the first date progesterone exceeded 1 or 2 ng/mL. Ten heifers (five high and five low line) did not attain puberty during the period in which blood samples were collected. Higher mean IGF-I concentration in the high line heifers (50.0 10.2 ng/mL; $P < 0.004$) did not result in a change in age at puberty (2.5 6.2 d younger in high line; $P = 0.71$). Mean age at puberty was 356 d. Residual correlations of age at puberty with IGF28, IGF42, IGF56, and mean IGF-I were -0.27 ($P = 0.10$), -0.20 ($P = 0.24$), -0.31 ($P = 0.06$), and -0.27 ($P = 0.10$), respectively. Cubic relationships were observed between age of heifers at puberty and IGF-I concentrations ($P = 0.0009$, 0.06, 0.08, and 0.003 for the cubic regression of age of heifers at puberty on IGF28, IGF42, IGF56, and mean IGF-I, respectively). These results suggest that changes in IGF-I concentration are not associated with changes in age of heifers at puberty, but some phenotypic relationships exist between these two variables.

Key Words: Insulin-like Growth Factor I, Age at puberty, Selection

T75 Effectiveness of performance testing for beef carcass traits to use embryonic cloning technique in Wagyu. K. Kuchida*[1], M. Ogasawara[1], S. Hidaka[1], T. Sakai[2], A. Minamihashi[2], and Y. Yamamoto[2], [1]*Obihiro University of A&VM, Obihiro-shi Japan,* [2]*Hokkaido Animal Research Center, Shintoku-cho Hokkaido Japan.*

Embryonic cloning can be a technique for producing multiple offspring from one embryo and can be used for a diverse range of comparative trials and performance tests. Embryonic clone testing could shorten the generation interval of traditional progeny testing and lead to efficiency of genetic improvement. The objective of this study were to investigate similarities for shape of muscle, fat area ratio to the muscle area (FATPER), and coarseness of marbling particle with computer image analysis on the quadruplets and quintuplets derived from each embryo, and on two sets of traditional progeny testing. Blastomeres obtained from Japanese Black donors were collected, and male clones were produced by cell fusion with electro-stimulation using enucleated oocytes from ovaries of Holsteins. Four and five clones were fattened with the method of Wagyu progeny testing until 21 months. Eight and nine half-sib steers from two sets of progeny testing were treated as control. The areas of *M. longissimus dorsi, M. trapezius, M. rhomboideus, M. semispinalis capitis, M. semispinalis dorsi, M. anterior serratus* and *M. iliocostalis* at the 6th and 7th rib, and FATPER of those muscles were measured by image analysis. Coarseness of marbling particles of *M. longissimus dorsi* was calculated by image analysis method. The ranges of carcass weight (CWT) and area of *M. longissimus dorsi* (RIBEYE) for two sets of embryonic clones were 369 to 435 kg and 336 to 393 kg, and 48.2 to 63.6 cm^2 and 38.5 to 50.4 cm^2, respectively. The ranges of CWT and RIBEYE for two sets of traditional progeny testing were 312 to 406 kg and 277 to 392 kg, and 38.0 to 54.8 cm^2 and 35.0 to 47.2 cm^2, respectively. This indicates that the degree of similarities for CWT and RIBEYE between embryonic clone steers were not high. The ranges of FATPER of *M. longissimus dorsi* were 35.0 to 37.6 % and 27.2 to 28.4 % for two sets of embryonic clones, and those for two sets of traditional progeny testing were 22.6 to 45.3 % and 25.4 to 40.9 %. This shows that the similarity of FATPER of *M. longissimus dorsi* on embryonic clones was high compared with that on half-sib progeny. The same trend was recognized for other muscles. Low similarity was recognized for the coarseness of marbling particles on embryonic clones as well as on half-sib steers.

Key Words: Embryonic clone, Wagyu, Image analysis

T76 Effect of calving difficulty on cow survival. S. McClintock*[1], J. Morton[2], K. Beard[3], and M. Goddard[1,4], [1]*University of Melbourne,* [2]*Department of Primary Industry,* [3]*Australian Dairy Herd Improvement Scheme,* [4]*Victorian Institute of Animal Science.*

Cow loss following different degrees of dystocia, and its associated cost was estimated for Australian Holstein-Friesian cows, for use in the calculation of the economic weights for bull breeding values for dystocia. Cow termination (i.e. non-survival through culling or death) due to the effects of dystocia was considered over two periods: before or after 21 days post partum. Two cost outcomes, death or sale, were considered. Separate estimates were made for primiparous and multiparous cows. Any degree of dystocia increased both the short and long-term likelihood of cow termination for all cows. Increasing severity of dystocia increased the likelihood of termination. Termination rates increased from early to late lactation for cows requiring surgery. Average cow loss cost was estimated to be A$1,071 for periparturient termination and A$713 for termination after 21 days. Termination patterns for cows with and without dystocia were not the same. Cows that had dystocia were more likely to be terminated early in the lactation or before a lactation record was initiated.

Key Words: Dystocia, Cost, Holstein-Friesian

Nonruminant Nutrition

T77 Effects of supplemental pantothenic acid during all or part of the grow-finish period on growth performance and carcass composition. J.S. Radcliffe*, B.T. Richert, L. Peddireddi, and S.A. Trapp, *Purdue University, West Lafayette, IN.*

Ninety barrows and 90 gilts were used in a 15-wk experiment to study the effects of supplementing pantothenic acid (PA) to the diet during all or part of the grow-finish period. Pigs were blocked by sex and weight (initial BW=29 kg), randomly assigned to pens (30 pens, 6 pigs/pen), and fed four phases of split-sex diets during the grow-finish period. Treatments included: 1) Control (13.2 ppm PA), 2) Control + 30 ppm PA added in the grower and finisher phases, and 3) Control + 30 ppm PA added in the finisher phases only. Pig BW and pen feed intake were recorded biweekly. Ultrasonic scans of tenth rib loin eye area (LEA) and backfat thickness were performed at 4-wk intervals on 3 pigs/pen. At the end of the experiment, pigs were harvested at a commercial slaughter facility and individual hot carcass weights, Animal Ultrasound System (AUS) backfat, and loin muscle depths (LMD) were recorded. There were no treatment x sex interactions (P>.10), and therefore, only the main effects of treatment are presented. Supplementation of PA did not affect (P>.10) ADG or feed efficiency. Overall ADFI was higher (P<.05) for pigs fed PA during the finisher phase only compared to pigs fed PA during the grower and finisher phases. However, overall ADFI was not different between the PA treatments and control fed pigs. Ultrasound LEA were larger (P<.003) at the end of the grower phase for pigs fed diets supplemented with PA. However, there were no differences (P>.10) in LEA at the end of the experiment. Tenth rib and last rib ultrasound backfat depths were not different (P>.10) between control fed pigs and PA supplemented pigs. Tenth rib carcass fat depths were numerically lower for pigs fed diets with supplemental PA, but differences were not significant (P>.10). Likewise, there was no effect of PA supplementation on carcass tenth rib LMD (P>.10). Carcass lean percent tended to be higher for pigs fed PA during the growing and finishing periods compared to control fed pigs. However, carcass weights were approximately

2.0 kg lighter (P<.05) for pigs fed supplemental PA during the grower and finisher periods compared to control fed pigs.

Key Words: Pig, Pantothenic acid, Growth

T78 Effect of supplemental *myo*-inositol in diets for weanling pigs. S. E. Crowe*, K. R. Roneker, M. Villa-Garcia, and X. G. Lei, *Cornell University, Ithaca, NY USA*.

Myo-inositol was considered an essential nutrient in 1950s and plays vital roles in metabolism. It is still unclear whether fast-growing animals such as young pigs could synthesize sufficient *myo*-inositol in the body to meet their physiological needs. The objective of this experiment was to determine whether supplementing pure *myo*-inositol in the diets for young pigs could improve their growth performance. A total of 24 weanling pigs (3-wk old, 7.1 kg body weight) were divided into three groups (n = 8) and fed a corn-soybean meal based diet supplemented with myo-inositol (99% pure) at 0, 400, or 800 mg/kg of feed. Individual growth performance including average daily gain, average daily feed intake, and gain to feed ratio, and plasma inorganic phosphorus concentrations were monitored weekly for 4 wk. Examination revealed no significant difference among the three treatment groups in either growth performance or plasma inorganic phosphorus concentrations. In conclusion, addition of *myo*-inositol to the corn-soybean meal diets for weanling pigs at 400 or 800 mg/kg did not appear to provide a beneficial effect over the control diet.

Key Words: *Myo*-inositol, Pig, Supplement

T79 Influence of dietary δ-Aminolevulinic Acid on growth performance and skin color in weaned pigs. J. W. Hong*[1], I. H. Kim[1], B. J. Min[1], O. S. Kwon[1], J. H. Lee[2], J. H. Kim[3], W. B. Lee[1], and K. S. Son[1], [1]*Department of Animal Resource & Sciences, Dankook University,* [2]*Easybio System, Inc., Seoul, Korea,* [3]*Agribrands Purina Korea, Seoul, Korea*.

A total of ninety six pigs (7.12±0.03kg average initial body weight) were used in a 28-d growth assay to determine the effects of dietary δ-aminolevulinic acid on growth performance and skin color in weaned pigs. Dietary treatments included 1) NC (without antibiotic), 2) PC (NC diet + 110ppm neomycin and oxytetracycline), 3) NCALA (NC diet + 0.1% δ-aminolevulinic acid) and 4) PCALA (PC diet + 0.1% δ-aminolevulinic acid). For d 0 to 14, average daily gain, average daily feed intake and gain/feed were not significantly different among the treatments. For d 14 to 28, pigs fed antibiotic diets (PC and PCALA) had higher average daily gain than pigs fed diets without antibiotic(NC and NCALA) with significant difference (P<0.03). For overall period, pigs fed antibiotic diets (PC and PCALA) grew faster than pigs fed diets without antibiotic(NC and NCALA) (P<0.05). However, pigs fed δ-aminolevulinic acid diets (NCALA and PCALA) had greater average daily gain compared to pigs fed without δ-aminolevulinic acid diets (NC and PC). The a∗-values(redness) of the skin color was increased by dietary δ-aminolevulinic acid (P<0.01). In conclusion, the results obtained from this feeding trial suggest that the dietary δ-aminolevulinic acid was an effective means of improving a∗-values of the skin color in weaned pigs.

Key Words: δ-Aminolevulinic acid, Performance, Pigs

T80 Selenium and measures of oxidative stress in the developing porcine fetus. C. E. Hostetler* and R. L. Kincaid, *Washington State University*.

To investigate the role of selenium (Se) in the developing porcine fetus, pre-pubertal gilts (n = 42) were randomly assigned to either Se adequate (0.39 ppm Se) or Se deficient (0.05 ppm Se) gestation diets 6 wk prior to breeding. Gilts were humanely killed at d 10, 20, 30, 45, 70 and 90 of pregnancy, and at term (d 114), for collection of maternal and fetal liver. Concentrations of Se in maternal blood and liver decreased (P < .05) during gestation in sows fed the low Se diet. Activity of cellular glutathione peroxidase (GPx) was decreased (P < .05) at d 30 and 45 in sows fed the low Se diet. Concentrations of total lipid peroxides (LPO) and hydrogen peroxide (H_2O_2), measures of cellular damage, were greater (P < .05) in liver homogenates from sows fed the low Se diet. The concentration of Se in the whole fetus was not affected by maternal diet, but fetal liver Se decreased (P < .05) if sows were fed the low Se diet. GPx activity in fetal liver was not affected by maternal diet; however, concentrations of LPO and H_2O_2 in fetal liver were greater (P < .05) in fetuses from sows fed low Se diet. Liver of sows fed the adequate Se gestation diet had greater (P < .01) concentrations of Se throughout gestation compared to fetal liver. These results indicate that maternal dietary Se intake affects fetal liver Se concentration and feeding low Se gestation diet increases oxidative damage to the fetus as measured by fetal liver hydrogen peroxide and total lipid peroxides.

Key Words: Trace element, Antioxidant, Pig

T81 WITHDRAWN. , .

T82 Effect of chromium methionine supplementation on egg size and serum concentration of glucose, protein, ferritin and iron in breeders of Japanese quail. G. Contreras*, L. García, A. Montoya, and R. Barajas, [1]*FMVZ-Universidad Autónoma de Sinaloa (México), Culiacan*.

To determinate the effect of chromium methionine supplementation on egg size and serum concentration of glucose, protein, ferritin and iron in breeders Japanese quail. In a complete randomized design experiment, six hundred forty Japanese quail (160 males and 480 females; 15 week old), were used. The animals were allocated in a controlled temperature barn. Groups of eight quails (2 males and 6 females) were placed in metal wire cages. Groups of 20 cages were randomly assigned to consume one of four diets in that consists the treatments: 1) Diet with 21% of CP and 2,900 Kcal of ME/kg (control); 2) Diet supplemntated with 100 μg/kg of Cr from chromium methionine (Cr100); 3) Diet supplementated with 200 μg/kg of Cr (Cr200); and 4)Diet supplementated with 400 μg/kg of Cr (Cr400). To obtain egg measurements, 560 eggs were collected from day 14 to 21. At 21 days the quail were slaughtered and blood samples were taken. Analysis for glucose, protein, ferritin and iron were performed. The Cr200 increased (P<0.05) feed intake (27.99 vs. 29.07 g/d). The Cr supplementation at any level decreased (P<0.05) the glucose concentration in blood, with values of 318, 231, 198, and 190 mg/dL for control, Cr100, Cr200, and Cr400, respectively. Protein in blood was increased (P<0.05) by Cr supplementation with values of 4.0, 5.63, 4.98, and 5.08 g/dL for control, Cr100, Cr200, and cr400, respectively. The Cr100 increased (P<0.05) ferritin blood concentration with respect to control diet (0.51 vs. 2.14 ng/mL). The concentration of iron in blood (1,085 μg/dL) was not affected (P>0.05) by treatments. Egg length was increased (P<0.05) by Cr100 and Cr200 (3.48 vs. 3.45 cm). Weight of egg (13.94 g), and width (2.72 cm) were not affected (P>0.05) by treatments. It is concluded, that chromium methionine supplementation modifies some blood metabolites in Japanese quail breeders.

Key Words: Chromium, Ferritin, Japanese quail

T83 Effect of chromium methionine supplementation on internal and external egg quality characteristics in Japanese quail. F. G. Ríos*, J. J. Portillo, C. Angulo, M. R. Hernández, and R. Barajas, *FMVZ-Universidad Autónoma de Sinaloa, Culiacan, México*.

To determine the effect of chromium methionine supplementation on internal and external egg quality characteristics in Japanese quail, 320 Japanese quail (240 females and 80 males), were grouped (six females and two males) and placed in metal wire cages, as part of two batteries, with five levels and four cages by level. In agreement of a complete randomized block design experiment, the animals were assigned to receive one of two treatments: 1) Diet with 21 % of CP and 2,900 kcal of ME/kg (control); and 2) Diet control but supplemented with 100 ppb of Cr from Cr-Met. During 100 weeks, 20 eggs from each treatment were collected weekly. The next measurements were weight, length, and width of eggs, dense albumin height, yolk height, and yolk color (L*a*b*), shell weight, and shell thickness. From these data, shape index, yolk index, and Haugh units were calculated. Egg weight was not affected (P>0.05) by treatments. Egg length was not modified (P>0.05) by diets. Egg width was similar (P>0.10) between treatments. Egg dense albumin height was increased (P<0.05) by chromium (5.45 vs. 5.61 mm). Yolk height and yolk color were equal (P>0.05) in both treatments. Shell weight was not affected (P>0.05) by treatments. Shell thickness was decreased (P<0.05) by chromium (0.18 vs. 0.17 mm). Haugh units were increased

(P<0.01) by chromium supplementation (0.922 vs. 0.932). It is concluded that chromium methionine supplementation improves internal quality characteristics of Japanese quail eggs.

Key Words: Chromium, Egg quality, Japanese quail

T84 Relative availability of calcium of different source for broiler chickens. E. Muniz*, A. Arruda, E. Pereira, C. Leseux, and N. Tsuzuki, *Universidade Estadual do Oeste do Parana, Brasil*.

An experiment was conducted to determine the relative bioavalaibility of calcium in carbochelate and two calcitic limestone A and B by utilizing analytical grade calcium carbonate as the standard source. The experiment was conducted in hot batteries with duration of 28 days with 12 treatments and 2 replicates for each sex with 12 chicks of the Cobb line per experimental unit. The completely randomized design with a 4 and 3 and 2 factorial arrangement was utilized. A total of 12 corn and soybean meal based rations at levels of 0.60, 0.75 and 0.90 percentage of Ca were utilized. Evaluations of pH, granulometry and solubility of the sources under study were done. To evaluate performance the ration intake, weight gain and feed conversion were determined. On the 29 day of age , two birds from each plot were slaughtered for tibia removal. The relative bioavalabilitity of Ca of the sources were determined by using as a response criteria, the percentage of tibia ashes making use of the abscissa method. Ca from carbochelate influenced negatively the broiler performance, impairing ration intake and hence weght gain, calcitic limestone were greatly similar to analytical degree CaCo3 in the evaluation of performance. There were no significant differences for sex in the performance for any source under study. For the evalution of length and diameter of tibia, it was found that this variable was a reflex of the broiler growth regardless of the factors. As the criterion percentage of ashes, it was observed that calcium carbochelate provide the broiler with a mineral deposition as efficient as those of limestones A and B. In relation to sex, male and female differed only in the criteria of percentage of bone ashs, females presenting higher mean. The relative bioavailabilities of Ca for the 3 source under study were 115, 106 and 94 percentage, respectively for Ca carbochelate, calcitic limestone A and calcitic limestone B. According to results it was concluded that although bioavalability among the sources range from 94 to 115 percentage, only carbochelate affect negatively the broiler performance indices, the other sources being similar in this variable.

Key Words: Calcium, Broiler, Nutrition

T85 The digestibility of phosphorus (P) in dicalcium phosphate in pigs. T.S. Stahly and T.R. Lutz*, *Iowa State University, Ames*.

The digestibility of dicalcium phosphate P in pigs was determined and the effects of the dietary Ca/ P regimen and stage of pig growth (10 or 30 kg BW) on its digestibility were evaluated. Pigs were self-fed diets containing .2, .3, .4, .5, .6 or .7% bioavailable P (aP, based on analyzed P x % availability [NRC, 1998] of P in each ingredient) from 7 to 32 kg BW. Fifteen sets of six littermate barrows were allotted within litter to one of six P regimens consisting of a basal, corn-soy-whey diet (.56% analyzed P) supplemented with incremental additions of dicalcium phosphate (17.94% analyzed P) at the expense of starch-limestone. Dietary calcium was either fixed in each of the 6 diets at 1.15% (1.1 to 1 Ca/total P ratio in highest P diet) or adjusted in each diet to achieve a 2.5 to 1 Ca/aP ratio. Dietary P digestibility and absorption-excretion were determined in each pig for 4 days at BW ($\pm$ 1.3 kg) of 10 and 30 kg. Digestibility of P in dical was estimated by subtracting basal diet contributions to P intakes and P absorption-excretions of each pig during each stage of growth and then regressing the daily intake of added dical P against dical derived P absorbed from the GI tract. The digestibility of dical P (slope of absorbed dical P/ intake of dical P, r^2=.89) was estimated as 68.1 $\pm$ 1.9% (inclusive of both Ca/P regimens and stages of growth). Digestibility of dical P in diets containing a fixed dietary Ca concentration (1.15%, dietary Ca/aP ratios of 5.8, 3.8, 2.9, 2.3, 1.9, and 1.6, respectively) was estimated to be 73.3 $\pm$ 5.8% (r^2=.77) and 70.5 $\pm$ 3.5% (r^2=.90) for pigs at BW of 10 and 30 kg, respectively. Similarly, digestibility of dical P in diets containing a constant 2.5 to 1 dietary Ca/aP ratio was estimated to be 72.1 $\pm$ 3.6% (r^2=.92) and 67.5 $\pm$ 4.9% (r^2=.84) for pigs at BW of 10 and 30 kg, respectively. These data highlight the opportunity/incentive for technologies aimed at improving P digestibility in P sources with relatively high (i.e. inorganic P sources) as well as low (i.e. plant P sources) phosphorus bioavailabilities.

Key Words: Phosphorus, Dicalcium phosphate, Digestibility

T86 Efficacy of microbial phytase in swine diets. R. N. Dilger*[1], S. A. Adedokun[1], J. A. Jendza[1], J. S. Sands[2], P. H. Simmins[2], and O. Adeola[1], [1]*Purdue University, West Lafayette, IN,* [2]*Danisco Animal Nutrition, Marlborough, UK*.

Three experiments were designed to assess both nutrient metabolism and growth performance of young swine fed microbial phytase-supplemented diets. Dietary treatments were similar between experiments and consisted of a positive control, basal, and basal plus either 500 or 1000 g/kg microbial phytase. In the first study, twenty four 15-kg crossbred barrows were assigned to crates according to a RCBD resulting in 6 pigs per diet to characterize the effect of phytase on apparent fecal digestibilities of DM and P. Diets were formulated at 165 g/kg CP with the positive control and basal diets containing 5.5 and 3.3 g/kg total P, respectively. A positive phytase effect was observed for apparent fecal digestibilities of DM (quadratic, $P < 0.05$) and P (linear, $P < 0.05$) fecal digestibility. The second study utilized 48 pigs in a 21-d growth performance trial arranged as a RCBD with 12 pigs (6 barrows, 6 gilts) assigned to the 4 dietary treatments. The positive control and basal diets (209 g/kg CP) contained 5.7 and 4.0 g/kg total P, respectively. A linear phytase effect ($P < 0.05$) was observed for average daily gain and feed efficiency at week 1 and overall. Final plasma P concentrations were also shown to be positively affected by phytase addition (linear, $P < 0.05$). In the third study, 128 crossbred were assigned to the 4 dietary treatments with 4 pens of gilts and 4 pens of barrows per diet according to a RCBD. The positive control and basal diets were formulated at 170 g/kg CP and contained 5.3 and 3.6 g/kg total P, respectively. ADG, ADFI, and G:F exhibited a linear phytase response ($P < 0.01$) at weeks 4 and 6 as well as overall. In conclusion, pigs fed phytase-supplemented diets gave results comparable to those fed phosphorus-adequate diets in both nutrient utilization and growth performance.

Key Words: Microbial phytase, Growth performance, Pigs

T87 Effects of the addition of phytase and monocalcium phosphate to sorghum-soybean meal diets on growing commercial pigs. H. Bernal-Barragan*, Z. Ruiz-Chavez, J. Colin-Negrete, E. Gutierrez-Ornelas, and H. Morales-Treviño, *Universidad Autonoma de Nuevo Leon*.

Two experiments were conducted to determine performance and phosphorus output of growing pigs fed diets supplemented with different amounts of phytase (as FTU) and monocalcium phosphate. Pigs of both genders were individually housed with *ad libitum* access to water and feed. Body weight and daily feed consumption were registered over the 5 week length of trial. On a single day of the fourth week, feces were quantitatively collected, in order to measure fecal phosphorus output. In experiment 1, 21 pigs (initial BW of 65 kg) were allotted (n = 7) in a complete randomized design, to one of three dietary treatments: 1) basal diet, sorghum-soybean meal (S-SBM) without addition of monocalcium phosphate (0.32% P), 2) Basal diet + 750 FTU phytase/kg, and 3) basal diet with addition of 9.40 kg monocalcium phosphate/ton (0.52% P), but without phytase. Additions of phytase (T2) and monocalcium phosphate (T3) increased (P = 0.08) ADG in 8.4% and 12.1%, respectively compared with the basal diet (ADG = 874 g). Daily feed intake and feed conversion were not affected by treatments ($P > 0.05$), but fecal phosphorus output was 34% higher ($P < 0.05$) for the diet added with monocalcium phosphate (T3), compared with diets T1 and T2. In experiment 2, 24 pigs (initial BW of 53.4 kg) were allotted (n = 6) in a complete randomized design, to diets added with 0, 3.5, 7.0 and 10.5 kg of monocalcium phosphate/ton, in order to achieve 0.35, 0.42, 0.49 and 0.56% of P, respectively. First three diets were supplemented with 750 FTU phytase/kg, but not the fourth diet. There were not treatment effects on ADG and feed conversion. Fecal phosphorus output increased (P = 0.18) 25%, 36% and 61% on diets T2, T3 and T4 respectively, related to diet T1. Results indicated that addition of either 0 or 3.5 kg monocalcium phosphate/ton plus 750 FTU phytase/kg may be enough to reduce phosphorus fecal output, without affecting the growth parameters of growing-finishing pigs.

Key Words: Phytase, Monocalcium phosphate, Pigs

T88 Phytase additions to conventional or low-phytate corn-soybean meal diets on phosphorus balance in growing pigs. E. G. Xavier*, G. L. Cromwell, and M. D. Lindemann, *University of Kentucky, Lexington.*

A balance experiment was conducted to assess the effects of phytase (Natuphos®, BASF; 750 units/kg) in diets containing low-phytate (LP) corn and LP-, low-oligosaccharide soybean meal (SBM) or near-isogenic normal (N) corn and N-SBM from near-isogenic soybeans. The corn and SBM were provided by Pioneer Hi-Bred International, Johnston, IA. The LP-corn, N-corn, LP-SBM, and N-SBM contained 0.28, 0.25, 0.77, and 0.70% total P and 0.10, 0.20, 0.22, and 0.48% phytate P with estimated P bioavailabilities of 75, 20, 50, and 20%, respectively. Twelve pigs (60 kg) were placed in metabolism crates and fed four diets (0.75% lysine) for a 5-d collection period. Feeding level was equalized within replicates and averaged 92% of ad libitum intake. Diets were (1) N-corn + N-SBM, 0.48% P; (2) N-corn + N-SBM + phytase, 0.38% P; (3) LP-corn + LP-SBM, 0.35% P; and (4) LP-corn + LP-SBM + phytase, 0.35% P. Ca was reduced from 0.55% in Diets 1 and 3 to 0.50% in Diets 2 and 4. Diet 1 was estimated to meet the requirement for total and bioavailable P, and Diets 3 and 4 contained no added P. Daily feed and P intake averaged 2.07, 2.03, 2.07, 2.09 kg/d and 9.91, 7.72, 7.24, 7.30 g/d for Diets 1-4, respectively. Daily P excretion in feces, urine, and both were affected ($P < 0.01$) by diet (4.94, 2.97, 2.69, 1.79 g/d; 0.26, 0.63, 0.04, 0.18 g/d; 5.20, 3.60, 2.73, 1.98 g/d), as were daily P absorbed and retained (4.97, 4.75, 4.56, 5.51 g/d; 4.71, 4.12, 4.52, 5.32 g/d). Apparent P digestibility was increased by feeding LP- vs N-diets and by phytase addition to both (50.1, 61.6, 62.9, 75.4%; $P < 0.01$). Total P in feces and urine was 2.93, 1.91, 1.68, 1.12% of DM ($P < 0.01$) and 2.9, 6.9, 0.5, 1.5 mg/dl ($P < 0.01$). Soluble P in feces, expressed as percent of total P, increased by 26% with feeding of the LP-diet and with phytase addition to either diet (1.31, 1.66, 1.65, and 2.08%), but these differences were not significant ($P > 0.20$). In urine, soluble P averaged 98% of total P. Total P excretion decreased by 31% when phytase was added to the N-diet, by 48% when the LP-diet was fed, and by 62% when phytase was included in the LP-diet.

Key Words: Pigs, Phosphorus, Phytase

T89 Ileal amino acid digestibility in pigs fed grain sorghum-soybean meal diets added with a phytase. M. Cervantes*[1], M. A. Barrera[1], F. Copado[2], J. L. Figueroa[2], W. Sauer[3], M. Cuca[2], and N. Torrentera, [1]*Instituto de Ciencias Agrícolas, UABC, Mexicali,* [2]*Colegio de Postgraduados, Montecillos, México,* [3]*University of Alberta, Canada.*

A digestion trial was conducted to evaluate the effect of adding a phytase to grain sorghum-soybean meal diets on the apparent ileal digestibility (AID) of amino acids (AA) in pigs. Six pigs (86.1 kg body weight) fitted with cannulas in terminal ileum were used in three experimental periods according to a replicated 3 x 3 Latin Square design. Treatments (T) were as follows: T1) basal, grain sorghum-soybean meal diet plus vitamins and minerals, T2) + 500 phytase units (FU), and T3) + 1 000 FU. The basal diet contained 17% crude protein. Yellow endosperm grain sorghum and hulless soybean meal were used in this trial. The enzymatic activity of the phytase used in this experiment was equivalent to 10 000 FU/g. Pigs were fed two times daily (0700 and 1900), the same ration at each feeding time. The AID (%) of the essential amino acids for treatments T1 to T3 were: Arginine, 85.3, 85.7, 85.8; Phenylalanine, 78.3, 78.8, 78.7; Histidine, 79.9, 80.0, 79.9; Isoleucine, 77.0, 77.6, 77.9; Leucine, 77.8, 78.1, 77.9; Lysine, 80.9, 81.2, 81.9; Methionine, 76.9, 76.0, 75.7; Threonine, 69.1, 68.2, 68.0; Valine, 74.8, 75.2, 75.3, respectively. There was no effect of phytase supplementation on the AID of the essential or the non-essential amino acids. Arginine had the highest AID, whereas threonine had the lowest AID value. The AID of the essential amino acids was higher than that of the non-essential amino acids. In conclusion, the supplementation of phytase containing 10 000 FU/g, to grain sorghum-soybean meal diets does not affect the AID of the essential or non-essential amino acids in finishing pigs.

Key Words: Phytase, Ileal digestibility, Amino acids

T90 Effect of phytase and/or pancreatin supplementation to grain sorghum-soybean meal diets on the apparent ileal amino acid digestibility in pigs. F. Copado[2], M. Cervantes*[1], J. L. Figueroa[2], M. Cuca[2], J. Yañez[1], and W. Sauer[3], [1]*Instituto de Ciencias Agrícolas, Universidad Autónoma Baja California, Mexicali,* [2]*Colegio de Postgraduados, Montecillos, México,* [3]*University of Alberta, Canada.*

A digestion trial was conducted to evaluate the effect of adding a phytase and/or pancreatin to grain sorghum-soybean meal diets on the apparent ileal digestibility (AID) of amino acids (AA) in pigs. Eight growing pigs (86.1 kg body weight) fitted with cannulas in terminal ileum were used in four experimental periods according to a replicated 4 x 4 Latin Square design. Treatments (T) were as follows: T1) basal, grain sorghum-soybean meal diet plus vitamins and minerals, T2) + 1 050 phytase units (FU), T3) + 591 mg pancreatin/kg feed, and T4) + 1 050 FU + 591 mg pancreatin/kg feed. The basal diet contained 18.2% crude protein. Yellow endosperm grain sorghum and hulless soybean meal were used in this trial. The enzymatic activity of the phytase used in this experiment was equivalent to 10 000 FU/g. Pancreatin digests not less than 100 times its weight of casein in 60 min at pH 7.5. The AID (%) of the essential amino acids for treatments T1 to T4 were: Arginine, 83.0, 82.6, 83.0, 82.2; Histidine, 75.6, 75.7, 75.1, 73.9; Isoleucine, 73.5, 73.0, 72.8, 72.2; Leucine, 73.2, 73.3, 72.3, 71.5; Lysine, 77.8, 77.7, 77.0, 76.3; Methionine, 67.5, 66.3, 62.9, 66.0; Phenylalanine, 74.6, 74.5, 74.0, 73.3; Threonine, 64.0, 63.6, 62.2, 61.8; Valine, 70.0, 70.0, 69.5, 68.4, respectively. Except for methionine, there was no effect of phytase or pancreatin supplementation on the AID of the essential AA. The AID of methionine tended to decrease with the addition of pancreatin to the basal diet. Arginine was the AA with the highest AID value, whereas threonine had the lowest AID value. In conclusion, the supplementation of phytase containing 10 000 FU/g, alone or in combination with pancreatin, to grain sorghum-soybean meal diets does not affect the AID of the essential amino acids in growing pigs.

Key Words: Pigs, Phytase-pancreatin, Ileal amino acid digestibility

T91 Phytase and crystalline amino acids supplementation to grain sorghum-soybean meal diets for growing pigs. F. Copado[2], M. Cervantes*[1], J. L. Figueroa[2], M. A. Barrera[1], J. Yañez[1], M. Cuca[2], S. Espinoza[1], and N. Torrentera[1], [1]*Instituto de Ciencias Agrícolas, Universidad Autónoma Baja California, Mexicali,* [2]*Colegio de Postgraduados, Montecillos, México.*

An experiment was conducted with 30 crossbred (Landrace-Hampshire-Duroc) pigs (20.9 kg av. initial body wt.) to evaluate the effect of adding crystalline lysine plus threonine and phytase to grain sorghum-soybean meal diets on the performance of growing pigs. Pigs were randomly allotted to five dietary treatments based on sex, weight and litter. Treatments were: 1) basal grain sorghum-soybean meal diet, 2) + 1 050 ppm phytase, 3) + .13% lysine + .05% threonine, 4) + 1 050 ppm phytase + 13% lysine + .05% threonine, 5) control grain sorghum-soybean meal diet. Diet of treatment 1 was formulated to supply 90% the requirement of digestible lysine for the 20 to 50 kg pigs; the control diet supplied at least 100% the requirements of all the essential amino acids. Crystalline lysine and threonine were added to T3 and T4 to match their content in the control diet. Vitamins and minerals were added to all diets to meet the animals requirements. Weight gain, feed and lysine intake, and feed conversion were: 1.01, .98, 1.09, 1.04, 1.03 kg/d; 1.81, 1.79, 1.69, 1.74, 1.90 kg/d; 12.1, 12.0, 13.0, 13.4, 14.6 g/d; 2.08, 1.77, 1.48, 1.77, 1.77, respectively. Supplementation of phytase or the level of lysine and threonine did not affect daily weight gain ($P>.24$), and feed ($P>.40$) and lysine ($P>.11$) intake. But, the supplementation of phytase, alone or in combination with crystalline lysine plus threonine, improved ($P<.01$) the feed conversion of pigs, as compared with those fed the basal diet. There was no difference ($P=.91$) in feed conversion between pigs fed the control diet and the average of the other treatments. These results indicate that phytase may improve the efficiency of feed utilization in growing pigs fed grain sorghum-soybean meal diets.

Key Words: Phytase, Swine, Crystalline amino acids

T92 Effects of diet and age on metabolic characteristics and gene expression profile in the dog. Part 1: Metabolic characteristics. K. S. Swanson*, K. N. Kuzmuk, L. B. Schook, and G. C. Fahey, Jr., *University of Illinois, Urbana, IL*.

The objectives of this experiment were to determine the effects of diet on metabolic characteristics and gene expression profile in old and young dogs. Old (ave. age = 11.1 0.6 yr; 6 M, 6 F) and weanling (age = 8 wk old; 6 M, 6 F) Beagles were used. Three of each gender and age were randomly assigned to one of two dietary treatments. Diet A was primarily composed of high quality, animal-derived ingredients and was formulated to contain 30% crude protein and 20% fat. Diet B was primarily composed of plant-derived ingredients and was formulated to contain 22% crude protein and 8% fat. Old dogs were fed to maintain bodyweight while weanling puppies were fed ad libitum. Blood samples were collected via jugular puncture at baseline and after 3, 6, and 9 months for analysis of complete blood count (CBC) and serum chemistry profile. A 4-day total fecal collection was performed to determine total tract macronutrient digestibilities after 3 months on the experiment. Data were analyzed using the GLM procedure of SAS. As expected, dry matter (DM) and organic matter (OM) digestibilities were greater ($P < 0.05$) for dogs fed Diet A. Dry matter ($P = 0.06$) and OM ($P < 0.05$) digestibilities also were greater in old dogs. Dogs fed Diet B had lower ($P < 0.05$) fecal DM% and greater ($P < 0.05$) fecal output (when expressed either on as-is or DM basis) and fecal output (as-is): food intake (DM) ratio. Age had a major impact on CBC and serum chemistry profile. At baseline, young dogs had greater ($P < 0.05$) total white blood cell, neutrophil, lymphocyte, and blood glucose concentrations. Old dogs had greater ($P < 0.05$) red blood cell, hemoglobin, hematocrit, albumin, creatinine, blood urea nitrogen and total protein concentrations at baseline. In conclusion, diet and age had dramatic effects on nutrient digestibility, fecal characteristics, CBC, and serum chemistry profile.

Key Words: Canine, Nutritional genomics, Nutrient digestibility

T93 Effects of diet and age on metabolic characteristics and gene expression profile in the dog. Part 2: Gene expression profiling. K. S. Swanson*, K. N. Kuzmuk, L. B. Schook, and G. C. Fahey, Jr., *University of Illinois, Urbana, IL*.

Detecting dietary effects on gene expression profile in geriatric and weanling dogs was the objective of this experiment. Blood samples were collected via jugular puncture at baseline and after 3, 6, and 9 months for RNA isolation. Liver biopsies also were collected after 6 and 9 months for RNA isolation. Isolated RNA samples can be hybridized with an oligonucleotide microarray to generate a gene expression profile. Oligonucleotide microarrays monitor the expression of hundreds or thousands of genes simultaneously, making them a powerful alternative to conventional techniques that limit experiments to measuring only a few genes at a time. We designed an oligonucleotide microarray containing 384 genes with major emphasis placed on metabolic pathways and immune function. With the use of Vector NTI (Informax Inc., Frederick, MD), a bioinformatics tool used for sequence analysis and molecular biology data management, canine expressed sequence tags (ESTs) and gene sequences were identified from the public domain. Genes of interest were analyzed to determine unique oligonucleotide sequences (70-mers) that could be used as a probe on the microarray. Selected sequences were then synthesized and printed on microarray slides. As with humans, diabetes is highly prevalent in dogs and is positively correlated with age. Identification of biomarkers predictive of disease is needed and is a goal of this experiment. Therefore, genes associated with glucose metabolism and homologous to human genes demonstrated to contribute to the development of diabetes were included on the microarray. To conclude, a 384-gene oligonucleotide microarray has been developed to study metabolic pathways and immune function in dogs with a strong emphasis on glucose metabolism and diabetes. This microarray will be used to generate gene expression profiles of dogs in the current experiment and those in future experiments.

Key Words: Canine, Nutritional genomics, Oligonucleotide microarray

T94 Case study of preparing a submission for regulatory clearance of a new ingredient. L. B. Deffenbaugh*, *Kemin Nutrisurance, Inc*.

New ingredients for companion animal diets become available only occasionally because of the rigorous approval process. Regulatory options for clearance of a new ingredient for petfoods include: Food Additive Petition (US), Letter of Non-Objection (US), GRAS declaration (US) or an Assessment of Additives in Animal Nutrition (EU). The key objectives of the regulatory clearance processes are purpose (utility) and safety. Rosemary extract is a natural botanical for which antioxidant properties have been widely reported for decades. The US Food and Drug Administration allows for the use of rosemary extract as a flavor or spice, but not as an antioxidant, in animal feeds under 21 CFR 582.20, Substances Generally Recognized as Safe (GRAS). Kemin Nutrisurance, Inc. has prepared a Letter of Non-Objection submission to extend clearance of rosemary extract to include use as an antioxidant in animal feeds. While the data gathered for the submission appears replete and voluminous, the process to collect the information was quite straightforward once a clear outline was prepared. The data for the rosemary extract submission will be described in such a way to provide a template for readers who are considering preparation of an LNO submission for a new ingredient. The process was found to be valuable as the requirements for the submission fulfill many of the steps required to develop and launch a new ingredient.

Key Words: Regulatory clearance, Letter of non-objection, Rosemary extract

T95 Effects of spray-dried animal plasma on apparent digestibility, intake and fecal consistency in adult Beagles. J. D. Quigley, III*, K. Dahm, and T. A. Wolfe, *APC, Inc., Ames, IA*.

Effects of spray-dried animal plasma (SDAP) on intake, fecal output, fecal scores and apparent total tract digestibility were determined using 14 adult Beagle dogs (BW = 13.3 kg). The SDAP (Endure, APC, Inc.) was coated on the exterior of extruded dry dog food kibbles at 2% of weight. Coated kibbles (27% CP and 13 to 16% ether extract) were fed to dogs in two experiments (n = 6 and 8 in experiments 1 and 2, respectively) in a switchback design using two 15-d periods. The final 5 d of each period were used for feed and fecal collections. In experiment 1, kibbles were coated with 5% tallow, 2% commercial flavor and 0 or 2% SDAP. In experiment 2, commercially available dry dog food, previously coated with fat and flavor were coated with 0 or 2% SDAP by mixing in a cement mixer. Intake, fecal consistency and apparent digestibility of nutrients were determined. Addition of SDAP did not affect chemical composition of diets or intake of most nutrients. Fecal scores were unaffected but total feces excreted was reduced by 13.1 and 21.8% in experiments 1 and 2, respectively. Addition of SDAP improved digestibility of DM, ash, crude fiber, and fat in experiment 1 and DM, organic matter, ash, and crude fiber in experiment 2. Digestion of crude fiber was improved from 1.8 to 20.3% in Experiment 1 and 5.4 to 29.1% in Experiment 2 with addition of SDAP. Digestion of ash was improved from 32.5 to 42.8% in Experiment 1 and 37.4 to 44.7% in Experiment 2. Changes in digestion that occurred with addition of SDAP suggested improved digestive capacity in dogs.

	Expt 1				Expt 2			
Item	CON	SDAP	SEM	P*	CON	SDAP	SEM	P*
DM intake, g/d	221	217	6	NS	262	246	9	NS
Wet feces, g/d	137	119	5	0.08	119	93	4	0.01
Fecal score**	3.82	3.80	0.10	NS	3.85	3.72	0.10	NS
Digestibility, %								
DM	78.3	80.1	0.4	0.04	83.1	86.2	0.6	0.01
Organic matter	84.4	85.2	0.3	NS	86.6	89.3	0.5	0.01
Crude protein	83.8	84.3	0.9	NS	85.8	89.4	1.1	0.07
Fat	93.2	94.2	0.2	0.03	93.5	94.5	0.4	NS
Ash	32.5	42.8	1.8	0.02	37.4	44.7	1.5	0.01
Crude fiber	1.8	20.3	3.0	0.01	5.4	29.1	2.3	0.01

*Probability of a treatment effect; NS = $P > 0.10$.
**Fecal score on scale of 1 = watery diarrhea to 5 = hard, dry, crumbly.

Key Words: Canine, Digestibility, Spray-dried animal plasma

T96 Effects of supplemental spray dried plasma on food intake, nutrient digestibility, and gastrointestinal microflora in healthy adult dogs. J. M. Dust*[1], G. C. Liu[1], C. M. Grieshop[1], N. R. Merchen[1], J. D. Quigley, III[2], and G. C. Fahey, Jr.[1], [1]*University of Illinois, Urbana, IL,* [2]*APC, Inc., Ames, IA.*

Four purpose-bred ileally cannulated adult female dogs with hound bloodlines were used to evaluate the effects of supplemental spray dried plasma (SDP) on food intake, nutrient digestibility, and gastrointestinal microflora using a 4 x 4 Latin square design. Spray dried plasma was solubilized in poultry fat and applied to the exterior of extruded kibbles at 0, 0.5, 1, or 2%. Dietary treatments were fed for a 10-d adaptation phase followed by a 4-d sample collection phase. Inclusion of SDP did not affect ($P > 0.05$) food intake during the collection period. Wet fecal output, fecal score, and fecal dry matter percentage also were not affected ($P > 0.05$) by SDP supplementation. Ileal digestibility of dry matter, organic matter, crude protein, and fat were increased in dogs fed diets containing 0.5 and 1.0% SDP but decreased in dogs fed diets containing 2.0% SDP resulting in a significant ($P < 0.05$) quadratic effect of SDP inclusion on ileal digestibility of these nutrients. In contrast, dietary inclusion of SDP did not affect ($P > 0.50$) total tract digestibility of dry matter, organic matter, crude protein, nor fat. Spray dried plasma supplementation reduced ($P < 0.05$) ileal concentrations of total anaerobic and total aerobic bacteria, lactobacilli, and Clostridium perfringens, but did not affect ($P > 0.05$) ileal concentration of bifidobacteria. In contrast, only fecal lactobacilli concentrations were reduced ($P < 0.05$) by SDP supplementation. From these data, low levels of SDP inclusion in diet do not adversely affect nutrient digestibility or fecal characteristics of healthy adult dogs.

Key Words: Spray dried plasma, Dog, Digestibility

T97 Corn hybrid impacts ileal and total tract nutrient digestibility by dogs. A. M. Gajda, E. A. Flickinger*, C. M. Grieshop, N. R. Merchen, and G. C. Fahey, Jr., *University of Illinois, Urbana, IL U.S.A.*.

Corn is a commonly used ingredient in dry pet foods because there is a stable supply and it is a relatively inexpensive source of nutrients. Corn hybrids are available that are higher in crude protein and amylose concentrations and lower in phytate concentration than conventional hybrids. Ileal and total tract digestibilities of high protein (HP), high-protein, low-phytate (HPLP), and high amylose (HA) corns were compared to those of a conventional (CONV) corn and amylomaize starch (AM). Five ileal cannulated dogs were fed each corn hybrid at approximately 31% of the diet in a 5 x 5 Latin square design. High protein corn-containing diets had higher ($P < 0.05$) ileal organic matter (OM) digestibility (70.3%) and tended to have higher ($P < 0.10$) DM digestibility (66.5%). Ileal starch digestibilities were lower ($P < 0.05$) for dogs fed HA (64.0%) and AM (63.0%). Ileal digestibilities of essential (66%) and non-essential amino acids (62%) were higher ($P < 0.05$) for HP diets, and tended to be higher ($P = 0.09$) for total amino acids, compared to CONV. Total tract DM, OM, CP, and gross energy digestibilities (76, 82, 77, 84%, on average, respectively) were higher ($P < 0.05$) for dogs fed CONV, HP, and HPLP compared to AM (66.9, 71.6, 72.6, 76.5%) and HA (60.6, 65.7, 69.7, 71.5%). Total tract fat digestibilities were lower ($P < 0.05$) for dogs fed HA diets (86.6%) compared to all other treatments (91.0%, on average). Total tract starch digestibilities were higher ($P < 0.05$) for dogs fed CONV, HP, and HPLP (98%, on average) compared to HA (72.8%) and AM (76.5%). As-is fecal output and fecal DM output were higher ($P < 0.05$) for the HA treatment (218 and 72.6 g/d, respectively). Fecal scores were similar among treatments. No differences were detected among treatments in bifidobacteria, lactobacilli, or Clostridium perfringens concentrations. The experiment demonstrated that HP and HPLP corns had similar ileal and total tract nutrient digestibilities as CONV corn, while HA resulted in similar responses to AM, a well established resistant starch ingredient.

Key Words: Corn, Dog, Digestibility

T98 Evaluation of low-oligosaccharide low-phytate whole soybeans and soybean meal in canine foods. R. M. Yamka*[1], B. M. Hetzler[1], and D. L. Harmon[1], [1]*Department of Animal Sciences, University of Kentucky, Lexington, KY 40546.*

Eight mature dogs (19.3 ± 0.1 kg) were used in a replicated 4X4 Latin square design experiment to determine the consequences of feeding low-oligosaccharide, low-phytate soy on nutrient availability in complete foods fed to dogs. All foods were isonitrogenous (20% CP) and contained low-oligosaccharide, low-phytate soybean meal (LLM), conventional soybean meal (SBM), low-oligosaccharide, low-phytate whole soybeans (LLB), or conventional whole soybeans (WSB) as the protein source. Daily DMI averaged 287 ± 4 g/d. The LLB and WSB foods had the highest fecal outputs averaging 48.2 g DM/d. Small intestinal DM digestibility was highest for LLM (80.9%) and lowest for LLB (74.0%). Large intestinal DM digestibility was not affected by oligosaccharides ($P > 0.65$). Total tract DM digestibility was highest for LLM (87.0%) and lowest for WSB and LLB (averaging 83.3%). Fecal N excretion was lowest for LLM and SBM (1.5 and 1.6 g N/d, respectively) and highest for LLB and WSB (2.3 and 2.0 g N/d, respectively). No differences in N balance, small intestinal N digestibility or large intestinal N digestibility were observed due to the presence of oligosaccharides ($P > 0.67$, $P > 0.21$ and $P > 0.12$, respectively). Tryptophan digestibility was higher for SBM when compared to LLM ($P < 0.04$) and higher for WSB than LLB ($P < 0.001$). Histidine digestibility was higher in WSB when compared to LLB ($P < 0.05$). No differences in nonessential AA digestibility were observed when comparing soy-based foods. The results of this study demonstrate that LLM, SBM, LLB and WSB can be good sources of protein for canine foods and have a high digestibility. Statistical differences in small intestinal digestibility were not observed (with the exception of tryptophan and histidine) when comparing SBM to LLM and WSB to LLB indicating that oligosaccharide and phytate content did not affect digestibility in the present study.

Key Words: Dogs, Soybeans, Digestibility

T99 Accounting for the proportion of alpha-amino nitrogen in crude protein improves metabolizable energy prediction in dry extruded dog foods. R. M. Yamka*[1], K. R. Mcleod[1], D. L. Harmon[1], H. C. Freetly[2], and W. D. Schoenherr[3], [1]*Department of Animal Sciences, University of Kentucky, Lexington, KY 40546,* [2]*USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE 68933,* [3]*Hill's Pet Nutrition, Topeka, KS 66617.*

The modified Atwater's equation [metabolizable energy (ME) kcal/kg = 3.5*crude protein (CP) + 8.5*ether extract (EE) + 3.5*nitrogen free extract] is currently used to predict the metabolizable energy (ME) content of dog foods. However, we found that the equation consistently under predicted ME compared to the observed ME in 55 balance trials. It was our objective to use these balance trials to develop an equation based on chemical composition of the diet to predict ME content of the diets. Eight diets that varied in ME content (3,463 to 4,233kcal/kg) and were fed at maintenance and used in the analysis. The diets varied in protein source, with the major protein sources being low-oligosaccharide whole soybeans, low-oligosaccharide low-phytate whole soybeans (2 sources), conventional soybean meal (2 sources), low-ash poultry meal, low-oligosaccharide low-phytate soybean meal or conventional whole soybeans. A mutlivariate regression analysis was used to predict ME content based on chemical composition. Two initial models were fit to the data. **Model 1** included CP, EE and crude fiber (CF). **Model 2** replaced the CF term with acid detergent fiber (ADF) and neutral detergent fiber (NDF), which resulted in a model that contained CP, EE, NDF, and ADF. Because the diets varied in protein sources the ratio of alpha-amino N (AAN) to non-alpha-amino N (NAAN) ranged from 3.5 to 14.4, therefore we hypothesized that accounting for the proportion of AAN in CP would improve the fit of the models. Model 1 had an r^2 of 0.46 and when AAN and NAAN were substituted for CP, the model had an r^2 of 0.79. Similarly, Model 2 had an r^2 of 0.43 and when AAN and NAAN were substituted for CP the model had an r^2 of 0.82. Residual analysis suggests that by replacing the CF term in Model 1 with ADF and NDF in Model 2 there was an improvement in prediction of ME content. By splitting CP into an AAN and NAAN fractions we have further defined the chemical composition of the diet. These data suggest that defining protein quality improves the ability to predict ME content of dog foods.

Key Words: Dogs, Metabolizable energy, Alpha-amino nitrogen

T100 Estimation of the proportion of bacterial nitrogen in canine feces using diaminopimelic acid as an internal bacterial marker. L. K. Karr-Lilienthal[1], C. M. Grieshop[1], J. K. Spears[1], A. Patil[2], N. M. Merchen[1], and G. C. Fahey, Jr.[1], [1]*Unversity of Illinois at Urbana-Champaign, IL USA,* [2]*Nestle Purina Research, St Joseph, MO USA.*

Approximately 50% of the mass of dog feces may be of bacterial origin, but this number is based on human data. A bacterial marker can be used to determine the portion of fecal N that is of bacterial origin as well as the effect of dietary ingredients on the bacterial N content found in feces of the dog. Two experiments were conducted to determine the efficacy of diaminopimelic acid (DAPA) and purines as bacterial markers in dogs. In experiment 1, five adult, female dogs were fed the same commercial diet. In experiment 2, fifty dogs were fed one of four test diets: a prebiotic-free control, or a diet containing either 1% chicory, 1% mannanoligosaccharide (MOS), or 1% chicory plus 1% MOS. Fresh feces were collected in both experiments and used to isolate a bacterial rich sample (BRS) by differential centrifugation. In experiment 1, the BRS had a 0.66 N:purine ratio and an 18.9 N:DAPA ratio. The coefficient of variation for the N:purine ratio was much higher than that for the N:DAPA ratio, indicating that DAPA would provide a less variable estimate of fecal bacterial N. Using either marker, approximately 50% of the fecal N was estimated to be of bacterial origin. In experiment 2, the N:DAPA ratio of the BRS was not different ($P > 0.05$) among treatments. Dogs fed prebiotic-containing diets had N:DAPA ratios ranging from 17.5 to 18.2, while dogs fed the control were lower at 15.9. For dogs fed prebiotic-containing diets, approximately 48% of the fecal N was of bacterial origin compared with 45% for dogs fed the control. When calculating fecal bacterial concentration using the average N:DAPA ratio for all dogs, little difference existed in the estimation compared to using the individual values. However, for dogs fed the control, the value using the average ratio was approximately 18% higher than when using the individual ratios. This is due to the lower N:DAPA ratio for dogs fed the control compared with dogs fed the other treatments. Based on the consistency of the N:DAPA ratio of the BRS, DAPA appears to be a valuable tool for estimation of bacterial N in feces.

Key Words: Diaminopimelic acid, Dog, Marker

T101 The effect of preservation time length and thawing on *Lactobacillus* population from fecal material. C. J. Fu and M. S. Kerley, *University of Missouri-Columbia.*

A study was conducted to determine the effect of preservation time length on *Lactobacillus* population in dog feces. *Lactobacillus* is typically used as an indicator of dietary-induced bacteria population change, because its presence is important to normal bowel function. Also, reviewers have questioned the validity of using preserved digesta/fecal material for enumeration bacterial populations. The objective of this research was to determine fecal storage effects on *Lactobacillus* population number. The treatment conditions were: 1) Maintained in buffered (pH = 7) anaerobic dilution solution for 2, 4, 7, or 14 days at 4 ^{o}C; 2) Frozen (-80 ^{o}C) overnight (12 h) in the same dilution solution, thawed at 4 ^{o}C for 2 h, and then put in cold tap water for 30 min; and 3) Repeat of the freeze-thaw procedure on the thawed samples generated in treatment 2. Media used to plate the *Lactobacillus* were MRS broth (Difco, #288130, Sparks, MD, USA, 55 g/L) and agar (20 g/L) with 20 mg/L vancomycin supplement. Incubation time was 48 h in an anaerobic chamber at 37 ^{o}C. The population count was compared to the population count of fresh material. The *Lactobacillus* population decreased ($P< 0.05$) after 2, 4, 7, and 14 days storage at 4 oC with 92%, 83% 81%, and 68% of the initial population enumerated, respectively. The *Lactobacillus* population from treatment 2 and treatment 3 was decreased ($P< 0.05$) by 57% and by 89% compared to fresh material, respectively. We concluded from this study that statistical differences in *Lactobacillus* population could occur due to preservation conditions. However, population differences deemed of biological significance (10-fold reduction in population count) would only have occurred when fecal material was refrozen. Caution should be exercised when comparing *Lactobacillus* population counts across different preservation regimens.

Key Words: Feces, *Lactobacillus*, Preservation

T102 Effect of dietary antioxidants on immune system parameters in dogs and cats. D. Jewell*[1], K. Friesen[1], L. Larson[2], T. Sharp[2], and R. Schultz[2], [1]*Hill's Pet Nutrition, Inc,* [2]*The University of Wisconsin - Madison.*

Forty dogs and forty cats were used to evaluate the effect of increasing dietary antioxidants on delayed type hypersensitivity and circulating antibody response to vaccination. The experimental protocol was reviewed and approved by the Institutional Animal Care and Use Committee. Subjects were assigned to dietary treatment groups and fed the treatment foods for 84 days. Dietary treatments consisted of a control food meeting all requirements for adult maintenance and three treatment groups with incrementally increased antioxidant supplementation. The foods with increased antioxidant supplementation all received similar amounts of vitamin C and β-carotene with varying levels of increased vitamin E. Dietary vitamin E was increased by 500, 1000, and 1500 IU/kg in the supplemented foods. Circulating vitamin E increased in a linear ($P<0.01$) and quadratic ($P<0.05$) fashion with antioxidant supplementation in dogs and cats. The standard intradermal skin test (delayed type hypersensitivity) increased in response to increasing dietary antioxidants in dogs ($P<0.05$) and numerically increased in cats. A standard vaccine for four strains of Leptospirosis was used in the dog with the stimulated antibody response measured by specific serovar titer. The sum of the titers from each strain, when compared between the control and the dietary treatment groups had a quadratic trend ($P<0.1$) with the maximum response occurring at 1000 IU Vitamin E/kg. Rabies serology was used to determine an antibody response in cats. A quadratic response ($P<0.05$) was demonstrated in cats with the treatment groups of the first two levels of antioxidant increase having increased titers and the highest antioxidant level supplementation group having a decreased titer when compared to the control. In conclusion, immune function benefits of increased response to a vaccine and increased immune response in an intradermal skin test, were demonstrated in both dogs and cats when antioxidants were added to the food. Both dogs and cats had a maximal benefit by the 1000 IU/kg addition of vitamin E to foods.

Key Words: Antioxidants, Canine, Feline

T103 Evaluation of delta-6 desaturase kinetics in canine liver microsomes for alpha-linolenic acid in the presence of competitive amounts of linoleic acid. J. E. Bauer* and B. L. Dunbar, [1] *Texas A&M University.*

The rate-limiting step in the conversion of essential fatty acids to long chain derivatives is controlled by delta-6 (d-6) desaturase. This enzyme competitively utilizes both linoleic (LA) and alpha-linolenic acids (ALA) as substrates. Efforts to characterize the kinetics of unpurified enzyme for ALA are confounded by the presence of endogenous LA present in the source material. A technique to correct this problem was developed and used to more accurately estimate the Km and Vmax of d-6 desauturase for ALA in the presence of these inhibitory amounts of LA. Microsomes were prepared from fresh canine liver tissue from normally fed adult, mixed breed dogs, and incubated with 14C labeled LA or ALA substrates under standardized conditions. Lipids were extracted, saponified, and the resultant fatty acids phenacylated. Fatty acid phenacyl esters were separated by HPLC and counted by liquid scintillation counting. LA and ALA contents of the microsomes were determined using internal standardization and gas chromatography. This data was then used to construct a graphical correction for the presence of varying and competitive amounts of LA in canine hepatic microsomal enzyme preparations. A similar correction for LA activity was unnecessary due to insignificant amounts of ALA in the microsome preparations. Delta-6 desaturase activities (Vmax) of 62.4 and 5.4 pmol/min mg protein with ALA and LA respectively were thus found with apparent Km values of 12.4 and 41.8 mM, respectively. These data show that dog liver microsomes have EFA desaturation capabilities and that ALA is preferred due to its higher Vmax and lower Km compared to LA. In spite of this preference it was found that liver concentration of ALA averaged only 2.4 mM. Thus, tissue ALA concentrations his may never exceed the Km for desaturation unless high dietary ALA is provided. Hence conversion of ALA may be slow. By contrast, LA is readily converted because its microsomal content (64.4 mM) exceeds its Km. These characteristics may explain low in vivo ALA conversion rates in dogs and

other species. The data further suggest that high levels of dietary ALA may be needed to exceed the Km for d-6 desaturase.

Key Words: Delta 6 desaturase, Kinetics, Alpha linolenic acid

T104 The effect of dietary fat on the fatty acid composition of olfactory mucosal tissues in young adult dogs. C. T. Middendorf, K. A. Cummins*, E. A. Altom, and M. Craig-Schmidt, *Auburn Univeristy, AL* .

Previous studies have indicated that dogs fed a diet high in saturated fat had a decrease in olfactory acuity. A study was designed to determine the influence of dietary fat source on the phospholipid fatty acid composition of olfactory and respiratory mucosa in young-adult dogs. Fifteen young-adult female beagles (average age = 2 yr, body weight average = 9.69 kg) were randomly assigned to receive one of three diets varying in the amount and source of fat. These were Diet A, with 12% crude fat; Diet B, containing 16% crude fat formulated by the addition of 4% corn oil to the maintenance diet; and Diet C, containing 16% crude fat formulated by the addition of 4% coconut oil. Dogs were fed the diets for a period of sixty days, euthanized, and then samples were collected from the olfactory turbinates and nasal passage. Fatty acid compositions of phosphatidylcholine (PC) and phosphatidylethanolamine (PE) were analyzed by capillary gas chromatography. The amount of 16:0 in respiratory PC was greatest from dogs fed Diet B ($P<0.10$), while the amount of 20:4n-6 incorporated into respiratory PC was less ($P<0.10$). No differences were reported for the 20:4n-6 content in PC of olfactory mucosa ($P>0.10$). The amount of 18:2n-6 in PC from both mucosal tissues was greater in dogs fed Diet B than in dogs fed Diets A or C ($P<0.10$). Despite increased amounts of 18:2n-6 in Diet B, there were no differences among treatments in the amount of 18:2n-6 or 20:4n-6 incorporated into PE ($P>0.10$) of either tissue. No differences were observed in the ratio of unsaturated to saturated fatty acid incorporation into phospholipids ($P>0.10$), or in the mean chain lengths ($P>0.10$). No differences were observed in the unsaturation index for the PE fractions and the olfactory PC ($P>0.10$). However, the unsaturation index was lower in dogs fed Diet B in respiratory mucosal PC ($P<0.10$). Results from this study do not fully explain the differences observed in olfactory acuity.

Key Words: Canine, Nutrition, Lipids

T105 Heritability of hypoadrenocorticism in the Portuguese Water Dog and the Leonberger. A. M. Oberbauer*, K. N. Simpson, J. M. Belanger, and T. R. Famula, *University of California, Davis, CA*.

Hypoadrenocorticism (Addison's) is a recognized late onset disorder in the dog. Symptoms are diffuse and a result of deterioration of the adrenal cortex with its subsequent reduction in the capacity to synthesize and secrete glucocorticoids and mineralocorticoids. Diagnosis of Addison's is by ACTH stimulation challenge. Some breeds have a higher than expected incidence of Addison's suggesting a genetic component to the disorder. We have recently reported that Addison's has a genetic basis in the Bearded Collie and Standard Poodle although the mode of inheritance differed. Here we compare the heritabilities and mode of inheritance for the disorder in two additional but related breeds, the Leonberger and the Portuguese Water Dog (PWD). Owners were requested to submit data on the Addisonian status for the above-mentioned breeds along with pedigree, gender, and DNA. The binary nature of the data required a threshold model; a mixed Bayesian analysis model was used to arrive at heritability estimates. Complex segregation analyses were employed to characterize mode of inheritance. The heritability estimates for Addison's disease in the Leonberger (n=294 dogs) and PWD (n=504) were 0.62 and 0.57, respectively. In contrast to the findings in Standard Poodles, the Leonberger and PWD data do not support a single locus of large effect influencing the transmission of Addison's disease. However, when the Leonberger data is corrected for ascertainment bias, the major gene model becomes significant. Although these findings may reflect limited sample sizes, the possibility that different though related breeds have unique patterns of inheritance for Addison's disease may affect the search for genes causal in the expression of canine Addison's.

Key Words: Hypoadrenocorticism, Dog, Heritability

Horse

T106 Use of ass's milk for novel probiotic beverages. E. Salimei*[1], E. Sorrentino[2], M. Succi[2], F. Fantuz[3], G. Varisco[4], and R. Coppola[2], [1]*Dept. SAVA, Univ. of Molise, CB Italy,* [2]*Dept. STAAM, Univ. of Molise, CB Italy,* [3]*Dept. Sci. Vet., Univ. of Camerino, MC Italy,* [4]*Ist. Sperim. Zooprofilattico, Brescia Italy.*

Nutritional and therapeutic properties of ass's milk are known since ancientry, and recent clinical studies confirm its efficacy in the treatment of most complicated cases of infants' multiple food intolerance. In order to deepen the knowledge on ass's milk and its feasible production, 6 asses were studied over two consecutive lactations (150 days/lactation). During the experimental period asses, machine milked, produced in average 740 mL milk/milking; milk yield was higher in the second lactation. Results on ass's milk chemical composition confirm the relative dilution of this product characterized by low fat (averaging 0.38%) and protein (1.72%, in average) contents but with a high lactose content (mean value 6.88%). Protein fraction of ass's milk showed a low protein allergenic content along with a higher content of lysozyme (1.5 g/L). Moreover, due to its high lactose content, ass's milk could be placed amongst the new generation of milk beverages making it possible to effectively combine the advantageous properties of the raw ingredient with lactic acid bacteria. The high levels of lysozyme detected in raw and heat-treated ass's milk could explain the observed low bacterial concentration ($4x10^4$ CFU/mL) of raw milk. Besides this, pH values of control milk (heat-treated and uninoculated) were stable throughout the experiment (15d), confirming the possible role of lysozyme. Ass's milk revealed to be a good growth medium for potentially probiotic lactobacilli strains since pH ranged between 3.67 and 3.85 for all the tested strains after a 48 hour period of incubation. Values were stable up to the end of the experiment. Results evidenced that ass's milk can be adopted as a substrate of probiotic and therapeutic beverages.

Key Words: Ass's milk, Probiotic beverages, Hypoallergenic food

T107 The influence of training on flat walking temporal variables of Tennessee Walikng Horse yearlings. K. M. Holt* and M. C. Nicodemus, *Mississippi State University, Mississippi State, MS*.

Tennessee Walking Horse (TWH) gaits are often described as learned, placing great importance on the training of young horses. To determine the impact of training on yearling TWH gaits, temporal variables were measured before and after a 60-day training period. 60 Hz frame-by-frame analysis was done before and after training to measure temporal variables and kinematic analysis determined velocity and wither height. Five strides of a consistent flat walk with a velocity of 1.7 (0.2) m/s were measured for 4 yearlings. Means (SD) were determined with temporal variables given as % of stride and paired t-tests ($P=0.05$) were used to determine differences before (T1) and after (T2) the training period (Table 1). The flat walk was determined to be a symmetrical, 4-beat gait with an irregular rhythm and lateral couplets. The stride alternated between periods of bipedal and tripedal support in which the lateral bipedal support was longer than the diagonal. The majority of the stride was spent in a stance phase with a similar percent of stance for both the fore and hind limbs. These characteristics did not significantly change after the training period. Flat walking weanlings were found to have similar characteristics as the yearlings, except for some of the weanlings demonstrated regularity of rhythm with an equal percentage of lateral and diagonal bipedal support. This may indicate more of a relationship between growth and temporal variables, rather than training. Understanding the influence of such variables as growth and training on TWH gaits will assist in both clinical and performance applications.

	T1	T2
Height(m)	1.4(0.1)	1.5(0.1)
Stride Duration(ms)	1055(33)	1098(27)
Fore Stance(%)	59(2)	61(2)
Hind Stance (%)	59(1)	61(1)
Lateral Advanced Placement(%)	19(5)	20(4)
Diagonal Advanced Placement(%)	30(4)	30(4)
Lateral Advanced Lift-Off(%)	22(8)	21(6)
Diagonal Advanced Lift-Off(%)	31(6)	29(5)
Bipedal Support(%)	62(5)	55(2)
Tripedal Support(%)	38(3)	45(2)

Table 1: Mean values (SD) for the temporal variables.

Key Words: Tennessee Walking Horses, Temporal variables, Training

T108 Walking temporal variables of the padded Tennessee Walking Horse.

M. C. Nicodemus* and K. M. Holt, *Mississippi State University, Mississippi State, MS*.

Shoeing is a major component of showing for the Tennessee Walking Horse (TWH). The most popular TWH show classes are the padded classes in which multiple wedges are added to the front hooves to enhance the horse's performance. To better understand the influence of this shoeing on the gaits, the flat and running walks temporal variables of the padded TWH were measured and compared to earlier studies done on the flat shod TWH. 4 padded, show horses were ridden at the flat and running walks while being filmed. Shoeing weight, height, and angles met TWH show standards for open padded classes. 60 Hz frame-by-frame analysis of the video determined stride duration and percent of stride duration for fore and hind stance; lateral and diagonal bipedal, unipedal, and tripedal support; and lateral and diagonal advanced placement and lift-off. Means (SD) are given in the table with similar superscripts between variables within a gait representing significant differences according to paired t-tests ($P<0.05$).

Both gaits had longer hind stance and diagonal advanced lift-off. The flat walk had a regular rhythm with longer lateral bipedal support. The running walk had an irregular rhythm with diagonal couplets and even periods of bipedal support. In comparison to earlier flat shod TWH studies, the flat shod flat walk had shorter periods of forelimb swing and single hind limb support while demonstrating a period of tripedal support with two forelimbs. The flat shod running walk compared to the padded demonstrated lateral couplets while having a shorter period of single hind limb support and uneven periods of bipedal support. The flat shod and padded TWH gaits may be different due to shoeing. Further shoeing research can assist in both the clinical and performance evaluations of the TWH.

Temporal Variables	Flat Walk	Running Walk
Stride Duration(ms)	794(27)	783(21)
Fore Stance(%)	$36(3)^a$	$36(2)^a$
Hind Stance(%)	$54(2)^a$	$54(2)^a$
Diagonal Adv. Placement(%)	21(8)	$14(9)^b$
Lateral Adv. Placement(%)	29(4)	$36(4)^b$
Diagonal Adv. Lift-Off(%)	$38(8)^c$	$36(4)^c$
Lateral Adv. Lift-Off(%)	$13(8)^c$	$14(4)^c$
Single Hind Support(%)	28(4)	28(3)
Diagonal Bipedal Support(%)	$23(4)^d$	28(7)
Lateral Bipedal Support(%)	$40(6)^d$	35(5)
Tripedal Support-2 Hind Limbs(%)	8(2)	9(1)

Key Words: Tennessee Walking Horses, Temporal variables, Shoeing

T109 Effects of post-partum ivermectin administration to broodmares on the incidence of foal-heat diarrhea.

S. E. Harris[1], M. M. Vogelsang*[1], E. E. Bass[2], and G. D. Potter[1], [1] *Texas A&M University, College Station, TX USA*, [2] *University of Georgia, Athens, GA USA*.

Foal-heat diarrhea (FHD) is the most common self-limiting diarrhea in foals less than two weeks of age with an incidence as high as 70-80 percent. Although FHD does not seem detrimental to long-term health, it does present a management problem and can predispose foals to more severe diarrhea. It has been proposed that the parasite, *Strongyloides westeri*, could be the causative agent for FHD since infestations in foals develop about 10 to 14 days of age. The objective of this on-farm study was to determine the efficacy of post-partum anthelmintic treatment of mares for reducing the incidence and/or severity of FHD in foals. Although a number of anthelmintics are effective against *S. westeri*, ivermectin was utilized because of availability and efficacy against milk borne strongyloides infestations. Twenty-four mares and their foals were alternately assigned to a treated or non-treated group according to expected foaling date. Treatment consisted of oral administration of Zimectrin® to the dam within 12 h post-foaling. From d1 through d25, foals were weighed and vital signs, incidence or absence and severity of diarrhea recorded. Incidence scores (severity of diarrhea) were assigned on a 0-3 scale with 0 being absence of symptoms and 3 being extremely profuse diarrhea. Only 1 foal (from the treated group) did not demonstrate symptoms of diarrhea during the 25-day data collection period. Foals from treated mares had symptoms of diarrhea from d2 through d21 and those from non-treated mares from d2 through d25. The greatest number of foals from treated mares showed symptoms from d8 through d13 while those from non-treated mares showed symptoms from d9 through d18. There was no difference in incidence scores due to treatment; however there was a trend for foals from treated mares to experience a more severe diarrhea over a shorter duration. There was no difference in weight change related to treatment or non-treatment of mares. Post-partum administration of ivermectin to mares did not decrease the incidence or severity of diarrhea in foals or affect growth rate of foals.

Key Words: Foal heat diarrhea, *Strongyloides westeri*, Ivermectin

T110 Body condition scores and biometric measurements to predict body weight in warm blood German riding horses.

S. Schramme and E. Kienzle*, *Chair of Animal Nutrition, Ludwig-Maximilians-University, Munich, Germany*.

Existing systems of body condition scoring (BCS) and biometric measurements were developed for other breeds but not for warm blood German horses. Consequently there are some problems with transferring these systems to German warm bloods, such as more prominent hook bones in this breed. The present investigation was carried out to adapt existing BCS systems (scale 1 emaciated – 9 obese) to German horses, especially with regard to frequently asked questions of the owners, and to develop a more reliable method to predict body weight from biometric measurements in this breed. For adaptation of the BCS-System of Henneke et al. (1983) 145 horses were scored. In addition to sonographic measurements, in some cases, post mortems, measurements of skinfold thickness, and neck fat were carried out. Several horses with substantial changes of BCS were observed over time. In total 181 horses were scored, measured and weighed. The heart girth, withers height (measured by tape and by rule), circumference of horse (at the height of pin bones), circumference of cannon bone, and circumference of neck base were measured to develop a predictive equation by multiple regression calculation. The following equation was obtained: Body weight (kg) = -1160 + 2.594*withers height (by tape, cm) + 1.336*heart girth (cm) + 1.538*circumference of horse (cm) + 6.226*circumference of cannon bone (cm) + 1.487*circumference of neck base (cm) + 13.63* BCS (points); r=0.94**. This equation was applied to 139 other horses (actual body weight 365-742 kg). The regression equation between predicted and actual body weight (predicted body weight=0.84*actual body weight +86; r=0.918**, SE=17) demonstrates a high predictive precision of this equation for warm blooded German horses.

Key Words: Body condition scores, Body weight prediction, Warm blood horses

T111 Effects of feeding a blend of grains naturally-contaminated with *Fusarium* mycotoxins on feed intake and indices of athletic performance of horses.

S. L. Raymond*, T. K. Smith, and H.V.L.N. Swamy, *University of Guelph*.

An experiment was conducted to determine the effect of feeding blends of grains naturally-contaminated with *Fusarium* mycotoxins to mature horses and to test the efficacy of a polymeric glucomannan mycotoxin adsorbent (GM polymer, MTB-100, Alltech Inc.) in preventing *Fusarium* mycotoxicoses. Six mature, light, mixed breed mares were assigned to one of three dietary treatments for 21 days following a duplicated 3 x 3 Latin square design. Feed consumed each day was a combination of up to 3.5 kg of concentrates and 5.0 kg of mixed timothy/alfalfa hay. The concentrates fed included: (1) control (2) blend of 36% contaminated wheat and 53% contaminated corn and (3) contaminated grains + 0.2% GM polymer. Diets containing contaminated grains averaged 11.0 ppm deoxynivalenol, 0.7 ppm 15-acetyldeoxynivalenol and 0.8 ppm

zearalenone. Feed intake and body weight were monitored over a 21-day period. Horses were maintained on a fixed exercise schedule during the supplementation phase. At the end of the supplementation phase each horse completed a time to fatigue treadmill step test. Parameters measured during pre-test, each step of the test and 5 and 10 minutes post-test were: (1) time to fatigue (2) heart rate (3) hematology (4) serum lactate levels. Feed intake of horses fed contaminated grains was significantly reduced compared to controls throughout the experiment. Consumption of forage remained unaffected regardless of diet fed. Significant weight loss over 0 to 21 days was observed in horses fed contaminated grains as compared to control. Horses fed contaminated grains had significantly higher serum lactate levels at time of fatigue, while levels were significantly reduced 10 minutes post-test. It was concluded that horses are susceptible to *Fusarium* mycotoxicoses as indicated by appetite suppression and weight loss.

Key Words: Deoxynivalenol, Equine, Exercise

Rabbit

T112 Effect of doe-litter separation on reproductive performance of lactating rabbits does. A. Espinosa, R. Lazaro*, R. Carabaño, and P.G. Rebollar, *Universidad Politecnica de Madrid. Spain.*

Two trails were conducted to study the influence of separating the litter from the doe for 53 h on fertility and reproductive parameters of multiparous Californian x New Zealand White crossbred female rabbits. There were two treatmeants; a control group in which litters had free access to nursing and a bioestimulated group in which litters were separated from their does from Day 9 (9:00 a.m) to Day 11 (14:00 p.m) postpartum. All the does were artificially inseminated (AI) between 10:00 and 11:00 a.m of Day 11 postpartum. In trail 1, a total of 419 AI (experimental unit), carried out in 132 multiparous does, was analyzed to determine fertility rate (number of farrowing/number of AI x 100). Separation of the litter from the doe increased fertility with respect to the control group (68% vs 53%, $P < 0.001$). In fact, fertility rate was 38%, 30%, and 31% higher for 2nd, 3rd, and 4th parturition ($P < 0.05$) for the bioestimulated does. In trial 2, a total of 16 does, between 3rd and 6th farrowings and having more than seven suckling rabbits at parturition were used to estimate milk production from 1 to 21 d postpartum. The experimental treatments were the same than in trial 1 and there were eight replicates (one doe) per treatment. Milk production was higher in the control than in the bioestimulated does (5,090±161 vs 4,593±150 g, $P < 0.05$). In fact, on Day 12, 13, 14, and 15 of the lactation period, milk production was 40% ($P < 0.0001$), 18% ($P < 0.05$), 15% ($P < 0.05$), and 15% ($P < 0.01$) higher for the control than for the bioestimulated group, respectively. Also, restricting suckling for 53 h from Day 9 to Day 11 of lactation increased oestradiol 17-β during 48 h after the separation and reduced prolactin serum concentrations 24 h after the separation. We concluded that bioestimulation increased fertility rate, specially from the 2nd to the 4th farrowing, but reduced milk production during the first 21 d postpartum.

Key Words: Doe-litter separation, Rabbit fertility, Milk production

T113 Milk production evaluation in rabbits milking one or two times a day. R. Salcedo-Baca*[1,2], J. L. Echegaray-Torres[2], and A. Robinson[1], [1]*University of Guelph, Guelph, ON, Canada,* [2]*Universidad Autonoma Chapingo, Texcoco, Estado de Mexico, Mexico.*.

Milk production (MP) is an important trait for profitability of rabbit production, since it affects the litter weaning weight. Currently, under a typical management system, the doe is allowed to milk her litter only once a day for 5 to 10 minutes. Some reports in the literature have indicated that around 20 to 30 % of the does would get into the nest to milk 2 times a day if they were allowed. The objective of this study was to evaluate the effect of the number of times milked in a day (one or two) on the total milk production of the doe. In the Universidad Autonoma Chapingo, Mexico rabbitery, sixteen multi-parous New Zealand does with their litters (85 young) were evaluated for a lactation period of 35 days (during January and February, 2003). Every day the litter was weighed before and after milking in order to measure the MP of the doe. Does were separated into morning only milking (T1, n=7) and morning and night milking (T2, n=9). SAS PROC GLM was used to analyze the records, fitting a model including milking pattern, and litter size at birth, day 3, 15 and 30 as covariates. The model explained 75% of the variation. Highly significant differences were found between treatments: 3232g and 4070g for T1 and T2 respectively, the litter size was a significant variable as well. To investigate the effect on fertility, the does were not allowed to milk on day 10 and artificially inseminated (AI), on day 11 after parturition. Pregnancy diagnosis through abdominal palpation was conducted 11 days after breeding. T1 and T2 had 72% and 89% of pregnancy respectively. There were no significant differences in the doe weight change during the last 2 weeks of the experiment. For the entire period mortality of the young was 8.6% and 6.0% for T1 and T2 respectively. The average individual weight of the young at the end of the test was 511g and 657g for T1 and T2, with litter size of 4.6 and 5.2 respectively. Two times a day milking, when labor cost is not expensive, is thus recommended.

Key Words: Rabbit, Milk, Production

T114 Parturition synchronization in rabbits using prostaglandins: Optimal time for hormone application. J. L. Echegaray-Torres*[1], R. Salcedo-Baca[1,2], and C. Flores-Martinez[3], [1]*Universidad Autonoma Chapingo, Chapingo, Edo. de Mexico,* [2]*University of Guelph, Guelph, ON, Canada,* [3]*Instituto Tecnolgico Agropecuario de Oaxaca, Oaxaca, Mexico.*

Currently, industrial rabbit systems typically manage does in sets (bands). Each set of does is artificially inseminated together, but parturition can occur over a 4 d period. This spread in parturition time increases labor demands to attend to does, or alternatively, increases the risk of mortality in the progeny. In addition, fostering young from bigger to smaller litters increases in difficulty as age gaps widen. The objectives of this study were to use pregnant N.Z. White does to 1) evaluate the effectiveness of prostaglandins (PG) in syncronizing parturition and 2) discern optimal PG application times. In Exp. 1, 39 (Jan. 2001) and 31 (Nov. 2002) does were injected with PG 29 d post-insemination (100 mg PG/doe; T1). Respective control groups (T2) contained 38 and 27 does. Time of parturition was measured in hours considering zero the moment of hormone application. Time of parturition was higher (P=0.05) in between treatments 53:55 and 66:22 for T1 and T2 respectively. Also, more (97% vs. 60%;) deliveries occurred within 48 h from start of first delivery in T1 than in T2. Litter size at birth (live progeny) was similar in T1 (7.8) and T2 (8). In Exp. 2 (Jan. 2003), different PG application days and times post-insemination (same dose as Exp.1), were tested against a control group (Td), d 29 am (Ta), d 29 pm (Tb), and d 30 am (Tc), each group with 20 does. There were significant differences between treatments in time of parturition (50:42ab, 54:07b, 43:25a, and 55:10b for Ta, Tb, Tc and Td respectively). Parturitions recorded in the first 24 h after the first delivery was 69, 89, 43, and 70% for Ta, Tb, Tc, and Td respectively. In conclusion, injection of 100 mg/doe PG on day 29 (pm) of pregnancy is recommended for rabbit production systems where does are managed in sets.

Key Words: Rabbits, Parturition, Synchronization

T115 The shape of the lactation curve in rabbits milking once or twice a day, and the function to estimate the total milk production. R. Salcedo-Baca*[1,2], J. L. Echegaray-Torres[2], and A. Robinson[1], [1]*University of Guelph, Guelph, ON, Canada,* [2]*Universitad Autonoma Chapingo, Texcoco, Edo. de Mexico, Mexico.*

A typical doe production milk (MP) curve starts with around 50g/day increasing to reach a peak, between 200 and 250g, around day 21 and then declines to day 30 when it varies around 150g. The total MP is affected by the litter size. The persistency is known to be influenced by the breed-back schedule; shorter days open results in the MP declining sooner. To predict the total MP the following regression equation is recommended (RER) in the literature to model a rabbit lactation curve (LC): MP = 1.77 + 1.39 LW21, where LW21 is the litter weight at day 21. Currently milking in rabbits, under commercial production systems, is restricted to once a day. The aim of this study was to find out if there are differences in total MP, shape of the lactation curve and goodness of

fit of the LC function estimating MP under one (T1) or two (T2) times a day milking. The material and methods have been described in another abstract in these proceedings*. The statistical analysis was done with SAS, PROC REG and PROC CORR, to derive a new lactation curve prediction equation (NLC). Total MP was higher for T2 compared to T1 (4070g vs. 3232g). The peak was reached between days 17-18 and 19-20 for T2 and T1 respectively. Persistency, however, was better for T1, which had a higher production after day 29 than T2. The NLC derived in this study added two components; MP on day 4 and day 30, as follows: MP = 804 +9.4 MP4 + 1.4 LW21 + 5.5 MP31. The correlations were 0.92 and 0.96 between the true MP and LC, and true MP and NLC. In addition MP was underestimated on average in 40% of does with LC while NLC overestimated MP in just 4% of does. If MP is a trait to be improved genetically based on a prediction of lactation milk yield, we recommend fitting a regression incorporating multiple measures of daily milk yield like NLC.

Key Words: Lactation, Curve, Rabbits

Ruminant Nutrition: Dairy and Beef

T116 Effects of rumen degradable protein and fiber quality on extracellular proteolytic activity in continuous culture. D. Hastings, K. Griswold*, T. Kochman, B. Jacobson, and G. Apgar, *Southern Illinois University*.

The effects of rumen degradable protein (RDP) and fiber quality on extracellular proteolytic activity (PA) were examined using a 4 x 4 Latin square with a 2 x 2 factorial arrangement of treatments in dual-flow continuous culture. Factors were level of RDP and quality of fiber, and the treatments were: 1) high RDP (12.4% of dietary DM), high quality alfalfa (156 RFV) (HPHF); 2) high RDP (12.4% of dietary DM), low quality alfalfa (105 RFV) (HPLF); 3) low RDP (10.4% of dietary DM), high quality alfalfa (156 RFV) (LPHF); and 4) low RDP (10.4% of dietary DM), low quality alfalfa (105 RFV) (LPLF). Periods were 10 d and samples were collected daily at 0800 h from fermenter contents and from 24 h effluent composites. Samples were centrifuged (20,000 x *g*, 20 min, 4°C), and supernatant was analyzed for protein content and PA. Using an azocasein assay, PA was defined as units of activity/mg protein, where a unit equaled the change in absorbance at 450 nm/min based on the purified activity of Subtilisin (EC 3.4.21.62). Data were analyzed using SAS MIXED procedures with the model including period, fermenter, RDP, fiber quality, RDP x fiber quality interaction, type of sample (composite vs single time point), and day included as a covariate. Composite samples had greater (P=0.01) protein concentrations and less (P=0.05) PA than single time point samples. Sample protein concentration (mg/mL) was 0.27, 0.40, 0.34, and 0.36, and PA (units/mg protein) was 0.18, 0.16, 0.16, and 0.14 for HPHF, HPLF, LPHF and LPLF, respectively. Dietary RDP concentration had no effect (P>0.05) on sample protein concentration or PA. There was a RDP x fiber quality interaction for HPHF protein concentration to be less (P<0.01) than all other treatments. Decreasing fiber quality increased (P<0.01) protein concentration, and in turn, decreased (P=0.05) PA. These results suggest dietary fiber quality may have a greater influence on ruminal extracellular proteolytic activity than dietary RDP.

Key Words: RDP, Fiber quality, Proteolytic activity

T117 Relative transite time of chyme between duodenal and jejunal segments of the small intestine of cattle. V. M. Gonzalez[1], E. G. Arellano[1], G. Mendoza[1], F. G. Monge[1], A. Plascencia*[1], E. Silva-Pena[1], C. Vasquez[1], and R. A. Zinn[2], [1]*Universidad Autonoma de Baja California, Mexico,* [2]*University of California, Davis*.

Two steers (228 ± 4.5 kg) were equipped with cannulas (25 mm ID) in the small intestine to measure transit time of chyme within the duodenum, and jejunum. Sites for cannula placement were 1) proximal duodenum (6 cm from the pyloric sphincter); 2) duodenal-jejunal juncture (10 cm from the duodenocolic fold) and 3) distal ileum (22 cm from ileocecal valve). Steers were fed 5.75 kg of alfalfa hay (ground to pass through a 7.6 cm screen). Transit time was measured during three consecutive days using aniline dye, pulse-dosed via the duodenal and jejunal cannulas. Subsequently, steers were euthanazed. Site of cannula placement were confirmed using anatomical reference and tissue analysis. The small intestine was then dissected and measured. Transit time (time required between infusion of aniline dye into the proximal duodenal cannula and its appearance at the duodenal-jejunal and distal ileal cannulas was 2.56 ± 0.06 and 176 ± 4.21 min, respectively. Length of duodenal, jejunal, and ileal segments of the small intestine were 135 ± 4, 2730 ± 27 and 110 ± 1 cm, respectively. Transit time of chyme within the duodenum and jejunum averaged 46 and 14 cm/min, respectively. Considering that the duodenum represents less of 5% of total length of small intestine, that duodenal transit time is threefold faster than that of the rest of the small intestine, and that pancreatic and bile secretions into the duodenum occur midway along its length, we conclude that the duodenum plays a minor role in net nutrient absorption from the small intestine.

Key Words: Small intestine, Transite time, Cattle

T118 Effects of feeding a slow-release urea on ruminal nitrogen dynamics in steers. K. C. Hanson*[1], S. E. Kitts[1], N. B. Kristensen[1], D. E. Axe[2], and D. L. Harmon[1], [1]*University of Kentucky, Lexington,* [2]*IMC, Lake Forest, IL*.

Twelve ruminally-cannulated steers (529 ± 11 kg BW) were used to determine the effect of feeding a slow-release urea on ruminal N dynamics. Steers were equally divided into two groups: control (feed grade urea; FGU) or slow-release urea (SRU). Steers were fed corn silage plus 10% supplement at 1.29% BW for 35 d. Diets were formulated to be isonitrogenous and contain 12.5% crude protein. All supplemental N was from FGU or SRU (42% of N intake). Blood was collected via jugular vena-puncture on d 33 and plasma was harvested for analysis of urea, glucose, glutamate, and glutamine. On d 34, ruminal fluid was collected every two h for ten h post-feeding and analyzed for NH_3, VFA, and pH. Samples taken 4 h post-feeding were analyzed for urease activity. On d 35, an in situ study determined the release of SRU from nylon bags suspended in the rumen. Nylon bags containing SRU were suspended for 0, 2, 4, 6, 8, 12 and 24 h. Upon removal, bags were rinsed and dried at 55° C before analysis for N content. Body weights and DM intakes were similar. Ruminal pH (6.5) was not affected by treatment but ruminal ammonia was less (8.9 vs. 14.1 mM; P < 0.02) and ruminal urease activity was greater (149 vs. 89 mmol/(min·mL rumen fluid); P < 0.06) in steers consuming SRU. In situ rates of SRU degradation were not affected by treatment (6.28 %/h), indicating that the ruminal microbes did not adapt during 35 d of feeding SRU. Plasma glucose concentrations were less (50 vs. 60 mg/dL; P < 0.02) in steers fed SRU. Plasma urea (5.1 mM), glutamine (255 μM), and glutamate (174 μM) concentrations were not affected. Ruminal VFA molar proportions or concentrations were not affected by treatment. These results demonstrate that SRU possesses the ability to slowly release N in the ruminant.

Key Words: Ruminant, Urea, Nitrogen

T119 Effect of a novel hexadecatrienoic acid from marine algae (*Chaetoceros*) and olive oil on methane production by ruminal fluid in vitro. E. M. Ungerfeld*[1], S. R. Rust[1], M. T. Yokoyama[1], R. Burnett[1], and J. K. Wang[2], [1]*Michigan State University, East Lansing, MI, USA,* [2]*University of Hawaii at Manoa, Honolulu, HI, USA*.

Since methane emissions by ruminants are a major loss of feed energy and also contribute to global warming, there is considerable interest in decreasing ruminal methanogenesis. Fats and oils usually decrease methane production both in vitro and in vivo, although they also inhibit fermentation. We studied the effects of a novel hexadecatrienoic acid ($C_{16:6,9,12}$) and of olive oil on ruminal fluid 24 h-batch in vitro fermentation. The hexadecatrienoic acid was purified from a marine algae (*Chaetoceros*) at the Univ. of Hawaii-Manoa. Initial concentrations of both additives were 0, 0.5, 1, and 2 mg/L (n = 4). The hexadecatrienoic acid linearly decreased (P < 0.01) methane production by 96%, while olive oil did not affect it. The hexadecatrienoic acid also caused (P = 0.02) a 6-fold hydrogen accumulation. Production of carbon dioxide was linearly decreased (P < 0.01) by the hexadecatrienoic acid by 46%, while olive oil increased carbon dioxide production linearly (P = 0.03) by 17%. Neither additive had an effect on final pH. Apparently fermented OM, as estimated from the VFA stoichiometry, was linearly decreased (P < 0.01) by the hexadecatrienoic acid by 47%, while olive oil increased it linearly (P = 0.03) by 5%. The hexadecatrienoic acid linearly decreased (P < 0.01) acetate molar percentage from 69 to 55%,

tended to decrease (P < 0.10) butyrate molar percentage, and increased (P < 0.01) propionate molar percentage from 21 to 36%. Olive oil linearly decreased (P < 0.01) acetate molar percentage from 70 to 66%, and increased (P = 0.02) propionate from 22 to 23% and butyrate from 6.1 to 9.5%. The hexadecatrienoic acid linearly decreased (P = 0.04) ammonia concentration by 21%, while olive oil did not affect it. The hexadecatrienoic acid was a strong inhibitor of ruminal methanogenesis, but it decreased fermentation, and caused some hydrogen accumulation. Olive oil could be used to increase dietary energy without negatively affecting fermentation.

Key Words: Methane, Rumen, Oil

T120 Short-term energy and protein supplementation affects ammonia, urea and glucose flux across portal-drained viscera (PDV) and liver in Holstein steers. J. H. Eisemann*[1], J. E. Ramirez[1], K. E. Govoni[2], S. A. Zinn[2], and G. B. Huntington[1], [1]*North Carolina State University,* [2]*University of Connecticut.*

The objective was to determine the effect of dietary supplements on plasma concentration of IGF-I, IGF binding proteins (BP) and on net splanchnic flux of glucose, urea, and ammonia (NH3). Eight Holstein steers (212 ± 5 kg) with catheters in the hepatic portal vein, a branch of the hepatic vein, a branch of the cranial mesenteric vein and an artery were fed a basal, low ME and low CP diet for 3 wk (4 kg/d, 8.84 Mcal ME, 424 g CP) before receiving one of two supplements similar in ME but different in protein content. The high protein supplement (HIPRO, 4 steers, 400 g/d soybean meal:corn gluten meal 1:1.5 (w:w), 1.37 Mcal ME, 210 g CP) or low protein supplement (LOPRO, 4 steers, 385 g/d corn grain, 1.29 Mcal ME, 30 g CP) was fed for 7 d. Steers were fed equal-size meals every 12 h. Plasma concentrations of NH3, urea N, and glucose, plasma flow (indicator dilution) and net flux (mmol/h, venoarterial differences x plasma flow) through PDV and liver were measured hourly for 12 h during the basal period and after 7 d of supplementation. Plasma IGF-I, BP2 and BP3 concentrations were measured in arterial samples taken 4 h post-feeding. Means ± SEM for the basal period (8 steers) were 0.214 ± 0.018 mM, 1.53 ± 0.18 mM, and 4.34 ± 0.09 mM for arterial NH3, urea N and glucose, 386 ± 23 L/h and 470 ± 24 L/h for PDV and liver plasma flow, 46 ± 3.4 and 48 ± 3.7 for net PDV release and net liver uptake of NH3, 38 ± 5.7 and 50 ± 8.5 for net PDV uptake and net liver release of urea N, 30 ± 3.3 and 121 ± 13.7 for net PDV uptake and net liver release of glucose, 108 ± 13 ng/mL, 22 ± 3 arbitrary units (AU), and 24 ± 2 AU for arterial IGF-I, BP2 and BP3. Supplement minus basal differences in concentration or net flux within steer were used to assess response (P < 0.05). Supplement NH3 responses were due to increased PDV release and liver uptake with HIPRO. Supplement urea responses were due to increased PDV uptake and liver release with HIPRO. Supplement glucose responses were due to a combination of decreased PDV uptake and liver release with LOPRO and increased PDV uptake and liver release with HIPRO (P < 0.13 for liver). Supplement did not affect plasma concentration of IGF-I, BP2 or BP3. Ruminal degradation of supplemental protein and gluconeogenesis from absorbed amino acids likely explain observed responses.

Key Words: Protein, Energy, Steers

T121 Is ruminal biotin availability decreased by low pH? O. Rosendo*[1], D. Bates[1], C. R. Staples[1], L. R. McDowell[1], R. J. McMahon[1], W. M. Seymour[2], and N. Wilkinson[1], [1]*University of Florida, Gainesville, Fl.,* [2]*Roche Vitamins, Inc., Parsippany, NJ.*

The objective of this study was to measure biotin availability for ruminal microorganisms to degrade forage fiber in media pH of 6.7 and 5.3. In vitro 24-h Tilly and Terry incubations of alfalfa hay (54.8% NDF), bermudagrass hay (76.7% NDF), or corn silage (47.6% NDF) (OM basis) were conducted without adding biotin to media. Ruminal inocula was obtained from a lactating Holstein cow fed a diet composed mainly of corn silage, alfalfa hay, whole cottonseed, ground corn, and soybean meal. Three tubes for each pH by forage source were incubated with a 4:1 ratio of McDougall's buffer and ruminal fluid for 0 and 24 h at 39°C for each fermentation run. Three fermentation runs were conducted. Tube contents at 0 and 24 h were centrifuged for 20 min at 20,000 x g (4 °C) and aliquots of the supernatant (1 ml) were centrifuged at 13,000 x g for 10 min to obtain a clear cell-free supernatant. Biotin concentrations in cell-free rumen fluid at 0 and 24 h were assayed as avidin binding substances, and analyzed using the GLM procedure of SAS. The model included factors for run, forage, pH, hour, and interactions. Mean biotin concentration was higher in media from bermudagrass (12.8 nM) than that from alfalfa (10.1 nM) but was not different from that from corn silage (11.7 nM). Interactions of forage source by pH (P = 0.32) and forage source by hour (P = 0.14) were not significant. The magnitude of increase in biotin concentration from 0 to 24 h of fermentation averaged across forage sources varied with pH (pH by hour interaction, P = 0.0001). Biotin concentration in media increased from 0 to 24 h incubation by 25 and 104% for pH 6.7 (7.9 to 9.9 nM) and 5.3 (9.3 to 19.0 nM), respectively. Almost no NDF digestion occurred at a pH of 5.3 compared to a pH of 6.7 (13.2 vs. 35.6%). Results suggest that biotin was less utilized at pH 5.3 likely due to a decrease in the growth of cellulolytic microbes. At pH of 6.7, equilibrium between biotin producers and utilizers may have prevented accumulation of biotin in the medium.

Key Words: Biotin, In vitro, pH

T122 Ammonia production rate from five protein sources. E. B. Venable* and M. S. Kerley, *University of Missouri-Columbia.*

The purpose of this study was to measure the rate of ammonia production by ruminal fermentation of five common protein sources. It is possible to minimize nitrogen waste in the rumen if excessive ammonia production does not occur. Ammonia consumption in the rumen can be estimated based upon microbial growth and efficiency. Matching ammonia production to ammonia consumption requires knowledge of ammonia production rates from the degradable protein sources, which was the objective of our research. An in vitro batch culture was used to ferment five sources of rumen degradable protein (RDP) to ammonia. Those sources were soybean meal (SBM), soyhulls (SH), corn gluten meal (CGM), corn gluten feed (CGF), and dried distiller's grains with solubles (DDGS). Rumen fluid and McDougall's buffer was mixed to .1 L volume at a ratio of 1:4 with 2.5 g of RDP source added. Samples were taken at 1, 2, 4, 8, 10, 12, 16, 24, and 30 hours and analyzed for ammonia concentration. The rate of ammonia N released per hour per gram of protein was 0.3, 0.5, 0.4, 0.3, and 0.9 for DDGS, CGF, CGM, SH and SBM, respectively. These values are a function of RDP mass and fermentation rate. When rate was expressed as a percentage of the fermented protein fraction, ammonia N production rate was 3.2, 3.0, 3.2, 2.6, and 3.5% for DDGS, CGF, CGM, SH, and SBM, respectively. Concluded from this research was that proteolytic activity against degradable protein followed substrate limiting kinetics with ammonia N production rates similar across sources of protein studied. Therefore, ammonia production could be calculated by an empirical equation based upon the degradable protein mass consumed.

Key Words: Protein, Ammonia

T123 Influence of abomasal carbohydrates on small intestinal sodium-dependent glucose co-transporter activity and abundance in steers. S. M. Rodriguez*[1], K. C. Guimaraes[1], J. C. Matthews[1], K. M. McLeod[1], R. L. Baldwin[2], and D. L. Harmon[1], [1]*University of Kentucky, Lexington,* [2]*USDA, ARS, Beltsville, MD.*

There is conflicting data concerning the extent of up-regulation of SGLT1 in response to carbohydrate in the small intestinal lumen. An experiment was conducted to determine the effect of glucose and starch hydrolysate on activity and abundance of sodium-dependent glucose co-transporter 1 (SGLT1) in the small intestine of steers. In a randomized complete block design, forty crossbred beef steers (243 ± 2 kg BW) were fed 0.163 Mcal ME/(kg $BW^{0.75}$·d) (1M) or 0.215 Mcal ME/(kg $BW^{0.75}$·d) (2M) or they were fed 0.163 Mcal ME/(kg $BW^{0.75}$·d) and infused for 35 d into the rumen (R) or abomasum (A) with starch hydrolysate (S) or into the abomasum with glucose (G). Steers were slaughtered, and brush-border membrane vesicles were prepared from the small intestinal samples obtained from five equidistant sites along the intestine. The maltase activity, Na^+ dependent glucose transport capacity and SGLT1 protein abundance of the vesicles were determined. Maltase specific activity in vesicles and homogenates differed with intestinal sampling site (quadratic; P < 0.001). The AG treatment yielded a higher intestinal maltase specific activity (38 nmol glucose/(mg protein#min) compared to the AS, RS, 1M or 2M treatment 34, 26, 23, and 23 nmol glucose/(mg protein#min), respectively (SEM=3; P = 0.02). Sodium dependent glucose uptake was not affected by treatment, but decreased distally along the intestine (P < 0.001). There was no effect

of treatment on SGLT1 protein abundance, but SGLT1 protein abundance increased from the duodenum to the ileum (linear; P = 0.05). The inverse relationship between glucose uptake and SGLT1 abundance suggests that regulation of glucose transport capacity is complex, involving factors other than SGLT1 abundance.

Key Words: Glucose, Ruminant, Transport

T124 Effects of combinations of ethyl 2-butynoate and crotonic acid or 3-butenoic acid on ruminal degradability and microbial efficiency in vitro. E. M. Ungerfeld*, S. R. Rust, and R. Burnett, *Michigan State University, East Lansing, MI, USA*.

It is desirable to decrease methane formation in the rumen because it represents an energy loss and contributes to global warming. Ethyl 2-butynoate has been shown to inhibit ruminal methanogenesis in vitro, but also had adverse consequences on fermentation. As crotonic acid and 3-butenoic acid seemed to stimulate fermentation, it was hypothesized that they could relieve the fermentation constraints caused by ethyl 2-butynoate. In 1000 mL-Erlenmeyer flasks, 750 mL of a 4:1 mixture of buffer and ruminal fluid was delivered under O_2-free CO_2, and 6 g of grass hay used as substrate. Ethyl 2-butynoate at 0, 4, and 8 mM initial concentration was combined with crotonic acid (Exp. 1) or 3-butenoic acid (Exp. 2) at 0 or 4 mM (n = 3). Flasks were incubated at 39 °C for 72 h. ^{15}N was used as a microbial marker. In Exp. 1, ethyl 2-butynoate decreased N (P = 0.04; quadratic response) and OM (P = 0.04; quadratic response) degradability from 48 to 19%, and from 36 to 31%, respectively. Ethyl 2-butynoate increased the efficiency of microbial CP (P < 0.01) and OM (P = 0.02) synthesis by 58 and 47%, respectively. Crotonic acid had no effects on OM or N degradability, or on microbial efficiency of OM or CP synthesis. In Exp. 2, ethyl 2-butynoate decreased (P < 0.01) N degradability from 71 to 57%, and did not affect OM degradability. Ethyl 2-butynoate tended to increase the efficiency of microbial CP (P = 0.06) and OM (P = 0.08) synthesis by 28 and 18%, respectively. 3-Butenoic acid had no effects on OM or N degradability, but tended to improve the microbial efficiency of CP (P = 0.12) and OM (P = 0.08) synthesis by 12 and 13%, respectively. Both 3-butenoic and crotonic acid were ineffective in improving fermentation. It remains to be elucidated if the improvement in the microbial efficiency of OM and CP synthesis caused by ethyl 2-butynoate was a consequence of the change in H dynamics caused by the inhibition of methanogenesis, or a particular effect of ethyl 2-butynoate on some microorganisms.

Key Words: Methane, Rumen, Degradability

T125 Amino acid profiles of tropical forages and of residues after incubation in the rumen and phosphate borate buffer corrected by the ADIP amino acid profile. L. Miranda[1], N. Rodriguez[2], R. Sainz*[3], E. Pereria[4], M. Gontijo Netto[5], C. Veloso[6], and P. Fernandes[7], [1]*FEAD-Minas, Brazil,* [2]*Universidade Federal Minas Gerais, Brazil,* [3]*University of California- Davis, USA,* [4]*Universidade Estadual Oeste Parana, Brazil,* [5]*EMBRAPA Gado de Corte, Brazil*.

Amino acid (AA) profiles of several feed protein fractions were determined for foliage from leucaena (Leucaena leucocephala), perennial soy (Neonotonia wightii), cassava (Manihot esculenta), rami (Boehmeria nivea) and pigeon pea (Cajanus cajan) using in situ and in vitro procedures. Fractions included total feed protein; phosphate-borate buffer (PBB) insoluble residue; and (rumen) undegradable intake protein (UIP), the residue after 18h rumen incubation in nylon bags, corrected by the ADIP amino acid profile. These were analyzed by HPLC after acid hydrolysis or peroxidation followed by acid hydrolysis. Amino acid concentrations were determined for three replicates of each forage and their corresponding residues, in a totally randomized design. Data were analyzed by analysis of variance (PROC GLM), and means were compared using Tukey's test with a 5% significance level. Protein fractions B2 and B3, representing available insoluble amino acids, were expressed as a % of crude protein of the corresponding residue. There were differences in the amino acid profiles of the original forage and PBB residues, as well as after 18h of rumen incubation for all forages except for pigeon pea. In rami only the content of Lys was higher (P > 0.05) in PBB than in the original forage. For leucaena, several AA (EAA, Phe, His, Iso, Leu, Lys, and Thr) contents differed between the original forage and the UIP residue. The same was true for perennial soybean (EAA, Leu, Lys, Met, and Val) and cassava (Arg, Iso, Phe and Lys). If the insoluble fraction has higher chances of bypassing rumen fermentation, the amino acid profiles of the insoluble fraction and of non-degradable amino acids would be similar. However, the present study identifies differences between the amino acid profiles of the PBB insoluble residue and of residues after 18h of rumen incubation.

Key Words: Amino acid, Tropical forage, ADIP amino acid profile

T126 Contribution of degraded starch to the prediction of fermentable organic matter for ruminants. A. Offner* and D. Sauvant, *INA P-G INRA, Paris, France*.

In ruminants, the amount of organic matter truly fermented in the rumen (**RFOM**, % of DM) has many consequences, especially on microbial growth. The objective of this study was to examine the influence of starch degraded in the rumen on prediction of RFOM. A database on starch digestion in ruminants was built from 87 references and included 316 treatments. Data were analyzed by GLM including the *study* effect. First, RFOM measured *in vivo* was compared to RFOM predicted by the CNCPS and INRA models. The CNCPS tended to overestimate RFOM (+15.8 % of DM). Variations in RFOM within study were predicted by the CNCPS with a residual standard deviation (*rsd*) of 3.51 % of DM. The RFOM was estimated by INRA from digestible organic matter (**DOM**), ruminally undegraded protein (**RUP**) and ether extract (**EE**): RFOM = DOM - RUP - EE. In this case, variations in RFOM within study were predicted with a *rsd* of 3.15 % of DM. These results confirmed the need for a more accurate prediction of RFOM in feeding systems. This could be achieved by including ruminally degraded starch (**RDS**, % of DM) in RFOM predictions: RFOM = 42.2 + 0.59 × RDS (n = 200, n_{exp} = 85, R^2 = 0.94, rsd = 3.4 % of DM, sd_{exp} = 14.8 % of DM). Despite the correlation between DOM and RDS (r = 0.65), the INRA equation did not accurately account for RDS effects. This equation can be adjusted: RFOM = 10.6 + 0.69 × RFOM $_{INRA}$ + 0.29 × RDS; variations in RFOM within study were then predicted with a *rsd* of 2.99 % of DM. These results emphasized the significant and large influence of RDS on RFOM. Such equations could be of a practical interest in feeding systems, allowing better estimation of RFOM for various feeds.

Key Words: Rumen, Fermentable organic matter, Starch

T127 Using Synchrotron infrared microspectroscopy to probe molecule chemical difference between two types of barley with distinguished biodegradation behaviors. P. Yu*[1], J. J Mckinnon[1], C. Christensen[2], M. D. Drew[1], B. G. Rossnagel [3], and D. A Christensen[1], [1]*Department of Animal and Poultry Science, University of Saskatchewan,* [2]*BioMedical Imaging Group,* [3]*Department of Plant Sciences, University of Saskatchewan*.

Feed-type barley (cv. Valier) and malting-type barley (cv. Harrington) markedly differ in degradation behavior in ruminants. Harrington barley is higher but Valier barley in the rate and extent of rumen degradation. A high degradation of barley may result in digestive disorders in ruminants when feeding barley-based concentrate diets. Traditional "wet" chemical analysis methods cannot detect such distinguished biological differences mainly because the chemical structures and molecular characteristics of intrinsic structures of plant are destructed during the processing for analysis. Synchrotron Fourier transform infrared microspectroscopy (S-FTIR) is an advanced and newly emerging bioanalytical microprobe capable of exploring the molecular chemistry within microstructures. The objective was to use the non-invasive S-FTIR to explore and identify molecular chemically difference on ultra-structural matrix of endosperm tissue. Results show that infrared absorbance intensity of starch to protein ratio was different (4.12 vs. 2.78 for Harrington and Valier barley, respectively, P < 0.05), indicating the chemical matrix of micro-endosperm tissue are different. Harrington barley had a wider range of starch to protein ratio (1.41 to 10.12 vs. 1.42 to 4.27, P < 0.05), suggesting that Harrington barley is more heterogeneous than Varlier barley in chemical makeup of endosperm. In conclusion, different chemical makeup in micro-endosperm matrix may explain the biological difference. Lower starch to protein ratio in micro-endosperm tissue of Valier barley implicates that starch granules in Valier barley have more proteins associated with. This may prevent Valier barley degrade fast and highly in the rumen. More research is needed on plant chemical makeup of intrinsic mciro-structure for a better understanding of

plant inherent micro-structure in relation to biodegradation behaviors in animals

Key Words: Synchrotron infrared microspectroscopy, Chemical micromatrix of barley endosperm tissue, Ultra-structure

T128 Improved method for measuring processing degree and gelatinized starch in steam-flaked grain. Marcus Meilahn[1] and Davy Brown*[2], [1]*Weld Laboratories,* [2]*Agland, Inc.*.

The nutritive value of flaked grain can be quantified by measuring starch availability, degree of processing, and the percentage of gelatinized starch in relation to the total amount and availability of starch in whole (unprocessed) grain. A new, commercially available, enzymatic method is described for measuring the degree of processing and starch gelatinization in grain. The method utilizes the differences in reaction rates between corn starch and gelatinized corn starch. This method was used to determine the relationship between glucose yield and geletinized starch percent of known reference standards, whole grain, and flaked grain samples. The sensitivity for measuring degree of processing and gelatinized starch percent in flake grain was significantly improved (P<.001)over that by other methods currently used in the feeding industry. These data have been used to provide valuable information for grain processors to adjust milling practices resulting in improved flaked grain quality.

Key Words: Steam-flake, starch gelatinization, degree of processing

T129 Comparative effect of pork meat meal and chicken meat meal on apparent digestibility of diets for sheep. A. Estrada*[1], R. Barajas[1], and J. F. Obregon[1], [1]*FMVZ-Universidad Autónoma de Sinaloa (México).*

To determinate the comparative effect of pork meat meal and chicken meat meal on apparent digestibility of diets for sheep, a digestibility experiment by total fecal collection was conducted. Four Pelibuey sheep, males (BW=18.75 kg) were used in a cross over design experiment. The animals were placed individually in metabolics crates (0.6 x 1.2 m), and randomly were assigned to consume one of two diets in that consists the treatments: 1) Diet 15.8% of CP and 3.16 Mcal of DE/kg, containing (DM basis), pork meat meal 5.84%, ground corn 50.73%, sesame meal 10.22%, sudan grass hay 19.45%, sugarcane molasses 11.1%, urea 0.72%, limestone 1.1%, and mineral premix 0.89% (PMM); and 2) diet similar to treatment 1, but containing 5.84% of chicken meat meal (CHM) substituting all the pork meat meal. Diets were offered twice a day (800 and 1600 h), after six day of adaptation period, samples of diets (1 kg) and the total of feces produced were collected during four continuous days. samples were dried, weighed. DM and CP analyses were performed, and apparent digestibility was calculate. DM fecal excretion was not affected (P=0.23) by treatments (177 vs. 165 g/day). DM digestibility was similar (P=0.26) across treatments (73.5 vs. 75.2%). the fecal excretion of crude protein was similar (P=0.41) between treatments (34.0 vs. 35.6 g/day). The apparent digestibility of crude protein was not affected (P=0.62) by the kind of meat meal included, with values of 68.4% and 69.2% for pork and chicken meat meal, respectively. Calculate digestible energy of diets was equal (P=0.26) in both treatments (3.137 vs. 3.213 Mcal/kg). It is concluded that both pork meat meal and chicken meat meal could be indistinct used as rumen undegradable crude protein source, in growing sheep diets without affecting its digestion characteristics.

Key Words: Pork meat meal, Chicken meat meal, Digestibility

T130 Effects of intranasal administration of a lysozyme/zinc/carbopol preparation on health and performance of newly received beef cattle. J. D. Rivera*[1], J. T. Richeson[1], J. F. Gleghorn[1], N. A. Elam[1], M. L. Galyean[1], M. E. Hubbert[2], and S. E. Bachman[2], [1]*Texas Tech University, Lubbock, TX,* [2]*Ganado Research, Amarillo, TX.*

Ninety-one crossbred (British x Continental) steer and bull (17.5%) calves (average BW = 231± 17.5 kg) were used in a randomized complete block design to examine the effects of intranasal administration of a lysozyme/zinc/carbopol preparation on health and performance of lightweight newly received cattle. Calves were assigned randomly to pens, and each pair of pens (block) was assigned randomly to one of two treatments at receiving: intranasal (1 mL/nostril) of 1) lysozyme/zinc/carbopol solution (LYS); or 2) intranasal glycerol and water solution (CON). The lysozyme/zinc/carbopol solution was composed of 2.5 g of lysozyme, 2 g of zinc acetate, 1.25 g of carbopol 940, and 75 mL of glycerin brought to 100 mL volume with deionized water. Cattle were allowed ad libitum consumption of a 65% concentrate receiving diet along with long-stem alfalfa hay. Hay was fed for the first 5 d, after which only the 65% concentrate diet was offered. Cattle were monitored daily for signs of bovine respiratory disease (BRD) and treated with antibiotics as needed based on rectal temperature ($\geq 39.7^{(o)}$C). Body weight was measured on d 14 and 28 to determine ADG, and DMI was measured for the same time intervals as ADG. Intranasal administration of LYS did not affect (P > 0.10) ADG for d 0 to 14, 14 to 28, or 0 to 28. In addition, LYS administration did not affect feed:gain at any period of the study; however, administration of LYS tended to decrease (P < 0.08) DMI from d 0 to 14 and from d 0 to 28 (P < 0.11). Moreover, a trend (P < 0.12) for increased morbidity from BRD was observed for cattle receiving intranasal LYS. When analyzed by day after arrival, LYS increased morbidity (P < 0.03) on d 5 following receiving compared with CON. Results suggest that administration of LYS intranasally at receiving tended to increase morbidity later in the receiving period and decrease DMI, possibly because intranasal lysozyme might have increased the potential for later re-inoculation of the nasopharynx by respiratory pathogens.

Key Words: Lysozyme, Beef cattle, Health

T131 Effect of N-source on in vitro microbial crude protein and glycogen yields and NDF digestion from NDF and sucrose fermentations. L. Holtshausen* and M. B. Hall, *Department of Animal Sciences, University of Florida, Gainesville, FL USA.*

The effect of N-source on microbial crude protein yield (MCP), microbial glycogen yield (GLY), and NDF digestion was examined in two 16 h batch culture fermentations of isolated bermudagrass NDF (iNDF) or 50% sucrose+50% iNDF (SuNDF)(240 mg substrate/tube) with mixed ruminal microbes in 50 ml tubes fitted with gas release valves. The isonitrogenous media used were Goering and Van Soest medium (GVM), [non-protein nitrogen (NPN)+true protein; B], and GVM modified to contain only NPN (U) by substituting urea for casein acid hydrolysate, or to contain only true protein (C) by substituting casein acid hydrolysate+sodium bicarbonate for ammonium bicarbonate. Fermentation tubes for each substrate and medium were destructively sampled every 4 hours and analyzed for MCP, GLY and residual NDF. MCP was estimated as CP precipitated with 20% trichloroacetic acid, and GLY as alpha-glucan corrected for free glucose. MCP and GLY at each hour were corrected for 0 h and sampling hour fermentation blanks. All values presented are least squares means data at 16 h unless indicated. Orthogonal contrasts U vs B+C and B vs C were used for media comparisons (see table). By 8 h, no free sucrose, glucose or fructose remained. Maximum GLY was achieved at 4 h and MCP at 16 h. Media pH did not decline below 6.45. For all media, MCP was lower for iNDF than for SuNDF (P<0.01). For SuNDF MCP differed among media (P<0.01). At 4 h GLY did not differ across media for SuNDF (P=0.64). Medium affected NDF digestion for SuNDF (P<0.01) but not for iNDF (P=0.18). Gross efficiency of MCP per unit sucrose differed by medium (P<0.01). Adding true protein increased MCP from NDF, as well as increased fiber digestion, MCP, and efficiency of MCP when sucrose was present.

Item	B-iNDF	C-iNDF	U-iNDF	B-SuNDF	C-SuNDF	U-SuNDF
16 h MCP, mg^{a,x,y}	3.61	3.50	1.77	14.28	15.70	8.05
16 h MCP/Suc, mg^{x,y}	-	-	-	0.119	0.131	0.067
16 h NDF dig., %^{x}	18.5	16.0	16.6	21.0	19.5	14.4
4 h GLY, mg	-	-	-	7.31	7.17	6.84

Contrast superscripts: SuNDF: x = U vs B+C, y = B vs C, differ P<0.05; iNDF: a = U vs B+C, b = B vs C, differ P<0.05

Key Words: Sucrose, Nitrogen source, Fermentation

T132 Biohydrogenation of unsaturated fatty acids and duodenal flow of CLA and *trans*-fatty acids in dairy cows fed a high-concentrate diet supplemented with linseed, sunflower, or fish oil. J. J. Loor*[1,2], K. Ueda[1], A. Ferlay[1], Y. Chilliard[1], and M. Doreau[1], [1]*INRA, 63122 St.-Genes Champanelle, France,* [2]*Department of Animal Sciences, University of Illinois.*

Ruminal hydrogenation and duodenal flow of hydrogenation intermediates were evaluated in three lactating Holstein cows fed a diet with a high concentrate:forage ratio (65:35) plus 5% (DM basis) sunflower oil (SO), 5% linseed oil (LO), or 2.5% fish oil (FO). A 3 × 3 Latin square with 4-wk periods was used. Grass hay was the forage. Hydrogenation of *cis*9-18:1 (76%) did not differ ($P > 0.05$)due to oils. Dietary SO increased ($P < 0.05$) hydrogenation of 18:2*n*-6 (91%) compared with FO or LO (79%). Cows fed LO had greater ($P < 0.05$) 18:3*n*-3 hydrogenation (94%) compared with FO or SO (84%). Hydrogenation of eicosapentaenoic (EPA) and docosahexaenoic (DHA) acid due to feeding FO averaged 94% and 92%. Total CLA flow was greater ($P < 0.05$) in cows fed SO (8.0 g/d) compared with FO (4.0 g/d). Feeding LO resulted in flow of 6.9 g total CLA/d. Among CLA isomers, flow of *cis*9,*trans*11-CLA (9-11CLA) was ($P = 0.10$) 2.4 g/d with SO but only 0.4 g/d with FO. Dietary LO resulted in 1.6 g 9-11CLA/d. *Trans*10,*cis*12-CLA flow was not affected ($P > 0.05$) by diets and averaged 0.67 g/d. *Cis*9,*cis*11-CLA and *trans*11,*trans*13-CLA flow (1.0, 2.0 g/d) was greater ($P < 0.05$) in response to LO compared with FO or SO (0.3, 0.7 g/d). *Trans*,*trans*-CLA was greater ($P < 0.05$) when feeding SO (2.2 g/d) than FO or LO (1.2 g/d). Flow of *trans*11,*cis*15-18:2, derived from 18:3*n*-3 hydrogenation, ranked by treatment was ($P < 0.05$) LO (47 g/d) > FO (18 g/d) or SO (7.6 g/d). Total *trans*-18:1 flow did not differ due to oils (254 g/d). *Trans*10-18:1 flow was numerically greater ($P > 0.05$) in cows fed FO or SO (88 g/d) than LO (28 g/d). *Trans*11-18:1 flow averaged ($P > 0.05$) 89 g/d for FO or SO and 119 g/d for LO. Flow of 18:0 was ∼4× greater ($P < 0.05$) in cows fed SO or LO (373 g/d) than FO (96 g/d). Data suggest, hydrogenation of 18:2*n*-6, 18:3*n*-3, EPA, and DHA was largely a function of amount consumed. Supplemental 18:2*n*-6 and 18:3*n*-3 resulted in production of specific CLA isomers in the rumen.

Key Words: Biohydrogenation, *Trans* fatty acids, Oil

T133 Conjugated linoleic acids (CLA) and *trans*-fatty acid profiles of blood plasma and milk fat in dairy cows fed a high-concentrate diet supplemented with linseed, sunflower, or fish oil. J. J. Loor*[1,2], A. Ferlay[1], A. Ollier[1], K. Ueda[1], M. Doreau[1], and Y. Chilliard[1], [1]*INRA, 63122 St.-Genes Champanelle, France,* [2]*Department of Animal Sciences, University of Illinois.*

Profiles of hydrogenation intermediates in plasma and milk lipids due to dietary 18:2*n*-6, 18:3*n*-3, or 20:5*n*-3 were evaluated using three lactating Holstein cows fed a high-concentrate diet (65:35 concentrate to forage) with 5% (DM basis) sunflower oil (SO), 5% linseed oil (LO), or 2.5% fish oil (FO). A 3 × 3 Latin square with 4-wk periods was used with grass hay as the forage. Milk yield (26 kg/d), DMI (18 kg/d), and percentages of milk fat (2.64) and protein (3.22) did not differ ($P > 0.05$). Total plasma fatty acids averaged ($P > 0.05$) 2.8 mg/mL across diets. Percentage of *cis*9,*trans*11- (9/11CLA), *trans*10,*cis*12- (10/12CLA), *cis*9,*cis*11- (*c*9*c*11CLA), and *trans*11,*trans*13-18:2 (11/13CLA) in blood plasma also was similar ($P > 0.05$) (0.32, 0.09, 0.01, and 0.12%, respectively). *Trans*,*trans*-18:2 (*tt*CLA), however, was greater ($P < 0.05$) due to feeding FO (0.48%) compared with LO or SO (0.24%). Percentage of *trans*11,*cis*15-18:2 (11/15LA), an intermediate of 18:3*n*-3 hydrogenation, was greater ($P < 0.05$) when LO (0.87%) was fed, intermediate with FO (0.47%), and lower ($P < 0.05$) with SO (0.15%). Plasma *trans*10-18:1 was not altered ($P > 0.05$) by diets (0.90%). Plasma *trans*11-18:1 (TVA) was greater ($P < 0.05$) when FO (4.1%) was fed compared with LO or SO (2.3%). Percentage of 9/11CLA (2.2%), 10/12CLA (0.07%), *c*9*c*11CLA (0.07%), 11/13CLA (0.10%), and *tt*CLA (0.11%) in milk fat did not differ ($P > 0.05$). Milk 11/15LA ranked by treatment was ($P < 0.05$) LO (2.9%) > FO (1.8%) > SO (0.4%). Milk *trans*10-18:1 (4.8%) and TVA (5.4%) percentage was not altered ($P > 0.05$) by diets. Stearic acid in plasma or milk fat due to FO (8.4%, 3.5%) was reduced ($P < 0.05$) compared with LO or SO (14%, 11%). Except for TVA and *tt*CLA, results show that responses in the profile of other CLA, 11/15LA, and *trans*10-18:1 in blood plasma and milk fat followed the same trend due to feeding each oil.

Key Words: Oil, CLA, *Trans* fatty acids

T134 Effect of chromium methionine supplementation in diet on milk production of holstein pure breed and 3/4 holstein cows receiving recombinant bovine somatotropin in hormone injection. R. Barajas*[1], R. Zambada[1], J. J. Portillo[1], L. M. Rubio[1], C. Lizarraga[2], Z. Verdugo[1], and N. Gonzalez[1], [1]*FMVZ-Universidad Autonoma de Sinaloa (Mexico),* [2]*Establo Lechero.*

Whith the objective of determinate the effect of chromium methionine supplementation in diet on milk production of holstein pure breed and 3/4 holstein cows receiving recombinant bovine somatotropin hormone injection, a milk production experiment was conducted. Eighteen dairy cows (8 holstein pure breed cows, and 10 holstein 3/4 brahman 1/4 blood cows), pregnant, body size condition upper than 3.5, and producing upper than 17 kg of milk/day, were used in a complete randomized block design experiment. The cows were placed in a ground flour pen, providing an area of 48 m2/cow, shade area of 7.5 m2/cow, 3.1 m of feed bunker/cow and 0.5 m of drinker/cow. the animals were fed with a ration consistent in sudan grass silage 40 kg, alfalfa hay 2 kg, and 11 kg of pellet concentrate (18%CP, 7%CF, 4%fat, and 0.7% Ca) and has free access to a mineral premix. After a 14 days adjustment period, daily milk production (DMP) by cow was recorded during seven days, and was considered as previous milk production. Next days all the cows receiving an intradermal injection of bovine somatotropin hormone (STB), and agreement with its blood, and previous DMP were grouped and assigned to treatments: 1) Regular management as was described above (control); and 2) similar to control but receiving a supplementation of 12 mg of Cr/cow/day from chromium methionine during 14 days. Milk production was measured during 14 days. Data was analyzed as a factorial arrangement (Cr x day) of treatments and previous daily milk production has not effect (P=0.29) as covariate variable. STB increased (P<0.01) in 22.6% milk production (19.74 vs. 24.2 kg). In holstein pure breed cows STB improved (P<0.01) DMP (22.10 vs. 26.76 kg) in the same proportion (21%) than in 3/4 holstein cow (17.85 vs. 21.63 kg). Chromium methionine supplementation increased (P=0.02) DMP in 2.5% with relationship of cows that not received it (23.9 vs. 24.5 kg). It is concluded, that chromium methionine could help to improve milk production in dairy cows receiving bovine somatotropin hormone.

Key Words: Chromium, Somatotropin, Dairy cows

T135 Comparison of inorganic and complexed trace element supplements on performance of dairy cows. R. L. Kincaid*[1], J. D. Cronrath[1], and M. T. Socha[2], [1]*Washington State University,* [2]*Zinpro Corporation.*

To determine the effect of chemical form of trace element supplements on performance of dairy cows, Holstein cows (n = 36) were assigned to dietary treatments of inorganic trace elements and a combination (1:1) of inorganic and complexed trace elements. Starting 21 days prepartum, dry cows were fed hay and 1 of 2 grain supplements that contained the trace element supplements. Estimated concentrations of trace elements in the dry cows diets were 12 ppm Cu, 52 ppm Mn, 68 ppm Zn, and 1.8 ppm Co. From parturition until 150 DIM, cows were fed their respective TMR that contained 11 ppm Cu, 41 ppm Mn, 59 ppm Zn, and 2.5 ppm Co, by analysis. Cows fed the complexed trace elements lost less ($P < 0.05$) weight prepartum (23 vs 55 kg); however, there was no difference ($P > 0.05$) between treatments in postpartum weight change or BCS. Cows fed complexed trace elements prepartum had colostrum with higher ($P < 0.05$) IgG (5.1 vs 7.6 g/dl) and lower Zn (125 vs 91 ppm). There was no difference ($P > 0.05$) in concentrations of IgM, Co, Mn or Cu in colostrum. Dry matter intakes of lactating cows were similar between treatments (26.0 vs 26.4 kg/d). Although there were period effects on serum concentrations of IgG, IgM, NEFA, Zn, and Ca, there were no treatment effects. Actual milk yield (42.2 vs 41.7 kg/d), 3.5 FCM (42.3 vs 42.3 kg/d), and measures of production efficiency also were similar between treatments. These results indicate similar performance of cows fed inorganic and a mixture of inorganic and complexed trace elements.

Key Words: Cows, Inorganic trace elements, Complexed trace elements

T136 Effects of Lactonin on milk production of dairy cow during weeks 20 through 42 of lactation. Z. M. Shen*[1], R. F. Zhang[1], F. Chen[2], and T. S. Lu[3], [1]*Nanjing Agricultural University, Nanjing, China,* [2]*Shanghai Bright Group, China,* [3]*Shanghai Walcom Bio-Chem Co., Ltd , China.*

Lactonin is a compound containing 30% of cysteamine (CS). CS is a special component of coenzyme A and therefore an endogenous substance. One of the physiological functions of CS is to decline somatostatine but increase the blood glucose level. The purpose of this study was, therefore, to investigate the effects of Lactonin on milk production during weeks 20 through 42 of lactation. 100 black and white dairy cows were assigned to 4 groups (G1, n=21; G2 and G3, n=24 and G4, n=31) on the basis of their daily milk yield prior to the experiment and their calving date. The recorded daily milk yield (M) prior to the experiment is: G1<29 kg; G2,30-34 kg; G3,35-39 kg and G4>40 kg, respectively. In each group the cows were divided randomly into Lactonin treatment (LT) and Control. In all LT the Lactonin was administered progressively within 10 weeks period at the CS doses of 10-30 mg/d and then degressively to 15 mg/d through the experiment. In G1 cows received LT produced 17.8 % more milk (P<0.05) than did Control cows during the entire 23 weeks of treatment. But it was not in the cows received LT in the other groups, suggesting that the effect of LT on milk production was influenced by the starting basic milk yield of the cow in the pretreatment period. Milk fat percentage was greater for cows given LT both in G2 (5.8 %, P<0.05) and G4 (10.8 %, P<0.05) than that of Control cows. In G2 and G4 a trendy of increase (P=0.10) of milk protein percentage was observed in the cows treated with LT. In G4 The milk protein synthesis was 11.0 % higher (P<0.05) with cows given LT, resulting from the greater milk protein percentage induced by Lactonin. This study indicates that Lactonin can improve the milk yield and milk composition. The effects of Lactonin on milk production are related to the production level of cows prior to the treatment.

Key Words: Cysteamine, Cow, Milk production

T137 Serum β carotene concentrations and variability factors in US dairy herds. T. H. Herdt[1] and W. M. Seymour*[2], [1]*Michigan State University,* [2]*Roche Vitamins Inc.*

To determine descriptive statistics and selected variability factors for serum β carotene concentrations in US dairy cows, selected samples from the 1996 NAHMS Dairy study (Reference of 1996 Dairy Management Practices, USDA) were analyzed for β carotene, retinol, and cholesterol concentrations. A total of 358 serum samples distributed among 35 herds were tested by HPLC with UV detection. Samples were analyzed in 2001 and had been held at –80 C for approximately 80% of the storage time, and at –20 C for the remainder. Samples were selected to create a balanced data set with respect to herd size classification, region of the US, and use of pasture as a major forage (+/-). The overall mean of serum beta-carotene was 2.02 μg/ml with SD 1.94 μg/ml. The distribution of values was markedly skewed to the right, but approximated normal after log transformation. Serum β carotene was correlated positively (P<0.02), but weakly (R^2 =0.06) with serum retinol. In univariate analysis, samples from the Midwest had values lower than the Northeast, West, and Southeast, and samples from herds using pasture feeding had values higher than those not using pasture. Whether or not the cows from which the samples were taken were receiving pasture at the time of sampling was not known. A multivariate descriptive model of serum β carotene variation was constructed using PROC MIXED (SAS). Initial independent variables included herd, region, pasture, and pasture by region interaction. Serum cholesterol concentration was included as a covariate. Independent variables remaining in the model were herd (P<0.001), serum cholesterol (P<0.001), and pasture (P=0.08). Herd accounted for 68% of the total variability in serum β carotene. We conclude that serum β carotene concentrations in US dairy cattle are affected by herd management conditions, probably those associated with nutrition. Furthermore, many US dairy cows have serum β carotene concentrations less than 2.5 μg/ml, a target minimum concentration suggested by other investigators.

Key Words: β Carotene, Vitamin A, Retinol

T138 Phosphorus balance in dairy cows fed sub-optimal dietary phosphorus. K. V. Shore*, T Mutsvangwa, T. M. Widowski, J. P. Cant, W. J. Bettger, and B. W. McBride, *University of Guelph, Guelph, Ontario, Canada.*

Overfeeding phosphorus (P) in dairy rations is common practice with the average diet balanced to 0.48% P, approximately 30% more than recommended by NRC. The objective of this experiment was to determine if P homeostasis could be maintained at sub-optimal levels of P intake. This was established through P balance at two dietary levels of P, one at the recommended NRC level of 0.36% (n=7) and one at 0.24% (n=7), which has been previously shown to deplete cows of P. P balance was measured one week before the dry period, at 1 month prepartum and at 2 weeks postpartum to establish P balance on a corn silage, haylage based TMR. Once on the experimental diet (3 weeks to 13 weeks postpartum), P balance was measured at 6 weeks and 13 weeks postpartum. The experimental diet consisted of corn silage, urea, soybean meal, soybean hulls, beet pulp, bloodmeal, limestone, dicalcium phosphorus, salt, magnesium oxide, tallow and a mineral mix balanced to 0.36% P or 0.24% P. Results to date show there was no significant difference (p>0.05) in milk yield (31.3 $\pm$ 4.8 kg/day - 0.36% P; 31.6 $\pm$ 4.8 kg/day - 0.24% P) or dry matter intake (15.5 $\pm$ 0.9 kg/day - 0.36% P; 15.3 $\pm$ 0.9 kg/day - 0.24% P). Furthermore, there was no significant difference (p>0.05) in blood plasma calcium (2.48 $\pm$ 0.03mM - 0.36% P; 2.53 $\pm$ 0.03mM - 0.24% P), magnesium (1.02 $\pm$ 0.02mM - 0.36% P; 1.04 $\pm$ 0.02mM - 0.24% P) or P (1.84 $\pm$ 0.07mM - 0.36% P; 1.76 $\pm$ 0.07mM - 0.24% P), and all parameters remained within normal physiological range.

Key Words: Phosphorus, Dairy cattle, Balance

T139 Effects of supplemental conjugated linoleic acid and *trans*-octadecenoic fatty acids on the insulin-like growth factor system in periparturient Holstein cows. K. T. Selberg, A. C. Dinges, C. R. Staples, and L. Badinga*, *University of Florida, Gainesville.*

Thirty-eight multiparous Holstein cows were utilized in a completely randomized design to examine the effect of feeding ruminally-protected conjugated linoleic acid (CLA) and *trans*-octadecenoic fatty acids (tFA) on the insulin-like growth factor (IGF) system during the transition to lactation. Dietary treatments were initiated approximately 28 d prior to expected calving dates and continued through d 49 postpartum. Prepartum treatments consisted of 1) a basal TMR diet (control), 2) basal TMR + 231 g/d CLA mix (CLA), and 3) basal TMR + 214 g/d tFA mix. Average intakes of CLA and tFA mixes were 258 and 261 g/d, respectively, during the 49 d postpartum treatment period. On d 2, 14, and 28 $\pm$ 2 postpartum, liver samples were collected by biopsy and stored at -80^{o}C until analyzed for mRNA abundance. Plasma IGF-I concentration decreased (P<0.01) from 120.3 $\pm$ 5.5 ng/ml at 2 wk before parturition to 91.4 $\pm$ 5.4 ng/ml at calving, and remained low through 7 wk of lactation. In spite of small tendencies, IGF-I concentration in blood did not differ among dietary treatments. Plasma IGF-binding protein (IGFBP) profiles (MW = 44-48, 35, 31, 30, and 28 kDa) were unaffected by dietary treatment and sampling day. Liver IGF-I mRNA transcripts were low during the first few weeks of lactation and did not differ among treatments. The 7.5 kb IGF-I transcript was not detected until d 28 postpartum. Dietary supplementation of tFA upregulated steady-state levels of IGF-II and IGFBP-2 genes in the liver. The abundance of IGFBP-3 mRNA in the liver did not vary among dietary treatments. Results provide the first direct evidence that dietary tFAs induce hepatic IGF-II and IGFBP-2 genes in cattle. Additional studies are warranted to elucidate the interactions between supplemental fats, energy homeostasis and the IGF system in Holstein cows during the early lactation period.

Key Words: Fatty acids, IGF system, Cattle

T140 Effects of feeding calcium salts of fatty acids with methionine hydroxy analog and bacterial fermentation residue vs. tallow-vegetable blend and plant proteins on lactational performance and in-vitro fermentation. K. A. Koudele*[1], W. K. Sanchez[2], L. H. Adams[1], D. E. Weber[2], D. R. Metzger[3], N. R. St-Pierre[4], and E. Block[2], [1]*Andrews University, Berrien Springs, MI,* [2]*Arm & Hammer Nutrition Group, Church & Dwight Co, Inc., Princeton, NJ,* [3]*Metzger Cousulting Services, Goshen, IN,* [4]*Ohio State University, Columbus, OH.*

One hundred fifty-five free-stall housed multiparous Holstein cows from a high producing herd (RHA = 12,190 kg) were randomized by DIM (14-165 d) and milk production into two equally managed groups. Each group was fed either a control (CON) ration containing tallow-vegetable blend and plant proteins or a treatment (TMT) ration containing calcium salts of fatty acids complexed with methionine hydroxy analog (MEGALAC Plus®), and bacterial fermentation residue (FERMENTEN®) in a switch back design with five-28 d periods. Cows were fed ad lib daily with refused feed weighed weekly. Data from the last week of each period were used in the analysis. Diets were formulated to be similar in NDF, NFC and fat. Groups were the experimental units in the statistical analyses. Milk yield (43.5 vs. 43.2 kg), protein (2.79 vs. 2.76 %), lactose (4.79 vs. 4.79 %), SCC (313,000 vs. 310,000), and DMI (25.8 vs. 25.5) did not differ (P>0.05) between CON and TMT, respectively. However, milk fat % was higher (P=0.03) in the TMT group (3.99 vs. 3.75%). The TMR of CON and TMT rations were evaluated in triplicate 9-day continous culture fermenters which resulted in no differences (P>0.05) between CON and treatment in VFA production, acetate:propionate ratio and pH. Crude protein efficiency (% degraded feed N as microbial N) was greater (P=0.002) in the TMT group (84.73 vs. 88.19) due in part to the greater (P=0.03) ammonia-N production for CON (8.83 vs. 6.41 mg/dl). These differences were likely due to how the fat and proteins affected rumen fermentation and biohydrogenation. The higher milk fat % from cows on the TMT diet indicated that the combination of MEGALAC Plus® and FERMENTEN® were utilized more efficiently in the rumen than the tallow-vegetable blended fat and plant proteins.

Key Words: Dairy nutrition, Calcium salts of fatty acids, Bacterial fermentation residue

T141 Effects of saturation ratio of supplemental dietary fat on production performance of lactating Holstein cows in early lactation. M. A. Ballou*, E. J. DePeters, H. Perez-Monti, S. J. Taylor, and J. W. Pareas, *University of California, Davis.*

Lactating Holstein cows (n=47) were randomly assigned to one of four treatments to evaluate the effect of supplemental fat (tallow or yellow grease) from sources varying in proportion of unsaturated and saturated fatty acids on lactation performance. All diets (45% chopped alfalfa hay and 55% concentrates) contained 12% whole cottonseed (as-fed) and were fed as a TMR. Treatments were no supplemental fat (Control, 3% total fatty acids, DM basis) or the addition of 2% supplemental fat from Tallow, Yellow Grease, or Blend (60% tallow: 40% yellow grease). Unsaturated to saturated fatty acid ratios were 1:1 for tallow, 2.5:1 for yellow grease, and 1.5:1 for the blended fat. All cows were fed the control diet during week 3 of lactation. Cows were then assigned to their treatment diets beginning week 4 and ending week 18 of lactation. Cows were milked twice daily and yields recorded. Cows were fed their assigned TMR twice daily. Milk samples were collected once weekly and analyzed for fat, protein, solids-not-fat, and nitrogen fractions. Body condition scores (BCS) and body weights (BW) were assessed once weekly. Repeated measures were analyzed by the PROC MIXED procedure of SAS using week 3 as a covariate. There were no significant differences for intake of DM (25.6, 25.9, 25.6, and 26.4 kg/d) and yield of milk (41.8, 42.3, 42.3, and 43.6 kg/d) for the Control, Blend, Tallow, and Yellow Grease, respectively. Digestible energy intakes (DM basis) tended to increase when yellow grease was supplemented as compared to tallow. BCS and BW were similar across all treatments. Concentrations and yields of milk components were unaffected by fat supplementation or saturation level. Supplementing the diet of lactating cows with fat during early lactation did not affect production performance, and there were no effects due to the differences in the unsaturated to saturated fatty acid composition of the supplemental fat source.

Key Words: Dairy cows, Fat saturation, Fatty acids

T142 Techniques to measure the bioavailability of rumen-protected methionine supplements. C. E. Moore*[1], B. Sloan[2], D. A. Henderson[1], and L. H. Baumgard[1], [1]*University of Arizona, Tucson, AZ,* [2]*Adisseo, Alpharetta, GA.*

Methionine bioavailability was assessed in two ways: 1) blood plasma methionine concentrations and 2) impact on milk composition. Two different rumen-protected methionine supplements were evaluated using 72 Holsteins (H) and 48 Brown Swiss (BS) 40 to 200 DIM at trial initiation. Animals were pre-blocked based on breed and parity (primiparous vs. multiparous). Cows were then randomly assigned to a control diet (C: 48% alfalfa hay and 14.9% steam flaked corn; Alimet® was included [21.8 g/hd/d] to maximize microbial protein synthesis) formulated to be adequate in metabolizable lysine (6.83% of MP - CPM Version 1), or C supplemented with either Smartamine™ M (S; 16 g/hd/d), or Mepron® M85 (M; 14.1 g/hd/d), both supplements provided 12 g methionine/hd/d. Milk yield was recorded daily and milk samples were obtained on 2 consecutive milkings from each cow on d -1, 14, 28, 42 and 56 relative to treatment initiation for compositional analysis. Blood plasma samples were obtained on d 56 from 10 cows/trt and analyzed for amino acid content. There was no effect of treatment (P = 0.07) on milk yield (35.3 kg/d). Milk fat percentage was affected by treatment 3.80^a, 3.85^{ab} and 3.98^b for C, M and S, respectively. Milk protein % was increased by methionine treatments 3.11^a, 3.16^b and 3.20^b for C, M and S, respectively and milk lactose content and yield were reduced (2 and 4%) by both methionine supplements. Plasma concentrations (mg/ml) of methionine (P < 0.01) and methionine as a percentage of total amino acids (P < 0.01) were both significantly higher for S (3.43^a, 4.11^b, 5.20^c and 1.13^a, 1.27^b, 1.62^c for C, M and S, respectively). Both methionine supplements increased milk protein content and S increased milk fat compared to C and this illustrates the benefits of providing supplementary bio-available methionine to a ration adequate in metabolizable lysine. Furthermore, blood plasma methionine proved to be the more precise technique to discriminate between the relative methionine bioavailability of different rumen protected technologies.

Key Words: Methionine, Milk protein, Lactation

T143 Comparison of abomasal infusion of free fatty acid and methyl ester forms of conjugated linoleic acids on milk fat depression in dairy cows. M. J. de Veth*[1], J. M. Griinari[2], A. M. Pfeiffer[3], and D. E. Bauman[1], [1]*Cornell University, Ithaca, NY,* [2]*Clanet Ltd, Espoo, Finland,* [3]*BASF-AG, Offenbach, Germany.*

Conjugated linoleic acids (CLA), specifically the *trans*-10, *cis*-12 isomer, have been shown to be potent inhibitors of milk fat synthesis. The majority of studies investigating CLA-induced milk fat depression have used mixtures of CLA in free fatty acid form. However, in the commercial synthesis of CLA, methyl esters of CLA are initially formed. The objective of this study was to compare effects of the free fatty acid CLA (FFA-CLA) and methyl esters of CLA (ME-CLA) on the inhibition of milk fat synthesis. Three mid-lactation Holstein cows fitted with a rumen fistula were used in a 3 × 3 Latin square design. Treatments were 1) control, 2) FFA-CLA, and 3) ME-CLA. Treatments 2 & 3 involved a 60% CLA formulation that was composed equally of *trans*-10, *cis*-12 and *cis*-9, *trans*-11 isomers; the CLA formulation was solubilized in ethanol and a daily dose of 4.2 g of *trans*-10, *cis*-12 CLA was infused abomasally as equal aliquots at 6 h intervals. Each treatment period was 5 d with a 7 d interval between periods. CLA treatments reduced milk fat yield (P < 0.02) compared to control (0.77 kg/d), but there were no differences (P > 0.92) between FFA-CLA and ME-CLA (39% and 38% reduction, respectively). Milk yield, yield and content of milk protein, and DMI were unaltered (P > 0.14) by CLA treatment. Both *de novo* synthesis and the uptake of preformed fatty acids were affected as yields of all fatty acids (P < 0.08) were reduced by CLA treatment. However, there were no differences in the yield or proportions of individual fatty acids between the FFA-CLA and ME-CLA. Milk fatty acid content of *trans*-10, *cis*-12 CLA increased (P = 0.01) from < 0.01% in control to 0.18% and 0.17% for FFA-CLA and ME-CLA, respectively. The transfer efficiency of the abomasally infused *trans*-10, *cis*-12 CLA into milk fat averaged 18.8% for FFA-CLA and 17.8% for ME-CLA. Overall, results demonstrate that the ME-CLA are equally potent at reducing milk fat synthesis as the FFA-CLA, and that the presence of the methyl ester had no apparent effect on intestinal absorption of CLA or its incorporation into milk fat. Therefore, rumen-protected forms that utilize either free

fatty acids or methyl esters of *trans*-10, *cis*-12 CLA would be effective dietary supplements of CLA to induce milk fat depression.

Key Words: Conjugated linoleic acid, Milk fat depression, Milk fat

T144 *Trans*-fatty acids (*t*FA), CLA isomers, and milk fat depression (MFD) in dairy cows receiving incremental doses of fish oil. J. J. Loor*[1,3], J. M. Chardigny[2], J. Chabrot[1], M. Doreau[1], A. Ollier[1], J. L. Sebedio[2], and Y. Chilliard[1], [1]*INRA, 63122 St.-Genes Champanelle, France,* [2]*INRA, 21065 Dijon, France,* [3]*Department of Animal Sciences, University of Illinois.*

Correlations (CORR) between percentage of *t*FA in milk and milk fat percentage (MF%) due to fish oil (FO) were evaluated using data from two independent exp. (n = 45). Exp. were conducted as replicated 3 × 3 Latin squares with 4-wk periods using corn silage, and doses of 0, 200, 300, or 400 mL FO/d into the rumen. MF% was 3.52, 2.40, 2.51, or 2.17 due to incremental FO. Highest positive CORR were between 18:0 (0.68) or oleic acid (0.63), both of which were markedly reduced by FO, and MF%. All *t*-18:1 isomers, except *t*16-18:1, were negatively correlated with MF%. *T*9-18:1 (-0.69) and *t*12-18:1 (-0.68) had the most negative CORR. CORR for *t*10-18:1 and *t*11-18:1 (TVA) were -0.58 or -0.47. All CLA isomers, except *t*10,*c*12-CLA which was not detectable, were negatively correlated with MF%. *T*11,*t*13-18:2 had the most negative CORR (-0.55). *T*11,*c*15-18:2, derived from 18:3*n*-3 hydrogenation, had a CORR of -0.62 with MF%. Among individual isomers, *t*4- to *t*13+14-18:1 were all negatively correlated with 6:0, 8:0, or 10:0 concentration. *T*10-18:1, however, had the most negative CORR with 8:0, 10:0, 12:0, and 14:0 (0.33-0.55). Although CORR between *t*-18:1 isomers and 16:0 was not significant (-0.16), that between *tt*-CLA and 16:0 was -0.59. Concentration of EPA, DPA, and DHA also were negatively correlated (-0.55) with 16:0, but not with MF% (-0.16). *T*4- to *t*9-18:1 and *t*12- to *t*13+14-18:1 had CORR of 0.67 to 0.80 with TVA, and -0.14 to 0.59 with *t*10-18:1. TVA had CORR of 0.15 with *t*10-18:1. CORR between TVA and *c*9,*t*11-CLA was 0.94. Data suggest other *t*-18:1 are more closely associated with MFD than *t*10-18:1 or *t*10,*c*12-CLA in cows fed FO. Certain rumen-derived *t*-18:1 and CLA isomers may interact to reduce *de novo* FA synthesis. Lower endogenous synthesis of *c*9-18:1, due to reduced 18:0 availability, may be an additional factor leading to decreased MF% and fat yield in cows fed FO.

Key Words: Fish oil, CLA, *Trans* fatty acids

T145 *Trans* fatty acids (*t*FA) and CLA in liquid-associated (LAB) and solid-adherent (SAB) ruminal bacteria from dairy cows fed diets varying in forage:concentrate ratio (F:C) and level of linseed, sunflower, or fish oil. J. J. Loor*[1,2], K. Ueda[1], A. Ferlay[1], Y. Chilliard[1], and M. Doreau[1], [1]*INRA, 63122 St.-Genes Champanelle, France,* [2]*Department of Animal Sciences, University of Illinois.*

CLA and *t*FA percentage in LAB and SAB due to F:C and unsaturated oils was evaluated. Exp. periods lasted 4-wk with grass hay as the forage. In exp. 1, four Holstein cows were fed a diet with low (35:65) or high (65:35) F:C without (LC, HC) or with linseed oil at 3% of DM (LCL3, HCL3) in a 4 × 4 Latin square. In exp. 2, three Holstein cows were fed HC with 5% linseed (HCL5), 5% sunflower (HCS5), or 2.5% fish oil (HCF2.5) in a 3 × 3 Latin square. LAB and SAB contained 65-95 mg total FA/g DM with LC and HC, or 65-168 mg/g with oils. *C*9,*t*11-CLA (9/11CLA) was 0.3% in SAB and 0.1% in LAB with LC or HC, and increased little with LCL3 or HCL3. Feeding HCF2.5 increased 9/11CLA (1.0% vs 0.6%) in SAB compared with HCL5 or HCS5. In LAB, 9/11CLA averaged 0.6% across diets. *T*10,*c*12-CLA (10/12CLA) in SAB was greater when LC or HCL3 (0.1%) were fed compared with LCL3 or HC (0.05%). No differences in 10/12CLA were found in LAB (0.1%). Oils did not alter 10/12CLA in SAB (0.2%) or LAB (0.2%) in exp. 2. *C*9,*c*11- (*c*9*c*11CLA) and *t*11,*t*13-CLA (11/13CLA) in SAB or LAB increased with LCL3 or HCL3. Feeding HCL5 also increased *c*9*c*11CLA and 11/13CLA but only in SAB. *T*11,*c*15-18:2, an intermediate of 18:3*n*-3 hydrogenation, was markedly higher in SAB or LAB in response to LCL3, HCL3, and HCL5 but also increased with HCF2.5. *T*10-18:1 was 4.5% in LAB or SAB when HC or HCL3 were fed compared with LC or LCL3 (0.7%). Feeding HCS5 or HCF2.5 increased *t*10-18:1 in SAB or LAB compared with HCL5 (6.8% vs 2.1%). *T*11-18:1 (TVA) averaged 12% in SAB and LAB from cows fed HCL3 compared with 4.1% for LC, LCL3, or HC. Oils did not alter TVA (11%) in SAB or LAB in exp. 2. Low F:C alone nearly maximized *t*10-18:1, but not TVA or CLA/s. Profiles of FA in bacterial and duodenal lipids were similar. PUFA composition of oils, regardless of F:C, distinctively alters CLA and *t*FA in ruminal bacteria.

Key Words: CLA, Ruminal bacteria, *trans* fatty acids

T146 Effects of free methionine and lysine on performance and ruminal fermentation of late lactation Holstein cows. Y. H Chung*, H. G. Bateman, C. C. Williams, C. C. Stanely, P. A. Terrell, and D. T. Gantt, *LSU AgCenter, Baton Rouge, LA.*

Sixteen Holstein cows in late lactation (mean DIM = 207) were paired by current milk production and DIM and randomly assigned to one of two diets. Diets were based on corn silage with alfalfa hay. Concentrates for diets included ground corn and a commercial protein mixture. Diets differed by addition of 0.29% methionine and 2.9% lysine (DM basis). Methionine was provided as dl-methionine and lysine was provided as lysine-HCl. Cows were fed individually and intake measured daily for 28 d. Milk was measured and sampled at each milking. Samples of rumen fluid were collected via stomach tube at the beginning, midpoint, and end of the trial. Adding amino acids did not alter mean DMI, OM intake ($P > 0.15$), milk yield ($P > 0.7$), or milk production efficiency (kg milk / kg DMI; $P > 0.6$). Supplemental amino acids also had no effect on milk component percentages or production ($P > 0.5$). There was a statistical interaction of treatment and day on study for DMI, OM intake ($P< 0.01$), and milk production efficiency ($P < 0.05$) but the biological implications of these interactions are nonsignificant. As expected, supplemental amino acids increased ruminal NH_3 concentrations ($P < 0.01$). Supplemental amino acids decreased ($P < 0.01$) the proportion of acetate and increased ($P < 0.01$) the proportion of butyrate without affecting the proportions of any other VFA ($P > 0.2$) or total VFA concentrations ($P> 0.6$). These data indicate that free methionine and lysine alter ruminal fermentation but this change may not be large enough to elicit a production response in late lactation cows.

Key Words: Methionine, Lysine, Milk production

T147 Transfer of dietary fatty acids and hydrogenation intermediates from duodenum to milk in cows fed diets varying in forage:concentrate ratio and level of linseed, sunflower, or fish oil. . J. J. Loor*[1,2], K. Ueda[1], A. Ferlay[1], M. Doreau[1], and Y. Chilliard[1], [1]*INRA, 63122 St.-Genes Champanelle, France,* [2]*Department of Animal Sciences, University of Illinois.*

Relationships between duodenal flow and milk secretion of fatty acids due to dietary forage:concentrate ratio (F:C) and unsaturated oil were evaluated using data from two exp. Exp. periods were of 4-wk with grass hay as the forage. In exp. 1, four Holstein cows were fed a diet with low (35:65) or high (65:35) F:C without (LC, HC) or with linseed oil at 3% of DM (LCL3, HCL3) in a 4 × 4 Latin square. In exp. 2, three Holstein cows were fed HC with 5% linseed (HCL5), 5% sunflower (HCS5), or 2.5% fish oil (HCF2.5) in a 3 × 3 Latin square. Mean transfer of 18:2*n*-6 from duodenum to milk was 48% in cows fed LC compared with 41% for HC. Feeding LCL3 increased 18:2*n*-6 transfer (59%) compared with HCL3 (28%). In exp. 2, no differences due to diet were observed (37%). Dietary 18:3*n*-3 transfer averaged 60% or 53% in cows fed LC or HC. Feeding LCL3 compared with HCL3 increased 18:3*n*-3 transfer. Transfer of 18:3*n*-3 in exp. 2 was greater in cows fed HCF2.5 (42%) compared with HCL5 (29%). In exp 2., transfer of 20:5*n*-3, 22:5*n*-3, and 22:6*n*-3 in cows fed HCF2.5 averaged 39, 52, and 22%, respectively. *Trans*10-18:1 transfer was greater in cows fed LC than HC (72% vs 51%), but decreased in response to LCL3 or HCL3. In exp 2., *trans*10-18:1 transfer was 43%. Transfer of *trans*11-18:1+*cis*9,*trans*11-CLA (TVA+CLA) was 59% or 50% due to LC or HC, and feeding LCL3 increased it compared with HCL3 (63% vs 26%). In exp. 2, HCF2.5 increased TVA+CLA transfer markedly compared with HCL5 or HCS5 (66% vs 40%). There was a positive correlation (r = 0.66) between duodenal flow of TVA+CLA and their yield in milk, and between duodenal TVA flow and milk CLA yield (r = 0.74). Results indicate transfer rate for dietary fatty acids and biohydrogenation intermediates from duodenum to milk differs with forage:concentrate ratio and oil type.

Key Words: Forage:concentrate ratio, Oil, Milk fat

T148 Effect of level of dietary crude protein on milk yield and ruminal metabolism in lactating dairy cows. J. J. Olmos Colmenero*[1] and G. A. Broderick[2], [1]*University of Wisconsin-Madison,* [2]*U.S. Dairy Forage Research Center.*

Optimizing dietary CP is important for improving N efficiency in dairy production. Forty lactating Holstein cows (10 ruminally fistulated) were used in an incomplete 5 x 5 Latin Square design with 4-wk periods to assess the effects of different dietary CP levels on milk yield and ruminal metabolism. Diets contained (% of DM) 25% alfalfa silage, 25% corn silage, and 50% concentrate. High moisture corn was replaced with solvent soybean meal to increase CP from 14.6% (diet A), to 15.6% (diet B), 16.6% (diet C), 17.1% (diet D), and 18.4% (diet E). DMI and milk and lactose yield followed the same pattern, with response on diet C being greater than that on diets A and D. Yield of FCM and protein had a similar pattern except that diet C was only greater than diet A. Milk/DMI, fat yield, and ruminal propionate and total VFA did not differ. As expected, MUN and ruminal ammonia increased linearly with dietary CP content. Digestibility of DM and NDF was higher on diets B and C than on diets A, D, and E and significant quadratic effects were noted for both traits. Overall, poorer N utilization was associated with diets higher in CP. A diet containing 16.6% CP was adequate to sustain production under the conditions of this study.

	CP, % of DM						Prob.	
Item	14.6	15.6	16.6	17.1	18.4	SE[1]	Linear	Quad.
DMI, kg/d	21.6^{b}	21.8^{ab}	22.5^{a}	21.6^{b}	21.7^{ab}	0.4	0.91	0.12
Milk Yield, kg/d	36.3^{b}	37.2^{ab}	38.3^{a}	36.6^{b}	36.7^{ab}	0.9	0.60	0.11
3.5 % FCM, kg/d	34.1^{b}	35.6^{ab}	36.7^{a}	35.7^{ab}	36.1^{ab}	1.1	0.09	0.17
Milk/DMI	1.71	1.71	1.72	1.70	1.72	0.04	0.87	0.99
Fat yield, kg/d	1.14	1.20	1.24	1.23	1.24	0.06	0.06	0.30
Protein yield, kg/d	1.10^{b}	1.15^{ab}	1.18^{a}	1.13^{ab}	1.15^{ab}	0.03	0.21	0.10
Lactose yield, kg/d	1.78^{b}	1.81^{ab}	1.91^{a}	1.78^{b}	1.82^{ab}	0.06	0.58	0.18
MUN, mg/dl	7.71^{d}	8.50^{d}	11.2^{c}	13.0^{b}	15.6^{a}	0.6	< 0.01	0.13
DM digestibility, %	71.2^{c}	74.6^{a}	74.0^{a}	72.5^{b}	72.3^{bc}	0.6	0.79	< 0.01
NDF digestibility, %	45.8^{d}	51.2^{a}	49.5^{a}	48.0^{bc}	48.7^{bc}	1.0	0.18	< 0.01
Ruminal metabolites								
Total VFA, mM	78.0	83.0	84.7	84.1	84.3	4.8	0.17	0.34
Acetate, mM	45.1^{b}	48.4^{ab}	49.0^{ab}	49.9^{ab}	50.9^{a}	2.9	0.03	0.56
Propionate, mM	18.5	20.1	20.9	19.0	18.5	1.3	0.76	0.06
Ac:Pr	2.63^{c}	2.57^{cd}	2.48^{d}	2.77^{b}	2.91^{a}	0.07	< 0.01	< 0.01
Ammonia, mM	4.34^{c}	5.49^{b}	6.54^{b}	9.08^{a}	9.14^{a}	0.54	< 0.01	0.34

^{a,b,c,d}Means in rows with no common superscripts are different (P < 0.05). [1]SE = Standard error of the difference of the least square means.

Key Words: Dietary protein, Milk yield, N-efficiency

T149 Feeding calcium salts of linoleic and linolenic essential fatty acids to pre and post-partum Holstein cows improves reproduction, health and profit. W. K. Sanchez*, E. Block, and K. R. Cummings, *ARM & HAMMER Animal Nutrition Group, Church & Dwight Co, Inc., Princeton, N.J..*

Field trials involving over 5,000 high producing Holstein cows (averaging > 12,300 kg ME milk) with over 14,000 eligible breedings were conducted to evaluate the effects of feeding calcium salts of essential fatty acids (linoleic and linolenic acids as MEGALAC-R®; MEG-R) on reproduction, health, and lactational performance. Cows were fed either a control close-up, fresh cow, and high group ration; CON) or a similar set of treatment rations plus MEG-R (115 g for 21-d before calving, 227 g for 10-21 d postpartum, and 454 g through 110 d postpartum) in place of tallow or MEGALAC®). In two trials MEGALAC was the control and in two trials tallow was the control. The percentages of pregnancies and health events were compared using a standard chi-square analysis. Overall cumulative pregnancy rates were 6.5% greater (P < 0.05) for animals fed MEG-R. Primiparous cows responded better (>10% response) to MEG-R than multiparous cows, but the multiparous cows fed the larger dose (454 g) of MEG-R had the greatest response (19% increase overall). Health events were recorded in three trials and milk fevers, displaced abomasums, cases of mastitis, and abortions were all lower (P < 0.10) for cows fed MEG-R. Milk production and milk composition was similar (P > 0.05) between groups, likely due to the fact that the control and treatment diets were similar in calories. Effects of reproduction and health changes on milk yield, culling patterns and herd composition (i.e. the number of calves, heifers, and cows) were used to estimate the economic impact. With $10/cwt milk, $500 culls, $250 calves, and $1500 replacements the net return from feeding MEG-R was $19 per cow overall (a 90% return on investment). The herd fed 454 g MEG-R netted $45 per cow (a 250% return on investment). This research indicates that feeding calcium salts of linoleic and linolenic essential fatty acids can improve reproduction, health and profitability on commercial dairy farms.

Key Words: Dairy nutrition, Reproduction, Health

T150 Effect of dietary soybean oil on lactation performance and conjugated linoleic acid (CLA) concentration in milk of cows on commercial dairy farms. N. Plourde*, J. P. Faucher, J. Delisle, D. Pellerin, and P.Y. Chouinard, *Universite Laval.*

The CLA content of milk from cows in usually low. However, this proportion can be enhanced by dietary addition of soybean oil (SO), which is rich in linoleic acid. Our objective was to evaluate the effect of dietary SO on milk production, milk composition and CLA concentrations in milk from cows under commercial conditions. In this multi-site trial, 254 cows from 12 different farms were used. For the first 7 farms, the herd was divided into two groups. The first group remained on the normal herd diet and the second group received SO at the rate of 1 l/d. For the other 5 farms, the herd was divided into two groups according to lactation stage (early vs. late). Within each of these groups half of the cows remained on the herd diet. The second half received SO at the rate of 1 l/d for cows in early lactation, and 0.5 l/d for cows in late lactation. Soybean oil was added to the diets at the expense of grain concentrates on an energy basis. Metabolizable protein supply was maintained by adjusting the concentration of rumen-undegradable protein. Vitamin E was added in SO at the rate of 1000 IU/l. Experimental period was 8-wk in length. Milk production was recorded and milk was sampled every week for chemical analysis. Milk yield and milk protein yield were not affected by treatments. Milk protein content tended to decrease (P<0.06) for cows receiving 1 l/d of SO (-3.0%). Milk fat content decreased (-6.3% and -18.7%; P<0.05) for cows fed 0.5 and 1 l/d of SO, respectively. Milk fat yield decreased (-22.2%; P<0.05) only for cows receiving 1 l/d of SO. Dietary addition of SO increased (P<0.05) milk fat content of CLA from 5.2 to 20.0 and 18.8 mg/g of fatty acids for cows fed 0.5 and 1 l/d of SO, respectively. Soybean oil can be used on commercial dairies to produce high CLA milk fat.

Key Words: soybean oil, conjugated linoleic acid, milk fat

T151 Effects of essential oils and monensin on ruminal pH, ammonia concentration and in situ degradation of dry matter and nitrogen in the rumen of lactating dairy cows. C. Benchaar*[1,2], T. D. Whyte[2], H. V. Petit[1], R. Berthiaume[1], D. R. Ouellet[1], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Lennoxville, Quebec, Canada,* [2]*Nova Scotia Agricultural College, Truro, Nova Scotia, Canada,* [3]*Universite Laval, Ste-Foy, QC, Canada.*

ABSTRACT Four ruminally cannulated lactating cows were used in a 4x4 Latin square design to examine the effects of dietary addition of essential oils (Crina®) and monensin (Rumensin®) on in situ ruminal degradability of soybean meal, ruminal pH and ammonia concentration in the rumen fluid. Cows were fed for ad libitum intake a TMR unsupplemented (control, CO), or supplemented with essentials oils (2 g/d, EO), monensin (350 mg/d, MO) or a combination of both additives (EO+MO). Each experimental period consisted of two weeks of adjustment to the diet, three days for in situ incubation, and two days for rumen fluid sampling. No interaction was observed (P>.05) between EO and MO. The rapidly (a), and the slowly degradable fractions (b) of DM were not affected (P>0.05) by additive treatments (36.9 and 62.8%, respectively). However, DM degradation rate tended to be higher (7.1 vs 6.4%/h; P=0.08) and effective degradability (ED) was increased (67.5 vs 65.9%; P<0.05) for cows fed MO. Fractions (a) and (b), and degradation rate of OM were not changed (P>0.05) by treatments. ED of OM was slightly higher (66.7 vs 64.9%; P<0.05) for cows fed MO. Degradation kinetics of CP showed that the fraction (a) was lower (P<0.05) with MO. Inversely, this fraction was increased (P=0.05) when cows were fed EO. Fraction (b) was not changed by dietary treatments (83.9%; P>0.05).

CP degradation rate was slightly higher (6.0 vs 5.5%/h; $P<0.05$) with MO and tended to increase (5.9 vs 5.6%/h; $P=0.07$) for cows fed EO. Effective CP degradability increased (55.6 vs 53.0%; $P<0.05$) with MO. Ruminal pH was increased (+ 0.11 points; $P=0$ .04) or tended to increase (+ 0.09 points; $P=0.08$) with the addition of EO and MO, respectively. Ammonia concentration in the rumen fluid was reduced (12.7 vs 14.3 mg/100 ml; $P<0.05$) for cows fed MO. This study showed that the addition of EO and MO in dairy cow diets has minor effects on protein degradation and ammonia concentration in the rumen. More investigation is needed to assess the effectiveness of essential oils to impact protein digestion and rumen fermentation.

Key Words: Essential oils, Monensin, Protein degradation

T152 Effect of vitamin E supplementation in late lactation on milk production and milk fatty acid profile. J. K. Kay, L. H. Baumgard, E. S. Kolver, and J. R. Roche, [1]*Dexcel (formerly Dairying Research Corporation), Hamilton, New Zealand,* [2]*University of Arizona, Tucson, Arizona.*

High dietary concentrations of vitamin E (Vit. E) have been shown to prevent milk fat depression in lactating dairy cows. Pasture-fed cows have higher milk fat concentrations than cows on TMR and it was hypothesised that the higher concentration of Vit. E in pasture (107 ± 38 iu/kg), compared with TMR (26 ± 3 iu/kg), may contribute to the higher milk fat concentration, possibly through lower *trans*-10, *cis*-12 conjugated linoleic acid (CLA) concentration in milk fat. Eighteen Holstein-Friesian cows in late lactation receiving either ad libitum pasture (n=6) or a TMR of corn silage, grass silage and concentrates, were used. The 12 TMR cows received either the recommended (NORM) dietary Vit. E concentration (23 iu/kg DM; n=6) or an additional 10,000 iu/cow/d of supplemental Vit. E (HIGH; n=6) for 21 d. AM and PM milk samples were collected on d 20 and 21. Pasture cows produced milk with higher ($P < 0.1$) milk fat concentration and produced more *cis*-9, *trans*-11 CLA and *trans*-11 18:1 (TVA), and less *trans*-10 18:1 per 100g total milk fatty acids than cows fed TMR. HIGH cows produced milk with a higher ($P < 0.05$) fat concentration than NORM cows, but fat yield was not affected. Although concentrations of TVA were higher ($P < 0.1$) in the plasma of HIGH cows and there was a trend ($P < 0.14$) for a reduced concentration of *trans*-10 18:1, there was no difference in the concentration of these fatty acids in milk. *Trans*-10, *cis*-12 CLA concentrations were not detectable in milk or plasma. Further research is required to investigate the role of Vit E. in milk fat synthesis.

Key Words: Pasture, Vitamin E, Milk fat depression

T153 Partial replacement of corn grain with calcium salts of fatty acid in the concentrate fed to grazing primiparous and multiparous dairy cows. G. F. Schroeder*[1,2], G. A. Gagliostro[3], L. I. Vidaurreta[1], J. J. Couderc[1,2], P. Gatti[4], A. Rodriguez[4], and G. Eyherarbide[1], [1]*Fac. Cs. Agrarias. UNMdP,* [2]*CONICET,* [3]*INTA EEA Balcarce,* [4]*INTI CITIL PTM, Argentina.*

Thirty-two multiparous (**MC**, 580 kg BW) and 18 primiparous (**PC**, 497 kg BW) Holsteins cows grazing an alfalfa pasture were used in a factorial design to study the effects of parity and calcium salts of unsaturated fatty acids (**CSFA**) supplementation on DMI, milk production and composition, and milk fatty acids (**FA**) profile. The dietary treatments consisted in two isoenergetic concentrates composed by 7 kg/d of ground corn grain and 0.4 kg/d of fish meal (**Control**) or 4.8 kg/d of corn grain, 0.4 kg/d of fish meal and 0.9 kg/d of CSFA (**Fat**). The FA composition of CSFA was: 16% C16:0, 13.5% C18:0, 32% C18:1, 30% C18:2. Neither pasture nor total DMI were affected by dietary treatment or parity. Milk yield was increased in PC receiving CSFA but no effects were observed on MC. Fat corrected milk, milk fat percentage and milk fat yield were decreased by CSFA supplementation on MC with no effects on PC. Milk protein percentage was increased in MC but decreased in PC by fat supplementation. No interaction between dietary treatment by parity was found for milk FA composition recorded at 60 DIM. The partial replacement of corn by CSFA in the concentrate resulted in a reduction in short- (7.8 vs 5.1 %) and medium-chain FA (38.7 vs 30.4 %) and an increase in C18:1 (21.4 vs 25.6 %), C18:2 (2.8 vs 8.9 %), and C18:3 (0.94 vs 1.24 %) contented. Fat supplementation increased milk CLA content in MC (1.82 vs 2.05 %) with no effects on PC. In conclusion, the effect of CSFA supplementation in grazing MC and PC on milk production and composition seemed to be different depending on the parity of the cows.

	Dietary treatment					P value		
	Control		Fat					
	MC	PC	MC	PC	SEM	Dietary	Parity	D x P
DMI, kg/d								
Concentrate	4.51	4.64	3.87	3.82	0.05	0.01	0.47	0.11
Pasture	13.7	15.0	15.3	13.1	0.91	0.92	0.64	0.09
Total	18.2	19.6	19.2	17.0	0.90	0.41	0.66	0.08
Milk, kg/d	26.6	20.4 b	25.0	22.2 a	0.47	0.93	0.01	0.02
4 % FCM, kg/d	24.5 a	18.9	21.2 b	19.9	0.98	0.14	0.01	0.01
Milk Fat, %	3.53	3.57	3.22	3.40	0.07	0.02	0.28	0.53
Milk Fat, kg/d	0.93 a	0.72	0.76 b	0.73	0.03	0.04	0.01	0.02
Milk Protein, %	3.19 b	3.20 a	3.30 a	3.09 b	0.03	0.90	0.03	0.02
Milk Protein, kg/d	0.85	0.65	0.81	0.68	0.02	0.96	0.01	0.13

a, b, c Least square means in the same row with different superscripts differ ($P < 0.05$).

Key Words: Fat supplementation, Parity, Grazing

T154 Biotin supplementation for periparturient dairy cows. O. Rosendo[1], C. R. Staples*[1], L. R. McDowell[1], R. J. McMahon[1], and W. M. Seymour[2], [1]*University of Florida, Gainesville, FL,* [2]*Roche Vitamins, Inc., Parsippany, NJ.*

Multiparous Holstein cows were fed an average of 0 or 20 mg/d of biotin from an average of 17 d prepartum to calving and 0 or 30 mg/d of biotin from calving to 70 d postpartum. Diets fed during the nonlactating period were 1.63 Mcal NEL/kg and 13.4% CP whereas diets fed during the lactating period were 1.69 Mcal NEL/kg and 17.3% CP (DM basis). Mean concentration of biotin in plasma sampled weekly was greater in cows fed biotin (9.4 vs. 4.3 nM/liter; S.E. = 0.5). Mean intake of DM was 8.6 and 10.3 kg/d (S.E. = 0.8) during the nonlactating period and 22.1 and 23.8 kg/d (S.E. = 0.7) postpartum for cows fed control (C; n = 18) and biotin (B; n = 20) diets, respectively. Intakes were not different. Production of milk (35.8 vs. 34.8 kg/d; S.E. = 1.3), milk fat concentration (3.59 vs. 3.69%; S.E. = 0.08), and milk protein concentration (2.73 vs. 2.83%; S.E. = 0.05) were similar between treatment groups. Concentrations of plasma NEFA were lower at weeks 2 (652 vs. 413 mEq/L) and 4 (381 vs. 196 mEq/L) postpartum whereas mean concentration of plasma glucose was greater for cows fed supplemental biotin (63.4 vs. 66.6 mg/dl; S.E. = 0.8). Mean concentration of plasma beta-hydroxybutyric acid (5.4 vs. 4.8 mg/dl; S.E = 0.3) and urea nitrogen (14.9 vs. 14.8; S.E = 0.4) were not affected by biotin supplementation. Biopsies of liver were taken at 2 d, 14 ± 2 d, and 28 ± 2 d postpartum. Total lipid concentration of liver (wet and dry basis) in control cows tended to increase at d 14 whereas that of cows fed biotin decreased (quadratic effect of day by diet interaction). Mean total lipid concentration was 6.8 vs. 6.3, 7.5 vs. 5.7, and 5.6 vs. 4.8% (wet basis) for control and biotin-supplemented cows on days 2, 14 and 28 respectively. Feeding supplemental biotin at 20 g/d during the last 17 d prepartum and at 30 g/d postpartum had a positive effect on metabolic status as evidenced by lowered blood NEFA, elevated blood glucose, and lowered liver lipid concentrations.

Key Words: Biotin, Lactation, Liver

T155 Effects of dietary addition of essential oils and monensin on nutrient digestibility, nitrogen retention, milk production and milk composition of Holstein cows. C. Benchaar*[1,2], T. D. Whyte[2], R. Berthiaume[1], H. V. Petit[1], D. R. Ouellet[1], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Lennoxville, Quebec, Canada,* [2]*Nova Scotia Agricultural College, Truro, Nova Scotia, Canada,* [3]*Universite Laval, Ste-Foy, QC, Canada.*

Four lactating dairy cows were used in a 4 x 4 Latin square design to study the effects of dietary addition of essential oils (Crina®) and monensin (Rumensin®) on nutrient digestibility, nitrogen retention, milk production and milk composition. Cows were fed for ad libitum a TMR unsupplemented (control, CO), or supplemented with essentials oils (2 g/d, EO), monensin (350 mg/d, MO) or a combination of both additives (EO+MO). Each experimental period consisted of 21 days of adjustment

to the diet and 7 days for data recording and sample collection. No interaction ($P>0.05$) was observed between EO and MO. Dry matter intake was not affected by dietary additives (22.7 kg/d, $P>0.05$). Apparent DM (66.6%), OM (68.3%), and NDF (47.9%) digestibilities were similar ($P>0.05$) among treatments. However, apparent ADF digestibility was higher (48.9 vs. 46.0%; $P<0.05$) for cows fed EO. Apparent CP digestibility was increased (65.0 vs. 63.6%; $P=0.05$) when cows were fed MO. Nitrogen retention was not changed (27.1 g/d; $P>0.05$) by treatments. Production of milk and 4% FCM remained unchanged ($P>0.05$) among treatments (33.6 and 33.4 kg/d, respectively). Milk protein and lactose concentrations were not different ($P>0.05$) between treatments (3.5 and 4.6%, respectively). Milk fat and total solids contents were lower (3.8 vs. 4.1% and 12.6 vs. 13.0%; $P<0.05$) for cows fed MO. Milk urea-nitrogen concentration tended to increase (12.6 vs. 12.0 mg/dl; $P=0.06$) for cows fed MO. Somatic cell count was not affected by additive treatments ($55x10^3$/ml; $P>0.05$). Initial and final body weights were unaffected ($P>0.05$) by treatments. However, body weight change was higher (0.4 vs. 0.2 kg/d; $P=0.05$) for cows fed EO. This study showed that the addition of essential oils and monensin does not have major impacts on nutrient digestibility and milk production and composition in dairy cows. Further investigations are needed to evaluate the potential of adding essential oils in dairy cow diets to manipulate rumen fermentation and to improve feed efficiency.

Key Words: Essential oils, Monensin, Cows

T156 Relation of arterial concentration of lysine and methionine milk and milk protein production: a twenty-year literature review.

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This study investigated relationships of blood methionine and lysine concentration from literature studies to milk yield, protein yield and milk protein %. Data consisted of all studies published in the Journal of Dairy Science between 1982 and 2002 with sufficient information on dietary composition, dry matter intake, milk yield, milk protein percent and jugular concentrations of MET and LYS. Sixty-six studies met the established criteria, representing 281 diets at 21 institutions. Diets were entered into the Mepron Dairy Ration Evaluator (AMRE) to predict duodenal amino acid flow, MET and LYS as a percent of metabolizable protein and ratio of LYS:MET. Main effects of AA measurement (serum or plasma), cow breed and study type (protein fed or infused beyond the rumen) were assessed with PROC MIXED of SAS. Linear relationships between blood MET and LYS concentrations and dietary measures were assessed with PROC REG, while non-linear relationships were studied with PROC NLIN.

In these studies there was no significant difference in MET or LYS concentration whether measured in serum or plasma, so studies were pooled. Breed had a significant effect on milk protein %, but not on blood AA concentration. Linear regression was significant only for duodenal flow of MET on milk yield and milk protein yield (P<.05) overall. There was no significant relation to blood AA. Non-linearly, duodenal MET and LYS were significantly associated with milk yield, milk protein % and milk protein yield (P<.01). Duodenal MET, MET as % of MP or LYS:MET were not significantly related to blood MET. Duodenal LYS and LYS:MET, but not LYS as % MP, were related to blood LYS. Blood MET but not LYS was related to protein%. This study suggests that duodenal MET and LYS as well as MET and LYS as a percent of MP are associated with milk yield, protein % and protein yield in a non-linear manner. Blood AA is not consistently correlated, and its use as a measure of AA adequacy is questionable.

Key Words: Methionine, Lysine, Dairy cattle

T157 Response of pre-partum and early lactation dairy cows to dietary inclusion of ruminally inert conjugated linoleic acid.

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A study was conducted to determine the feed intake and milk production response of pre-partum and early lactation dairy cows to inclusion of partially rumen protected calcium salts of conjugated linoleic acid (CLA). Thirty-four multiparous cows during dry period were blocked according to calving date and milk yield from previous lactation. Within blocks cows were randomly assigned to control (CT) or CLA (CL) treatments. Cows in both treatments were fed a dry cow diet containing 84% forage 3 wk prior to due calving date, a fresh cow diet containing forage to grain in 51:49 ratio for 2 wk post-calving and a milking diet containing forage to grain in 47:53 ratio during weeks 3 to 10 of lactation. In addition to the basal diet, cows in CT and CL received 0 and 150 g of CLA supplement before calving and 225 g of hydrolyzed animal fat or 225 g of CLA supplement after calving, respectively. The fat supplements were top dressed on the total mixed ration. Daily feed intake and milk yield were recorded. Weekly milk samples from 6 consecutive milkings were analyzed for fat, protein and lactose content. Weekly composite milk samples collected from 6 consecutive milkings during 1, 2, 3, 4, 5 and 10 wk were analyzed for fatty acid profile. Cows in CT and CL treatments had similar DMI before calving. During 1-10 wk of lactation the average DMI was 23.0 and 20.8 kg/d (P <0.07), milk yield 46.0 and 45.0 kg/d, energy corrected milk 32.8 and 29.6 kg/d (P <0.03), fat content 3.90 and 3.45% (P <0.01), protein content 2.89 and 2.82%, fat yield 1.76 and 1.47 kg/d (P <0.01), protein yield 1.31 and 1.24 kg/d, lactose content 4.86 and 4.81%, and ECM/DMI 1.48 and 1.52 in CT and CL treatments, respectively. The average CLA content of milk was 3.8 and 3.5 mg/g of fat in CT and CL treatments, respectively. Results suggest that feeding partially rumen protected CLA supplement 3 wk prior to calving had no influence on feed intake. Feeding CLA supplement during early lactation reduced fat content, fat yield and energy corrected milk yield and had no influence on CLA content of milk fat. The CLA supplement can be used as a tool to reduce fat content of milk.

Key Words: Cow, Milk, Conjugated linoleic acid

T158 Comparison of commercially available rumen-stable choline products.

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The objectives were to determine the rumen DM and choline stability of five commercially available rumen-stable choline products and to determine qualitative differences of rumen-stable nutrients by measuring rumen DM and nutrient stability. Products evaluated were Reashure® (25% choline; Balchem Encapsulates, New Hampton, NY), product A (13% choline) product B (40% choline; Italian manufactured, North American distributed), product C (40% choline, Italian manufactured, Asian distributed), product D (25% choline; Canadian manufactured, North American distributed). Products were obtained through commercial distributors, and stored at ambient temperature. Dry matter and choline stability were determined at 0.5, 6, 12 and 24 hours of incubation using an Ankom Dairy II Incubator. Triplicate samples were used for each time point; corn silage was used as an internal standard. Each sample bag was dried for 24 hr at 65 C, with residues weighed and analyzed for choline content using a choline oxidase based detection system. Rumen-stability was calculated by subtracting the recovered DM or choline from the amount of DM or choline added to the bag originally. Results are detailed in the table below. All products had reasonable DM stability (63 to 98% at the 12 hr time point). However, choline stability varied considerably, with only one product (Reashure) having choline stability after 12 hr of incubation. In conclusion, considerable differences exist between commercially available rumen-stable choline products. Measuring DM stability is not an acceptable method for accessing the quality of rumen-stable nutrients.®

	Reashure		Product A		Product B		Product C		Product D	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Time(hr)	Rumen DM stability, %									
0.5	99.8	1.1	87.5	1.1	63.7	0.4	65.5	0.7	79.3	1.4
6	98.9	1.2	86.6	0.7	63.1	0.6	63.1	0.5	73.4	1.0
12	98.4	0.9	86.6	0.8	63.0	0.3	63.1	0.1	71.6	0.2
24	97.4	0.8	85.7	3.3	62.0	1.6	62.4	0.3	71.3	0.8
	Rumen choline stability, %									
0.5	82.3	3.7	3.0	1.8	0.4	0.4	7.2	3.6	21.9	1.5
6	77.8	3.3	1.3	1.6	0.0	0.0	0.0	0.0	3.5	1.2
12	75.6	1.1	0.8	1.0	0.0	0.0	0.0	0.0	1.6	0.1
24	70.4	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Key Words: Choline, Rumen, Stable

T159 A comparison of the 1989 and 2001 National Research Council models on predicting protein requirements for dairy cows. K. Guo* and R. Kohn, *University of Maryland.*

The objective of this study was to compare the accuracy and precision of predicting protein requirements for lactating dairy cows using the 1989 and 2001 NRC models. The study was based on two previously published research datasets. Both of the datasets were conducted with specifically formulated low crude protein (CP) diets with varied rumen degraded (RDP) and rumen undegraded protein (RUP) and a high CP diet as control. The first dataset varied RUP percentage at a constant CP content in early, mid and late lactation. Low RUP diets resulted in reduced milk production especially in early lactation (32 kg/d vs. 37 kg/d). The 1989 model predicted reduced milk production with the low RUP diet, especially in early lactation (30.1 kg/d vs. 34.6 kg/d), as observed. The 2001 model overestimated RUP supply, predicting adequate RUP even when production losses were observed from RUP deficiency. The 1989 model predicted sufficient N for bacterial synthesis for cows at all lactation stages fed both control and high RDP diets. The 2001 model predicted deficient rumen N for all diets and all stages. The second dataset included diets with different RDP concentrations but the same level of RUP. The low RDP diets resulted in reduced milk production (32.2 kg/d vs. 34.0 kg/d). Both 1989 model and 2001 model predict the reduced milk production (32.3kg/d vs. 34.5kg/d and 31kg/d vs. 38.8kg/d respectively). For both data sets, the 1989 model predicted protein allowable milk production was similar to the actual milk (P>0.05). The 2001 model underestimated allowable milk by 2.72kg/d for the first data set, and overestimated allowable milk by 2.5 kg/d for the second data set. With both datasets, 2001 model predicted significantly lower bacteria synthesized protein (p<0.001) and higher supply of RUP than the 1989 model.

Key Words: Protein requirement, RDP, Model evaluation

T160 Influence of HMBi concentration on in vitro estimated organic matter digestibility of diets varying in proportion of corn silage relative to concentrate. J. C. Robert*, S. Paquet, C. Richard, and B. Bouza, *Adisseo, Antony, France.*

HMBi is a novel source of methionine for ruminants : 50% is absorbed by the rumen wall to provide metabolisable methionine and the remaining 50% is hydrolysed in the rumen to HMB which stimulates rumen fermentation in vitro (Robert et al., 2002). Using the rumen simulation technique (HFT gas test-Menke et al., 1988), 4 doses of HMBi were tested in this study (mg/syringe : respectively : 0-3-6-9 Met. equivalent) with 5 combinations : corn silage (CS), concentrate (C), CS+C (%70-30)(CSC_1), CS+C(%50-50)(CSC_2), CS+C(%30-70)(CSC_3). The concentrate composition was (%) barley, 41 ; beetpulp, 37 ; soyabean meal, 15 ; urea, 2 ; molasses, 5. Main characteristics of corn silage were : %DM, 29.8 ; protein, 7.6 ; UFL/Kg DM : 0.88. 200 mg of dried and ground substrate was incubated with 10 ml of rumen juice + 20 ml of buffer in syringes gently agitated at 39°C. Gas production was measured after 24h. 2 replicates per serie and 6 series were completed. The prediction equations proposed by Menke et al(1988) were used to calculate organic matter digestibility (OMD %) and energy values (UFL/Kg DM). Significant increases of OMD were observed for all the combinations incubated with 6 or 9 mg of HMBi. The effects of HMBi on corn silage and the concentrate were additive.
From these results, the projected improvement (UFL/Kg DM) is estimated at 0.02 and 0.05 for the corn silage and concentrate respectively in the presence of HMBi. This corresponds to a 0.5 to 1.1 UFL/day increase in energy supply to a lactating dairy cow which theoritically corresponds to about 1 to 2 kg more milk.

Substrates	CS (σ)	C (σ)	CSC_1 (σ)	CSC_2(σ)	CSC_3(σ)
Control	72.6b(1.8)	88.5b(1.3)	75.9b(1.4)	80.2b(1.6)	82.7b(1.2)
HMBi (9 mg)					
measured	74.2a(1.9)	91.4a(1.4)	78.2a($_1$)(1.3)	82.2a($_1$)(1.1)	85.3a($_1$)(0.9)
calculated*	-	-	79.2($_1$)(1.5)	82.7($_1$)(1.5)	86.2($_1$)(1.4)

values with the same letter and figure (1) in column are not significantly different p<0.05.
*calculated taking into account values measured in CS and C and proportions in mixed rations.

Key Words: HMBi, Lactating dairy cows, Digestibility

T161 Milk production and composition and prostaglandin secretion in dairy cows fed different fat sources. H. V. Petit*[1], C. Germiquet[2], and D. Lebel[2], [1]*Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre,* [2]*Département de Biologie, Université de Sherbrooke.*

Four non-lactating multiparous Holstein cows were used in a 4 X 4 Latin square design experiment to study the effects of feeding different fat sources on milk production and composition and prostaglandin secretion. All cows were fed a total mixed diet containing around 50% silage and 50% concentrate. All diets were equal in protein and energy contents. Four different concentrates were tested: Megalac®, whole linseed, whole sunflower seed, and absence of fat in the concentrate. Estrous cycles were synchronized for each period and animals were challenged with oxytocin (100 IU) to stimulate uterine PGF production. Mean concentrations of 13,14-dihydro-15-keto-PGF_{2alpha} in blood between 0 and 120 min following the oxytocin injection were lower ($P = 0.07$) for cows fed Megalac (55.1 pg/ml) and flaxseed (55.5 pg/ml) than for those fed whole sunflower seed (102.7 pg/ml); cows fed control had intermediate values (71.4 pg/ml). Mean plasma progesterone concentration was lower ($P < 0.05$) for cows fed flaxseed (6,430 pg/ml) compared to those fed control (10,108 pg/ml) or sunflower (9,061 pg/ml); cows fed Megalac had intermediate values (6,610 pg/ml). Feed intake averaged 21.7 kg/d and was similar ($P > 0.05$) among treatments. Milk yield was greater ($P < 0.05$) for cows fed Megalac (31.5 kg/d) and flaxseed (32.1 kg/d) compared to those fed sunflower seed (25.9 kg/d) and control (24.8 kg/d). Digestibilities of DM, CP, ADF, NDF, and energy were similar among treatments. Milk fat percentage was similar ($P > 0.05$) among treatments but milk protein concentration tended ($P = 0.11$) to be greater for cows fed flaxseed (3.87%) and control (3.92%) compared to those fed Megalac (3.68%); cows fed sunflower seed had intermediate values (3.74%). Feeding flaxseed decreased ($P < 0.05$) the omega 6 to omega 3 fatty acids ratio in milk (2.8) compared to feeding control (6.5), Megalac (6.8) and sunflower (9.9). In conclusion, feeding a source of omega 3 fatty acids such as flaxseed decreased secretion of the the dienoic prostaglandin PGF_{2alpha} compared to feeding a source of omega 6 fatty acids such as sunflower seed, which could contribute in improving gestation rate as observed in other studies.

Key Words: Dairy cattle, Fatty acids, Reproduction

T162 Effects of monensin and (or) high levels of zinc on ruminal degradation of free lysine and liquid hydroxy-methylthiobutanoic acid. H. G. Bateman, II*[1], C. C. Williams[1], D. T. Gantt[1], Y. H. Chung[1], A. E. Beem[1], C. C. Stanley[1], G. E. Goodier[1], P. G. Hoyt[2], and L. D. Bunting[3], [1]*LSU AgCenter, Baton Rouge, LA,* [2]*LSU School of Vet Medicine, Baton Rouge, LA,* [3]*Archer Daniels Midland Company, Quincy, IL.*

Four nonlactating Holstein cows were used in a Latin square designed experiment to investigate the effects of monensin (M) and high levels of Zn on ruminal degradation of lysine and hydroxy-methylthiobutanoic acid (HMB). Treatments were arranged as a 2 x 2 factorial of added ZnSO4 (0 or 500 ppm Zn) with or without M (0 or 40 ppm). Diets were based on alfalfa hay (50% of DM) with a grain supplement and were limit-fed at 8.2 kg of DM/cow daily. Lysine-HCl (85g) and HMB (50g) were dosed through the rumen cannula on the last day of each period and ruminal concentrations of each compound were measured every 0.5 h for 8 h. Neither added Zn nor M affected the fractional disappearance rates of lysine ($P > 0.2$) through 8 h. Stable rumen lysine concentrations were reached by 6 h post-dosing; when data prior to 6 h were analyzed, M tended ($P = 0.13$) to decrease the rate of disappearance of lysine. The disappearance rate of HMB tended ($P = 0.098$) to be decreased by M through 8 h. High levels of Zn increased ($P = 0.04$) the proportion of propionate in rumen fluid but had no effect on the proportion of acetate. As expected, M decreased ($P = 0.052$) the proportion of acetate and increased ($P = 0.02$) the proportion of propionate in rumen fluid. Neither M nor Zn affected ($P > 0.19$) total VFA in ruminal fluid. Dietary treatments had no effect ($P > 0.2$) on ruminal NH3 or peptides. Unexpectedly, supplemental Zn increased ($P = 0.02$) the rate of disappearance of soybean meal and tended ($P = 0.08$) to increase the rate of disappearance of extruded soybean meal from nylon bags. These data suggest that supplemental Zn and M alter ruminal fermentation patterns and M but not Zn may decrease the rate of ruminal degradation of lysine and HMB.

Key Words: Hydroxy-methylthiobutanoic acid, Amino acid, Degredation

T163 Influence of HMBi, HMB and combination of both on ruminal metabolism in vivo. J. C. Robert*, E. Madiot, C. Richard, and B. Bouza, *Adisseo, Antony, France*.

Four non lactacting, rumen cannulated, Holstein cows were randomly assigned in a latin square design (4×3 week periods) to four treatments (animal per day supplementation) : C = Control, H1 = 8g Rhodimet AT88 ^{TM} (Adisseo) ; H2 = 9.8g HMBi ; H3 = 4g Rhodimet AT88^{TM} + 9.8g HMBi. These quantities supplied respectively 7g methionine equivalent for H1 and H2 and 10.5g for H3. Estimated HMB available in the rumen was : 7g for H1 and H3 and 3.5g for H2 based on assumed availabilities in the rumen of 100% for pure HMB and 50% for pure HMBi. Ration fed was composed of (DMI per animal per day) = corn silage 4.2 kg + corn grain 1 kg + concentrate 2 kg (composition % barley, 41 ; beet pulp, 37 ; soybean meal, 15 ; molasses, 5 ; urea, 2). Ruminal juice was collected two days during the third week of each period at 8h30 and 10h30 for pH, ammonia-N and VFA measurements. Representative gas samples were collected through rumen canulae with a special device (Jouany et al., 1979)on two days during the third week of each period at 8h30 and 9h30 for CO2, CH4, H2S, CH3SH and DMS determinations. In general treatments H1 and H3 lowered concentrations of acetate (molar%)and increased concentrations of ammonia-N, butyrate (molar%), H2S and CH3SH compared to the Control and H2 treatment. It appears that the quantity of HMB ruminally available from the level of HMBi used in H2 was insufficient to modify ruminal metabolism except for propionate which was decreased with H2 but the mode of action is unclear and this result needs to be verified. For the higher levels of rumen available HMB (H1 and H3), the changes in individual VFA (molar%) : decrease in acetate, increase in butyrate -classic with HMB- could be due to changes in microbial population. Increases of ammonia-N, H2S and CH3SH can be assumed to be linked directly to dethiomethylation of HMB in the rumen and linked to the quantity of HMB degraded.

		C	H1	H2	H3	SED
Ruminal Juice						
VFA						
(molar%)	Acetate C2	68.3a	67.0b	68.1a	67.8a	0.84
	Propionate C3	15.6a	15.2a	14.4b	15.4a	0.69
	Butyrate C4	11.5c	13.1a	12.7ab	12.5b	0.56
	ratio C2/C3	4.39b	4.43b	4.76a	4.45b	0.244
Ammonia-N						
(mg%g)	N-NH3	26.0b	31.9a	28.9ab	29.1ab	4.37
Ruminal gas	(mg/L)					
	H2S	0.461b	0.613a	0.539a	0.582a	0.074
	CH3SH	0.012b	0.019a	0.013b	0.016a	0.004
HMB available in rumen (%DMI)		0	0.1	0.05	0.1	

a,b : values in the same line with the same letter are not significantly different : $p < 0.05$

Key Words: Amino acid, Ruminant, Nutrition

T164 Milk choline concentration as an index of bioavailability of rumen-protected choline. J. R. Newbold* and J. Lavrijssen, *Provimi Research and Technology Centre, Brussels, Belgium*.

Milk choline has been suggested as an index of bioavailability of rumen-protected choline (RPC). Our objective was to identify the response of milk choline concentration to RPC in order to define an appropriate feeding rate at which different sources of RPC may be compared. Eight primiparous Holstein cows (days in milk = 233, SE 14.3) were used in duplicate 4x4 Latin Squares with two-week periods. Treatments were: A, Negative control; B, Low-RPC (equivalent to 25g choline chloride/d); C, High-RPC (50g choline chloride/d) and D, Unprotected choline chloride (50g/d). RPC was a fat-encapsulated product (Provimi Italia, Agrate Brianza, Italy)containing 250g/kg choline chloride. Fractionated palm oil was used to equalise fat intake across treatments. A semi-complete ration based on maize silage, grass silage and a protein concentrate was offered ad libitum, supplemented with 1kg (Square 1) or 0.5kg (Square 2) of an additional concentrate. Milk choline was determined for four consecutive milkings at the end of each period by a modification of the method of Woollard and Indyk (2000, Journal of AOAC International 83:131).There were no effects (P>0.1)of treatment on dry matter, milk yield or milk fat or protein concentration. Mean choline concentrations (mg/l milk) were: A. 47.2; B. 53.7; C. 58.3; D. 54.1, SE=2.64, P=0.06). Milk choline concentration varied considerably between cows (38.0-69.5mg/l). There was a weak linear response of milk choline concentration to supplemental RPC (milk choline (mg/l) = 47.5 + 0.22 (g/d choline chloride as RPC), P=0.12, r2=0.12). With no evidence of a curvilinear response, a feeding rate of 50g/d may be appropriate for comparison of sources of RPC. However, large variation between cows suggests that replication should be increased if possibly subtle differences between RPC sources are to be identified. Exploratory linear regression showed a weak positive relationship between milk choline and dry matter intake (P=0.09). Lack of effects on milk production was not unexpected, given the advanced stage of lactation of cows in this experiment.

Key Words: Choline, Dairy, Cow

T165 Lactation performance of dairy cows fed different amounts of protein. E. B. Groff* and Z. Wu, *Pennsylvania State University*.

Excess N from agriculture has become a crucial experimental problem. Reducing protein allowances and altering the forage portion of the diet are tools considered to be effective in minimizing N excretion. Sixteen Holstein cows (80 ± 18 DIM) were utilized in a replicated 4 x 4 Latin square design to determine the effects of dietary protein concentration on lactation performance and N excretion. The experimental period included 2 wk for adaption followed by 1 wk for data collection. Diets had a 50 : 50 forage to concentrate ratio and were formulated to contain 15.00, 16.25, 17.50, or 18.75% CP. The forage portion of the diet consisted of 75% alfalfa silage and 25% corn silage. Increasing dietary CP did not (P >0.05) have an effect on milk yield, but resulted in a linear increase in MUN, PUN, fecal N and urinary N concentrations(P <0.05). Varying the conentration of protein from 15.00 to 18.75% in diets that used a 75 : 25 alfalfa to corn silage ratio did not effect overall lactation performance. Results are consistent with previous trials that used different alfalfa to corn silage ratios.

Dietary Protein (%)

Item	15.00	16.25	17.50	18.75	Effect	SEM
DMI (kg/d)	28.6	28.4	30.0	28.9	L	0.8
Milk (kg/d)	34.7	34.9	35.8	36.5	NS	1.4
MUN (mg/dl)	6.2	6.8	8.5	9.9	L	0.5
Milk fat (%)	3.46	3.55	3.54	3.63	NS	0.17
Milk protein (%)	3.06	3.01	3.04	3.03	NS	0.08
PUN (mg/dl)	7.8	8.4	10.1	12.3	L	0.5
Fecal N (%)	14.9	16.2	17.0	17.7	L	0.2
Urine N (g/L)	5.1	5.6	6.6	7.5	L	0.3

Significant at P <0.05 for C = cubic, L = linear effects, or NS = not signficant effects.

Key Words: Protein, Dairy cows, Forage

T166 Limiting amino acids of some tropical forages and their residues after rumen incubation, related to milk protein amino acidic composition. L. Miranda[1], N. Rodrigues[2], R. Sainz*[3], E. Pereira[4], M. Gontijo Netto[5], C. Veloso[6], and A. Queiroz[7], [1]*FEAD-Minas, Brazil,* [2]*Universidade Federal Minas Gerais, Brazil,* [3]*University of California- Davis, USA,* [4]*Universidade Estadual Oeste Parana,* [5]*EMBRAPA Gado de Corte, Brazil*.

A comparison between the amino acid profiles of feed protein and milk protein can help to assess the ideal amino acid supply required for milk protein synthesis. A comparative analysis of the profile of essential amino acids found in forages and their corresponding residues after 18 hours of rumen incubation, and the profile of milk protein (milk protein score, MPS) shows that: lysine, isoleucine and methionine were the first three limiting amino acids found in leucena, whereas for the corresponding residues the sequence was methionine, lysine and isoleucine. Lysine, isoleucine and leucine were the first three limiting amino acids found in perennial soybean; and methionine, leucine and lysine were the most significant ones in residues after 18 hours of rumen incubation. For cassava, the first three limiting amino acids were leucine, lysine and threonine, with leucine, arginine and histidine for the residue. Amino acid profiles were similar for pigeon pea and its residue after rumen incubation. Lysine, leucine and isoleucine were the limiting amino acids found for ramie, and arginine, lysine and phenylalanine were the limiting amino acids for the residue. MPS for ramie was the highest among forages, and remained the highest among residues of rumen incubation.

MPS for cassava was higher in the residue than in the original forage, but remained the lowest for all the forages studied. After rumen incubation, predominant limiting amino acids changed in all forages, except for pigeon pea, showing that the amino acid composition of the non-degradable fraction differs from the one found in the original forage.

Key Words: Limiting amino acids, Milk protein composition

T167 Changes in volatile fatty acid and *trans* fatty acid concentrations in the rumen of lactating Holstein cows fed four concentrations of unsaturated free fatty acids.

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The accumulation of unsaturated fatty acids in ruminal contents can disrupt both carbohydrate fermentation and lipid biohydrogenation increasing the passage of fiber and *trans* fatty acids to the intestines. Previous results suggested that these negative effects of unsaturated fatty acids are more related to their accumulation in the rumen as the free acid rather than in esterified lipid fractions. This study was conducted to determine the pattern and extent of changes in volatile fatty acid (VFA) and *trans* fatty acid concentrations that accompany increasing concentrations of unsaturated free fatty acids (UFFA) in the rumen. Four diets were fed to four lactating Holstein cows (fitted with a ruminal cannula) in a 4 x 4 Latin square design with 2-week periods. Diets contained 0, 1, 2, or 3% (DM basis) added unsaturated free fatty acids (UFFA) consisting of 61% linoleic acid, 29% oleic acid, and 5% linolenic acid. Samples were taken from the rumen just prior to the morning feeding, and at 0.5, 1, 1.5, or 2 hours after feeding on the last day of each period. As UFFA increased in the diet, the concentrations of UFFA in ruminal contents increased ($P < 0.01$) linearly (4.2, 5.8, 7.5, and 8.5 mg/g DM), dry matter intake declined ($P = 0.02$) linearly (from 25.5 to 22.2 kg/d), but milk yield did not change. Total VFA concentration ($P = 0.07$) and the ratio of acetate to propionate ($P < 0.01$) both declined linearly as UFFA increased in the diet. However, as UFFA increased from 0 to 3% of the diet DM, the *trans*-C18:1 concentrations in ruminal contents increased quadratically averaging 4.6, 5.4, 5.3, and 9.4% of total fatty acids ($P = 0.13$) and 1.2, 1.7, 1.9, and 4.0 mg/g DM ($P = 0.14$). Linear increases in UFFA concentration in ruminal contents were accompanied by quadratic increases in *trans*-C18:1/C18:2 (0.46, 0.54, 0.60, and 1.31, $P = 0.04$) and *trans*-C18:1/C18:0 (0.11, 0.12, 0.12, and 0.22, $P = 0.13$). This study shows that increases in ruminal UFFA concentration from feeding fat supplements will disrupt fermentation in direct proportion to its concentration. However, ruminal UFFA concentrations in excess of 7.5 mg/g DM were required to appreciably disrupt biohydrogenation and increase the concentration of *trans* monoenes.

Key Words: Rumen, Fatty Acids, Fermentation

T168 Milk protein response to rumen protected methionine in two commercial herds in central Mexico.

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We wished to test whether a small amount of rumen protected methionine (RPMet) included in a total mixed ration and fed under commercial conditions could affect milk protein production. Rations were evaluated relative to the 2001 NRC suggested ratio of methionine and lysine as a percent of metabolizable protein, LYS:MET ratio and theoretical daily requirements for MET and LYS. Two dairy herds, feeding diets typical of the geographic area, feeding the same amount of protein supplement and having approximately the same ratio of LYS to MET in the diet were selected. RPMet (Mepron®) was fed at 11 g per day mixed into a protein supplement fed at 4.2 kg/head/day in a switchback design. Only cows finishing all six weeks of the study (n=613) were analyzed. Milk was weighed one day per week. Composite samples were submitted to a commercial laboratory for analysis of milk CP %, milk fat % and MUN (Alpura, Cuautitlan, Mexico). Statistical analysis was by the Mixed procedure of SAS with compound symmetry covariance. Fixed terms included RPAA and parity. Random factors were farm and period with time as repeated factor and cow (herd) as subject. AA sufficiency was analyzed using the Mepron Dairy Ration Evaluator (Ver 2.6). These data indicate small additions of RPMet can significantly increase milk protein production in a commercial setting. The milk protein response may be due to the increased supply of methionine as the first limiting amino acid or may be a consequence of improved amino acid profile as represented by the LYS:MET ratio.

Amino acid parameters:	Herd 1		Herd 2	
	Control	RPMet	Control	RPMet
MET % MP	2.31	2.56	2.37	2.62
LYS % MP	7.64	7.62	7.77	7.75
LYS:MET	3.31	2.97	3.28	2.96
Met, g above req.	0	6	5	11
Lys, g above req.	16	16	28	28

RPMET effects:

Variable	Control	RPMet	SE	P
Milk (kg)	31.3	31.5	0.85	.31
Milk fat (%)	3.54	3.50	0.17	.81
Milk fat (kg)	1.101	1.095	.050	.93
MUN (mg/dl)	15.78	15.50	.13	.11
Milk crude protein (%)	3.00	3.06	.014	.01
Milk protein (kg)	0.937	0.963	0.026	.01

Key Words: RPMet, Milk Protein

T169 Rumen undegradable protein characterization of three protein sources.

W. H. Kolath*[1], P. L. Bond Jr.[2], and M. S. Kerley[1], [1]*University of Missouri - Columbia,* [2]*Mid South Milling, Memphis, TN*.

Rumen undegradeable protein (RUP) is commonly used in dairy lactation diets to increase milk production and protein content. The objective of this study was to determine the RUP value of two blended protein sources (Apcon 1 and Apcon 2; Mid South Milling). Fish meal (Special Select, Omega Protein Inc.) was used as the control standard. Twenty-four single-phase continuous culture fermentors with a dilution rate of 6% hr^{-1} were used to determine the rumen undegradeable protein value of the three protein sources. Four treatments were fed, a control diet (C) consisting of soyhulls and purified cornstarch, Apcon 1 + C, Apcon 2 + C, and fish meal + C. The C was fed at 36g day^{-1} and the protein sources were added at 9g day^{-1}. True DM and OM digestibility was greatest ($P < 0.05$) for the Apcon 1 and fish meal diets. Microbial efficiency was similar among the three protein sources and lower ($P < 0.05$) for C. The RUP nitrogen was greatest ($P < 0.05$) for Apcon 2 and was similar ($P > 0.05$) among the other treatments. The RUP amino acid values were similar to the RUP nitrogen data. Cecamized roosters were fed 15g of effluent to determine the digestibility of the protein sources. The amino acid digestibilities of Apcon 1, 2 and fish meal were 69.90, 69.31 and 73.96 respectively. We concluded that Apcon 1 and Apcon 2 can be viable alternatives for post-ruminal delivery of amino acids.

	Treatment			
	Apcon 1	Apcon 2	Fish Meal	Control Diet
True DM Digestability	84.16	71.69	85.51	68.52
True OM Digestability	79.95	72.02	82.24	68.19
Microbial Efficiency	12.56	12.50	14.42	9.10
Ammonia (mg/mL)	2.51	6.54	23.14	7.50
% RUP Nitrogen	52.43	82.30	62.37	62.89
% RUP Amino Acid	38.39	59.82	46.75	
Amino Acid Digestability (%)	69.90	69.31	73.96	

Key Words: Rumen undegradable protein, Fish meal, Continuous culture

T170 Effects of nonfiber carbohydrate source and protein degradability on lactation performance and ruminal pH of Holstein cows.

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The effect of nonfiber carbohydrate (NFC) source and protein degradability on milk yield and composition and dry matter intake (DMI) were evaluated using 38 multiparous Holstein cows in a three period (21 d) partially balanced incomplete latin square design with a 3x2 factorial arrangement of treatments. Ruminal pH was evaluated with 6 ruminally cannulated dairy cows within the group. Dietary

treatments included three NFC sources (ground corn=starch=ST; molasses+sucrose=sugar=SU; and citrus pulp=soluble fiber+sugar=SF) and two concentrations of ruminally undegradable protein (+ or -RUP) achieved by the addition or omission of expeller soybean meal (SoyPlus). The total mixed rations were isonitrogenous and provided ad libitum. Milk yield and DMI were measured daily. Milk samples were taken on days 15, 17, and 19 of the period for composition analysis. Feed efficiency (FE) was calculated as 3.5% fat- & protein-corrected milk kg / DMI kg. Data were analyzed using PROC MIXED with orthogonal contrasts (ST vs SF+SU; SF vs SU). Data presented are least squares means. DMI was affected by NFC (P=0.09), but not RUP (P=0.64). SU gave a greater DMI than SF (P=0.08). NFC affected milk yield (P=0.01), but RUP did not (P=0.82). Cows fed SU had higher milk yield than SF (P<0.01), NFC*RUP was significant for milk yield for the contrast of ST vs SF+SU (P=0.05). Milk fat kg was not affected by NFC (P=0.26) or RUP (P=0.69), but ST vs SF+SU differed for NFC*RUP (P=0.07). Milk protein kg was only affected by NFC with ST greater than SU+SF (P<0.01), and SU greater than SF (P=0.06). Milk urea N was affected by NFC (P=0.05) and RUP (P=0.07) with ST yielding greater values than SF+SU (P=0.02). FE tended to differ for NFC*RUP (P=0.10), with ST differing from SF+SU (P=0.04). Rumen pH differed with NFC (P<0.01), RUP (P=0.02), and NFC*RUP (P<0.01). We conclude that manipulation of dietary NFC source and protein degradability may be used to modify lactation performance.

Item	ST-RUP	ST+RUP	SF-RUP	SF+RUP	SU-RUP	SU+RUP
DMI, kg	24.9	25.0	24.0	23.7	25.1	24.6
Milk, kg	41.0	39.1	38.0	38.6	40.1	40.9
Fat, kg	1.37	1.30	1.27	1.37	1.38	1.39
Protein, kg	1.13	1.06	1.01	0.98	1.05	1.05
Feed eff	1.58	1.48	1.51	1.58	1.53	1.56
MUN, mg/dl	13.6	13.2	13.1	12.1	12.8	12.2
Rumen pH	5.99	5.98	6.11	6.03	5.83	6.07

DMI = dry matter intake; Feed eff = 3.5% fat- & protein-corrected milk kg/DMI kg; MUN = milk urea nitrogen

Key Words: Nonfiber carbohydrates, Protein degradability, Milk production

T171 Production and reproductive performance of dairy herds fed different amounts of phosphorus. T. D. Edwards*, S. K. Tallam, and Z. Wu, *Pennsylvania State University*.

Field data were analyzed for the first 7 mo of an on-going three-year study to evaluate the lactation and reproductive performance of dairy cows fed differing amounts of P. Twenty-six farms in Northern and Central PA ranging from 41 to 1050 cows in size were categorized into low and high dietary P groups. The participating herds were chosen based on their ration formulation before beginning the study. The group included 16 herds fed P at $\geq$ 0.42% of the diet DM, and 10 herds fed P at $\leq$ 0.40% of the dietary DM. Feed samples were collected, and monthly DHIA reports were obtained. Reported data were based on herd averages of two quarterly samples for dietary P concentration, and June through December monthly DHIA reports for cows freshening during that time period. This resulted in 1194 and 943 cows for the low and high P groups, respectively, that contributed to the milk yield data. Of these, 474 and 261, respectively, were confirmed pregnant in that time frame, and used to calculate the reproductive measures. Analysis of data used herd as the experimental unit. The dietary P averaged 0.38 and 0.44% for the two groups, respectively. Milk yield was associated with large herd variation. Overall, there was no effect of dietary P on milk production or reproductive performance.

Item	Low P (n=16)	High P (n=10)	SEM	*P*
Dietary P, %	0.38	0.44	0.01	0.01
Milk, kg/d	32.8	34.0	1.4	0.55
Milk fat, %	3.92	3.74	0.10	0.25
Milk protein, %	3.02	3.00	0.01	0.29
Days to 1^{st} service	87.6	80.7	3.5	0.19
Days open	92.2	99.9	3.6	0.14

Key Words: Phosphorus, Reproduction, Dairy cows

T172 The new French available phosphorus allowances for ruminants. F. Meschy and A. Offner*, *Institut National de la Recherche Agronomique Paris France*.

Faced to new challenges as safety of animal products and environmental concerns, a re-assessment of nutritional allowances is needed. Excessive phosphorus (P) runoffs in the animal wastes contribute to the deterioration of groundwater (eutrophication); in France, two thirds approximately of the 300 000 t. of P annually rejected by the livestock productions come from the ruminants. Thus It seems necessary to revalue the level of P supply to the ruminants. A meta-analysis of literature data where faecal endogenous losses were measured by isotopic dilution of P and some recent experimental data allow a new nutritional standard based on available (absorbed) P. Major changes related to former systems concern maintenance requirement (MR) and principally the true absorption coefficient (TAC) of the components of the diet. Only the irreducible part of faecal endogenous losses corresponds to the MR and is strongly linked to salivary P production; for this reason MR (g/d) is now related to dry matter intake (DMI; kg/d) and body weight (BW; kg). MR = 0.83 DMI + 0.002 BW (n = 68, R2 = 0.89, rsd = 1.05) for cattle and MR = 0.905 DMI + 0.3 + 0.002 BW (n = 192, R2 = 0.95, rsd = 0.17) for small ruminants. We adopted the allometric equations of the AFRC (1991) for growth requirement for cattle as well as for small ruminants; The pregnancy requirement is assessed by AFRC (1991) equation for cow and by 0.4 and 0.6 g of P/day/fetus for ewe and goat respectively. The lactation requirement is set at 0.9 (cow), 0.95 (goat) and 1.5 (ewe) g of P/kg milk. The wide variations showed by TAC values of feedstuffs (from 0.6 for grass silage or alfalfa hay to 0.9 for sugar beet pulps) support the evaluation of dietary P supply on available P basis (total P x TAC). Our literature review did not show any significant difference between good inorganic sources of P; the TAC value for feed phosphates is set at 0.65 %. This re-assessment leads to a reduction of around 15 % of dietary P supply that may allow a P reduction in ruminant wastes of around 25 %. These new recommendations are in good agreement with recent international standards.

Key Words: Phosphorus, Requirements, Ruminants

T173 Tolerance of inorganic selenium in wether sheep. L. A. Cristaldi, L. R. McDowell*, C. D. Buergelt, N. S. Wilkinson, and F. G. Martin, *University of Florida, Gainesville, FL*.

This experiment evaluated the maximum tolerable level of selenium fed to growing wether lambs for one year. Sodium selenite was added to provide 0.2, 2, 4, 6, 8, and 10 ppm Se to a basal diet. Thirty-nine crossbred wether lambs initially weighing 22.8 $\pm$ 3.3 kg were randomly allotted to one of six treatments. Blood samples were collected and liveweight gain determined at 28 d intervals and tissue samples were collected at experiment termination. Serum and whole blood, wool, hooves, bile and five tissues were analyzed for selenium concentrations. Five tissues at experiment termination were microscopically evaluated for tissue breakdown due to selenium toxicosis. Also five enzyme concentrations and albumin were determined that are suggestive of selenium toxicosis. Lamb body weights were not influenced by dietary selenium concentrations (P < 0.01). Both serum and whole blood selenium concentrations increased at each collection period as dietary selenium level increased (P < 0.01) and the serum had a dietary selenium level x time interaction (P < 0.01). The whole blood selenium content was 2-3 times greater than serum selenium content. There was a strong positive correlation (r = 0.92) between serum and whole blood selenium level. All tissues and wool, hoof, and bile selenium concentrations increased as dietary selenium level increased (P < 0.01). Liver had the highest selenium concentration followed by the kidney in all but the lowest treatments. Both gross and microscopic evaluation of tissues revealed no significant lesions for any treatment groups. There was no apparent pathological suggestion of selenosis based on tissue evaluation. Albumin and serum enzyme levels suggestive of tissue breakdown as a result of selenosis did not vary (P > 0.15) among the treatment, and enzymes were within their respective normal ranges. These results suggest that $\leq$ 10 ppm dietary selenium is not toxic to wether lambs over the course of a year. It seems plausible, therefore, to consider the maximum tolerable level of selenium for ruminants to be considerably higher than 2 ppm.

Key Words: Selenium, Sheep , Tolerance

T174 Effect of diet on biotin balance in sheep. T. E. Peterson*[1], L. R. McDowell[1], R. J. McMahon[1], W. M. Seymour[2], N. S. Wilkinson[1], F. G. Martin[1], and P. R. Henry[1], [1]*University of Florida, Gainesville, FL,* [2]*Roche Vitamins Inc., Parsippany, NJ.*

Eight wether sheep were utilized in an experiment to determine the effect of diet forage: concentrate ratio on biotin balance. The pelleted diet included alfalfa, corn, soybean meal and corn oil. The four diets were formulated in percentages to contain forage:concentrate ratios as follows: A, 95:5; B, 50:50; C, 30:70; D, 10:90. Sheep were placed in metabolic crates and fed their respective diet for a period of ten days. The experiment was constructed as a 4x4 Latin Square in which the four groups of two sheep were fed a different diet (A-D) in each of the respective treatments. For each diet change there was a 20 d period; 10 days of adaptation with the 50:50 forage to concentrate diet followed by 10 days of the designated treatment diet. Feedings were conducted twice daily; 8:00am and 4:00pm. Total collection of feces and urine for determination of biotin balance was done twice daily on days 8, 9, and 10 of each period. Analyzed biotin for the four diets was 0.176, 0.157, 0.122 and 0.096 μg/g, respectively. Biotin balance was negatively higher (P<0.05) for the forage:concentrate ratio of 30:70 compared to the highest forage or concentrate diets due to the high (P<0.05) fecal biotin concentrations.

Table 1. Biotin (μg) balance data (3d)[1].

	Diet A	Diet B	Diet C	Diet D
Feed	595±29^a	552±5^a	385±17^b	259±25^c
Feces	2588±201^b	3464±498^{ab}	4763±978^a	2588±211^b
Urine	402±76	279±58	371±40	378±76
Balance	-2395±229^b	-3191±524^{ab}	-4748±961^a	-2707±221^b

[1]Means ± S.E. ^{abc}Means with different superscripts, within a row, differ (P<0.05).

Key Words: Biotin, Sheep, Balance

T175 Effect of VFA on [^{15}N]ammonia utilization for amino acid and urea synthesis by ruminal epithelial and duodenal mucosal cells isolated from growing sheep. M. Oba*[1], R. L. Baldwin, IV[2], S. L. Owens[1], and B. J. Bequette[1], [1]*Department of Animal and Avian Sciences, University of Maryland, College Park, MD,* [2]*Bovine Functional Genomics Laboratory, ANRI, USDA-ARS, Beltsville, MD.*

The objective was to determine effects of VFA on the extent of assimilation of ammonia N into amino acids and urea by isolated ruminal epithelial (REC) and duodenal mucosal cells (DMC) in short-term incubations. Cells were isolated from growing Polypay ram lambs (n=4) fed a mixed forage-concentrate diet, and incubated for 90 min in media containing [^{15}N]ammonia and glucose plus either acetate or propionate (5 mM each). Production of Ala, Asp, Glu, Arg + citrulline, and urea, and ^{15}N enrichment were determined by gas chromatography-mass spectrometry. Data are presented as a production rate per 10^6 cells during 90 min incubations. In both cell types, the total release of Ala, Asp, Glu, Arg + citrulline, and urea was not affected by VFA treatment. However, for REC, assimilation of ammonia N into Glu (0.51 vs. 0.40 nmol; $P < 0.05$) was greater, and that into Asp (0.19 vs. 0.15 nmol; $P = 0.07$) and Ala (0.64 vs. 0.40 nmol; $P = 0.10$) tended to be greater for acetate compared to propionate treatment. However, ammonia N was not incorporated into Arg + citrulline and urea by REC. For DMC, assimilation of ammonia N into Ala, Asp, and Glu was also greater for acetate (1.57, 0.69, and 2.07 nmol, respectively) compared to propionate treatment (0.86, 0.46, and 1.37 nmol, respectively; all $P < 0.05$). Utilization of ammonia N for Arg + citrulline synthesis tended to be greater for acetate compared to propionate treatment (0.75 vs. 0.49; $P = 0.08$), but ammonia N was not incorporated into urea. In summary, ruminant gut tissues are capable of assimilating ammonia N into amino acids, and VFA type affects the extent of ammonia N utilization for amino acid synthesis.

Key Words: Ruminal epithelial cells, Duodenal mucosal cells, Ammonia utilization

Production, Management, and the Environment

T176 Use of electronic rumen boluses for identification of sheep in the U.S. G. Caja*[1], D. L. Thomas[2], M. Rovai[1], Y. M. Berger[2], and T. A. Taylor[2], [1]*Universitat Autonoma de Barcelona, Bellaterra, Spain,* [2]*University of Wisconsin-Madison.*

A total of 791 sheep in two research flocks at the University of Wisconsin-Madison were used to study the effectiveness of three types of electronic rumen boluses for individual animal identification. One flock consisted of dairy sheep and the other of meat and wool sheep. All sheep carried at least one ear tag with a unique number for identification. The three types of electronic rumen boluses consisted of ISO radio frequency transponders of different technology encased in capsules of different size and construction: B1 (full duplex; 20×74 mm, 70 g, white plastic cover), B2 (half duplex; 21×68 mm, 79 g, white ceramic cover), and B3 (half duplex; 12×42 mm, 16 g, brown ceramic cover). Boluses were given orally to all sheep (rams, adult ewes, ewe lambs) on a farm on the same day by both trained and untrained operators using appropriate balling guns. Bolus readability was checked immediately before and after administration to ensure that only functional boluses were administered and present in each sheep. Boluses in all sheep were read 1 d following administration, approximately one wk later, and at approximately 1 mo intervals thereafter through d 102 using handheld transceivers. Animals ranged in weight from 25 to 145 kg in body weight at the time of bolus administration, and there were no injuries or deaths from bolus administration. Application time averaged 71.4 s and was affected by operator ($P < 0.05$). Application time was greater ($P < 0.05$) for rams than for adult ewes or ewe lambs. Approximately 102 d after administration, bolus readability varied by sheep group (rams, 88.0%; ewes, 92.0%; ewe lambs, 86.9%; $P < 0.05$) and bolus type (B1, 63.2%; B2, 99.5%; and B3, 98.7%; $P < 0.001$). The B1 bolus was insufficiently readable for ICAR requirements of 98% readability, but the B2 and B3 boluses were very effective in electronic identification of sheep.

Key Words: Sheep, Electronic identification, Rumen bolus

T177 Effects of bolus features on retention performance in the electronic identification of cattle. J. J. Ghirardi, G. Caja*, D. Garin, and M. Hernandez-Jover, *Universitat Autónoma de Barcelona, Spain.*

A total of 782 crossbreed calves were used to evaluate the retention rate of 12 prototypes of electronic identification boluses during fattening. Male and female calves were fed with concentrate (1.89 Mcal EN_f; and, 15.0% CP, as feed) and straw ad libitum and slaughtered at approximately 480 and 380 kg BW, respectively, before one year of age. In order to determine the anatomical limit for a bolus passing through the gastrointestinal tract, the size of the reticulo-omasal orifice was measured at slaughter in a total of 70 males and 42 females. Bolus prototypes consisted of two series of ceramic capsules of different features containing a glass encapsulated half duplex transponder (31.8×3.8 mm). Series #1 (n=544) consisted of six types of boluses with the same external dimensions (68×21 mm) but different specific gravity (2.39, 2.9, 2.79, 2.95, 3.12 and 3.36); and series #2 (n=238) consisted of different commercial prototypes varying in external dimensions and specific gravity (39×15, 3.08; 51×15, 3.00; 64×16, 3.63; 68×17, 3.60; 62×19, 3.60; and, 66×20, 3.11). Total weights ranged from 20 to 75 g. Boluses were applied to milk fed calves (2 to 5 wk of age) restrained in a head-locker using a balling gun. Three calves in series #1 (0.6%) could not be applied at the first attempt due to difficulties in swallowing and were applied one wk later. Bolus retention was checked at mo 1, 5 and 7, and at slaughter by using a handheld transceiver with a stick antenna. Retention rate until slaughter varied quadratically ($R^2 = 0.96$) with a plateau according to bolus weight for the two series: #1 (89.5 to 100%) and #2 (76.2 to 100%). Four boluses were retrieved from the abomasum. Minimum weight and specific gravity to reach the 98% retention rate established by ICAR were estimated to be 65 g and up to 3.00 for cattle. Diameter of reticulo-omasal orifice differed between males (32.5 ± 1.4 mm) and females (29.9 ± 1.3 mm) and were greater than diameters of retained boluses. As a conclusion, bolus features need to be optimized in order to achieve their maximum retention rate in cattle.

Key Words: Transponder, Electronic identification, Traceability

T178 Effect of different alum applications on the environment of dairy calf hutches. J. C. Lin*[1], B. R. Moss[1], K. A. Cummins[1], P. J. Tyler[1], W. H. McElhenney[1], and C. W. Wood[2], [1]*Animal Science Department,* [2]*Agronomy and Soils Department, Auburn University, AL.*

The effect of aluminum sulfate (alum) on calf hutch environment was evaluated. Twenty eight hutches (Calf-Tel®; Hampel Corp) were bedded with 22.7 kg of wood shavings that had been mixed with 0, 2.85, 5.70, or 8.55 l of liquid aluminum sulfate (48.5% solution; 1.33 kg solution per l = 0.65 kg alum per l) that provided 0, 1.85, 3.70, or 5.55 kg dry alum. Calves were weighed at birth, assigned to alternating treatments and maintained in the hutches with no additional bedding provided during the study. Ammonia emissions were measured within hutches when calves were 4 and 8 weeks of age at 1400 h when ambient temperatures averaged 23°C. Bedding samples were taken at biweekly intervals from age 2 to 8 weeks and analyzed for coliform counts. At the same time, fly population on calves and within hutches was determined. Respiratory and scour scores were determined weekly and 8 week body weights determined. Ammonia emissions were significantly affected by week ($P<0.002$) and alum treatment ($P<0.05$). Rates of ammonia emission (mg per m^2 per min) were 0.35, 0.16, 0.23 and 0.11 for 0, 1.85, 3.70 and 5.55 kg alum per hutch treatment, respectively, at 4 weeks and 1.97, 0.91, 0.47 and 0.13 at 8 weeks. There was no treatment by week interaction (>0.1). Fly population and coliform counts (g^{-1}) increased ($P<0.01$) with time in hutches, but no differences ($P>0.1$) existed due to treatment. There was a trend ($P<0.1$) for fewer flies on calves housed in hutches treated with alum. Incidences of respiratory problems and scours were essentially nil regardless of the treatment nor was there any evidence of skin abrasions. Eight-week body weights did not differ (>0.76).

Key Words: Ammonia emissions, Aluminum sulfate, Calf hutches

T179 Growth performance and health of dairy calves bedded with different types of materials. R. Panivivat*[1], J. A. Pennington[2], E. B. Kegley[1], D. W. Kellogg[1], and S. L. Krumpelman[1], [1]*University of Arkansas, Fayetteville,* [2]*University of Arkansas Cooperative Extension Service, Little Rock.*

Granite fines (GF), sand (S), rice hulls (RH), long wheat straw (ST) and wood shavings (WS) used as bedding for 60 heifer calves were compared at Ark-Tenn Dairy Research and Development Facility, a commercial 1100-cow dairy in central Arkansas. Growth, health, stress indices, behavior, physical characteristics and bacterial counts of bedding from d 1 to 42 were evaluated from August to October 2002. There were differences ($P < 0.05$) due to bedding type in dry matter intake (DMI) during wk 2. Calves housed on RH had the greatest and those housed on WS had the lowest DMI. Calf average daily gain and DMI for the entire 42 d did not differ ($P > 0.05$) due to bedding type. Using a subjective cleanliness score (1= clean to 4 = dirty), calves housed on GF were the dirtiest in appearance. There was a bedding material by week interaction ($P < 0.01$) for the number of antibiotic treatments given for scour control. During wk 2 calves housed on GF and S were treated more often for scours. During wk 1 and 2, calves housed on ST received the fewest antibiotic treatments. Serum cortisol, alpha-1 acid glycoprotein, and immunoglobulin G concentrations, and neutrophil:lymphocyte ratio were not affected ($P > 0.05$) by bedding type. On d 0, GF were harder than sand ($P < 0.05$), and all materials were harder than straw ($P < 0.05$). In addition, there were bedding material by week interactions ($P < 0.05$) for coliform counts ($P < 0.05$). On d 0, coliform counts were lowest in GF and greatest in RH. However, on d 14, 28 and 42, coliform counts were greatest in ST. On d 42 the concentration of ammonia, 10 cm above the bedding was lowest ($P < 0.05$) for ST. Growth performance of calves bedded for 42 d with five bedding materials did not differ. However, the number of antibiotic treatments given for scours and bacterial counts in the bedding did vary due to bedding type.

Key Words: Dairy calves, Bedding material, Bacterial Counts

T180 Effect of free-stall design on cow behavior and performance. R. J. Norell[1], S. Mosley[2], A. Ahmadzadeh[2], and P. Deaton[1], [1]*University of Idaho, Idaho Falls,* [2]*University of Idaho, Moscow.*

The objective of this study was to assess the effects of free-stall design on cow behavior and performance. Two groups of 18 lactating Holstein cows were housed in two different free-stall pens and animals moved between pens according to a switchback statistical design. Free-stall treatments varied in dimensions, lunge space, and stall bed surfaces. Modern stalls (MOD) were wider (1.22m vs 1.14m), had taller stall dividers (1.22m vs 0.91m), and had improved forward and sideways lunge space compared to the older design stalls (OLD). MOD stalls had neck rails and plastic brisket boards located 1.68m from the curb while OLD had neither component. Stall bases were deep beds of sand (OLD) or sand over commercial rubber filled mattresses (MOD). Cows were assigned to pairs based on parity and DIM then randomly assigned to groups for 90 d. Animals switched housing treatments on d 31 and again on d 61. Cow behavior in the free-stall area was scanned every 10 minutes throughout the trial with wireless digital cameras. Behavior comparisons utilized data from the last 4 d of each period while milk production comparisons utilized the last 7 d. Means and SE for stall occupancy, resting, standing in stall, daily resting periods and cow comfort index were: 737±20 vs 688±19 min/d; 672±22 vs 615±20 min/d; 61±10 vs 73±7 min/d; 6.9±0.3 vs 7.9±0.4 events/d, and 91.4±1.3 vs 89.1±1.0 percent for MOD and OLD, respectively. Treatment differences were assessed by the Wilcoxon Two Sample Test (a non-parametric test). Cows spent more time occupying MOD stalls ($p<0.001$), more time resting in MOD ($p<0.001$), and had fewer daily resting periods ($p<0.001$) in MOD. Standing behavior (all four feet in stall or half-in/half-out) was significantly shorter in duration for MOD stalls ($p<0.007$). Cow comfort index (resting time divided by stall occupancy time) was significantly higher ($p<0.03$) for MOD stalls. Milk production was not influenced by switching cows between housing treatments ($p>0.5$). We conclude that modern stalls significantly enhanced cow comfort by increasing daily resting time and decreasing time spent standing in the free-stall. In this study, improved cow comfort did not lead to higher milk production.

Key Words: free-stalls, behavior

T181 The effects of cooling strategy and level of milk production on milk constituents and body composition quality traits during summer heat stress in lactating Holstein dairy cattle. H. Evans[1,2], J. Murphey[3], E. Cuadra[4], T. Dickerson[2], S. Gandy[2], S. Willard[2], and R. Vann*[1], [1]*Brown Loam Branch Experiment Station, Raymond, MS,* [2]*Mississippi State University, Mississippi State, MS,* [3]*Coastal Plains Branch Experiment Station, Newton, MS,* [4]*Alcorn State University, Alcorn State, MS.*

The metabolic demands of milk production often draw on body energy reserves to fulfill the requirements of lactation. These demands can be further intensified by the effects of heat stress, which alone can negatively impact production performance in lactating dairy cows. However, various cooling strategies can alleviate some of the detrimental effects of summer heat stress on metabolic processes and production performance. The objective of this study was to determine whether type of cooling system (Fan vs. Fan and Sprinkler) influences production performance, body composition (BC), and milk constituents (MC) in dairy cattle exposed to summer heat stress. Lactating Holstein cows (n=96) were assigned to groups (n=24/group) based on high (H; 28.0 ± 0.9 kg/d) and low (L; 21.8 ± 0.8 kg/d) milk production and cooling strategy as follows: H-Fan only (HF); H-Fan and Sprinklers (HFS); L-Fan only (LF); L-Fans and Sprinklers (LFS). Data was collected prior to milking every 14d over an 84-d period and included: respiration rate (RR; breaths/min), dorsal coat temperature using infrared thermometers (DIR; °C) and rectal temperature (RT; °C). Measurements by real-time ultrasound for BC consisted of percent intramuscular fat, gluteus medius depth and stress scores for IMF and GM muscle. Environmental temperature, relative humidity (RH), and temperature-humidity index were recorded daily throughout the trial. Milk samples were collected at 14-d intervals and analyzed for fat, protein, somatic cell count (SCC), and lactose. Cows in the HFS and LFS groups had lower ($P<0.05$) RT, DIR and RR than cows in the HF and LF groups. No differences ($P>0.10$) in MC were observed relative to level of milk production (H vs. L) for SCC and lactose, however protein and fat were lower ($P<0.01$) in H than L cows. Milk fat, protein, and SCC did not differ ($P>0.10$) between F and FS groups, however lactose was lower ($P<0.05$) in the F-only compared to the FS group. Body composition traits did not differ ($P>0.10$) between F and FS groups, however both GM stress and IMF stress were higher ($P<0.05$) in the H than L milk production groups. In summary, while cows in the FS groups were less affected by heat stress than cows in the

F-only groups, body composition traits and most milk constituents were not influenced by cooling strategy.

Key Words: Milk production, Holstein, Body composition

T182 Relationships between body condition score and peak milk in Holsteins. M. L. Theurer*[1], M. A. McGuire[1], and J. J. Higgins[2], [1]*University of Idaho, Moscow,* [2]*Standard Nutrition, Richland, WA.*

Two hundred fifty-two Holstein cows were assigned body condition scores (BCS) in the close up pen through mid lactation to evaluate changes in BCS and their relation to milk production. The cows were housed at three commercial dairies in central Washington. Two individuals assigned BCS on a 5 point scale by 0.25 points beginning about 14 d before parturition, continuing monthly until approximately 140 DIM, without knowledge of previous scores. Using the REG procedure of SAS, peak milk yield was regressed with close up BCS and change in BCS as independent variables. The mean close up BCS was 3.30 with a range from 1.88 to 4.63. Regression analysis determined that no relationship existed between peak milk and close up BCS or change in BCS. To further determine if BCS had any effect on peak milk production, cows were grouped for analysis into three groups by close up BCS $>$ 3.5, 3.0 $<$ close up BCS $\leq$ 3.5, close up BCS $\leq$ 3.0 (n = 65, 110, and 77, respectively) or change in BCS $>$ 0.75, 0.5 $<$ change in BCS $\leq$ 0.75, change in BCS $\leq$ 0.5 (n = 91, 73, and 88, respectively). Peak milk by close up BCS and change in BCS group was analyzed using the GLM procedure of SAS with LS means reported. Peak milk yield for the high, mid, and low close up BCS groups (46.6, 47.5, and 49.2 kg, respectively; SEM = 1.0) were not different ($P > 0.10$). Peak milk yield was not affected by change in BCS ($P > 0.10$) for high, mid, and low groups (48.9, 46.3, and 47.4 kg, respectively; SEM = 1.0). Close up BCS had no effect on peak milk production. Similarly change in BCS did not affect peak milk production. Peak milk production in Holstein cows is driven by factors other than close up BCS or body condition loss in early lactation.

Key Words: Body condition loss, Early lactation, Milk yield

T183 BeefSys: An interactive database program for on-going experiments and archival of livestock data. F. M. Rouquette, Jr.*, K. D. Norman, G. M. Clary, and C. R. Long, *Texas A&M University Agricultural Research & Extension Center, Overton, TX/USA.*

Efficient, effective, and sustained use of data depends on interactive use of current information and a method of archiving previously collected data. BeefSys was developed by the Texas Agricultural Experiment Station and the Texas Beef Initiative to provide a data storage site to accommodate all phases and relevant data on beef production including climate, soils, forage, and birth-to-harvest data. BeefSys resides on a computer which runs the Linux Operating System. The database software used to manage BeefSys is MySQL, which is the most popular open source database server and was designed for speed, power, and precision in mission-critical, heavy load use. BeefSys is not an open database, but rather offers a security code for the user who has exclusive use of specific records and can control other user access. BeefSys is accessed via the Internet using a web browser. Data can be downloaded into BeefSys from Excel, Access, etc. spreadsheet format or entered directly. All data input is backed up on external storage media on a routine basis. The user can retrieve very detailed data (ie: all calves of a particular cow including birthing and weaning data), or summary data (ie: average carcass traits of a breedtype for a 20-yr period that received supplement during the stocker phase). Currently, there are 70 fields in the expandable template. The initial data sets to test BeefSys consisted of more than 6,000 records for cow-calf, stockers, feeders, and carcass data collected during a 30-year period at TAMU-Overton. A secondary priority of data assessment included a 4-year multilocation grazing-feedlot-carcass experiment that included nearly 1,000 stocker cattle. The ability to archive databases from locations, statewide, or regionally offers one of the best uses of BeefSys so that data are not lost due to changes in user-project leaders as well as the continued use of multiple-year databases for modeling, economic, and biological assessments.

Key Words: Beef, Database, Production

T184 Contribution of manure and legume nitrogen to crop fertilization plans of Wisconsin dairy farms. B. J. Towns* and M. A. Wattiaux, *University of Wisconsin-Madison.*

Producers should be encouraged to maximize the use of manure and legume nitrogen (N) to limit fertilizer purchases and risks of environmental pollution. Our objective was to determine the N-credit, that is, the contribution of manure and legume N to total crop N needs on mixed dairy/cropping operations, assuming producers fertilize crops according to current guidelines. Descriptive data were collected for nine farms using solid manure (SM) handling systems and nine farms using liquid manure (LM) systems for years 2000 and 2001. Cows, hectares (ha), and animal units (AU) were 91±10, 136±36, 184±27 and 611±101, 482±101, 929±144 for SM and LM farms, respectively. A "de-facto" N credit (kg/ha) was calculated as: (Total Crop N Recommended - Imported Fertilizer N)/N-Requiring Ha. A de-facto N credit (%) was calculated as: (Total Crop N Recommended - Imported Fertilizer N)/Total Crop N Recommended. University of Wisconsin-Extension guidelines were followed to calculate crop N recommendations. The de-facto estimates represent crop N supplied by sources other than imported fertilizer. Despite large differences in AU for SM and LM farms, AU/N-Requiring Ha were similar and averaged 4.8±1.2 and 4.5±0.7, respectively. De-facto N credit for all operations was 115±12 kg/N-Requiring Ha or 68±7% of total crop N recommendations. There was no difference (P>0.10) between the SM and LM farms as de-facto N credits were 71±8% (117±12 kg/N-Requiring Ha) and 65±12% (113±21 kg/N-Requiring Ha) of the total crop N recommendations, respectively. Imported fertilizer averaged 48±38 and 57±58 kg N/N-Requiring Ha for SM and LM farms, respectively. De-facto N credit was not correlated with cows, AU, N-Requiring Ha, or total hectares. This research indicates that producers rely heavily on manure and legume N in their crop fertilization plans because imported fertilizer accounted for only 32% of total crop N recommendations. Contributions of manure and legume N as crop fertilizer were similar between small producers on SM systems and large producers on LM systems.

Key Words: Manure credits, Legume credits, Dairy

T185 Impact of manure application timing in dairy pastures on the migration of nitrates to groundwater. T. Downing*, B. Lambert, and M. Gamroth, *Oregon State University.*

Manure application to pastures is a common management practice among dairy farmers. Manure application can increase pasture crop production and minimize manure storage and handling costs. The amount and timing of these manure applications may be important because of agronomic and environmental implications. Excess nitrogen, not absorbed by the pasture vegetation can leach past the root zone and into groundwater. High nitrate levels in groundwater can lead to health risks. A year-long study was conducted on grazing pastures at two dairies to monitor potential nitrate movement from the surface through the soil profile toward groundwater. Precipitation, irrigation, manure application, and grazing were compared to nitrate movement. Both sites were planted in cool season perennial pasture, comprised of rye grass and orchard grass. Both pastures were part of rotational grazing systems and receive periodic applications of manure by cattle and by typical manure application equipment. Sampling devices were located in the center of operational fields. A total of nine sampling wells (lysimeters) were installed at depths of 1, 1.3, and 1.6 m below the surface of each pasture. Each depth was replicated three times at each site. Water samples were taken every two weeks at each site and tested for nitrate-N. Manure application, forage harvests, and commercial fertilizer applications were recorded. Rainfall measurements were estimated using local weather data. Farm A applied a total of 600 kg N/hectare throughout the year while farm B applied approximately 300 kg. Farm A nitrate values averaged at 15.2 ± 12.2 ppm, 6.5 ± 6.9ppm and 2.9 ± 3.6 ppm at 1, 1.3 and 1.6 m respectively. Farm B nitrate values averaged 13.8 ± 8.5 ppm, 8.5 ± 5.7 ppm, and 1.3 ± 2.9 ppm at 1, 1.3 and 1.6 m. No relationship between farming activity and nitrate movement was noted. In addition, irrigation appeared to have no influence on nitrate movement. Substantial rainfall (>15 cm per two week period) appears to be the major factor in nitrate movement.

Key Words: Nitrate, Nitrogen leaching

T186 Effect of trucking density and transport time of market pigs on behavioural pattern during transport, plasma concentrations of stress-related biochemical markers and carcass quality. J. H. Woo, D. M. Ha, C. Y. Lee, and D. H. Kim*, [1]*Regional Animal Industry Research Center, Jinju National University*.

A total 114 market pigs weighing approximately 110 kg were transported to a local abattoir for 1 h or 3 h under a high (H; 0.34m/100 kg BW)-, medium (M; 0.38m)-, or low (L; 0.42m)- trucking density, under a 2 (transport time) x 3 (trucking density) factorial arrangment of treatments. Behavioural pattern of the pigs during transport were video-taped. Blood samples were taken at slaughter, after which Longissimus Dorsi muscle (LM) was taken for physicochemical analysis following overnight chilling of the carcass. Most of the pigs stood during transport at H-trucking density, whereas at M- or L-density, a substantial percentage of the pigs sat or lied. Plasma glucose concentration was greater ($P<0.05$) in the 3 h-transport group than in the 1 h-transport; lactate dehydrogenase concentations were less in the L-density and 1 h-transport than in M- or H-density and 3 h-transport groups, respectively. The lightness (L* value) of LM, which exibited no main effect, was affected ($P<0.01$) by a density x transport time interaction. The incidence of PSE (pale, soft and exudative) carcass was less in 1 h-transport group than in 3 h-transport group at H- (23.5 vs 29.4%) and L-density (11.5 vs 26.9%), but not at M-density (14.3 vs 14.3%). It is concluded from these results that a short transport within 1 h at L-trucking density is desiable in terms of animal welfare. However, under practical situations, M-density trucking density may be the most economical.

Key Words: Pig, Transport, Stress

T187 Exposure to short days during the dry period increase milk production in subsequent lactation in dairy goats. S. J. Mabjeesh*[1], A. Shamay[2], G. E. Dahl[3], and T. T. McFadden[4], [1]*The Hebrew University of Jerusalem, The Faculty of Agriculture, Israel,* [2]*The Volcani center, Agricultural Research Organization, Israel,* [3]*University of Illinois, Urbana,* [4]*University of Vermont, Burlington*.

The effect of long day photoperiod (LDPP) or short day photoperiod (SDPP) during late gestation on subsequent milk yield was examined under thermoneutral conditions (23±1 °C; NT). The experiment was conducted on 4 goats in each group, which were held on metabolic crates in fully controlled rooms. The LDPP treatment group was held in 16 h light: 8 h dark and the SDPP in 8 h light: 16 h dark cycles in 70% relative humidity atmosphere. Blood samples were collected every 5 d until week 12 after kidding to assess concentrations of IGF-I and PRL. After kidding, goats were held in outdoors yards and had the same management like the other goats on the farm. Goats were milked twice daily and milk samples were taken every 7 days and analyzed for milk components. Milk production was measured automatically by flow meters.Milk yield was higher in the SDPP group by 26% compared to the LDPP for the 12 weeks post kidding (2932 vs 2320 g/ d, $P< 0.001$, SE = 105). Plasma prolactin concentration was higher in the LDPP group from week 6 prior to kidding compared to SDPP and averaged 169 and 112 ng/ ml ($P< 0.005$, SE = 11). However, prolactin concentration across the 12 weeks post kidding was similar for both groups and averaged 13411.9 ng/ ml. Similar profile was measured to IGF-1 concentration. IGF-1 concentration averaged 0.177 ng/ ml compared to 0.073 ng/ ml ($P< 0.001$, SE = 0.01) in the LDPP and SDPP groups, respectively. After kidding IGF-1 concentration was 0.075±0.01 ng/ ml for both treatments. These results are the first to demonstrate the effect of photoperiod during the prepartum period on subsequent lactational performance in dairy goats. These results further confirm the association of LPDD with higher prolactin and IGF-1 in plasma prepartum. It is believed that the sensitivity of the mammary gland to prolactin during the dry period or early in postpartum is the mechanistic explanation for the higher milk production observed in SDPP.

Key Words: Milk production, Dairy goats, Photoperiod

Forages & Pastures

T188 Forage mineral concentrations in West Virginia pastures. E. B. Rayburn, W. L. Shockey*, and R. M. Wallbrown, *West Virginia University, Morgantown, WV*.

Mineral nutrition of grazing livestock is directly related to pasture mineral concentration. Livestock mineral intake varies because pasture forage species are not constant, fertilizer application varies, and most pastures are not tested for mineral content. An evaluation of pasture mineral status was conducted over 5 years (1997 through 2001) and involved the cooperation of 17 extension agents in 18 counties. Objective was to develop a livestock mineral supplement that would insure adequate mineral intake for livestock grazing West Virginia pastures. Data represents over 105 site-years with monthly samples taken randomly from selected farms from May to September. Forage samples were analyzed by commercial laboratory for protein, fiber, and mineral concentration. Mineral concentration mean and 10, 50 and 90 percentile values were Ca 0.68, 0.44, 0.65, 0.96; K 2.46, 1.76, 2.46, 3.21; Mg 0.25, 0.17 0.24 0.33; P 0.34, 0.23, 0.34, 0.46; S 0.24, 0.17, 0.24, 0.32; Al 254, 48, 154, 522; Cu 10.9, 7.0, 10.0, 15.2; Fe 403, 124, 253, 792; Mn 110, 54, 93, 194; Mo 1.08, 0.30, 0.88, 2.08; Na 0.237, 0.009, 0.020, 0.070; and Zn 34.7, 20.0, 27.8, 47.0, respectively. Concentration vs probability percentile was calculated for each mineral to determine the % of time pastures were below a given animal nutrient requirement. By comparing an acceptable risk level (for example the 10th percentile) to the animal's mineral requirement, a mineral supplement requirement can be calculated that should ensure that 90% of the animals consuming the supplement would meet NRC established requirements. Most pastures in West Virginia are adequate for average producing cattle used in a cow/calf production system, the primary pasture use in the state. Where animals of above average production ability are desired, above average management is needed to provide adequate forage quantity and quality over the grazing season.

Key Words: Pasture, Minerals, Livestock

T189 The effects of irrigation of soil and stage of harvest on mineral contents of grasslands located at high altitude. A. Hayirli*[1], I. Kaya[2], K. Haliloglu[3], and B. Karademir[4], [1]*Dept. of Animal Nutrition, School of Veterinary Medicine, Ataturk University, Erzurum 25700, Turkey,* [2]*Dept. of Animal Nutrition, College of Veterinary Medicine, Kafkas University, Kars 36100, Turkey,* [3]*Dept. of Agronomy, College of Agriculture, Ataturk University, Erzurum 25100, Turkey,* [4]*Dept. of Internal Medicine, College of Veterinary Medicine, Kafkas University, Kars 36100, Turkey*.

In this study, the effects of soil irrigation and maturity stage on mineral concentrations were evaluated on 4 irrigated and 4 non-irrigated grasslands located at altitude of 2100 m. Grasslands were irrigated for one week and composites of plant subsamples (n = 10) from each grassland were pooled by cut with 14-d interval (n = 5) between May 21-July 30, 1999. The model included main effects of soil irrigation and maturity stage and their interaction in 2-way ANOVA. Irrigation did not affect soil pH (6.92), and clay (28.84%), sand (39.14%), OM (6.69%), K (50.60 Meq/g), Ca (1.22%), Mg (3.17 g/kg), Al (0.05 ppm), Ba (1.27 ppm), Co (0.07 ppm), Cu (1.82 ppm), Fe (6.59 ppm), Li (0.09 ppm), Mn (8.14 ppm), Zn (0.38 ppm), and Sr (2.54 ppm) levels. However, concentrations of Na (109.6 vs. 39.9 mg/kg), P (19.1 vs. 4.68 g/kg), Cd (0.02 vs. 0.001 ppm), Cr (0.09 vs. 0.001 ppm), Ni (1.62 vs. 0.97 ppm), and Pb (0.39 vs. 0.07 ppm) were greater in irrigated soils than non-irrigated soils. Concentrations (ppm) of Mn (79.62), Al (472.6), B (8.27), Ba (4.55), Cr (1.90), Cu (2.44), Fe (397.7), Li (9.19), Se (0.81), and V (4.20) in plants were not affected by irrigation. However, concentrations of plant K (262.6 vs. 220.8 Meq/g) P (3.24 vs. 2.62 g/kg), Mg (1.71 vs. 1.47 g/kg), S (555 vs. 529 g/kg), Na (0.87 vs. 0.52 g/kg), and Zn (19.09 vs. 13.52 mg/kg) were greater and Ca (4.18 vs. 5.60 g/kg) and Sr (6.71 vs. 12.11 mg/kg) levels were lower in irrigated grasslands than non-irrigated grasslands. There was no effect of stage of maturity on plant Mg, S, Mn, Na, Al, B, Ba, Ca, Cr, Fe, Li, Se, and V levels. There were linear decreases in concentrations of plant K from 258.8 to

221.9 Meq/g, P from 3.36 to 2.70 g/kg, Cu from 4.05 to 1.25 mg/kg, and Zn from 20.15 to 13.11 mg/kg and there was a linear increase in concentration of plant Sr from 4.32 to 15.77 mg/kg as maturity progressed from 1 to 5^{th} cut. There was no effect of irrigation of soil by stage of maturity interaction on plant mineral concentrations. Apparently, regardless of maturity stage, soil irrigation tends to alter both macro- and micro-mineral levels in soils and only macro-mineral levels in plants.

Key Words: Irrigation of grassland, Stage of maturity, Mineral

T190 Effects of soil irrigation and maturity stage on organic macronutrient composition and nutritive value of grasslands at high altitude. I. Kaya[1], A. Hayirli*[2], K. Haliloglu[3], and S. Yildiz[4], [1]*Dept. of Animal Nutrition, College of Veterinary Medicine, Kafkas University, Kars 36100, Turkey,* [2]*Dept. of Animal Nutrition, School of Veterinary Medicine, Ataturk University, Erzurum 25700, Turkey,* [3]*Dept. of Agronomy, College of Agriculture, Ataturk University, Erzurum 25100, Turkey,* [4]*Dept. of Physiology, College of Veterinary Medicine, Kafkas University, Kars 36100, Turkey.*

Effects of soil irrigation (SI) and maturity stage (MS) on nutrient composition and nutritive value of grasslands located at altitude of 2100 m were studied. Four of 8 grasslands were irrigated after each cut (n = 5, with 14-d interval between May 21-July 30, 1999). Pooled plant composites (n = 10) by grassland at each cut were analyzed for DM, OM, CP, NDF, CF, EE, and ash. Three cannulated rams were utilized for nutritive value. Kinetic parameters for degradability of nutrients were assessed using equation P= a+b(1-e^{-ct}), where P = degradability (%), a = soluble and readily degradable fraction, b = insoluble and slowly degradable fraction, and c = rate constant, and t = time relative to incubation, respectively. For effective degradability (Pe), passage rate was assumed to be 0.02, 0.05, and 0.08% per h. Two-way ANOVA was used in data analyses. There was no effect of SI on OM (90.8), CP (16.1), NFE (43), and ash (9.2) levels (%), but DM (25.1 vs. 32.0%) and EE (1.8 vs. 2.0%) were lower and NDF (60.1 vs. 55.7%) was greater in irrigated grasslands than non-irrigated grasslands. There was no effect of MS on OM, EE, NFE, and ash levels. There were linear increases in DM from 28 to 33% and NDF from 50.9 to 65.2% and there was a linear decrease in CP from 20.8 to 10.4% as MS advanced. There was no effect of SI by MS interaction on nutrient density. SI did not affect parameters "c" (0.06), lag phase (2), and Pe at 2 (76.3), 5 (66.6), and 8% (61.3) for CP, but parameter "a" (43.3 vs. 39.4) was greater and parameter "b" (45.7 vs. 48.8) was lower for irrigated grasslands than for non-irrigated grasslands. Parameter "a" and Pe at 2, 5, and 8% decreased and lag phase increased linearly as MS advanced. SI affected only parameter "a" for CF (3.6 vs. 5.3 for irrigated vs. non-irrigated grasslands) and average of parameters "b" and "c", lag phase, and Pe at 2, 5, and 8% was 75.9, 0.05, 2.4, 58.8, 42.9, and 34.5, respectively. MS linearly decreased parameters "a", "b", and Pe at 2, 5, and 8% for CF. Regardless of MS, SI mainly affects plant fiber level and its effects on nutritive value seem to be related to changes in nutrient compositions.

Key Words: Organic macronutrient, Irrigation of soil, Stage of Maturity

T191 Nitrate concentration of cereal forage species at three stages of maturity. L.M.M. Surber*, S. D. Cash, J.G.P. Bowman, and M. C. Meuchel, *Montana State University, Bozeman, MT USA.*

Cereal forages have become an increasingly economical source of winter feed for livestock producers, comprising 11% of all hay harvested in Montana. Livestock producers need to be concerned with nitrate concentrations when feeding annual cereal forages. Six cereal forage species (18 varieties) were grown in a randomized complete block design field trial (r = 4) under irrigated conditions in Bozeman, MT, and were used to test the effects of cereal forage species and stage of maturity on forage nitrate concentration. Plots were 1.52 x 6.10 m in length and spaced 0.46 m apart. Forage clip samples were collected at three stages of plant maturity; boot, anthesis and when the plots were harvested for hay (milk stage of maturity). A 0.15 m clip sample of one row was cut at stubble height and dried at 60C for 48 h. Forage clip samples were ground to pass a 1-mm screen in a Wiley mill and evaluated for DM and nitrate-nitrogen (NO_3-N). The range in NO_3-N was from 0.01 to 0.55 % (CV = 47.2%). There were significant ($P < 0.05$) cereal forage species, stage of maturity and species x maturity interaction effects on NO_3-N concentration. Nitrate-nitrogen concentration at the boot stage of maturity did not differ ($P > 0.05$) when compared to the anthesis stage of maturity (avg. 0.244 %). However, NO_3-N concentration at harvest was 36% lower than at anthesis (0.168 vs. 0.230 %). Barley forage NO_3-N was similar ($P > 0.05$) when compared to emmer, triticale and wheat x spelt crosses (avg. 0.195 %) and lower ($P < 0.001$) when compared to oats and spelt forage (0.186 vs. 0.341 and 0.258 %, respectively). Barley forage NO_3-N concentration was highest ($P < 0.05$) at the boot stage, intermediate at anthesis and lowest at harvest (0.230, 0.195 and 0.131 %, respectively). Oat forage maintained high NO_3-N concentrations at all growth stages ($P > 0.05$; avg. 0.341%). It appears that stage of maturity and cereal forage species greatly affect NO_3-N concentration. Also, NO_3-N concentrations of various cereal forage species respond differently at boot, anthesis and harvest. This implies that different harvest management must be implemented for oats when compared to other cereal forage species.

Key Words: Cereal forage, Stage of maturity, Nitrate concentration

T192 Relationship of ADICP and NDICP to crude protein and soluble protein in forages fed to dairy cattle. R. T. Ward*[1], M. J. Stevenson[2], and R. A. Patton[3], [1]*Cumberland Valley Analytical Service, Maugansville, MD,* [2]*Degussa Canada, Inc., Burlington, ON,* [3]*Nittany Dairy Nutrition, Mifflinburg, PA.*

New computer models for balancing rations as well as 2001 NRC depend on measurement of ADICP and NDICP for accurate prediction of energy content of forages. Accurate predictions of either ADICP or NDICP could reduce cost of analysis. As part of the development of a database for the Amino Cow-Mepron Ration Evaluator, we examined the relationships between ADICP and NDICP to CP and soluble protein (SP). In this study ADICP, NDICP, CP and SP were determined chemically as a percent of dry matter. Simple correlations and regression equations were developed using PROC CORR and PROC REG of SAS. Means, standard deviations and simple correlations are presented below. Overall relationships between ADICP and NDICP among DM, CP, SP, ADF and NDF were weak (i.e. no regression equations with R^2 greater than .55). The magnitude of ADICP and NDICP values significantly affects calculation of energy and protein flows in ration formulation. Since accurate prediction of these terms does not appear to be feasible, ADICP and NDICP should be analyzed. These data are generally consistent with the values reported in 2001 NRC.

Feed	N	ADICP	SD	R^2CP	R^2SP	NDICP	SD	R^2CP	R^2SP
Alfalfa hay	1017	1.43	0.43	-.02	-.33	3.14	1.56	.05	-.45
Alfalfa silage	978	1.78	0.58	-.07	-.19	3.40	1.28	-.03	-.54
Corn silage	3793	1.05	0.27	.25	.00	1.60	0.50	.35	-.16
Grass hay	236	1.51	0.67	.16	.04	4.10	1.78	.26	-.03
Grass silage	160	1.68	0.63	-.15	-.18	3.57	1.33	.31	-.15
Mixed legume-grass silage	266	1.98	0.55	.05	-.12	3.75	1.20	-.03	-.42
Sorghum silage	114	1.64	0.60	.60	.13	2.44	0.97	.51	-.05
Wheat silage	119	1.22	0.33	.09	-.07	1.98	0.84	.38	-.05

Key Words: ADICP, NDICP, Forages

T193 Relationship of starch content in common forages to dry matter, crude protein, non-fiber carbohydrate and neutral detergent fiber. R. T. Ward[1], M. J. Stevenson[2], and R. A. Patton*[3], [1]*Cumberland Valley Analytical Service, Maugansville, MD,* [2]*Degussa Canada, Inc., Burlington, ON,* [3]*Nittany Dairy Nutrition, Mifflinburg, PA 17844.*

Improvement in prediction of microbial protein synthesis requires better knowledge of nutritionally relevant carbohydrate amounts in feedstuffs. Although data exists for starch in grains and byproducts, few data are available for forages. Analytical variation was minimized by using results from one laboratory using current best practice for starch analysis. Samples varied widely in quality / nutrient content. Our objective was to determine whether starch content could accurately be predicted by more traditionally measured nutrients. CP, NDF and starch were determined chemically, while NFC was determined by difference. Investigation of relationships was by the PROC REG of SAS using the MaxR

option. Equations that improved the R^2 less than 5 percent were rejected. Starch contents are presented below (DM basis). Regression for starch as a percent of NFC was always less significant than as a percent of dry matter except for grass hay where R^2 =.73. Due to high standard deviation and low correlations, this data suggests that starch should be expressed on a percent of dry matter basis. Accuracy in prediction of starch content from other constituents was only achieved for silages with high starch content.

Feed	N	Mean	Std Dev	Min	Max	Regression Equation	R^2
Alfalfa hay	159	1.80	0.76	0.40	4.55	(0.058*NFC) -(0.084*CP)+2.208	.09
Alfalfa silage	132	2.67	2.63	0.30	13.47	(0.125*NFC) -(0.231*CP)+4.964	.17
Corn silage	1771	26.7	6.74	1.34	65.43	(0.870*NFC) -5.628	.77
Grass hay	20	2.25	0.97	0.96	13.47	(0.016*NDF) + (0.087*NFC)+0.0248	.12
Grass silage	45	2.08	1.19	0.52	7.57	(0.018*DM) +(0.035*NDF)- 0.928	.11
Mixed legume-grass silage	30	2.39	1.88	0.73	10.80	(0.244*CP) -2.763	.27
Sorghum silage	84	12.16	7.50	0.96	29.89	(0.836*NFC) -7.800	.59
Wheat silage	39	5.88	6.75	0.67	26.09	(0.736*NFC) -(0.401*NDF)+17.350	.80

Key Words: Starch, Forage

T194 Sugar content in common forages and its relationship to non-fiber carbohydrate percentage.

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The aim of the present study was to determine whether sugar content could be correlated with nutrients more commonly measured in forage. It was felt that a single laboratory analyzing a broad cross-section of forage submitted by farms would offer the best opportunity to detect correlations. Sugar was determined enzymatically. CP, NDF and starch were determined chemically, while NFC was determined by difference. Investigation of relationships among nutrients was by PROC REG of SAS using the MaxR option. Regression equations that provided less than a 5% improvement in R^2 were rejected. Sugar data for common forages on a percent dry matter basis are below. Regression for sugar as a percent of NFC was generally of greater significance than was sugar as a percent of dry matter except for corn silage and sorghum silage. However, all regressions on sugar as a percent of NFC explained less than 45% of total variation, and thus are not sufficiently accurate for practical use. Hays contained more sugars than did silages. Since sugar content is known to influence rumen fermentation, this data suggests sugar determination should be included in forage analysis.

Feed	N	Mean	Std Dev	MIN	MAX	%NFC	Std Dev	High R^2
Alfalfa hay	121	6.80	1.95	1.20	11.70	25.76	7.38	.24
Alfalfa silage	89	2.51	1.57	0.10	7.00	12.18	8.20	.18
Corn silage	897	2.42	1.99	0.10	14.90	6.74	5.95	.01
Grass hay	12	5.89	1.93	2.10	8.30	46.97	15.99	.19
Grass silage	34	2.88	1.69	0.50	6.60	31.18	15.67	.27
Mixed legume-grass silage	21	3.71	3.23	0.50	13.90	20.86	20.50	.34
Sorghum silage	57	3.41	2.11	0.60	9.20	20.86	11.30	.07
Wheat silage	27	3.56	2.08	0.90	8.30	23.86	19.01	.10

Key Words: Sugar, Forage

T195 Utility of near infrared reflectance spectroscopy to predict forage energy content derived by summative models.

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Legume-grass silage (LGS; n = 210) and corn silage (CS; n = 300) samples were collected from submissions to the Marshfield Forage Laboratory, Marshfield, WI. Samples were dried and ground for chemical or NIRS determinations. Samples were scanned on a Model 6500 near infrared reflectance spectrophotometer and spectra retained. Center and select procedures using Infrasoft International software (version 2) were implemented, resulting in 90 and 70 spectrally different LGS and CS samples retained for NIRS equation development. Forages were evaluated for CP, ADF CP, NDF, NDF CP, 48 hr in vitro NDF digestibility (dNDF, % of DM), fat, and ash which are required for the NRC, 2001 summative (forage energy) prediction model. Lignin was not determined and dNDF was substituted as the digestible NDF fraction as prescribed by the NRC, 2001.

The NIRS cross validations (r^2) for CP, ADF CP, NDF, NDF CP, dNDF, fat and ash were 0.97, 0.70, 0.96, 0.35, 0.87, 0.52, and 0.51 for CS and were 0.93, 0.71, 0.94, 0.75, 0.79, 0.53, and 0.73 for LGS, respectively. Data suggest NIRS prediction of ADF CP, NDF CP, fat, and ash content of forages has limitations. Data also suggest prediction of dNDF via NIRS has limitations and may be co-dependent with NDF prediction. Nutrient composition of each forage as determined by laboratory chemistry (LC) or NIRS was then used in NRC, 2001 summative (forage energy) prediction models and TDN for each forage was determined. The TDN determinations for the forages were compared to 48h in vitro, organic matter (dOM, % DM) digestibility.

The relationship (r^2) between NRC, 2001 predicted TDN and dOM was 0.98 and 0.98 for LGS and CS, respectively, when components were determined LC. When NIRS was used to determine model components, the relationship between NRC, 2001 predicted TDN and dOM of forages was 0.78 for CS and 0.69 for LGS. Data indicates some nutrient components in forage required by the NRC, 2001 summative (forage energy) models are poorly predicted by NIRS, ultimately reducing the utility of NIRS to predict forage energy content. ®

Key Words: Forage, Near infrared, In vitro

T196 Optimal sampling schedule of diet components.

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Various recommendations have been issued regarding sampling schedules of diet components, especially forages. Their bases are unclear and none are justified from an economic standpoint. The process of forage removal from storage can be conceptualized as a quality control issue that can be monitored using a Shewhart X-bar chart. This procedure requires three inputs: number of samples (n), frequency of sampling (h), and control limits (L). All three affect the performance of the chart and, thus, the total cost of quality. A quality cost function made of four parts is proposed: cost per cycle while the process is in-control (A); cost per cycle while the process is out-of-control (B); cost per cycle for sampling and analyses (F); and expected duration of a cycle (D). $A = C_0 / J$, where C_0 is quality cost/d while producing in control, and $J = 1/\text{mean}$ time process is in control. $B = C_1 (E - \tau - A_2h + T_1 + T_2) + sY/A_1 + W$, where C_1 is quality cost/d while producing out of control, E = time to sample and analyze one item, $\tau = [1-(1+Jh)e^{-Jh}]/[J(1-e^{-Jh})]$ and is the expected time of occurrence of the assignable cause given that it occurs between the i^{th} and the $(i+1)^{th}$ sample, $A_2 = 1/(1-\beta)$ and is the average run length while out of control, T_1 is the expected time to discover the assignable cause, T_2 is the expected time to fix the diet, b is the probability(in control signal — process is out of control), $s = (e^{-Jh}) / (1-e^{-Jh})$ and is the expected number of samples taken while in control, $A_1 = 1/\alpha$ and is the average run length while in control, α is the probability(out of control signal — process is in control), and W = cost to fix the diet. $F = [(a + bn)/h (1/J-\tau+E+A_2h+T_1+T_2)$, where a is the fixed cost per sample, and b is the cost per unit sampled. $D = 1/J-\tau+E+A_2h+T_1+T_2$. The total quality cost per day (TCQ) = (A+B+F)/D. The TCQ function can be optimized with respect to n, h, and L to yield an optimal sampling schedule. Because of the highly nonlinear structure of the TCQ function, gradient-based optimization algorithms are not well suited for the optimization task. Instead, a modified genetic algorithm is proposed.

Key Words: Feed sampling, Quality control, Quality costs

T197 Evaluation of the profile of fatty acids extracted from fresh alfalfa.

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Quantity and profile of fatty acids from fresh forage samples may be altered by repeated extractions. Fatty acids from fresh alfalfa were extracted by hexane:isopropanol (H:IP, 3:2 v/v) in three sequential extractions. The percentage and profile of fatty acids from each of the three extractions were evaluated by a randomized complete block design with repeated measure in space. Samples of fresh alfalfa were randomly harvested and immediately submerged in liquid nitrogen. For the first extraction, approximately 5 g of the frozen alfalfa was mixed with 18 ml of H:IP per gram of material. Samples were then centrifuged and the supernatant was collected. The second and third extractions were done by adding H:IP to the pellet (3 ml/g of the original sample weight),

mixing for 2 min, and then centrifuging. Samples were submerged in H:IP and stored in the dark at 8 °C at all times. The solvent from each extraction was partially evaporated and the fatty acids methylated by methanolic HCL. Repeated extractions increased the percentage of total fatty acids ($P < 0.01$) recovered from the DM. The concentration of fatty acids in the alfalfa after three extractions was 4.0%. The first, second and third extractions resulted in 92.67%, 4.77%, and 2.56% of the total fatty acids extracted, respectively. There was no effect of extraction on the proportion of 16:0, 18:0, 18:1 and 18:2 fatty acids ($P > 0.05$). However, the proportion of 18:3 in the extract decreased ($P < 0.01$) from the first to the second extraction. Therefore, the ratio of saturated to unsaturated fatty acid tended to increase from the first to the third extraction. The results of this experiment revealed that the profile of fatty acids can vary with the number of extractions performed. The higher amount of 18:3 in the first extraction may reflect the higher proportion of linolenic acid in the more easily extracted plant fractions.

Key Words: Alfalfa, Fatty acids, Fatty acid extraction

T198 The relationship between non-structural carbohydrates and total dry matter yield in cool season grasses.

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The efficiency of grass nitrogen utilization by ruminants tends to be low, due partly to the slow rate of energy release in the rumen. When additional sugars are introduced to the rumen, microbial protein is increased. Recent research reports indicate forages bred for higher soluble sugars can increase milk production and animal growth rates over grasses with average sugar content. Additional work has suggested forage carbohydrate differences influence nitrogen utilization, as indicated by changes in nitrogen excretion in the urine. Authors theorized this was primarily due to differences in the microbial capture of rumen degradable nitrogen. Very little work has been done looking at the natural variations between cultivars in sugar content or the relationship between total non-structural carbohydrates and yield. The objectives of this trail were to evaluate the non-structural carbohydrate variation found in modern cool season grasses by studying the seasonal and variety variations in comparison to yield. Perennial cool season grasses (n=17) were planted in a randomized plot design replicated three times. Four commercially available varieties of orchard grass (Dactylis glomerata), eleven ryegrasses (Lolium perenne) and two brome grasses (genus Bromus) were included in the study. Plots were harvested mechanically throughout the growing season and yield data recorded. Total non-structural carbohydrates were analyzed each sampling day in April, July and October from each variety. Annual dry matter yields ranged from 14,446 to 21550 kg per hectare averaging 18220 ± 1667. Average total non-structural carbohydrate values ranged from 14.7% to 22.5% averaging 19.3% ± 2.6. Total nonstructural carbohydrates and yield for each variety were compared using correlation analysis. For all varieties, total nonstructural carbohydrate values were negatively correlated (-.67) with total annual yield. Analysis of each variety by cutting indicated that the early (April) and late (October) total non-structural carbohydrate values were also negatively correlated with yield, -.52 and -.73 respectively. The mid-season cutting, however, showed a positive correlation (.16) between yield and total non-structural carbohydrate levels in grasses tested.

Key Words: Non-structural carbohydrates, Cool season grasses

T199 Influence on ration formulation of on-farm variability in methionine and lysine content of alfalfa haylage and corn silage.

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This study was conducted to determine the baseline variability of nutrients, including amino acids, in haylage and corn silage from a well-managed dairy farm. Samples were taken weekly over a 5-month period, a total of 21 individual samples for each forage. Means (%DM), standard deviations and coefficients of variation are shown below for the various nutrient analyses. CVs were generally above 10% for trace minerals and below 10% for macrominerals. The higher CVs associated with MET and LYS in corn silage reflect the low contents and have minimal effect on metabolizable supply. Sample rations using 10 kg DM from either of these forages were evaluated in the 2001 NRC dairy ration balancing program. Adjustment of methionine content +/- one S.D. from the mean did not affect duodenal methionine flow, and adjustment of lysine +/- one S.D. from the mean varied duodenal lysine flow by one gram. Effects of variation in amino acid content of forages can be negligible on well-managed dairy operations.

		DM	CP	ADF	NDF	ADICP	NDICP	Lignin	Fat
Corn Silage	Mean	37.61	7.06	22.05	37.65	0.51	0.95	3.24	3.31
	SD	1.22	0.25	2.02	2.71	0.10	0.17	0.58	0.22
	CV%	3.2	3.5	9.2	7.2	20.2	17.2	17.9	6.5
		Ash	MET	LYS	LEU				
	Mean	3.41	0.11	0.15	0.63				
	SD	0.51	0.01	0.02	0.03				
	CV%	15.0	13.1	15.6	5.3				
		DM	CP	ADF	NDF	ADICP	NDICP	Lignin	Fat
Haylage	Mean	48.47	20.80	38.85	48.23	1.89	3.73	9.65	2.77
	SD	0.56	0.75	1.33	1.98	0.15	0.41	2.27	0.14
	CV%	1.2	3.6	3.4	4.1	8.2	11.1	23.5	5.0
		Ash	MET	LYS	LEU				
	Mean	9.79	0.23	0.78	1.08				
	SD	0.57	0.02	0.06	0.08				
	CV%	5.8	7.1	8.0	7.4				

Key Words: Methionine, Lysine, Forage

T200 Effect of different storage forms of alfalfa hay on the digestion characteristics in Holstein steers.

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An experiment was conducted to evaluate the effect of different storage forms of alfalfa hay on the duodenal flow (DF) and the apparent intestinal digestibility (AID) of amino acids in Holstein steers. The forage was harvested in June, dried on the field, baled, and stored for six months under different conditions. The maximum air temperature at the site where the experiment was conducted ranged from 40 to 49C. Five steers each adapted with cannulas in rumen, proximal duodenum, and distal ileum, were used according to a 5 x 5 Latin Square design. Treatments were: T1) hay stored without any cover, T2) hay stored under a metal hood, T3) hay completely covered with a vinyl tarp, T4) hay stored inside an oven at 45C, T5) hay stored inside a refrigerated room at 22C. The results were: DF (g/d), Arg 36.1, 27.3, 28.8, 36.0, 23.5; His 16.3, 12.4, 13.4, 15.8, 11.2; Ile 39.5, 30.0, 32.4, 38.9, 26.1, Leu 63.3, 48.8, 52.5, 63.6, 42.4; Lys, 50.2, 38.3, 41.2, 48.7, 34.1; Met 29.4, 22.3, 24.1, 29.2, 19.8; Phe 41.8, 31.8, 34.7, 41.7, 27.6; Thr 37.8, 29.7, 31.7, 38.4, 26.4; AID (%), Arg 68.7, 67.1, 67.6, 72.6, 67.9, His 50.6, 49.5, 50.8, 54.3, 52.8; Ile 58.9, 56.0, 58.6, 63.2, 57.2, Leu 59.1, 56.6, 58.8, 63.6, 57.6; Lys 59.6, 59.0, 60.5, 63.6, 61.8; Met, 56.6, 56.1, 58.0, 61.2, 58.2; Phe 63.7, 59.5, 61.9, 66.8, 60.8; Thr 51.5, 51.7, 53.6, 57.2, 53.8, respectively. The DF of all the amino acids was higher ($P<.01$) when steers were fed the hay either stored without cover or inside the oven, as compared with the other storage conditions. Storing the hay inside a cool room produced the lowest DF of all the amino acids. The AID of all the amino acids was higher when the steers consumed the hay stored inside the oven; no difference was observed between the other storage systems. These data suggest that alfalfa hay stored at high temperatures produces bypass proteins in steers without affecting the intestinal digestibility of amino acids.

Key Words: Alfalfa hay, Storage, Amino acid digestibility

T201 Effect of method of conservation on the n-alkane C_{31} concentration of alfalfa and two temperate grasses.

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The objective of the present study was to compare the effect of two methods of herbage conservation (freezing in liquid nitrogen or refrigeration) on the C_{31} concentration of two grasses (ryegrass and kikuyo grass) and alfalfa.
METHODOLOGY: Perennial ryegrass (*Lolium perenne*) and kikuyo grass (*Pennisetum clandestinum*) samples were collected at a site located at 2,800 m above sea level, where the mean temperature is 9.9 °C and the mean annual rainfall is 1,800 mm. Alfalfa samples (*Medicago sativa* L. var. Puebla 76) were collected at a site located at 2,250 m above sea level, where the mean annual temperature oscillates between

12 and 18 °C and the mean annual rainfall is 625 mm. The aerial part of several plants from each forage species was collected, thoroughly mixed and sub-sampled. **Refrigerated** samples were kept in sealed plastic bags in a plastic cooler with blue ice. **Frozen** samples were placed inside small plastic bags and frozen in liquid nitrogen. The samples were transported to the laboratory and 24 hours later they were freeze-dried. Freeze-dried forage samples, worked in triplicate, were ground (1 mm) and subjected to a Soxhlet extraction, using an internal standard (C_{34}) and n-heptane. The saponification procedure used ethanolic KOH and the reflux time was 3.5 hours. Samples were purified using a silica gel column and were injected into an HP 5890 SII gas chromatograph. Data (mg/Kg of C_{31}) were analyzed as a completely randomized design with a factorial arrangement of treatments.
RESULTS: The forage x method interaction was significant ($P \leq 0.01$). Refrigeration decreased the concentration of C_{31} in alfalfa (218.2 vs 239.3 mg/Kg) and kikuyo grass (41.8 vs 50.7 mg/Kg), but not in ryegrass (36.9 vs 36.3 mg/Kg) (SEM=2.9).
CONCLUSION: Freezing in liquid nitrogen appears to be a better method of forage conservation for n-alkane analysis than refrigeration, but there may be forage species differences.

Key Words: n-Alkane, Forages, Conservation

T202 The effect of milling on physical material lost through dacron bags of 53 micron pore size. C. W. Cruywagen*[1], G. Bunge, and L. Goosen, [1]*University of Stellenbosch, South Africa.*

Dacron bags of 53 μ pore size are typically used in in sacco trials to determine nutrient degradability values. The standard procedure recommended by the 2001 NRC Nutrient Requirements of Dairy Cattle involves the milling of feed samples through a 2 mm screen. A certain proportion of a feed sample would be milled to extremely fine particles (EFP) that could potentially be washed out of the dacron bag. The proportion of EFP would depend on the type of feed, e.g. hay vs. silage, alfalfa vs. wheat straw, etc. The presence of EFP could over estimate the soluble fraction of a nutrient which is usually determined by calculating the nutrient loss following a washing cycle in water. In the present study, samples of alfalfa hay and wheat straw were sieved through a 60 μ stainless steel mesh. The material that passed through the mesh screen is referred to as fine material (FM), while the material remaining on the screen is referred to as course material (CM). For both alfalfa hay and wheat straw, samples of FM, CM and unsieved material (UM) were analyzed for NDF and were also used in dacron bags to determine dry matter (DM) losses into water during a 15 minute washing machine cycle. The NDF content (%±SD) of FM, CM and UM was 52.5 (±1.5), 43.5 (±1.0) and 49.6 (±0.7), respectively, for alfalfa hay and 62.1 (±0.4), 49.7 (±0.9) and 60.2 (±0.1), respectively, for wheat straw. For alfalfa hay, DM losses (%±SD) from dacron bags after washing were 57.8 (±4.4), 25.6 (±0.3) and 32.5 (±0.6) for FM, CM and UM, respectively and for wheat straw DM losses were 62.2 (±2.9), 25.6(±0.8) and 32.2 (±0.4) % for FM, CM and UM, respectively. It was concluded that significant amounts of sample material could potentially be washed out from dacron bags during a water washing cycle and that soluble nutrient fractions of feedstuffs could be over estimated if care is not taken. More research is required to determine magnitudes and composition of fractions and nutrient losses due to washing cycle before final recommendations can be made.

Key Words: Particle size, In sacco, NDF

T203 Measuring detergent insoluble protein and fiber in corn silage using crucibles or filter bags. G. Ferreira*[1,2] and D. R. Mertens[2], [1]*Univ. of Wisconsin,* [2]*USDA-ARS, US Dairy Forage Research Center, Madison, WI.*

Objectives of this research were to compare the crucible (CR) and filter bag (FB) methods of measuring detergent insoluble protein and fiber in corn silage and to evaluate the differences in neutral detergent insoluble protein with or without the use of sodium sulfite and amylase. Thirty-three diverse corn silages (14.9 to 37.1% ADF and 26.8 to 57.4% NDF) were analyzed in duplicate. The CR method followed Official Methods with heating to boiling in 5 min and refluxing for 60 min, followed by three 5-min soakings in water, and two soakings in acetone. The FB method used an in-house procedure that involved heating for 15 min and extracting for 60 min in a closed Ankom Fiber Analyzer, followed by four 5-min washes using hot water (with closed chamber and heating), and two soakings in acetone. Three NDF modifications were used: original NDF (with sulfite and without amylase), neutral detergent residue (NDR?without sulfite and with amylase), and aNDF (with sulfite and amylase). Average blank-corrected results were: 26.6 or 26.1% ADF; 43.4 or 43.3% aNDF; 45.7 or 44.8% NDR; and 45.6 or 47.2% NDF for CR or FB, respectively. Mean fiber differed between CR and FB, except for aNDF. However, when FB was regressed against CR, only NDR yielded an intercept different from zero and slope different from one. CR gave lower fiber for ADF and NDR, but higher fiber for NDF compared to FB. With the exception of NDF, the standard errors of duplicate analyses were less for CR compared to FB: .25 vs .53% ADF; .47 vs .54% aNDF; .42 vs .47% NDR; and 1.08 vs .77% NDF, respectively. Acid detergent and neutral detergent with sulfite obtained lower insoluble crude protein (ICP): .40 or .38% ADICP; .86 or .97% aNDICP; 1.25 or 1.42% NDRICP; and .80 or .95% NDFICP for CR or FB, respectively. Except for ADICP, ICP differed between CR and FB. The in-house FB method obtained results similar to the CR method for aNDF. Small statistical differences in ADF and ICP between CR and FB may not be important in relation to variation in fiber analyses among laboratories.

Key Words: Fiber, Insoluble protein

T204 Orchardgrass soluble carbohydrate and digestibility levels in sward horizons under defoliation sequences initiated in morning and evening. T. C. Griggs[1], J. W. MacAdam[1], H. F. Mayland*[2], and J. C. Burns[3], [1]*Utah State University, Logan, UT,* [2]*USDA-Agricultural Research Service, Kimberly, ID,* [3]*USDA-ARS, Raleigh, NC, and North Carolina State Univ., Raleigh, NC.*

Diurnal cycles of nonstructural carbohydrates (TNC) in forage canopies, and higher TNC levels for hay cut in evening than in morning, have been documented. Temporal patterns of TNC and dry matter digestibility (DMD) have not been assessed in sward horizons under rotational grazing. Timing of herbage allocation in pastures may impact the daily balance of sward photosynthetic gain and respiratory loss and therefore energy intake by livestock. Our objective was to compare TNC and DMD levels in horizons of an orchardgrass sward under sequential clipping during a 24-hr period initiated in morning (AM) or evening (PM). Vegetative orchardgrass initially 40 cm tall was clipped to remove 0.33 of current sward height every 6 hr to a final stubble height of 8 cm. Clipping sequences were initiated at 7 AM and 7 PM in October, 2000 and June and August, 2001 in a randomized block design with 3 replications. Only the uppermost horizon in sequentially-clipped patches was analyzed at each time point. Whole-canopy control samples were also collected at each time point and sectioned into horizons. All samples were analyzed for levels of TNC and in vitro true dry matter digestibility. Conditions varied from cold and cloudy with little diurnal temperature fluctuation in October to high irradiance, temperatures, and temperature fluctuations in summer. Diurnal patterns of TNC and DMD levels were dissimilar among seasons. Levels of TNC and DMD in individual horizons of control samples were unrepresentative of those in uppermost horizons in clipped treatments. In October, horizon TNC levels increased throughout each 24-hr period, but to a greater extent in the PM treatment. In summer, horizon TNC levels decreased over 24 hours in the PM treatment, but increased and decreased diurnally in the AM treatment. Mean diurnal TNC levels for AM and PM treatments were 13.4 vs. 14.8, 8.8 vs. 8.2, and 5.8 vs. 7.1% for October, June, and August, respectively. In all seasons, DMD decreased from approximately 92 to 80-85% with sward depletion, presumably as a function of increasing fiber level, and displayed similar patterns among clipping treatments in spite of differences in patterns of TNC levels.

Key Words: Pasture nutritional value, Herbage composition, Orchardgrass soluble carbohydrates

T205 Nutritional quality of seventy four accessions of elephantgrass (*Pennisetum purpureum* Schum) from Embrapa's Brazil collection. A. V. Pereira[1], H. Carneiro*[1], F. de S. Sobrinho[1], and M. Villaquiran[2], [1]*EMBRAPA CNPGL, Minas Gerais, Brazil,* [2]*E. (Kika) de la Garza. American Institute for Goat Research, Langston, OK.*

Elephant grass is an important forage in Brazilian livestock production systems, especially for dairy cattle production. For several years Embrapa, Brazil's national agriculture research service, has conducted

plant breeding studies on elephantgrass and has developed several accessions. However, Embrapa has not evaluated the nutritional quality of the various accessions of elephantgrass. The objective of this study was to determine nutritional quality of Embrapa's elephantgrass collection. Over a 3-yr period, CP, in vitro and in vivo digestibilities (DIG), lignin (L), cellulose (C), and silica (S) of leaf blade and of whole green chopped plants of 74 elephantgrass accessions were evaluated at three different cutting (harvesting) periods of 30, 60, and 90 d. Data were analyzed as a complete randomized block with in two replicates. The statistical model included forage type (leaf vs whole plant), accession, cutting day, all two-way interactions, and the three-way interaction. The greatest variability ($P < 0.02$) was found at 60 d among all accesses. Differences ($P < 0.05$) were found among accessions in nutritional quality except C, L, and S. Crude protein decreased sharply with age from 17 to 4% CP for 30 to 90 day old grasses. For in vitro DIG, largest variability was from 68 to 49% for 30 to 90 day old grasses ($P < 0.02$). Considering the sharp decrease in CP, elephantgrass should be grazed around 30 d and no more than 60 d. For green chopping, CP after 60 d is considered extremely low for rumen function. The differences among nutritional qualities in the elephantgrass accessions could be responsible for wide differences in growth and lactation performance of grazing ruminants. Further research by plant breeders is needed to improve Embrapa's elephantgrass accessions in CP, and in vitro DIG.

Key Words: Elephantgrass, Nutrition Quality, Accession

T206 Yield and growth of *Panicum maximum* Jacq under different fertilization levels with N and P in humid tropical forest conditions. A. Rodriguez-Petit* and J. Zambrano, *Universidad Nacional Experimental Sur del Lago*.

An experiment was carried out to evaluate the yield and growth of the guinea grass (*Panicum maximun* Jacq) under different levels of N and P. The soils was taxonomically classified as Inceptisols, with pH 5.6. Three levels of N (0, 100 and 200 kg/ha/year) and three of P (0, 50 and 100 kg/ha/year) were evaluated in a design of split-pot with factorial arrangement in the secondary plot and four replications. The variables were height (H), total yield (TY), leaf yield (LY), stem yield (SY) and dead material yield (DMY) and were measured every 7, 21 and 35 days in three 35 day cycles. The guinea grass showed significant differences ($P<0.01$) for H, the highest value (172.33 cm) was obtained with the interaction of 200 kg N/ha and 100 kg P/ha. The most highest values to TY, LY and SY were observed at the 35 day by the simple effect of 200 kg N/ha (3940.31, 2381.47 and 1403.18 kg/MS/ha, respectively). The DMY not show statistical differences by treatments effect. The best performance of the guinea grass under this trial conditions was obtained every 35 days with the application of 200 kg N/ha/year and 100 kg of P/ha/year.

Key Words: *Panicum maximum*, Fertilization, Yield

T207 Evaluation of energy efficiency and CO_2 emission from forage production systems. M Wachendorf*, M Kelm, and F Taube, *University of Kiel, Kiel, Germany*.

Fossil energy use in agriculture is an important indicator for both the use of limited fossil resources and the release of carbon dioxide (CO_2) and other combustion gases. Based on experimental data, gathered within an integrated project on nitrogen fluxes in intensive dairy farming, an analysis of fossil energy input and energy efficiency in forage production from permanent grassland and maize was conducted. The grassland experiment consisted of all combinations of five defoliation systems, i.e. cutting-only, rotational grazing, mixed systems with one or two silage cuts plus succeeding rotational grazing respectively, and simulated grazing, four mineral N application rates (0, 100, 200, and 300 kg N ha^{-1} yr^{-1}), and two slurry levels (0 and 20 m^3 slurry ha^{-1} yr^{-1}). Prior to the start of the experiment, white clover was established in all plots by oversowing. Silage maize was grown without and with undersown ryegrass and comprised different rates of mineral N (0, 50, 100, 150 kg N ha^{-1} yr^{-1}) and slurry application (0, 20, 40 m^3 ha^{-1} yr^{-1}). Energy efficiency consistently decreased with increasing rates of mineral N application both in permanent grassland and silage maize. Application of 20 m^3 slurry per hectare increased energy efficiency in grazed grassland and silage maize, but not in cut grassland. Net energy yields of all grassland defoliation systems were much lower compared to maize at the same level of energy input. Silage maize was thus much more energy-efficient due to high net energy yields at low to moderate levels of nitrogen and energy input. The figures for fossil energy input and CO_2 emissions showed an almost similar pattern since the CO_2 emission factors for N fertilizer and diesel fuel were in a similar range. A CO_2 mitigation of 300-500 kg CO_2 ha^{-1} seems to be possible in forage production without a significant reduction in productivity. It is proposed that the environmental performance of dairy farming systems can be improved substantially by a change from N-fertilized grass-only swards towards unfertilized clover/grass swards and silage maize.

Key Words: Forage production, CO_2 emission, Energy efficiency

T208 Impact of maturation on cell wall degradability in corn stem internodes. H. G. Jung*, *USDA-ARS, St. Paul, MN*.

Degradability of forage cell wall (CW) material declines with maturity; however, the causes for this decline have not been adequately described. Stem CW development and degradability were observed in three nonrelated corn hybrids. The fourth above-ground stem internode was collected in 1998 and 1999 from a randomized complete block design field trial with two replications. Sampling began when the internode was 1-cm long (late June) and subsequent samples were collected 2, 4, 8, 12, 19, 26, 40, 68, and 96 d later. Internodes were analyzed for CW concentration and composition, and 24- and 96-h in vitro rumen degradability. While small significant differences were observed in CW development and degradability of the three corn hybrids, impact of maturity was much greater and all hybrids responded similarly to maturation. Stem internodes increased in length and diameter until 12 d after sampling began. CW concentration was 31% of internode OM in the first samples and did not change during the next 8 d of development. Subsequently, CW concentration increased at each sampling until a maximum (73%) was reached 26 d after sampling began, later CW concentration declined (minimum of 55%) because of sucrose accumulation in the stem. CW glucose and xylose concentrations increased from 35 and 18% of CW, respectively, in the first sample to 52 and 24% of CW 12 d later. In contrast, Klason lignin concentration declined from 11% of CW to 6% by 8 d after sampling had begun and then increased to 20% of CW by d 40. Degradability of internode CW polysaccharides was high and unchanged through d 4 (88 and 93% after 24 and 96 h, respectively), but then declined steeply to 26 and 39% (24 and 96 h, respectively) by d 68. Lignin/polysaccharide cross-linking by ferulates matched the beginning of the decline in CW degradability better than lignin concentration because these ferulates began to increase in concentration at the same time as the decline in degradability started whereas lignin concentration was still decreasing. These data indicate that the decline in CW degradability associated with maturation of grasses is a function of both lignin and ferulate cross-linking.

Key Words: Corn Stem, Cell Wall, Degradability

Dairy Foods: Cultured dairy products and dairy proteins

T209 Dissociation of casein supramolecules. B. S. Oommen* and D. J. McMahon, *Department of Nutrition and Food Sciences, Utah State University*.

Microstructure of dissociated caseins in bovine milk was studied using transmission electron microscopy. Cold and warm milk was treated with excess EDTA and glucono-δ-lactone to dissociate the colloidal casein aggregate. This was diluted 100 times, and caseins were adsorbed on to parlodion coated copper grids. Parlodion coated copper grids were coated with poly-L-lysine to improve the adsorption of protein on to the film. These grids were stained using uranyl acetate and oxalic acid, flash frozen in liquid nitrogen-cooled Freon 22, and freeze dried so that the native casein structure could be preserved. Grids were viewed using a transmission electron microscope and images were photographed at various magnifications ranging from 7,000x, to 250,000x at 80 kV. Cold milk EDTA-treatment resulted in linear and spherical aggregates of proteins. Warm milk EDTA- treatment resulted in filigreed ring-like protein aggregates. Fixing of the colloidal casein particles using gluteraldehyde before EDTA-treatment preserved the supramolecular structure of ca-

sein. Reduction of pH first resulted in small protein aggregates which further dissociated out of the supramolecule. This study reveals the various types of aggregation behavior of caseins when calcium is removed from the colloidal casein structure.

Key Words: Casein micelle, Acid, Calcium

T210 Antimicrobial activity of bovine milkfat globule membranes: A cautionary tale. D. A. Clare*, T. R. Klaenhammer, H. M. Hassan, G. L. Catignani, and H. E. Swaisgood, *North Carolina State University, Raleigh, N.C. / USA*.

Milkfat globule membranes (MFGMs) were prepared from bovine milk according to standard procedures. MFGMs and peptide hydrolysates, generated by incubation with immobilized trypsin, were screened for antimicrobial activity using three foodborne pathogens: *Escherichia coli* 0157:H7, *Listeria monocytogenes*, and *Salmonella typhimurium*. Two probiotic microorganisms, *Lactobacillus acidophilus* and *Lactobacillus gasseri*, were also included for evaluation purposes. Assays were performed on beef heart infusion (BHI) plates seeded with lawns of indicator cells, and protein/peptide fractions were spotted to monitor the zone of inhibition (ZOI). Initial results showed that these samples were active against *S. typhimurium* and *E. coli* 0157:H7. During the course of our studies, we have determined that bacteriostatic/bactericidal effects were most likely due to the generation of hydrogen peroxide (H_2O_2) by xanthine oxidase (XOX), a major protein constituent of the MFGMs. Similarly, purified XOX, evaluated under identical experimental conditions, showed analogous data trends including inhibitory effects with respect to *L. monocytogenes*. Probiotic *Lactobacillus* strains were only marginally affected. Microbial growth patterns were not influenced, however, when MFGMs, trypsin-generated MFGM hydrolysates, and XOX were evaluated for activity using Luria-Bertani (LB) test plates. Thus, the mechanism of this action was attributed to catalysis of purine substrates present in BHI but lacking in LB media. Furthermore, addition of catalase to XOX samples totally abolished the antibacterial effects, and microbial growth was not impaired when ZOI assays were performed using BHI plates under anaerobic conditions. Apparently, proteolysis of MFGMs using immobilized trypsin did not completely eliminate the catalytic (antimicrobial) capacity of XOX; whereas, sequential treatment with pepsin at pH 3.5 followed by digestion with trypsin at pH 8.1 resulted in complete inactivation of both enzymatic and bactericidal functions. Ultimately, antimicrobial properties of XOX were entirely associated with the oxidase form of the enzyme resulting in the production of H_2O_2 as the active inhibitory component.

Key Words: Milk enzymes, Antimicrobial proteins, Bactericidal reagents

T211 *In Vitro* stability of β-galactosidase microcapsules. H. S. Kwak, J. B. Lee, B. J. Jeon, and J. Ahn, *Sejong University, Seoul, Korea*.

The present study was carried out to examine the efficiency of microcapsules and a stability of lactase in vitro in the simulated gastric and intestinal conditions. As a coating materials, medium-chain triacylglycerol (MCT) and polyglycerol monostearate (PGMS) were used. The highest efficiency of microencapsulation was found in the ratio of 15:1 as coating to core material with both MCT (91.5%) and PGMS (75.4%). In a subsequent experiment, lactose content was measured to study a microcapsule stability. Lysis of microcapsules made by MCT in simulated gastric fluid was proportionally increased such as 3% in pH 5 and 11% in pH 2 for 20 min incubation. In the case of PGMS microcapsulation, 11-13% of lactose was hydrolyzed at 20 min in all pHs and also very little amount (less than 3%) of lactose was hydrolyzed after 20 min in all pHs. The highest percentages of lactose hydrolysis in MCT and PGMS microcapsules were 68.8 and 60.8% in pH 7 and 8 during 60 min, respectively. Based on out data, the lactase microcapsules seemed to be stable when they stay in the stomach, and hydrolyzed rapidly in small intestine where the bile acid was excreted.

Key Words: β-galactosidase, Stability of microcapsule, Lactose

T212 Microencapslation of water-soluble isoflavone and physico-chemical property in milk . J. S. Seok, I. H. Ko, and H. S. Kwak, *Sejong University, Seoul, Korea*.

This study was carried out to investigate the addition of water-soluble isoflavone into milk by means of microencapsulation technique. The yield of Microencapsulation, sensory attributes, and capsule stability of water-soluble isoflavone microcapsules in milk were measured during 12 days. Coating materials used were polyglycerol monostearate (PGMS) and medium-chain triacylglycerol (MCT), and core material was water-soluble isoflavone. The encapsulation yield of water-soluble isoflavone with MCT was 74.5 % and was 67.2 % with PGMS when the ratio of coating material to core material was 15 : 1. The rates of water-soluble isoflavone release were 15, 20, and 25% when stored at 4, 20, and 30 for 12 days in milk, respectively. In sensory evaluation, beany flavor and color of microcapsuled water-soluble isoflavone added milk were significantly different from control and uncapsuled water-soluble isoflavone added milk, however, bitterness was not significantly different. In vitro study, microcapsules of water-soluble isoflavone in simulated gastric fluid with the range of 3 to 6 pHs were released 3.0 to 15.0%, however, the capsules in simulated intestinal fluid with pH 7 were released 95.7% for 40 min incubation time. In conclusion, this study provided that MCT and PGMS as coating materials were suitable for the microencapsulation of water-soluble isoflavone, and the capsule containing milk did not affect to sensory attribute.

Key Words: Isoflavone, Microencapsulation, Milk

T213 FAT free sugar free plain set yogurt fortified with folic acid. C. A. Boeneke* and K. J. Aryana, *Louisiana State University Agricultural Center, Baton Rouge, LA*.

Folic acid fortification is used in the prevention of neural tube defects such as spina bifida and ancencephaly, heart defects, facial clefts, urinary tract abnormalities, and limb deficiencies. Although yogurt is not a good source of folic acid, fortification could aid in prevention of above mentioned defects. Fortification of yogurt with folic acid may or may not change its physico-chemical characteristics. Fat free sugar free yogurt was manufactured using 0, 25%, 50%, 75% and 100% of the recommended daily allowance of 400 micrograms of folic acid. Treatments included addition of folic acid at these levels before and after pasteurization. The objective was to examine the effects of folic acid on viscosity, pH, TA, syneresis, color, composition, and folic acid concentration in the product at one, three, and five week intervals. Data were analyzed using the General Linear Model procedure with a completely randomized block design by the Statistical Analysis System. Significant differences were determined at $P<0.05$ using Duncan's Multiple Range Difference Test. There were no significant differences in viscosity over the five week period. No significant differences were found in pH or syneresis of samples. Folic acid fortified yogurts showed significantly higher($P<0.05$) b* values than control indicating they were more yellow in color. There were no differences in the electrophoretic mobilities of the protein/peptides in the samples. Control yogurt had significantly higher($P<0.05$) mean flavor scores than yogurts with folic acid when tested by a trained sensory panel. Folic acid fortification of yogurt impacted some of its physico-chemical attributes.

Key Words: Fermented, Health, Sensory

T214 Microstructure of folic acid fortified fat free sugar free plain set yogurt. K. J. Aryana*, [1]*Louisiana State University Agricultural Center, Baton Rouge, LA*.

Folic acid is used in preventing birth defects of the spine and brain, hardening of arteries and colon cancer. Yogurt is not good source of folic acid. Earlier experiments on fortifying yogurt with folic acid revealed that at a high level of folic acid fortification, the yogurt has a powdery mouth-feel. This powdery mouth-feel may be due to localized protein aggregations. The objective was to study the microstructure of folic acid fortified yogurt. Folic acid was added before and after pasteurization viz. during mix preparation and after culture addition. Folic acid was added at one quarter and one half the recommended daily allowance. The microstructure was studied using scanning electron microscopy and transmission electron microscopy. Control yogurt and folic acid fortified yogurts showed the network of casein micelles in chains and clusters. Clusters in the folic acid fortified yogurts were larger ($P<0.05$) compared to the control. Also the folic acid fortified yogurts had significantly ($P<0.05$) more clusters of casein micelles per unit area compared to the control. These increased localized casein micelle aggregations were a factor contributing to the powdery mouth-feel of folic acid fortified yogurts.

Key Words: Structure, Fermented, Network

T215 Development of cholesterol-removed compound whipping cream by β-cyclodextrin. S. Y. Shim, H. J. Choi, and H. S. Kwak, *Sejong University, Seoul, Korea.*

This study was carried out to investigate the development of cholesterol-removed whipping cream. Cream with 36% milk fat was treated for cholesterol removal with 10% β-cyclodextrin, 40°C stirring temperature, 400, 800 and 1,200 rpm stirring speeds, and 10, 20 and 30 mins stirring time. The group of emulsifier and stabilizer was selected 0.3% β-cellulose, 0.3% sugar ester, 0.2% avicell, 0.3% sodium alginate, and 0.3% sucrose for making the cholesterol-removed compound whipping cream. The overrun percentage was the highest with 150%, and the foam stability was the most stable with 1.0ml defoamed cream when the ratio of cholesterol-removed whipping cream and palm oil whipping cream was 8 : 2. TBA values of the cholesterol-removed compound whipping cream were initially 0.08 and 0.15 after 4 week storage at 4° for sample. This result was not significantly different from cholesterol-removed whipping cream. In sensory evaluation, the scores of texture, cream flavor, color and overall acceptability in samples were not significantly different from cholesterol-removed whipping cream. In conclusion, cholesterol- removed compound whipping cream appeared to be stable under various experimental optimum conditions. Therefore, this study suggested the possibility of cholesterol-removed whipping cream in industry.

Key Words: Cholesterol removal, β-cyclodextrin, Compound whipping cream

T216 Development of cholesterol-removed compound whipping cream by β-cyclodextrin. S. Y Shim, H. J. Choi, and H. S. Kwak, *Sejong University, Seoul, Korea.*

This study was carried out to investigate the development of cholesterol-removed compound whipping cream. Cream with 36% milk fat was treated for cholesterol removal with 10% -cyclodextrin, 40 stirring temperature, 400, 800 and 1,200 rpm stirring speeds, and 10, 20 and 30 mins stirring time. The group of emulsifier and stabilizer was selected 0.3% -cellulose, 0.3% sugar ester, 0.2% avicell, 0.3% sodium alginate, and 0.3% sucrose for making the cholesterol-removed compound whipping cream. The overrun percentage was the highest with 150%, and the foam stability was the most stable with 1.0ml defoamed cream when the ratio of cholesterol-removed whipping cream and palm oil whipping cream was 8 : 2. TBA values of the cholesterol-removed compound whipping cream were initially 0.08 and 0.15 after 4 week storage at 4 for sample. This result was not significantly different from cholesterol-removed whipping cream. In sensory evaluation, the scores of texture, cream flavor, color and overall acceptability in samples were not significantly different from cholesterol-removed whipping cream. In conclusion, cholesterol- removed compound whipping cream appeared to be stable under various experimental optimum conditions. Therefore, this study suggested the possibility of cholesterol-removed compound whipping cream in industry.

Key Words: Cholesterol removal, β-cyclodextrin, Compound whipping cream

T217 Aerobic endospore distribution in a process to produce high phospholipid ingredients from commercial reconstituted buttermilk. L. Lassonde* and R. Jimenez-Flores, *Cal Poly DPTC.*

Bacterial endospores survive standard industrial processes to become food spoilage organisms when later reconstituted with water and exposed to appropriate environments to induce germination and growth. The objective of the study was to 1) Isolate and characterize a library of wild-type *Bacillus spp.* from a variety of commercial buttermilk powder (BMP) including endospore counts, metabolic activity and germination rates; 2) Characterize rejection of endospores in a pilot scale cold microfiltration process on reconstituted BMP; and 3) Characterize the survivability of endospores when exposed to super critical CO_2. The library of endospores isolated from commercial reconstituted BMP consists of 80 well- characterized strains of bacilli. Biological comparisons are possible at DPTC with bacilli from different dairy products. The process used reconstituted BMP (20 L per batch and 10% TS) and subjected to a micro- filtration process using a 0.8μm ceramic porous filtering system at 4°C, to enrich phospho-lipids into the retentate. Diafiltration with distilled water was added through the system three times the original volume of the reconstituted buttermilk (60 L). Both retentate and permeate were analyzed for TPCs, mesophilic and thermophilic endospore counts to determine endospore counts in the retentate. Mesophilic-spore counts in retentate and permeate were consistently $>10_2$ cfu/ml and <25 cfu/ml respectively. Retentate and permeate thermophilic spore counts were 10_3cfu/ml and <5cfu/ml respectively. The original BMP had meso- and thermophilic counts of 10_2 and 10_3 cfu/ml. The total balance of spores in the system resulted in a retention of between 75 to 98% of the total spores, and no significant difference between mesophilic and thermophilic counts. Supercritical inactivation of spores show a complex, thermal/supercritical lethal curve. It is apparent that the overall composition of the BMP interferes with the spores exposed to the treatment. Destruction rates were measured between 90 to 99.9% of the original spores in the retentate.

Key Words: Buttermilk powder, Micro-filtration, Bacillus

T218 Time-intensity measurement of "creaminess" in dairy mixes. T. M. Kruel*[1], K Adhikari[1], H Heymann[2], and I. U. Gruen[1], [1] *University of Missouri-Columbia,* [2] *University of California-Davis.*

Time-intensity (T-I) analysis is a descriptive analysis where a single attribute is tracked as it changes over a period of time. Temporal measurements have mainly been done on flavor release attributes of foods during eating. Texture attributes have mostly been evaluated using unipoint measurements. Therefore, the objective of the present study was to determine if the attributes that constitute creaminess could be evaluated by T-I analysis. Five combinations of dairy mixes with varying fat content were chosen for evaluation. The intensities of "fattiness", "smoothness", and "thickness" were measured individually for each dairy mix by a panel of 5 trained judges. All the samples were randomized, served in 50-ml deli cups and coded with 3-digit random numbers for taste evaluations. Two replications were carried out and the data was collected on Compusense® 5. Attribute intensity was measured every 0.1 second for a total of 20 seconds. Data analysis (Unscrambler® 7.8) included Non-centered Principal Component Analysis (PCA) to extract Non-centered Principal Time-Intensity Curves (NPTIC) by using the panelists' responses. Product differences were further analyzed by using Partial Least Square Regression (PLSR). The variance explained by the 1st two principal components for "smoothness", "fattiness" and "thickness" were 69 and 17%, 84 and 9%, and 93 and 3%, respectively. Results from "smoothness" showed no pattern depending on the fat content. Probably the absence of any perceptible particles in the mixes governed the randomness of the results. On the other hand, both "fattiness" and "thickness" were perceived by the judges to be part of creaminess and the results showed distinct differences between low fat and high fat dairy mixes. It might be concluded that temporal measurements of "fattiness" and "thickness" could be used to determine creaminess of liquid dairy products. The "smoothness" of the products might not contribute much towards the perception of creaminess.

Key Words: Dairy mixes, T-I analysis, PLSR

T219 Identification of aroma compounds in whey powder. S. Mahajan, M. Qian*, and L. Goddik, *Oregon State University.*

Volatile compounds from whey powder were extracted with pentane-diethyl ether and followed by solvent assisted flavor extraction. The aroma concentrates were analyzed by gas chromatography/olfactometry technique and mass spectroscopy. Acetic, benzoic, butanoic, hexanoic, octanoic were the major acidic compounds identified in the whey. Other acidic compounds identified were formic, propanoic, 2-methylpropanoic and 3-methylbutanoic acids. Major neutral compounds identified were dimethylsulfone, maltol, 2-furanmethanol, dihydro-3-hydroxy-2(3H)-furanone, hydroxydimethylfuranone and ethyl acetate. The odor-active compounds were studied using an Osme technique.

T220 Ingredient interactions with derivatized whey protein powders. J. D Firebaugh* and C. R. Daubert, *North Carolina State University, Raleigh, NC.*

Justification: Whey protein was modified to produce powders capable of thickening similar to pregelatinized starches. A basic understanding of ingredient interactions with the new whey ingredient will encourage optimal incorporation into dairy foods.

Objective: To investigate pH and salt interactions with a derivatized whey protein powder.
Methods: Whey protein isolate (WPI) solutions were modified through acid and thermal treatments, then spray dried into powders. Samples were prepared by hydrating the derivatized powders in deionized water and adjusting the sample pH from 3.35 to 4.0, 4.5, and 5.0 with 6M HCl. Salt studies were prepared by hydrating the derivatized ingredient in 0.05M, 0.10M, and 0.15M NaCl solutions and adjusting to pH 4.0 with 6M HCl. Physical properties were determined for each solution. Specifically, rheological properties of solutions were obtained using a controlled-stress rheometer with concentric cylinder geometry at 25°C. Also, a water absorption index was evaluated and calculated as the weight of gel obtained from 1g of dry sample post hydration.
Results: Water absorption and viscosity were affected by pH. The derivatized ingredient was calculated to have a water absorption index of 7.5 at native pH (3.35). As pH was raised to the isoelectric point, the absorption index decreased significantly. For viscosity assessment, a 50 1/s shear rate was selected for all comparisons. As the pH was elevated to 5.0 an 8% protein solution displayed a decreasing viscosity, ranging from 1000 mPa s to <100 mPa s (pH 5.0). As the ionic strength of the solutions was decreased at a constant pH of 4.0, the viscosity increased from 1.5 mPa s (0.15M NaCl) to 3.5 mPa s (0.05M NaCl).
Significance: Information on derivatized protein interactions with other ingredients common to dairy foods will expedite the development of applications with the novel dairy ingredient, particularly in those foods desiring an all-natural, or all dairy, food label.

Key Words: Whey, Rheology, Stabilizer

T221 Effect of drying methods on the physical and chemical properties of whole milk powder. L. F. Osorio*[1], J. U. McGregor[2], J. S. Godber[3], and N. Y. Farkye[4], [1]*Escuela Agrcola Panamericana, Zamorano, Tegucigalpa, Honduras,* [2]*Food Science and Human Nutrition Dept., Clemson University, Clemson, SC,* [3]*Food Science Dept., LSU Ag Center, Baton Rouge,* [4]*Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.*

The composition and properties of the milk, manufacturing procedures, thermal processing during manufacture, and drying technique are important variables that affect the quality of milk powders. Milk powders are widely used as food ingredients because they provide many functional properties. The objectives of this study were to evaluate the effect of various drying technologies on the physical-chemical stability of whole milk powder (WMP). WMP was manufactured by three different drying technologies: commercial spray; pilot spray and pilot pulse. Samples were evaluated for their physical-chemical characteristics and oxidative stability. Samples were stored at 45°C for 50 days in an incubator to accelerate oxidation. Samples were tested every 10 days for oxidation progress. Commercial spray dried WMP produced significantly less free fat, which suggests more efficient drying in terms of forming complete powder granules. Physical and chemical differences existed when comparing commercial spray drying and pilot spray drying systems. More stable and continuous operating temperatures and air flow of commercial dryers resulted in powders with better color and solubility values. Commercially dried WMP was more stable to oxidation compared to pilot spray dried and pilot pulse dried WMP. The two pilot scale technologies produced close to four times more mg malonaldehyde/kg than commercial spray dried WMP. Our results call into question the practical value of conclusions obtained from WMP research based on the use of pilot scale driers.

Key Words: Whole milk powder, Functional properties, Drying technology

T222 Effect of drying technologies on the microstructure of whole milk powder. L. F. Osorio*[1], J. U. McGregor[2], J. S. Godber[3], and N. Y. Farkye[4], [1]*Escuela Agrcola Panamericana, Zamorano, Tegucigalpa, Honduras,* [2]*Food Science and Human Nutrition Dept., Clemson University, Clemson, SC,* [3]*Food Science Dept., LSU Ag Center, Baton Rouge,* [4]*Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.*

The functional properties of dried milk products are related to the physical structures of the milk powder particles. These particle structures are influenced by the conditions of drying and by the various atomizing systems employed by the drying technologies. Scanning Electron Microscopy (SEM) is an appropriate technique to study the surface morphology as well as the internal structures of the milk powder particles and their relation to functional properties. The objectives of this study were to evaluate the effect of drying technologies on the microstructure of whole milk powder (WMP) manufactured using commercial spray, pilot spray and pilot pulse dryers. Powder samples produced using all three dryer technologies were evaluated using a Hitachi S-3500 N SEM. We were also able to observe hydrated samples of the powder by using variable pressure to simulate an environmental SEM. Pilot spray dried WMP had more broken granules than commercial dried WMP. The granule distribution was less uniform than commercial drying and small granules were entrapped in larger broken granules. Pilot dried powders had a higher free fat content that may have been related to a higher percentage of broken granule particles. Pilot pulse drying produced WMP granules with black indentions on the surface which could be burned crystallized lactose. Granule size varied greatly in the pilot spray dried powders. Pilot pulse dried WMP did not have as many broken granules as pilot spray dried WMP. Pilot pulse dried WMP was expected to have better solubility because of more wrinkled surfaces when compared to spray drying. Our insolubility test did not support this physical characteristic. Spray drying produced large central air vacuoles where as pilot pulse drying produced numerous air vacuoles inside the granule. This may lead to an increase in particle density since less air is present inside the granules. This observation is a potentially important discovery because an increase in the number of oxygen containing vacuoles may cause an increase in the oxygen surface contact area, promoting and accelerating oxidation in pilot pulse dried WMP.

Key Words: Whole milk powder, Microstructure, Drying technologies

T223 Effect of glycomacropeptide and homogenization pressure on particle size and torsional fracture of heat induced whey protein emulsion gels. . R. Suhareli, G. Perez-Hernandez*, and R. L. Richter, *Texas A&M University.*

A mixture for emulsions with 10% protein and 20% butter oil were prepared by dispersing sweet whey protein concentrate (SWPC), acid whey protein concentrate (AWPC), or AWPC + glycomacropeptide (GMP) in distilled water. The mixture was heated to 65°C and homogenized at 20 and 90 MPa. Whey protein emulsions were heated to 90°C for 30 min in a closed water bath to form gels. The addition of GMP to the AWPC emulsion did not cause a reduction ($p>0.05$) in the diameter of the fat globules after homogenization at 20 and 90 MPa. The mean particle size (d_{vs}) in the emulsion made from SWPC homogenized at 90 MPa was lower ($p<0.05$) than the d_{vs} of particles in the emulsion made from AWPC + GMP that was homogenized at 90 MPa. However, the d_{vs} in the emulsion made using SWPC was not different ($p>0.05$) from d_{vs} in the emulsion prepared from AWPC after homogenization at 90 MPa. The differences in particle size attributed to homogenization pressure were not different. Gels made using AWPC and AWPC + GMP had a higher shear stress at fracture (hardness) than gels made using SWPC. The shear stress at fracture of gels made using AWPC and homogenized at 20 MPa was 13.48 kPa and increased to 23.81 kPa when the emulsions were homogenized at 90 MPa. The shear stress at fracture of gels made using the AWPC + GMP emulsion homogenized at 20 MPa was 15.06 kPa and increased to 22.07 kPa when emulsion was homogenized at 90 MPa. The shear stress at fracture for gels containing AWPC + GMP was similar to the shear stress value at fracture for gels made from AWPC. Gels made using SWPC emulsions exhibited a higher shear strain ($p<0.05$)at fracture and had a more rubbery texture than gels made from AWPC and AWPC + GMP which had a lower shear strain at fracture value and a brittle texture.

Key Words: Glycomacropeptide, Whey protein gels, Homogenization pressure

T224 Rheological properties at fracture of thermally induced whey protein with lecithin emulsion gels. . G. Perez-Hernandez*, R. Suhareli, and R. L. Richter, *Texas A&M University, College Station, TX.*

The purpose of this research was to evaluate the effect of the type of lecithin and homogenization pressure on the fractural properties of heat-set, whey protein emulsion gels. Mixtures for emulsions that contained 20% butteroil, 10% protein (WPC 80), and 0% lecithin or 1% deoiled soy lecithin (zwitterionic) or 1% deoiled acetylated lecithin (ionic) were prepared. Mixtures were heated to 65°C and homogenized at 20 and 90

MPa. The emulsions were heated at 90°C for 30 min to form gels. The gels were stored overnight at 4°C and fractural properties were measured in a Hamann torsion gelometer. Emulsions homogenized at 90 MPa exhibited yield stress which indicated that conformational changes of the protein occurred which exposed reactive groups of the proteins. Gels from emulsions homogenized at 90 MPa had higher shear stress at fracture and lower shear strain at fracture compared to gels from emulsions homogenized at 20 MPa. The increased surface area of protein-coated oil droplets and greater availability of reactive groups after homogenization at 90 MPa might have contributed to more intermolecular disulfide bonding during heat treatment. Gels that contained lecithin had lower shear stress and higher shear strain at failure at both homogenization pressures. SDS-Page showed protein displacement from droplets in emulsions with lecithin that were homogenized at 20 MPa but no protein displacement when homogenized at 90 MPa. The type of lecithin did not affect the fractural properties of gels, but zwitterionic lecithin displaced more protein from the lipid surface than did the ionic lecithin. However, this did not completely explain the effect of lecithin on gel strength. Interaction between lecithin with protein at the interface or with protein in the aqueous phase might have been responsible for the rheological changes of the gels.

Key Words: Whey protein gels, High homogenization pressure, Lecithin

T225 Microencapsulated Iron for drink yogurt fortification. H. S. Kwak, J. Ahn, and J. S. Seok, *Sejong University, Seoul, Korea*.

This study was designed to examine the effect of microencapsulated iron fortified drink yogurt and vit C as a bioavailable helper of iron on chemical and sensory aspects during 20 d storage. Coating material was PGMS, and ferric ammonium sulfate and vit C were selected as core materials. The highest efficiency of microencapsulation of iron and vit C were 73% and 76%, respectively, with 5:1:50 ratio (w/w/v) as coating to core material to distilled water. Iron fortification did not affect to the fermentation time required for the drink yogurt to reach pH 4.2. The addition of uncapsulated iron decreased the pH during storage. TBA absorbance was significantly lower in capsulated treatments than those in uncapsulated treatments during storage. In sensory aspect, the yogurt sample added with uncapsulated iron and vit C, regardless of capsulation, showed a significantly high score of astringency, compared with those of control and other groups. A significantly strong sourness was observed in treatment containing capsulated iron and uncapsulated vit C at every time intervals. The present study provides evidence that microencapsulation of iron with PGMS is effective for iron fortification in drink yogurt.

Key Words: Iron fortification, Microencapsulation, Yogurt

T226 Impact of flax oil emulsion composition on the oxidative stability of omega-3 enriched milk beverages. S. Lamothe*[1], G. Trudeau[2], and M. Britten[1], [1]*FRDC, Agriculture and Agri-Food Canada, St-Hyacinthe, Qc, Canada,* [2]*Agropur, Granby, Qc, Canada*.

Milk enriched with flax oil could provide consumers with a means to meet the recommended daily intake of omega-3 fatty acids without changing eating habits. However, flax oil is extremely susceptible to oxidation. Pre-homogenization of flax oil in controlled conditions is proposed to slow down oxidation reactions. The objective of this study was to evaluate the oxidative stability of milk enriched with milk proteins-stabilized emulsions prepared from flax oil and butter oil. Emulsions (10% fat) were prepared in milk UF-permeate with pure flax oil, pure butter oil or a 25:75 (w/w) mixture of flax and butter oils. Homogenization was performed at 2000 psi with sodium caseinate (NaCas) or whey protein isolate (WPI) (1% protein) used as stabilizer. Fat concentration in skimmed milk was increased to 1% either with the mixed emulsion (method A) or a mixture of pure emulsions (method B) to reach 0.25% flax oil in the product. Milk samples were exposed to light and peroxide value (PV) and thiobarbituric acid reactive substances (TBARS) were monitored over a 40-hour period. The method used to enrich milk had a significant effect on light-induced oxidation ($p<0.01$). After the exposition period, PV and TBARS concentration in milks prepared according to method A averaged 45 mmole/kg and 4.8 μmole/L respectively. Oxidation of milk enriched according to method B, was more important with average PV and TBARS values of 91 mmole/kg and 8.0 μmole/L. The type of protein used to prepare flax oil emulsions had a strong influence on light-induced milk oxidation ($p<0.05$). Milk enriched with WPI-based emulsions showed PV and TBARS concentration significantly lower than milk enriched with emulsions made from NaCas. The results presented in this study demonstrated that the addition of butter oil to flax oil before homogenization resulted in an increased oxidative stability of enriched milks. High concentration of cysteine in WPI could also contribute to oxidation protection.

Key Words: Omega-3, Fluid milk, Oxidation

T227 Rheological Properties of Concentrated Skim Milk: influence of Heat Treatment and Genetic Variants on the Changes in Viscosity During Storage. A Bienvenue[1], H Singh[2], and R Jimenez-Flores*[1], [1]*Cal Poly Dairy Products Technology Center,* [2]*Massey University, New Zealand*.

Rheological properties of concentrated skim milks, with a total solids content of 45%, made from skim milk with defined genetic variants of β-lactoglobulin were studied as a function of shear rate and storage time at 50 °C. The effects of heat treatment of skim milk at 90 °C for 10 min prior to evaporation on apparent viscosity were also determined. All samples showed a decreasing apparent viscosity with increasing shear rate, with the presence of a yield stress. During storage of the concentrated milk, the apparent viscosity and yield values increased markedly, and that the age-dependent increase in viscosity in concentrated milks prepared from heat-treated skim milk was much more pronounced than those prepared from unheated skim milk. The increase in apparent viscosity and yield value with storage time was notably different for milks containing different genetic variants. Unheated concentrated milks containing the B variant of β-lactoglobulin showed most rapid increase in apparent viscosity with storage time while the viscosity increase was slowest in the concentrate containing the A variant. By contrast, heat-treated concentrated milks containing the A variant of β-lactoglobulin showed most rapid increase in viscosity with storage time while the viscosity increase was slowest in the concentrate containing the AB variant. The changes in apparent viscosity of concentrated milk were largely reversible under high shear during the early stages of storage, but samples stored for long time showed irreversible changes in apparent viscosity. Particle size analysis confirmed irreversible aggregation and fusion of casein particles during storage.

Key Words: Concentrated milk, Genetic variants, Rheology

T228 Effect of pore size and temperature on the fractionation of buttermilk using microfiltration. P. Morin*[1], R. Jimenez-Flores[2], and Y. Pouliot[1], [1]*Centre de recherche STELA, Universite Laval, Quebec, Canada,* [2]*Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.*.

Buttermilk is a unique dairy source of milk fat globule membrane (MFGM) lipids such as phospholipids and sphingolipids that have been recognized for their functional and nutraceutical properties. MFGM lipids can be isolated by solvent extraction but this approach is not suitable for dairy processing plants. Membrane processing such as crossflow microfiltration can be the first step to selectively concentrate buttermilk lipids which could be used to create novel functional ingredients. The use of microfiltration (MF) for the separation of MFGM lipids in buttermilk is restricted by the presence of caseins and whey proteins. A better knowledge of factors improving protein and lipid separation in buttermilk microfiltration is needed. Crossflow MF with 3 pore size (1.4 μm, 0.8 μm, 0.1 μm) and 3 temperatures (50°C, 25°C, 7°C) was carried out on fresh or reconstituted buttermilk. Transmission of lipids through the membrane was significantly ($p\leq0.05$) lower with the 0.1 μm membrane compared to the 0.8 and 1.4 μm membranes. However, retention level of proteins was the highest (78.3 %) using the 0.1 μm membrane and the lowest level was obtained using the 0.8 μm membrane (38.5 %). Temperatures tested did not induce significant ($p\geq0.05$) differences in protein transmission level and lower fat transmissions were observed at 25°C. Temperature increases had an important positive effect on permeation fluxes. Superior fat retention was also noticed using fresh buttermilk by opposition to reconstituted buttermilk. Phospholipids analysis

showed relative transmission of all main species of phospholipids found in buttermilk (phosphatidylethanolamine, phosphatidylcholine and sphingomyelin) at every combination of pore size, temperature and buttermilk type.

Key Words: Buttermilk, Microfiltration, Phospholipids

T229 Microbiological effects of pressurization with carbon dioxide on raw milk. M. Rajagopal*, J. H. Hotchkiss, and B. G. Werner, *Northeast Dairy Foods Research Center, Ithaca, NY/ USA*.

Addition of carbon dioxide at low pressures to raw milk was investigated as a non-thermal method to improve the keeping quality of raw milk. Our objective was to determine the effect of carbon dioxide on the indigenous microorganisms in raw milk. Raw milk was treated with carbon dioxide pressures between 68kPa and 689kPa and temperatures 20°C, 10°C and 6.1°C for 1 and 4 days. Survivor curves were expressed as $\log_{10}$(survivors) vs. time. Milk treated with 68kPa CO2 and held at 10°C demonstrated a lower growth rate compared to the untreated control. Higher pressures resulted in a reduction in numbers of survivors compared to initial counts. Treatment at 689kPa and 6.1°C resulted in an inactivation of approximately 1 log cycle after 4 days, while the untreated control increased by 2 log cycles. Enumerating for gram-negative bacteria and *Lactobacillus* sp. in the treated milk, treated to 6.1°C for 4 days did not show changes in proportions of these groups at all pressures. These data indicate that holding milk at low carbon dioxide pressures inactivates indigenous microorganisms in milk and may be a strategy for holding/shipping raw milk.

Key Words: Shelf life, Carbon dioxide, Milk

T230 Observation of bacterial exopolysaccharide in dairy products using cryo-scanning electron microscopy. A. Hassan*[1], J. Frank[1], and M. Elsoda[2], [1]*The University of Georgia, USA,* [2]*Alexandria University, Egypt*.

Cryo-scanning electron microscopy was used to visualize the microstructure of two types of cheese (karish and feta) and milk fermented with different ropy and nonropy strains of lactic acid bacteria. Specimen frozen in liquid nitrogen slush were transferred in a frozen state and under vacuum into the preparation chamber where they were fractured, etched and coated with gold. Specimen were then transferred under vacuum onto the cold stage and imaged using scanning electron microscopy. Milk fat and exopolysaccharide (EPS) were visible in pores within the protein network. Cheese and fermented milk made with EPS-producing cultures exhibited a porous structure in which the largest pores were associated with visible EPS. A compact structure with small pores was seen in cheese and milk fermented with EPS non-producing cultures. Exopolysaccharide and protein appeared to be segregated in both cheese and fermented milk. Exopolysaccharide formed a network-like structure. Differences were observed in the microstructure of EPS between moderately ropy and highly ropy strains. A relatively long etching (sublimation) time caused EPS to appear as thin filaments similar to those seen with conventional scanning electron microscopy.

Key Words: Cryo-scanning electron microscopy, Exopolysaccharide, Fermented dairy products

T231 Fat-level dependent impact of selected flavor volatiles on strawberry-flavored ice creams. S. T. Loeb*[1], I. U. Gruen[1], H. Heymann[2], K. Adhikari[1], L. N. Fernando[1], and R. D. Linhardt[1], [1]*University of Missouri, Columbia,* [2]*University of California, Davis*.

Consumer demand for healthier foods has led to an increase in development of reduced fat food products. Because many reduced fat products are not well accepted due to their overall flavor and texture profiles, it is necessary to study flavor-food interactions in order to produce more appealing low-fat and no-fat products.
The objective of this study was to determine the effect of full fat (10%) and low fat (4%) ice cream on the overall flavor and odor profile of selected artificial strawberry flavor components.
Ice creams with 4 and 10% fat levels were flavored with an artificial strawberry flavor composed of five components (*cis* 3-hexen-1-ol, ethyl-3-methyl-3-phenylglycidate, furaneol, γ-undecalactone, α-ionone). To determine the effect of fat on the individual flavor components, each of the five components were individually spiked at 200% of the base level to the flavored ice cream mixes before freezing. The spiked and control ice creams were then analyzed using generic descriptive analysis by a panel of 11 trained judges.
The attributes were grouped under appearance, flavor (aroma and taste), mouthfeel and aftertaste. All the 10% ice creams were perceived to have a flavor high in ethyl-3-methyl-3-phenylglycidate (candy-like), furaneol (cooked sugar), sweetness, creaminess, condensed milk and milk. The mouth feel was creamier, smoother and it imparted a greater mouth-coating impression. The 4% ice creams seemed to be impacted more by, iciness, *cis* 3-hexen-1-ol (leaf-like), γ-undecalactone (peach), and α-ionone (violet/woody).
The results indicate faster release of phenylglycidate and furaneol in 10% fat ice creams while in 4% fat ice creams the release was faster for hexenol, undecalactone and ionone. It can be concluded that fat level affects the perception of flavor compounds differently depending on factors such as hydrophobicity and interactions with lipids and proteins.

Key Words: Ice cream, Strawberry flavor, Descriptive analysis

T232 Microencapsulation of vitamin C and it's effect on iron bioavailability in iron fortified milk. H. S. Kwak, J. B. Lee, and Y. J. Lee, *Sejong University, Seoul, Korea*.

This study was carried out to investigate the fortification of vitamin C into milk by means of microencapsulation technique. The TBA value, sensory attributes, stability and bioavailability of iron microcapsules in milk during storage were measured. Coating materials used were polyglycerol monostearate (PGMS) and medium-chain triacylglycerol (MCT), and core materials were L-ascorbic acid and ferric ammonium sulfate. The yield of microencapsulated vitamin C was 95 % with MCT and was 94 % with PGMS when the ratio of coating material to core materials were 15 : 1, 5 : 1, respectively. The rate of vitamin C release was 4–9% when stored at 4° for 30 days, and temperature lower than 20° did not affect adversely vitamin C release in the milk during the storage. The TBA value was significantly lower in microencapsulated than those in uncapsulated vitamin C during storage. In sensory evaluation, the degree of sourness and off-taste were slight and total acceptability was moderate in 10mg vitamin C microencapsule -fortified milk at 8 day storage. In vitro study, microcapsules of vitamin C in simulated gastric fluid with the range of 2 to 5 pHs were released 4.7–13.2%, however, the capsules in simulated intestinal fluid with pH 8 were released 94.0% during 40 min incubation time. In the bioavailability of iron in vivo, transferrin saturation value of microencapsulated vitamin C and iron was two and half times higher than that of uncapsulated. In conclusion, this study provided that MCT and PGMS as coating materials were suitable for the microencapsulation of vitamin C and the microcapsules were effective on the bioavailability of fortified iron in milk.

Key Words: Vitamin C and Iron, Microencapsulation, Milk

T233 Effect of light exposure on flavor and oxidative stability of milk fortified with alpha-tocopherol and ascorbic acid. M. van Aardt*[1], S. E. Duncan[1], T. E. Long[2], S. F. O'Keefe[1], J. E. Marcy[1], and S. R. Nielsen-Sims[3], [1]*Food Science and Technology, Virginia Tech,* [2]*Chemistry, Virginia Tech,* [3]*Eastman Chemical Co*.

The effectiveness of added antioxidants against oxidation off-flavor development in light-exposed milk was evaluated using sensory and gas chromatographic analysis. Sensory similarity testing showed no perceivable difference between control milk and milk with added (i) α-tocopherol (0.05%) and (ii) α-tocopherol (0.025%) and ascorbic acid (0.025%), but did show a difference when adding ascorbic acid alone (0.05 %) (n = 30, $\beta = 0.05$, $\alpha = 0.30$). Subsequently, sensory difference testing showed a significant difference in oxidation off-flavor between light-exposed control milk and light-exposed milk with added α-tocopherol (0.025%) and ascorbic acid (0.025%), while addition of α-tocopherol (0.05%) alone showed no significant difference (n = 24, $\beta = 0.40$, $\alpha = 0.05$). Gas chromatographic analysis verified chemically the extent of oxidation for various antioxidant treatments. Since pentanal is a common light-oxidation by-product, its concentration was monitored over the 10 h period of light exposure. The controlled release of various natural and synthetic antioxidants from biodegradable polymer films

into model solutions (water, and Miglyol 812) was also evaluated as an alternative method of antioxidant addition.

Key Words: Natural antioxidants, Milk, Oxidation

T234 The storage stability of IGF-I fortified dairy products and its improvement by microencapsulation. S. H. Kang*[1], J. W. Kim[2], J. Y. Imm[3], S. J. Oh[4], and S. H. Kim[2], [1]*Seoul Dairy Cooperatives,* [2]*Korea University, Division of Food Science,* [3]*Kookmin University, Dept. Food & Nutrition,* [4]*Korea Yakult Co. Lt.*

The objectives of this study were to examine the stability of IGF-I fortified dairy products during storage and to suggest a process to improve storage stability. Powdered colostrum whey was used as a source of crude IGF-I and fortified to fresh milk, dried milk powder and yogurt at the level of 200 ng/ mL. The changes of IGF-I content in the fortified dairy products during storage were determined by radioimmunoassay using 125I at typical storage conditions. As a way to improve storage stability, IGF-I was encapsulated by surface reforming process (hybridization) using enteric coating materials (Sureteric and Eudragit L100-55) and the changes of IGF-I content were monitored. The IGF-I content in the fortified milk and dried powder was maintained during the tested periods (12 days for milk, 4 weeks for dried powder) but significant decrease ($p < 0.05$) was found during the storage of yoghurt for 3 wks. When the Powdered colostrum whey was coated with enteric wall materials before fortification, the IGF-I content in fortified yogurt was maintained during fermentation and no significant differences was found. Therefore, the enteric coating of IGF-I prior to fermentation can be used as an effective way to prevent degradation of IGF-I during fermentation.

Key Words: IGF-I, Storage, Enteric coating materials

T235 Use of chemical mutagenesis approach and spiral-sheet bioreactor for the production of lactose free milk. S. A. Ibrahim*[1], M. M. Salameh[1], G. Shahbazi[1], R. R. Shaker[2], and V. Shirley[1], [1]*North Carolina A&T State University,* [2]*Jordan University of Science and Technology.*

Lactose intolerance is the inability to digest milk sugar, lactose, causing gastrointestinal symptoms of flatulence, bloating, cramps and diarrhea in some individuals. About 75% of the world's population and approximately 90% of black Americans have some difficulty digesting lactose. Commercial lactase products are not usually the best choice for lactose intolerance, because even when these treatments provide relief they often produce other digestive tract distress symptoms. The purpose of this research was to develop a procedure that can reduce lactose content in milk. In this research, chemical mutagenesis was used to produce a cold resistant, over producing mutant of lactic acid bacteria that hydrolyze lactose to glucose at refrigerated temperature. *Lactobacillus helveticus* was tested by a single exposure to two chemical mutagens, ethyl methanesulfonate (EMS) and N-methyl-N'-nitro-N-nitrosoguanidine (MNNG). To screen for β-galactosidase (β-gal) overproducing mutants, optimized EMS and MNNG mutant pots for *L. helveticus* were plated on BHI agar containing 5-bromo-4-chloro-3-indolyl-β-D-galactopyranoside (X-gal). Colonies that exhibited a blue color were selected for quantitative β-gal activities using the o-nitrophenyl-β-galactoside (ONPG) assay. Three mutants were obtained that exceeded the wild strain β-galactosidase activity levels (70 vs. between 80 and 320 Miller units, respectively). Mutants were then immobilized on a spiral-sheet bioreactor for continuous conversion of lactose into glucose at 4 C. Approximately 65% of lactose was converted into glucose. This technology has the potential for helping dairy farmers increase the market for dairy foods, address public health concerns and enhance the nutritional quality and safety of dairy foods.

Key Words: *Lactobacillus helveticus*, Lactose free milk

T236 Milk protein composition and its role in the phase separation phenomenon in soft-serve ice cream. C. Vega* and D. Goff, *University of Guelph, Guelph, ON, Canada.*

Incompatibility between milk proteins (especially casein) and polysaccharide stabilizers, such as Locust Bean Gum (LBG), renders a characteristic phase separation phenomenon in soft serve ice cream mixes subject to long storage periods. The inclusion of k-carrageenan in levels above 0.015% is effective in avoiding such event, but the mechanism is not well understood. An study of the composition of the milk protein revealed that casein micelles seem to be necessary to allow k-carrageenan to be functional. The use of sodium caseinate (NaCas) instead of skim milk powder (SMP) at a constant protein content and casein:whey protein ratio, at equal polysaccharide (LBG, k-carrageenan) concentrations, showed that the SMP system is more stable against separation. This suggests that k-carrageenan interacts with k-casein and, since the latter is still attached to the casein micelle in SMP and not in NaCas, it is possible for the stabilizer to better "hold" the SMP mix from wheying-off. Analysis of different whey to casein ratios (at constant protein concentration) have shown that as casein proportion diminishes (from 70 to 10%), the polydispersity and instability of the mix decreases. This suggests that casein induces polydispersity, which in turn manifests as instability during storage. This finding is consistent with the fact that as emulsifier (polmo) content is decreased (from 0.3 to 0%), the proportion of casein adsorbed by the fat globule increases, leaving less amount of protein exposed in solution to interact with LBG, hence less separation. This event occurs at constant k-carrageenan concentration leading to the conclusion that, as the proportion of this stabilizer versus casein increases, it becomes more efficient.

Key Words: Carrageenan, Ice cream, Casein

T237 Optimization of Solid Phase Microextraction(SPME) for the analysis of volatile compounds in milk. H. Clarkson*, S. Duncan, and S. O'Keefe, *Virginia Polytechnic Institute and State University, Blacksburg, VA.*

Solid Phase Microextraction (SPME) is a relatively new technique for analysis of volatile compounds. The sensitivity of milk compounds to light wavelengths and impact on odor and flavor needs further study. Several carbonyl compounds, including ketones, aldehydes, acids and dimethyl sulfide, contribute to the odors and off-flavors produced in milk due to light exposure. Application of SPME to this purpose requires additional knowledge of methodology variability. Water and milk were spiked with 1-hexen-3-one, dimethyl sulfide, pentanal and butyric acid as representative compounds. Volatiles were trapped by SPME, condensed by cryofocusing, and quantified by gas chromatography. Equilibration time (12, 17, 22, 32, and 37 minutes) and SPME fibers (PDMS, PDMS/DVB, Car/PDMS) were compared for optimum detection of compounds in headspace of water and milk. Equilibration was optimized at 22 minutes for water using the CAR/PDMS fiber. Intra-variability was 7% for pentanal in water, as a representaative compound. Inter-variability was as high as 15% for compounds in water. Variation in detection of representative compounds was found for milk among the SPME fibers.

Key Words: SPME, Milk, Volatiles

ABSTRACTS
POSTERS, Wednesday, June 25, 2003

*** Author Presenting Paper**

Physiology: Metabolism, growth, and stress

W1 Identification and initial characterization of the adipocyte hormone adiponectin in Holstein bull calves. R. C. Cheatham*[1], P. C. Gentry[1], G. C. Duff[1], and R. J. Collier[1], [1]*University of Arizona*.

The importance of adipose as a secretory organ has become apparent in recent years. Adipose tissue plays an important regulatory role in energy metabolism and nutrient partitioning. Adiponectin, a hormone exclusively secreted by differentiated adipocytes, promotes fatty acid utilization by liver and skeletal muscle and reduces plasma glucose without influencing insulin or glucagon concentrations in mice. To date, adiponectin has only been identified in humans and rodents. The objective of our study was to determine if adiponectin is expressed in bovine adipose and to characterize its expression in growing calves. An 880 bp adiponectin cDNA was created by RT-PCR of bovine adipose total cellular RNA and verified by sequence analysis. The resulting PCR product indicated 93% and 95% sequence identity with mouse and human adiponectin, respectively. Adiponectin expression was characterized in abdominal adipose tissue collected from Holstein bull calves sacrificed at 4 d (n=3), 4 wk (n=6) and 12 wk (n=5) of age. All calves were fed colostrum for at least three feedings, then fed a commercial milk replacer. Beginning on d 12, calves were offered a corn-based starter feed free choice. At slaughter, tissues were collected and snap frozen in liquid nitrogen, then stored at -80C until RNA was isolated. Adiponectin mRNA was detected on all days, indicating a likely role for this hormone in both preruminant and ruminant animals. As in other species, adiponectin appears to be adipose-specific. Adiponectin was not detected in muscle, liver or pooled RNA representing all regions of the bovine digestive tract. Amplification of the housekeeping gene G3PDH positive control verified integrity of the template and PCR reaction. Experiments to assess adiponectin expression in adult animals under different dietary conditions are underway, as is further work characterizing adiponectin in growing calves.

Key Words: Adiponectin, Adipose, Calves

W2 Effect of physiological state and somatotropin on the response to lipolytic and antilipolytic signalling in ovine adipose tissue. M. H. Carvalho, E. F. Delgado, D.P.D. Lanna, R. Machado Neto, and I. Susin, *Universidade de Sao, Piracicaba SP/Brazil*.

Bovine somatotropin (bST) treatment in vivo alters adipose tissue metabolism by enhancing lipolytic response to adrenergic agonists. We examined the impact of bST and lactation on basal and stimulated lipolytic rates with isoproterenol (ISO; 10^{-5}nM), adenosine deaminase (ADA; 0.75 U/mL), ISO plus ADA in short-term (2h) incubations of ovine adipose tissue. The anti-lipolytic effect of phenylisopropyladenosine (PIA; non-hydrolyzable adenosine analog) was evaluated at various concentrations (0.5, 1.5, 3, 100 nM). Sixteen lactating Santa Ines ewes were randomly assigned to two groups. They received two s.c. injections, with a 14 day interval, starting at d 13 postpartum with either bST (160 mg) or Vitamin E (control). Eight similar nonlactating ewes received vitamin E. Omental adipose tissue biopsies were taken on d 8 after the second bST or vitamin injection. The lipolytic rate was determined by NEFA release in media as μEq of oleic acid.$2h^{-1}g^{-1}$ tissue. Basal lipolytic rates did not change with lactation or with bST treatment in vivo (P>0,05). ISO stimulated lipolytic rate increased compared to basal and was higher for the adipose tissue from lactating ewes treated with bST (P<0,05). The lipolytic rate for adipose incubated with ADA was higher than basal for lactating ewes, with the greater response for the control. Maximum lipolytic rate with ISO+ADA was also higher for lactating ewes treated with bST (P<0.01), and there was no difference between lactating and nonlactating ewes. The PIA effects were evaluated by the inhibition of ISO+ADA lipolysis, and adipose tissue from lactating ewes treated with bST showed a reduced response to PIA. The results demonstrate that in vivo somatotropin treatment increases maximal lipolytic rates and decreases the antilipolytic effect of PIA in omental adipose tissue in ewes.

Key Words: Somatotropin, Adenosine, Lipolysis

W3 Feeding Holstein cows anionic and cationic diets prepartum coupled with short dry periods and bST. M. S. Gulay*, M. J. Hayen, and H. H. Head, *University of Florida, Department of Animal Sciences*.

Eighty-four Holstein cows were used to evaluate effects of prepartum anionic (-10 to -15 mEq/100g DM) or cationic (+20 mEq/100g DM) diets with low K (1.14 % of DM) on prepartum and postpartum DMI, BW and BCS, and subsequent MY. Treatments were in a 3x2x2 factorial arrangement that included dry period (30 d dry, 30 d dry+ECP, and 60 d dry), diet, and prepartum and postpartum bST (POSILAC®,10.2 mg/d). No interactions of bST or dry period length with prepartum diet were detected for any measure. No significant effects of prepartum diet on prepartum DMI, BW or BCS were observed. During the postpartum period (wk 1 through 14), no differences in mean BW or BCS were detected between prepartum diets fed. Decreases in BW and BCS were seen during the first 6 wk postpartum. Mean DMI during the first 28 d postpartum were similar for cows fed anionic and cationic diets prepartum (25.5 kg/d and 26.1 kg/d, respectively). No differences due to prepartum diet were observed for mean milk or 3.5 % FCM yields or for milk composition during the first 10 wk of lactation. Similarly, mean MY of cows during the first 21 wk did not differ significantly due to prepartum diet fed (anionic diet=38.6 kg/d vs cationic diet=38.5 kg/d). Feeding the anionic diet did not significantly improve either prepartum or postpartum concentrations of Ca. Cows fed the prepartum anionic and cationic diets had similar mean serum concentrations of Ca (9.35 mg/dL vs. 9.34 mg/dL), and only 8 cows fed each diet had serum concentrations of Ca less than 7 mg/dL the day following calving. No cases of clinical hypocalcemia were observed irrespective of diet fed. In conclusion, it appears that cationic diet with low K during prepartum period did not cause detrimental effects on DMI, BW or BCS changes, MY or health problems before or after calving.

Key Words: Anionic-cationic, Milk yield, Transition period

W4 Milk production of dairy cows injected with low dose of bovine somatotropin (bST) during the transition period and lactation. M. Liboni*, M. S. Gulay, T. I. Belloso, M. J. Hayen, and H. H. Head, *Department of Animal Sciences - University of Florida*.

Objective was to evaluate effects of injecting a low dose of bST (0.4 mL, 10.2 mg/d, POSILAC®) during prepartum and/or postpartum periods on milk yield (MY) and composition, BW and BCS. Multiparous Holstein cows were assigned randomly to a 2x2 factorial arrangement of treatments (TRT) to give four groups (1=no bST, n=26; 2= bST postpartum, n=25; 3=bST prepartum, n=27; 4=bST prepartum and postpartum, n=25). Bi-weekly injections of bST were in left or right ischiorectal fossa and began 3 wk before expected calving date and continued through 70 DIM; beyond 70 DIM all cows were injected biweekly with POSILAC®(500 mg/14 d). Significant effects of bST ($P<0.0579$) were detected on mean daily MY through 70 DIM; means for the four TRT groups were 33.93, 36.48, 37.76 and 40.33 kg/d, respectively; all TRT means differed ($P\leq0.063$) except for 2 vs. 3. No effects of calving season (SEA) were detected on MY (P=0.6656), nor TRT or SEA effects on BW (P=0.2817 and P=0.4297) or BCS (P=0.4315 and P=0.5158). Mean BW and BCS for the four TRT groups were 659.1 and 3.14, 659.6 and 3.00, 659.5 and 3.10, 680.4 and 3.16, respectively. No effects of bST were detected on percentages of milk fat (P=0.8825) or protein (P=0.5336); mean percentages for TRT groups during first 70 DIM were 3.82 and 2.99, 3.78 and 2.95, 3.85 and 2.88, 3.72 and 2.91, respectively. No significant effects of TRT were detected on somatic cell count (SCC, P=0.5333); TRT means were 540, 608, 326 and 576 x 103 cells/mL milk. During 70-150 DIM, when all cows were injected with full dose of POSILAC®, increases in MY still were detected but magnitude of effects were reduced to about one-half of previous differences. Means for the four TRT groups were 36.97, 38.08, 39.61 and 40.63 kg/d, respectively. We concluded that injecting bST during prepartum and/or postpartum periods increased MY without adverse effects on milk composition or on health and differences were not lost completely during later lactation.

Key Words: Milk Yield, Dairy cow transition period, bST

W5 Use of bST in transition diary cows: Effects on dry matter intake, body weight, BCS and milk yields. M. S. Gulay*, M. J. Hayen, T. I. Belloso, M. Liboni, and H. H. Head, *University of Florida*.

Objective was to determine whether injections of bST during transition period improved DMI, BW, BCS and MY. Eighty four multiparous Holstein cows were assigned to a 3x2x2 factorial design that included prepartum and postpartum bST, dry period (30 d dry, 30 d dry+ECP, and 60 d dry), and prepartum anionic or cationic diet. Biweekly injections of bST began ±21 d (±3 d) before expected calving date and through 42 d (±2 d) postpartum (C, n=42 vs I, n=42; 0 vs 10.2 mg bST/d, POSILAC®). At 56 d (±2 d), cows in both groups were injected with 500 mg bST/14 d. No interactions of dry period length or prepartum diet with bST treatment were detected for any measure. No significant effects of prepartum diet fed or dry period length were observed for DMI, BW, BCS, or MY. During the prepartum period no differences were detected between treatment groups for mean BW (C=688 vs I=682 kg) or BCS (C=3.38 vs I=3.42). Birth weights of calves did not differ between groups (C=38.3 vs I=36.5 kg). Mean BW (C=688 vs I=682 kg) and BCS (C=688 vs I=682 kg) were not affected by treatment during postpartum period. bST did not affect mean DMI during prepartum (C=16.1 vs I=16.9 kg/d) or first 28 d postpartum (C=25.7 vs I=25.9 kg/d). Mean energy status of cows during the first 4 wk postpartum was negative and did not differ between groups (C=-18.25 vs I=-16.07 Mcal/d). During first 10 wk bST-injected cows had greater mean milk, 3.5 % FCM, and SCM yields (39.6 kg/d, 42.1 kg/d and 40.5 kg/d, respectively) than non-injected cows (36.7 kg/d, 38.9 kg/d and 37.5 kg/d, respectively). No differences were observed in percentages of protein (2.86 vs 2.87%) or fat (3.93% vs 3.96 %) due to bST, but non-injected cows had greater SCC than bST- injected during the first 10 wk of lactation (527 vs 323x103). When both injected and non-injected cows received a full dose of bST at d 60 the increase in milk production was maintained better through 21 wk in the bST-injected cows (C=37.5 vs I=40.5 kg/d; $P<0.03$). No prepartum or postpartum health problems or apparent calving problems were associated with bST.

Key Words: Transition cows, bST, Milk yield

W6 Effect of low dose of bovine somatotropin (bST) on hormone, IGF-I and metabolite concentrations during the transition period. M. S. Gulay*, M. J. Hayen, and H. H. Head, *University of Florida* .

Experiment was designed to evaluate concentrations of hormones (ST and INS), growth factor (IGF-I), metabolites (glucose and NEFA) and Ca in plasma of 80 Holstein cows injected biweekly with bST during the transition period (C, n=41 vs. I, n=39; 0 vs 10.2 mg bST/d, POSILAC®). Biweekly injections of bST were started prepartum 21 d (±3 d) before expected calving date and through 42 d (±2 d) postpartum. No differences were detected for mean concentrations of glucose (I=70.6 vs C=69.3 mg/dL) or NEFA (I=265.0 vs C=273.5 μEq/L) between bST treatment groups during the overall prepartum period (d -21 to d -1), but ST (I=8.19 vs C=5.51 ng/mL; $P<0.01$), IGF-I (I=318.7 vs C=235.2 ng/mL; $P<0.01$), and INS (I=0.85 vs C=1.06 ng/ml; $P<0.02$) did differ during prepartum period. No differences were detected for mean concentrations of INS (C=0.62 vs I=0.58 ng/mL), glucose (C=61.9 vs I=62.1 mg/dL or NEFA (C=584.3 vs I=634.2 μEq/L) due to bST treatment during the overall postpartum period (d 1 to 28). Cows in non-bST group had lower mean concentrations of ST in plasma (5.52 ng/mL) than cows in bST-injected group (10.33 ng/mL; $P<0.01$). Mean concentrations of IGF-I during the overall postpartum period also were greater for the bST treated group (I=150.2 vs C=117.4 ng/mL; $P<0.01$) and they were maintained greater (+27.9%) than non-bST group throughout the early postpartum period. Concentrations of Ca during the 2 wk before through 2 wk after calving did not differ significantly due to treatment (I=9.28 vs C= 9.41mg/dL). Although serum Ca concentrations were least the day following calving, only 16 of the 80 cows had concentrations of Ca less then 7 mg/dL at that time (I=5 and C=11 cows). Changes in concentrations of metabolic hormones, IGF-I and blood metabolites due to injections of 10.2 mg bST/d during transition period likely improve metabolic status of the cows during early lactation without causing calving or health problems prepartum or postpartum.

Key Words: bST, Hormones, Transition period

W7 Nutritional modulation of hepatic growth hormone responsiveness in late-lactating dairy cows. R. P. Rhoads*[1], L. H. Baumgard[2], M. E. Van Amburgh[1], and Y. R. Boisclair[1], [1]*Cornell University, Ithaca, NY,* [2]*University of Arizona, Tucson, AZ.*

The ability of recombinant bovine somatotropin (rbST) to enhance milk yield is compromised during periods of undernutrition, such as the period immediately following parturition. This has been attributed, in part, to decreased growth hormone (GH) dependent production of IGF-I in liver. Our goal was to develop a chronic animal model to study the basis of this impairment. Six non-pregnant, late-lactating dairy cows were subjected to two 14 d periods when they were offered a high or low plane of nutrition. The high plane of nutrition provided 120% of predicted energy requirements whereas the low plane provided only 33% of maintenance requirements. During each feeding period, excipient or rbST (40 mg IM, daily) was administered in a single reversal design with 4-d periods separated by a 2-d interval. Blood samples and liver biopsies were obtained on the fourth day of excipient or rbST treatment. The shift from the high to the low plane of nutrition resulted in lower plasma IGF-I (157 vs 69 ng/ml, $p<0.01$) even though the plasma concentration of GH increased (5.9 vs 9.8 ng/ml, $p<0.01$). The plasma concentration of insulin was also reduced by underfeeding. More importantly, administration of rbST increased the plasma concentration of IGF-I to a greater extent during the high plane of nutrition (104 vs 210 ng/ml, $p<0.01$) than during the low plane of nutrition (57 vs 81 ng/ml, $p<0.01$), suggesting impaired hepatic GH responsiveness. Surprisingly, rbST caused similar increases in IGF-I gene expression in liver at both feeding levels. We conclude that in late-lactating dairy cows, a severe nutritional insult is not sufficient to completely block GH-dependent IGF-I synthesis.

Key Words: GH resistance, Liver, IGF-I

W8 Mammary gene expression analysis in peripartal dairy cows using a bovine cDNA microarray. J. J. Loor*, J. K. Drackley, H. M. Dann, R. E. Everts, S. L. Rodriguez-Zas, and H. A. Lewin, *University of Illinois, Urbana, IL.*

We used cDNA microarray technology to study mammary gene expression in dairy cows. Mammary tissue was collected by percutaneous biopsy at -14, +1, and +14 d relative to parturition from 2 multiparous Holstein cows fed according to current NRC recommendations throughout the dry period and the first 49 d postpartum. A microarray consisting of 7,872 cDNA inserts was constructed from a collection of clones selected from placenta and spleen cDNA libraries. Annotation was based on similarity searches using BLASTN and TBLASTX against the human and mouse UniGene databases. A total of 6,626 sequences (84%) have significant similarity to human or mouse genes and could be assigned as putative orthologs. Gene Ontology terms were annotated to the sequences and putative functions assigned. Cy3- and Cy5-labelled cDNA from tissue and a universal control sample (derived from a mixture of cattle tissues not including liver or mammary tissue) were used for hybridization. Three exogenous plant genes were used as spiking controls for data normalization. A parametric test using the cross-gene error model with log-transformed ratios in GeneSpring was used. Preliminary data analysis demonstrated clear increases over time in the expression (fold-change expressed as tissue/universal control) of genes with known or unknown functions associated with metabolism that accompanies copious milk synthesis. Large fold-changes in mRNA expression were detected between -14 and +14 d for *stearoyl-CoA desaturase*, *xanthine dehydrogenase*, *fatty acid binding proteins-3* and *-5*, *fatty acyl-CoA ligase-2*, *transport proteins* (ABCG2, ABCA1, TAP1), GLUT1, IGFBP3, *Lipin-1*, SPP1, kinases (*Janus*, *pyruvate dehydrogenase-4*, *myosin light-chain*), PPAR-γ, *aminoacyl tRNA synthases*, *leucine aminopeptidase*, and *β-1,4 galactosyl transferase*. Expression of *immunoglobulin lambda* and *kappa* mRNA also was markedly upregulated by d 14 postpartum. Results demonstrate the power of microarrays to study patterns of gene expression in the bovine mammary gland.

Key Words: Microarray, Mammary gland, Dairy cow

W9 Hepatic gene expression analysis in peripartal dairy cows using a bovine cDNA microarray. J. J. Loor*, J. K. Drackley, H. M. Dann, R. E. Everts, S. L. Rodriguez-Zas, and H. A. Lewin, *University of Illinois, Urbana, IL.*

We used cDNA microarray technology to study hepatic gene expression in periparturient dairy cows. Five Holstein cows fed according to current NRC recommendations throughout the prepartum period and the first 49 d postpartum were used. Liver was biopsied at -65, -30, -14, +1, +14, +28, and +49 d relative to calving. A microarray consisting of 7,872 cDNA inserts was constructed from a collection of clones selected from placenta and spleen cDNA libraries. Annotation was based on similarity searches using BLASTN and TBLASTX against the human and mouse UniGene databases. A total of 6,626 sequences (84%) have significant similarity to human or mouse genes and could be assigned as putative orthologs. Gene Ontology terms were annotated to the sequences and putative functions assigned. Cy3- and Cy5-labelled cDNA from tissue and a universal control sample (derived from a mixture of cattle tissues not including liver or mammary tissue) were used for hybridization. Three exogenous plant genes were used as spiking controls for data normalization. A parametric test using the cross-gene error model with log-transformed ratios in GeneSpring was used. Preliminary analysis of data from four cows each at -14, +1, and +14 d showed clear increases over time in the expression (fold-change expressed as tissue/universal control) of genes with known functions associated with various aspects of hepatic metabolism at the onset of lactation. Fold-change for transcripts encoding *fatty acid transporter-2* (SLC27A2), *fatty acyl-CoA ligase-2*, *carnitine-palmitoyl transferase-1* and *-2*, *acyl-CoA oxidase*, and *acetyl-CoA acyltransferase-2* increased over time. Among genes involved in glucose metabolism, the *pyruvate dehydrogenase complex* (PDHB), *PDH kinase-4*, and two *dihydrolipoamide dehydrogenases* also increased over time. mRNA expression by +14 d of genes associated with cholesterol synthesis (*sterol-C4 methyl oxidase*), steroidogenesis (*sterol carrier protein-2*), IGF-1 and -2 metabolism (IGFBP4), and antioxidant activities (*catalase*, *selenoprotein P*) was markedly upregulated. Results demonstrate the power of microarrays to study patterns of gene expression in bovine liver.

Key Words: Microarray, Liver, Dairy cow

W10 Preliminary evaluation of a sustained-release delivery system of porcine (p) somatotropin (ST) in pigs. H. S. Ringrose*[1], K. E. Govoni[1], T. A. Hoagland[1], S. Martinod[2], and S. A. Zinn[1], [1]*University of Connecticut,* [2]*Smart Drug Systems, Inc.*

To begin evaluation of sustained-release of porcine (p) somatotropin (ST) from covered-rod implants (CRI), 3 experiments (Exp.) were conducted. In Exp. 1, 6 formulations of CRI were individually incubated in 0.05 M PBS (3 mL; pH 7.5; 20^oC) for 37 d. PBS was collected at regular intervals and analyzed (Biuret) for protein released into media. One CRI formulation was identified that secreted about 4 mg pST/d for 16 d and was used in Exp. 2 and 3. Yorkshire-crossbred pigs (Exp.2: n=38; Exp.3: n=40) were housed (2 pigs/pen) in a climate-controlled barn and given ad libidum access to a pelleted feed (16% CP, 1% lysine) and water. Pigs were blocked by BW, and within block, assigned to 1 of 4 treatment groups in Exp. 2 (control, implanted at 50 kg, implanted at 75 kg, implanted at 50 and 75 kg BW), and 1 of 3 treatment groups in Exp. 3 (control, first implanted at 50 kg, first implanted at 75 kg BW, and reimplanted every 10 d). Feed intake (FI) was measured daily and BW was measured weekly. Loin eye area (LEA) and back fat (BF) were measured every 4 wk. Blood (20 mL) was obtained by venipuncture of a vena cava weekly and concentrations of ST and IGF-1 were quantified by RIA. In Exp. 2, no difference ($p > 0.10$) was observed between control and treated pigs for ADG, FI, LEA or BF. Following implantation, treatment average concentrations of ST (2.7 ng/mL) and IGF-1 (496 ng/mL) were increased ($p < 0.05$) relative to control (1.5ng/mL, 300ng/mL). However, 14 d after implantation, ST and IGF-1 returned to control values. We concluded that ST was released from CRI and stimulated IGF-1 release, but perhaps the duration of elevated ST was not sufficient to stimulate ADG. To potentially maintain sufficient release of pST, pigs were reimplanted every 10 d in Exp. 3. Average concentrations of IGF-1 (425 vs 270 ng/mL) were greater ($p < 0.05$) in treated compared with control pigs for the duration of treatment. However, we did not observe an effect of treatment on ADG or FI ($p > 0.10$) in these pigs. We conclude that ST is released from CRI and has biological activity, but not at the concentration and(or) duration needed to stimulate ADG. We are currently working on further modifications of our CRI to increase the duration of release of pST to improve growth rate, feed efficiency and carcass composition.

Key Words: Somatotropin, Growth, Pigs

W11 Actions of lipopolysaccharide, prostaglandin-F2α, and the nitric oxide generator, sodium nitroprusside dihydrate, on oocyte maturation and embryonic development in cattle. P. Soto, R. P. Natzke, and P. J. Hansen*, *Dept. of Animal Sciences, University of Florida*.

Mastitis and immunization against constituents of organisms causing mastitis can reduce fertility of cattle and sheep, respectively. Here, it was hypothesized that these effects are mediated via actions of lipopolysaccharide (LPS), prostaglandin-F2α (PGF), and nitric acid on oocyte maturation and embryonic development. To evaluate effects on oocyte maturation, oocytes were matured with various concentrations of LPS, PGF, or the nitric oxide generator, sodium nitroprusside (SNP). Following maturation, oocytes were fertilized and cultured until d 8 after insemination. To test effects on embryo growth, oocytes were matured and fertilized and cultured after fertilization with LPS, PGF, or SNP. Addition of 100 and 1000 ng/ml LPS and 50 and 100 ng/ml PGF to oocyte maturation medium reduced ($P<0.05$) the proportion of oocytes that became blastocysts at d 8 after insemination. For example, the least-squares means for percent oocytes that became blastocyst was 29, 26, 26, 21, 24, 14, and 13% (pooled SEM=4.7%) for oocytes cultured with 0, 0.01, 0.1, 1.0, 10.0, 100.0, and 1000.0 ng/ml LPS, respectively (n=80-136 oocytes/group in 4 replicates). When added after fertilization, in contrast, neither LPS nor PGF reduced development to the blastocyst stage. Addition of SNP during oocyte maturation was without effect on the proportion of oocytes that became blastocysts. However, addition of 10 mM SNP to culture medium after fertilization blocked development to the blastocyst stage ($P<0.001$) while 0.1 and 1 mM SNP did not affect development (percent oocytes to blastocyst at d 8 after insemination = 15, 15, 15, and 0%; pooled SEM=2.2%; n=144-151 oocytes/group in 5 replicates). Results indicate that LPS, PGF, and NO can have adverse effects on oocyte function (LPS, PGF) and embryonic development (NO). It is concluded that increased local synthesis of PGF and NO may mediate effects of mastitis or immune activation on fertility in cattle. It is unlikely, however, that the direct action of LPS on the oocyte is an important cause of infertility in mastitis becase effects of LPS on oocyte maturation occurred at concentrations higher than seen in peripheral circulation during mastitis.

Key Words: Oocyte, Embryo, Mastitis

W12 Postpartum changes in hormones and metabolites during early lactation in summer and winter calving Holstein cows. L. I. Nordbladh*, A. E. Sweetman, and C. S. Whisnant, *North Carolina State University, Raleigh, NC*.

Heat stress is known to decrease milk production and reproductive performance in dairy cattle. The mechanism of action is uncertain. The purpose of the current experiment was to compare levels of metabolic hormone and metabolites in early lactation dairy cows in heat stress or cool environments. A total of 18 Holstein cows (Summer (S) n = 11; Winter (W) n = 7) were used. Maximum and minimum temperatures and relative humidity were collected daily for calculation of temperature humidity index (THI). Blood samples were collected within 24 hours after calving and then weekly thereafter for 12 weeks during both seasons. Plasma concentrations of progesterone (P4), thyroxine (T4) and beta-hydroxybutyrate (BHBA) were determined using radioimmunoassay (P4, T4) or commercial kit (BHBA, Sigma). Differences between seasons in concentrations of hormones and BHBA were determined using ANOVA with the GLM procedure of SAS for repeated measures. THI was greater during the period of sampling for S cows compared with W cows. The THI during S (70.2) was classified as mild heat stress. Based on serum P4 cows calving during S had a longer interval to first ovulation (47.3 $\pm$ 4.5 d) than those calving during W (32.5 $\pm$ 2.3 d). Serum T4 concentrations were higher ($P< 0.01$) in W calving cows (3.5 $\pm$ 0.3 ug/dL) than in S calving cows (1.8 $\pm$ 0.3 ug/dL) for the first 8 weeks postpartum but were not different for weeks 9 through 12. Concentrations of BHBA did not differ between S calving (9.4 $\pm$ 3.5 mg/dL) and W calving (8.1 $\pm$ 2.9 mg/dL) cows but did decline over time postpartum ($P< 0.05$) during both seasons. Reduced T4 concentrations in heat stressed early lactation dairy cows appeared to be associated with a delay in first postpartum ovulation.

Key Words: Heat Stress, Thyroxine, Dairy Cow

W13 Differences in sensitivity to heat-shock between preimplantation embryos from heat-tolerant (Brahman and Romosinuano) and heat-sensitive (Angus) breeds. J. Hernández-Cerón*[1], C. C. Chase Jr[2], and P. J. Hansen[3], [1]*Dept. de Reproduccin, Universidad Nacional Autnoma de Mxico, Mxico D.F.,* [2]*USDA-ARS Subtropical Agricultural Research Station, Brooksville, FL,* [3]*Dept. of Animal Sciences, University of Florida, Gainesville, FL 32611-0910*.

Certain heat-tolerant breeds of cattle have acquired mechanisms to protect cells against damage from high temperature. Exposure of embryos to 41°C reduced development more for Holstein and Angus (An) embryos than for Brahman (Br) embryos. The Romosinuano (Ro) is a Bos taurus from Colombia. Like Br, Ro is a tropically-adapted breed. It is not known, however, whether this breed, distinct in origin from Br, has evolved to possess cellular adaptations to heat shock. A study was performed to test whether Br and Ro embryos survive heat-shock better than An embryos. Cows (n=14 An, 17 Br, and 15 Ro) were slaughtered in groups of 2-3 per breed (5-6 replicates). For each replicate, ovaries were pooled within breed and oocytes harvested and fertilized with semen from a pair of bulls of the specific breed. A different pair of bulls was used for each replicate. At d 4 after insemination, embryos $\geq$ 8 cells were randomly assigned to control (38.5 °C) or heat shock (41°C for 6 h) treatments. Development to blastocyst was determined on d 8. The proportion of oocytes that cleaved at d 4 tended to be highest for Ro (54 $\pm$ 8.4%, 50 $\pm$ 7.7%, and 70 $\pm$ 7.7% for An, Br and Ro; Ro vs others, P=0.07). The proportion of cleaved embryos that were $\geq$ 8 cells at d 4 was lowest (P=0.05) for Br (76 $\pm$ 8.1%, 55 $\pm$ 7.4%, and 77 $\pm$ 7.4% for An, Br, and Ro). Heat shock caused a reduction in the proportion of embryos that became blastocysts at d 8 ($P<0.001$). At 38.5°C, there were no significant differences in development between breeds. Among embryos exposed to 41°C, however, development was lower ($P<0.05$) for An than for Br and Ro. Furthermore, there was a An vs (Br + Ro) x temperature interaction (P=0.09) because heat shock reduced development more for An (30.3 $\pm$ 4.6 % at 38.5°C vs 4.9 $\pm$ 4.6 % at 41°C) than for Br (25.1 $\pm$ 4.6 % vs 13.6 $\pm$ 4.6 %) and Ro (28.3 $\pm$ 4.1 % vs 17.5 $\pm$ 4.1 %). There were no effects on cell number of d 8 blastocysts. Results demonstrate that embryos from thermotolerant breeds (Br and Ro) are more resistant to elevated temperature than embryos from a thermosensitive breed (An). Thus, the process of adaptation of Br and Ro breeds to hot environments resulted in both cases in selection of genes controlling thermotolerance at the cellular level. (USDA IFAFS 2001-52101-11318 and TSTAR 2001-34125-11150).

Key Words: Embryo, Heat shock, Breed

W14 Differences in sensitivity to heat-shock between preimplantation embryos from heat-tolerant (Brahman and Romosinuano) and heat-sensitive (Angus) breeds. J. Hernández-Cerón*[1], C. C. Chase Jr[2], and P. J. Hansen[3], [1]*Dept. de Reproducción, Universidad Nacional Autónoma de México, México D.F.,* [2]*USDA-ARS Subtropical Agricultural Research Station, Brooksville, FL,* [3]*Dept. of Animal Sciences, University of Florida, Gainesville*.

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41°C, however, development was lower (P<0.05) for An than for Br and Ro. Furthermore, there was a An vs (Br + Ro) x temperature interaction (P=0.09) because heat shock reduced development more for An (30.3 ± 4.6 % at 38.5°C vs 4.9 ± 4.6 % at 41°C) than for Br (25.1 ± 4.6 % vs 13.6 ± 4.6 %) and Ro (28.3 ± 4.1 % vs 17.5 ± 4.1 %). There were no significant effects on cell number of d 8 blastocysts. Results demonstrate that embryos from thermotolerant breeds (Br and Ro) are more resistant to elevated temperature than embryos from a thermosensitive breed (An). Thus, the process of adaptation of Br and Ro breeds to hot environments resulted in both cases in selection of genes controlling thermotolerance at the cellular level. (USDA IFAFS 2001-52101-11318 and TSTAR 2001-34125-11150).

Key Words: Embryo, Heat shock, Breed

W15 Heat shock protein-70 is upregulated in retained testicles of cryptorchid stallions.

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Heat shock proteins (HSP) are a class of molecular chaperones that protect the three-dimensional structure of proteins subjected to thermal stress. Heat shock proteins have been implicated in fertility of several species, but have not, to date, been characterized in stallions. Lower levels of testicular HSP70 have been associated with decreased semen quality in boars. In the desert southwest US, environmental heat stress could further potentiate the decline in stallion sperm quality typical of summer months. Our objectives were to assess HSP expression in ejaculated sperm and testicular tissue. Heat shock protein 25, HSP40, HSP70 and HSP90 were assessed by Western blot using commercially available anti-human HSP antibodies validated for use with equine samples. In Exp. 1, HSP expression was determined in archived semen samples from four fertile stallions collected in January (low temperature, short photoperiod) and July (high temperature, long photoperiod), as well as in fresh and fresh frozen semen samples collected in August and September. Heat shock proteins were not detected in any semen sample, indicating that ejaculated stallion sperm do not express HSP at levels detectable by this method. In stallions, testosterone production is correlated with daylength, decreasing with decreasing photoperiod. Experiment 2 was designed to assess the effect of testis temperature independent of testosterone levels. Heat shock protein profiles were assessed in testicular tissue from three cryptorchid stallions castrated in January and February. HSP40 and HSP70 were detected in both normal descended and retained testes, however, HSP70 were increased two fold in retained testes relative to paired descended testicles, indicating that maintenance at core body temperature upregulates HSP70. Immunochemical detection of HSP in the retained testes suggest a role for HSP in maintenance of stallion sperm quality in vivo and may be useful in assisted reproductive techniques in horses.

Key Words: Stallion, Testes, Heat shock protein

W16 Nucleotide and predicted amino acid sequence of equine *bmal1*: a key biological clock component showing high homology to human *bmal1*.

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The mammalian master circadian clock resides in the suprachiasmatic nucleus (SCN) of the hypothalamus and drives daily variations in many physiological, biochemical and behavioral processes. The SCN receives photoperiod signals from the environment and supplies the principle timing cues for synchronizing the daily oscillations in peripheral tissues. Interacting positive and negative feedback loops, of which rhythmic regulation of *Bmal1* transcription provides the positive driving force, control the internal molecular time-keeping mechanism. We report the isolation of equine *Bmal1* cDNA from a prepared lymphocyte library and subsequent sequencing of 2Kb, incorporating 94% of the entire open reading frame (ORF) based on comparison with published human *Bmal1* sequence (GenBank Accession # D89722). NCBI Blast analysis of the equine sequence demonstrated 96% homology with human *Bmal1* mRNA. The deduced amino acid sequence of the equine BMAL1 protein shows 99% homology with that of the human. Interspecies phylogenetic analysis using the Align X program of VectorNTI shows the equine *Bmal1* gene clustering more closely with the human gene than that of the hamster, rat or mouse on a phylogeny tree. This sequence data can now be used to analyze expression profiles of the transcript in peripheral tissues, specifically peripheral blood mononuclear cells (PBMCs). Isolation of the transcript from a lymphocyte cDNA library signifies the likelihood of its detection in peripheral circulation and encourages an attempt to isolate further clock genes. Small mammals have historically been used as molecular models to investigate circadian function and disorders in humans. The particularly high homology observed between equine and human *Bmal1* provides incentive to consider a large mammal such as the horse as a molecular model for assessing human peripheral circadian systems, especially now that the impracticality of sacrificing the experimental animals may be overcome by non-invasive peripheral detection of molecular clock components.

Key Words: Circadian, Bmal1, Equine

W17 Characterization of soluble CD14 in bovine milk.

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Soluble CD14 (sCD14) has been shown to prevent death induced by "septic shock", inhibit dissemination of pathogens, stimulate lymphocyte proliferation, and facilitate phagocytosis of bacteria. It has been proposed that sCD14 in human milk plays a role not only in breast-feeding associated benefits, but also in protecting the mammary gland from bacterial infections. However, sCD14 in bovine milk has not been well documented. In the present study, milk samples from 100 lactating cows (396 functional quarters) were assayed for sCD14 to determine whether stage of lactation (0-4, 5-99, 100-200 and >200 d), somatic cell count (SCC) or intramammary infection affect concentration of sCD14 in milk. The average concentration of sCD14 was 6.90 0.17 μg/ml, was the highest 0–4 d postpartum (11.39 ± 0.49 μg/ml) and the lowest 100–200 d postpartum (4.56 ± 0.27 μg/ml). The concentration of sCD14 was lower in milk with a SCC < 250,000/ml (6.13 ± 0.28 μg/ml) than that of milk with a SCC > 750,000/ml (7.65 ± 0.29 μg/ml). No difference was found between non-infected and infected quarters. Results indicate that the concentration of sCD14 in bovine milk is close to the range of sCD14 in body fluids from other species, and can be affected by stage of lactation and SCC. The high content of sCD14 in milk 0-4 d postpartum may be associated with the known protective role of colostrum for the calf.

Key Words: CD14, Bovine, SCC

W18 Effects of recombinant bovine growth hormone on levels of the bacteria *Edwardsiella ictaluri* in channel catfish (*Ictalurus punctatus*).

B.C. Peterson* and A.L. Bilodeau, [1]*USDA/ARS.*

Research was conducted to examine the immunoregulatory role of recombinant bovine growth hormone (rbGH, Posilac) in channel catfish challenged with *Edwardsiella ictaluri* (*E. ictaluri*). A total of 240 fish (3.7 ± .7 g) were assigned randomly to four treatments with three replicates each. The treatments were 1.) Con-Exposed (Sham injected by needle puncture and challenged with *E. ictaluri*), 2.) Con-Nonexposed (Sham injected by needle puncture and not challenged), 3.) rbGH-Exposed (Posilac, injected at 30 μg/g BW and challenged with *E. ictaluri*), and 4.) rbGH-Nonexposed (Posilac, injected at 30 μg/g BW and not challenged). Treatments were then randomized to one of each sampling day (1 and 5). Fish were maintained in 24, 120-L tanks (10 fish/tank) for three weeks prior to challenge. During this time, fish were injected (rbGH or sham) and specific growth rates were assessed. Fish were reinjected (rbGH or sham) two days prior to challenge with *E. ictaluri*. A genetic assay utilizing real-time PCR was used for detection and quantification of *E. ictaluri* and mortality was recorded daily. Specific growth rate was higher (P = 0.06) in rbGH-treated fish compared to sham injected controls (3.5 vs 3.0) prior to challenge. All non-exposed fish tested negative for the presence of *E. ictaluri* throughout the trial. On days 1 and 5, rbGH-Exposed fish exhibited lower (P < 0.05) levels of *E. ictaluri* when compared to Con-Exposed fish (0 vs 3,250 ± 2,927) (cell-equivalents/100 mL whole blood) and (10,230 ± 5,813 vs 62,294 ± 34,315) (cell-equivalents/100 mL whole blood), respectively. Mortality was similar between rbGH-Exposed and Con-Exposed throughout the study. Reduced levels of *E. ictaluri* in rbGH-Exposed fish suggest an immunoregulatory role for rbGH in channel catfish.

Key Words: rbGH, *Edwardsiella ictaluri*, Catfish

W19 Effect of Iranain Kilka fish meal on performance and some blood metabolites in early lactating dairy cows. A.R. Heravi M*[1], M. Danesh Mesgaran[1], D. Zamiri[2], and F. Eftekhary[1], [1]*Department of Animal Science, Ferdowsi University, Mashhad, Iran,* [2]*Department of Animal Science, Shiraz University, Shiraz, Iran.*

Twelve multiparous Holstein cows at 27 days in milk were used in a randomized design, with repeated measures analysis, of 8 weeks to evaluate the feed intake, milk yield and composition, blood metabolites (glucose, urea N, soluble protein and cholesterol) and progesterone when soybean meal (SBM) was replaced with different levels of Iranian Kilka fish meal, KFM, (a fish sp. located in the Caspian Sea). On a dry matter (DM) basis, the control diet (T1) consisted of alfalfa (25.2%), corn silage (15.2%), ground barley (22%), ground corn (8.4%), soybean meal (7.9%), cottonseed meal (2.5%), cottonseed (4.9%), wheat bran (6.5%), beet pulp (5.9%), urea (0.1%), limestone (0.1%), dicalcium-phosphate (0.3%), salt (0.2%) and a mineral-vitamin complex (0.8%). In T2 and T3, 28.25 and 56.50% of SBM was replaced with KFM. Dry matter intake of the cows fed T1, T2 and T3 was 23.5, 23.8 and 22.3 0.16 kg/d, respectively, and was not affected by diet (P=0.09). Milk yield (38.51, 37.7 and 39.25 0.24 kg/d); milk fat (3.06, 2.64 and 2.53 0.084%); and milk protein (2.757, 2.88 and 2.967 0.21 %) were not significantly influenced by the experimental diets. At 35 d in milk, ovarian cycles were synchronized using the Pre-Synchronization/Ovsynch protocol. Plasma cholesterol and progesterone concentrations were not affected by diets on day of first GnRH (61 d in milk) or PG injection (68 d in milk) in Ovsynch protocol. At 80 DIM, blood was collected from coccygeal vessels at 0, 1.5, 3 and 4.5 hours after the morning feed. Plasma glucose, urea nitrogen and soluble protein were not significantly affected by the diets but plasma glucose and soluble protein varied over time (P<0.01). It may be concluded that the replacing SBM with KFM in the diets designed for early lactating cows did not alter the lactational performances, blood metabolites and progesterone concentration.

Key Words: Fish meal, Ovsynch, Blood metabolites

W20 WITHDRAWN. , .

W21 The relation between milking characteristics and adrenergic receptor mRNA-expression and ligand binding in the mammary gland of dairy cows. T. Inderwies, M. W. Pfaffl, and R. M. Bruckmaier*, *Techn. Univ. Munich-Weihenstephan, Inst. of Physiology.*

Adrenergic receptor stimulation in the bovine mammary gland affects milking characteristics such as milk yield and peak flow rate. The aim of this study was to detect correlations between milkability, receptor binding capacity and receptor expression at the mRNA level. In addition, dose-response relationships of α- and β-adrenergic receptor stimulation were evaluated after application of α- and β-adrenergic agonists, respectively. Density of adrenergic receptor binding sites in the region around the large mammary ducts were investigated as well as adrenergic receptor mRNA expression. Milk flow of one quarter was recorded in 10 cows without or with additional α- and β-adrenergic receptor stimulation in 3 dosages each. After slaughter, mammary tissue was taken from the region around the large mammary ducts in the previously investigated quarters. Protein and RNA were extracted for measuring α_1-, α_2-, and β_2-adrenergic receptor binding sites and mRNA expression levels by real-time RT-PCR. Peak flow rate without additional adrenergic receptor stimulation was negatively correlated ($p<0.05$) with α_2-adrenergic receptor binding (maximal binding capacity B_{max}) and positively correlated with α_2-adrenergic receptor expression at the mRNA level ($p<0.05$). During α-adrenergic receptor stimulation, there was a negative correlation ($p<0.05$) between milkability and α_2-adrenergic receptor mRNA expression, whereas during β-adrenergic receptor stimulation no correlations were detected. Dose-response relationships existed during α-, but not during β-adrenergic receptor stimulation. Significant changes ($p<0.05$) of milk yield and peak flow rate mainly occurred after α-adrenergic receptor stimulation. In conclusion, high mRNA expression or binding levels of adrenergic receptors are not necessarily related to according changes of milk yield and peak flow rate. To influence milking characteristics, individual reactions of the cow on adrenergic stimulation have to be considered.

Key Words: Cow, Mammary gland, Adrenergic receptors

Lactation Biology

W22 Characterization of a 4,600 gene bovine microarray. C.M. Stiening*[1], J. Hoying[1], A. Hoying[1], D. Henderson[1], P. Gentry[1], Y. Kobayashi[2], and R. Collier[1], [1]*Univ. of Arizona,* [2]*Michigan State Univ.*

A cDNA microarray containing approximately 4600 ESTs was created to evaluate differential gene expression in dairy and beef cattle, with attention to mammary, pituitary and gastrointestinal tissues. Of the 4600 sequences printed, 1526 were generated from mammary tissue, with 540 of those ("Lactation" subgroup) from a subtracted cDNA library (lactating minus involuted tissue) and the remaining 986 ("Non-lactation" subgroup) from the reciprocal library (involuted minus lactating tissue). Approximately 1000 non-redundant pituitary sequences were spotted, and the majority of the remaining 2000 sequences represent the complete GI tract from esophagus to colon. The pituitary and digestive tract ESTs came from sequenced cDNA libraries that were virtually subtracted to minimize redundancy. Printing was conducted at the Univ. of Arizona Genomics Research Lab. Each sequence was spotted in triplicate in an environmentally controlled workstation using a 48-pin print head. Spot morphology and hybridization parameters were evaluated using 3 standard tests. First, SybrGreen was used to verify the presence of DNA in each spot. Second, a random Cy3-labeled oligo (9-mer) was used to validate hybridization competency. Lastly, parameters of the hybridization protocol were evaluated using a same-sample test in which half of the sample was labeled with Cy3 and the other half with Cy5. A preliminary study was next analyzed to obtain initial estimates of variance. Two cDNA arrays arranged in an incomplete block design on dye and treatment were analyzed using statistical package "R". Rough estimates of array variance (confounded with dye variance) and average pooled gene variance were calculated, with array variance = 4.1 x 10^{-7}, gene variance = 0.313, and a mean absolute difference between treatment groups of 1.02 (natural log scale). These preliminary results suggest consistency in printing and hybridization techniques and help establish confidence in our ability to produce robust microarray results with minimal extraneous (non-genetic) sources of variation.

Key Words: Microarray, Variance, Bovine

W23 Effects of varying energy intakes on the deposition of type IV collagen (Col IV) and fibronectin (FN) in the mammary tissue of pre-pubertal heifers. J. W. Forrest*[1], R. M. Akers[1], R. E. Pearson[1], E. G. Brown[2], M. J. VandeHaar[2], and M. S. Weber Nielsen[2], [1]*Virginia Tech, Blacksburg, VA ,* [2]*Michigan State University, East Lansing, MI.*

Our objective was to determine the effects of energy intake on the extracellular matrix of mammary parenchyma. At 2 wk of age, Holstein calves were assigned to 1 of 4 treatments (HH, HL, LH, and LL) with 2 levels of energy intake (High or Low) during 2 periods of growth (2 to 8 and 8 to 14 wk of age). At 14 wk, parenchyma at the stromal interface (I), mid-gland (M), and above the cistern (C) were collected from each calf, fixed, and embedded in paraffin, resulting in 30, 21, 24, and 27 samples, respectively, for each treatment. Immunocytochemical staining of sections allowed visualization of Col IV and FN. Images representing 4 increasing grades (1,2,3,4) were used to quantify protein intensities. Neither feeding level nor zone affected the frequency or intensity of Col IV staining. Average Col IV staining intensity in the basement membranes (BMs) of terminal ductular units (TDUs) and subtending ducts (SUBs) was 1.5, however, staining was observed more frequently around SUBs (75%) than around TDUs (26%). FN staining intensity adjacent to SUBs was 0.27 $\pm$ 0.15 (mean $\pm$ SEM, $p<0.1$) and 0.43 $\pm$ 0.20 ($p<0.05$) greater for HH+HL vs. LH+LL heifers and HH vs. LL heifers, respectively. FN staining intensity adjacent to TDUs was 0.55 $\pm$ 0.17 ($p<0.001$) greater in HH vs. LL heifers, 0.35 $\pm$ 0.13 ($p<0.01$) greater in HH+LH vs. HL+LL heifers, and 0.19 $\pm$ 0.13 ($p<0.1$) greater in HH+HL vs. LH+LL heifers. In addition, FN staining intensity at TDUs was 0.29

± 0.14 (p<0.05) greater in M+C vs. I zones. Similar feeding level and zone effects on staining intensity were observed for FN that was not adjacent to epithelium (i.e., interlobular). FN staining in BMs was not observed in TDUs and only in 14% of SUBs. A high rate of gain, in particular a continuous high rate, between 2 and 14 wk of age increased FN, but not Col IV, deposition throughout mammary parenchyma.

Key Words: Calves, Mammary, Extracellular matrix

W24 Regional expression of IGF-I and estrogen receptor-alpha within prepubertal bovine mammary parenchyma and fat pad.

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In cattle, prepubertal mammary development is characterized by a period of allometric growth. During this period, ductal epithelium elongate into the mammary fat pad (FP). This growth is orchestrated by signals of both local and systemic origin and likely requires the interaction between the FP and the developing parenchyma. The goal of this study was to determine whether the expression of key regulatory genes, such as IGF-I and estrogen receptor-alpha (αER), vary within each compartment during mammary development. To answer this question, we collected mammary tissues from 200 kg prepubertal Holstein heifers. Total RNA was extracted from these tissues and specific transcripts were quantified by ribonuclease protection assays. Parenchyma was collected from the cisternal region, the region adjacent to the FP boundary, and from a region equidistant to the aforementioned regions (medial). The FP was sampled near the abdominal wall (dorsal region) near the supra mammary lymph node (caudal region) and adjacent to the parenchymal boundary. αER transcript was detected in all samples and there were no differences in expression within the various parenchymal or FP regions. Similarly, expression of the IGF-I gene did not differ across the different FP regions. However, in the parenchyma, expression of this transcript tended to be lower ($P < 0.08$) in the cisternal region than in either the medial region or the region adjacent to the FP boundary. These data demonstrate that αER transcript is expressed uniformly throughout the parenchyma as well as the FP. Likewise, IGF-I expression is uniform throughout the FP. However, IGF-I transcript abundance tends to be greater in parenchymal tissues collected dorsal to the cisternal region.

Key Words: IGF-I, Estrogen receptor-alpha, Mammary development

W25 Expression of translation initiation factors in mammary glands of lactating and dry dairy cows.

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Factors regulating processes and machinery involved in milk protein production were investigated using mammary glands from 12 non-pregnant dairy cows in late lactation (>250 DIM; 17 kg milk/d). For 42 d, 6 cows were milked as previously (LACT) while 6 cows were dried off (DRY). Cows were then slaughtered and mammary glands and tissue samples obtained. Quantitative histological analyses were performed on regions of interest (ROI) on micrographs of parenchymal tissue (n=4/group). Numbers of alveoli (15 ROI, magnification 40x) and lobules (9 ROI, magnification 2.5x) were similar (P>0.1) in both groups. Mammary size (P=0.07) and parenchymal weight, cell number, cell size and RNA content (P<0.05) were lower in DRY cows. Levels of main eukaryotic translation initiation factors (eIF), eIF2 and eIF4E, were also lower in DRY cows (75% and 67%; P<0.05). Together with a 44% decrease (P<0.05) in RNA:DNA from that in LACT cows, these results indicate decreased translational capacity in DRY glands. In both groups, a large percentage (48 to 60%) of intracellular eIF4E was bound to the eIF4E sequestering protein, 4EBP1, a complex that renders eIF4E biologically inactive. Active (phosphorylated) ribosomal protein S6 (rpS6) and its kinase, p70 S6K, facilitate synthesis of parts of translational machinery. In DRY cows, phospho-rpS6 and -p70 S6K were respectively maintained at 58% and 65% of that of LACT cows. This indicates a maintenance of cell signals involved in synthesis of translational machinery and mirrors the maintenance of RNA:DNA in DRY glands at 56% of LACT. In conclusion, the more pronounced decrease in expression of eIF2 than eIF4E following involution seems to indicate that eIF2 is most likely responsible for the increased translational capacity in lactation. The significant presence of the eIF4E:4EBP1 complex suggests there is an excess capacity for translation up-regulation in both lactating and dry dairy cows. Withdrawal of lactogenic and mammogenic hormones had an adverse effect on the ability of mammary glands to produce milk protein.

Key Words: Initiation factors, mRNA translation, Mammary involution

W26 Insulin-like growth factor-I (IGF-I) modulates the process of mammary apoptosis after weaning in IGF-I transgenic pigs.

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IGF-I plays a critical role in mammary cell proliferation and apoptosis. Studies in transgenic mice with mammary-specific IGF-I over-expression have reported reduced apoptotic loss of mammary cells in late lactation, with minimal effects in early lactation. The impact of mammary over-expression of IGF-I in pigs has not been previously reported. The objective of the present study was to determine the effect of mammary-specific transgenic over-expression of IGF-I on mammary epithelial cell apoptosis. IGF-I hemizygous transgenic swine over-expressing IGF-I under the direction of the bovine alpha-lactalbumin promoter (IGF) and non-transgenic (CON) gilts had litter size normalized to 10 piglets at farrowing and piglets were allowed to suckle until d 21 postpartum. On d 4 post-weaning (d 25 postpartum), animals underwent a surgical biopsy and blood and milk samples were collected. Serum IGF-I on d 4 post-weaning was not affected by mammary over-expression of IGF-I. IGF-I content in mammary secretions from d 4 post-weaning was approximately 36-fold higher (575 ± 271 μg/L) than CON (16.6 ± 1.2 μg/L) sows ($p \leq 0.001$). The predominant IGF binding proteins (IGFBP) in mammary secretions were IGFBP-2 and IGFBP-5, both of which were significantly higher in mammary secretions of IGF vs. CON sows ($p \leq 0.05$). The presence of apoptotic cells was determined in mammary tissue by Tunel assay and apoptotic cells were expressed as a percentage of total cell count. Mammary tissue from CON pigs had a significantly ($p \leq 0.05$) higher percentage of apoptotic cells than IGF transgenic sows (7.5 ± 1.7 vs. 4.6 ± 1.5 %, respectively) at d 4 post-weaning. Thus, over-expression of IGF-I results in increased IGFBP-2 and IGFBP-5 in mammary secretions during involution. However, programmed cell death in mammary tissue is lower in IGF transgenic sows, which could potentially prolong the process of involution. (Funded by the USDA CSREES under project NRICGP 00-35206.)

Key Words: IGF-I, Mammary gland, Apoptosis

W27 Changes of steroid hormone receptor expression and localization in the bovine mammary gland during different functional stages.

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Lactation can be induced in non-pregnant animals by steroid hormone treatment. These effects may be transmitted by estrogen receptors (ERa and ERb) or progesterone receptors (PR). Our aim was to study the expression of ERa, ERb and PR mRNA and protein during mammogenesis, lactogenesis, galactopoiesis (early, middle and late) and involution in the bovine mammary gland (total n=53 cows). The mRNA was assessed by means of real time RT-PCR (LightCycler) and the protein by immunohistochemistry and Western blotting. Both ERa and PR are expressed in fg/g total RNA range. Highest mRNA expression was found for ERa (285 fg/g) and PR (63 fg/g) in tissue of non-pregnant heifers followed by a significant decrease at lactogenesis (17 and 7 fg/g) with remaining low concentrations during lactation and the first 4 wk of involution. In contrast, expression of ERb was in the at/g total RNA range. Immunolocalization for ERa revealed a strong positive staining in nuclei of lactocytes in non-pregnant heifers, became undetectable during pregnancy, lactogenesis, lactation, and was again detectable 14-28 d after milking was stopped. In contrast, the PR is localized in nuclei or cytoplasm of mammary epithelial cells during all stages examined. The ERa, ERb and PR protein was found in all mammary gland stages examined by Western blotting. The signal for ERa is less abundant in tissue of heifers and at involution (4 wk). The ERb protein showed increased abundance (two isoform bands) in heifers and at 4 wk after milking was stopped. For the PR, 3 obvious isoforms (A, B and C) were found. But only the isoform B remains during the stages of lactogenesis,

galactopoiesis and involution. In conclusion, the data for ER and PR show clear regulatory changes suggesting involvement of these receptors in bovine mammary gland function.

Key Words: Steroid receptors, Mammary gland, Bovine

W28 Ontogenetic regulation of progesterone receptor (PR) expression in bovine mammary gland. E. E. Connor*, A. V. Capuco, D. L. Wood, T. S. Sonstegard, and A. F. Mota, *USDA-ARS, BARC, Beltsville, MD*.

The expression patterns of progesterone receptor (PR) mRNA and protein in the bovine mammary gland were characterized during various stages of mammary development and pregnancy. Mammary parenchyma was obtained from prepubertal heifers, pregnant heifers, non-lactating pregnant cows, lactating pregnant cows and lactating non-pregnant cows (n = 3 animals/stage). Samples were evaluated for PR mRNA by quantitative real-time RT-PCR and PR protein by western blotting and immunohistochemistry. Results indicated mean PR mRNA abundance was greatest in prepubertal heifers and lactating pregnant cows, but extremely low to non-detectable throughout most of gestation in heifers. Compared to prepubertal heifers, mean expression of PR mRNA was 6-10 times lower in non-lactating pregnant and lactating non-pregnant cows, although expression among non-lactating pregnant cows was highly variable. A similar pattern of expression was reflected in analyses of PR protein. Preliminary results of western blot analysis suggested the presence of two isoforms of PR of approximately 78 and 135 kDa, presumably representing PR-A and PR-B, respectively. Quantities of the PR-A and PR-B isoforms differed by physiological state. Our results demonstrate that PR expression in the bovine mammary gland is developmentally and hormonally regulated.

Key Words: Progesterone receptor, Mammary gland, Bovine

W29 Mammary mRNA expression of bovine haptoglobin and LPS-induced alterations. S. Hiss*[1], M. Mielenz[1], S. Schmitz[2], R. M. Bruckmaier[2], and H. Sauerwein[1], [1]*Institute of Physiology, Biochemistry and Animal Hygiene, Bonn University, Germany,* [2]*Institute of Physiology, Techn. Univ. Munich, Germany*.

Haptoglobin (Hp), an acute phase protein secreted from the liver, is discussed as a useful marker for animal health. Compared to non-ruminant species, Hp concentrations in blood are physiologically low in cattle, but the increase during inflammatory processes is more pronounced. Elevated Hp concentrations have also been reported in milk during mastitis. Our previous work using a highly sensitive Hp ELISA to characterize Hp concentrations in milk after intramammary lipopolysaccharide (LPS) challenge indicated that Hp in milk might be derived from local mammary sources. Here we demonstrate the presence of Hp mRNA in bovine mammary gland RNA extracts from the parenchymal region, from tissue around cisternal milk ducts and also from teat tissue by RT-PCR. Hp mRNA expression was then quantitatively evaluated by real-time RT-PCR during the first 12 h of LPS-induced mastitis. Results were normalized with ubiquitin mRNA expression. Six healthy lactating cows were injected in one quarter with 0.1 mg E. coli LPS (O26:B6). The contra-lateral quarter was injected with saline and served as control. Biopsies were collected from the treated and the control quarter before and 3, 6, 9 and 12 h after LPS challenge. Following LPS injections, higher Hp mRNA concentrations were observed in the treated vs control quarters at 3, 6 and 9 h ($p<0.05$). Compared to baseline values, Hp mRNA expression was increased at all times recorded after LPS challenge in treated quarters, with a peak at 9 h ($p<0.05$). In the control quarters, a less pronounced increase was observed ($p<0.05$) and might be attributed to the tissue damage induced by the biopsy procedure. In conclusion, the bovine mammary gland has to be considered at least as a partial source of milk Hp. The LPS induced increase of Hp mRNA supports a very close link between mastitis and Hp synthesis in mammary tissue and into milk and therefore emphasizes the diagnostic significance of this parameter.

Key Words: Haptoglobin, Mammary gland, Bovine

W30 mRNA expression of apoptosis-related genes in mammary tissue and milk cells in response to LPS treatment and during subclinical mastitis. A. Didier and R. M. Bruckmaier*, *Institute of Physiology, Technical University of Munich, Germany*.

Development of clinical or subclinical mastitis due to immunocompromised mammary gland physiology leads to additional costs and economical loss in the dairy industry. Our objective was to determine if induction of apoptosis in immune cells and udder tissue may contribute to impairment of immune response in the gland. In two experiments, mammary gland biopsies, udder tissue and somatic milk cells were investigated for alterations in mRNA expression of apoptosis-related genes (Caspase-3, Caspase-7 and FAS) by using real-time RT-PCR. Experiment I (6 cows) was performed on mammary gland biopsies after intramammary LPS infusion to mimic mastitis. All factors under study showed a significant increase in mRNA expression during the sampling period of 12 h in comparison to untreated control quarters ($P<0.0001$ for all genes after 3 and 6 h). FAS expression reached highest levels after 3 h of LPS infusion. Experiment II included a total of 15 cows. All control animals (n = 8) had a somatic cell count <150,000 cells/ml. Another 7 cows had partially elevated SCC with at least one quarter >150,000 cells/ml. At slaughter, milk cells and udder tissue were sampled and subjected to real-time RT-PCR. For milk cells, no significant differences in mRNA expression could be found comparing control cows with those having partially elevated SCC. In udder tissue, FAS and Caspase-3 expression was significantly higher in quarters with elevated SCC as compared to controls ($P\leq0.03$ for FAS and $P\leq0.01$ for Caspase-3). In summary, apoptosis-related gene expression is altered and may be an important factor in mammary gland immune defense under various in-vivo conditions. Increased expression of apoptosis-related genes may therefore be a factor leading to impairment of udder health.

Key Words: Apoptosis, Mammary gland immunology, Real-time RT-PCR

W31 Gene expression profiles in porcine mammary gland tissue during formation of colostrum. P. M. Schnulle and W. L. Hurley*, *University of Illinois, Urbana*.

Formation of colostrum is important for the newborn mammal. The goal of the project was to profile expression patterns of genes thought to be involved in colostrum formation in porcine mammary tissue during the peripartum period. Mammary gland tissue was collected by punch biopsy from 6 sows between 2 and 6 days prepartum, within 24 hours of parturition, and on days 3 and 6 postpartum. Total RNA was extracted, reverse transcribed, and polymerase chain reactions with primers specific for the cDNAs of interest were performed under optimized conditions. Densitometry of PCR products was standardized against 18s rRNA expression. The expression level of the neonatal Fc-gamma receptor (FcRn) was 3X higher at 2 to 3 days prepartum compared to the day of parturition ($P < 0.05$), but was not significantly different on other days. Beta2-Microglobulin is a subunit of FcRn and affects functionality of FcRn protein. Beta2-microglobulin expression increased by over 5X from lowest levels at 4 to 6 days prepartum to a peak at the day of parturition and day 3 of lactation ($P < 0.05$). Annexin II heterotetramer has low affinity binding to IgG. Annexin II light chain is necessary for functional expression of the heterotetramer. Annexin II light chain expression was 70% higher during the prepartum period and on the day of parturition than in the postpartum period ($P < 0.05$). Alpha-Lactalbumin expression, used as a marker of lactogenesis, was increased by 2.5X on the day of farrowing when compared to the prepartum period ($P < 0.05$). Polymeric immunoglobulin receptor expression also was increased on the day of farrowing (by 10X; $P < 0.001$), and was positively correlated with alpha-lactalbumin expression ($P < 0.001$). Results indicate that expression of beta2-microglobulin may affect the functional role of the FcRn expressed during colostrum formation. Furthermore, expression of annexin II light chain is associated with colostrum formation in the porcine mammary gland. Multiple IgG binding proteins may have a role in transepithelial immunoglobulin transport during colostrum formation.

Key Words: Colostrum, Immunoglobulin transport, Mammary gland

W32 Tight junction (TJ) protein expression during engorgement of rat and bovine mammary glands. C. V. Cooper*[1,2,3], K. Stelwagen[2], C. D. McMahon[2], K. Singh[2], V. C. Farr[2], and S. R. Davis[2], [1]*Dexcel Ltd., Hamilton, New Zealand,* [2]*AgResearch, Hamilton, New Zealand,* [3]*Massey University, Palmerston North, New Zealand.*

The pattern of expression of TJ proteins was investigated during engorgement of rat and bovine mammary glands. An increase in mammary TJ permeability was previously shown to occur within 24 h of milk accumulation. The expression of occludin and claudin-1, the major integral transmembrane components of TJ, was determined in two experiments. In experiment 1, Sprague-Dawley rats at peak lactation (d 16) had three abdominal inguinal glands on one side sealed to induce mammary engorgement, the remaining glands were not sealed and acted as suckled controls. Mammary tissue was collected post-mortem at 0, 6, 12, 18, 24 and 36 h after teat sealing (n = 6 rats per time point). In experiment 2, alveolar mammary tissue was collected post-mortem from 42 mid-lactation Holstein Friesian dairy cows at 0, 6, 12, 18, 24, 36 and 72 h following the last milking (n = 6 cows per time point). Immunoblotting showed a characteristic multiple banding pattern for occludin between 60 and 80 kDa. The higher molecular weight (MW) bands were highly phosphorylated and resistant to NP-40 detergent extraction, suggesting they predominantly derive from the tight junction complex. Occludin expression declined during mammary engorgement in rat and bovine glands ($P<0.05$). Claudin-1 migrated in SDS-PAGE as two bands at 22 and 28 kDa. In rats, expression of the 28 kDa band declined within 12 h of mammary engorgement ($P<0.05$), while that of the 22 kDa band, along with lower MW degradation products, increased ($P<0.05$). Both bands were expressed at low levels by 36 h of mammary engorgement. In contrast, claudin-1 protein expression did not alter with engorgement in bovine mammary glands ($P>0.05$). Occludin and claudin-1 expression showed large individual animal to animal variation. Furthermore, the response to mammary engorgement was locally regulated as no changes were detected in suckled control rat mammary glands. Between species variation in the pattern of TJ protein expression suggest that the increase in TJ permeability during milk accumulation is regulated differently between rats and dairy cows.

Key Words: Tight junction, Lactation, Mammary engorgement

W33 Developmental regulation of glucosidase II in mouse mammary gland. J. Feng* and I. K. Vijay, *University of Maryland, College Park.*

The mammary gland synthesizes and secretes large amounts of well-characterized glycoproteins of the milk fat globule membrane and α-lactalbumin during lactation. Previous studies from our laboratory have shown that several glycosyltransferases of the dolichol cycle are coordinately regulated during the growth and differentiation of the mammary gland as it cycles between dormancy and lactation. We have hypothesized that the processing glucosidases I and II would follow a similar pattern of expression in coordination with the glycosyltransferases. The developmental regulation of glucosidase II was investigated in mouse mammary gland. Glucosidase II is a heterodimer of a catalytically active subunit (α subunit) and a smaller subunit (β) that contains the signal for endoplastic reticulum (ER) retention. Mouse mammary glands at different stages of development (n=30 for virgin and post lactating glands; 20 for all the other stages) were examined for glucosidase II mRNA by RT-PCR (both α and β subunits), immunoreactive α and β subunits, and enzyme activity. All three parameters showed a similar pattern, i.e., they were low in tissues from virgin animals, increased steadily during pregnancy and lactation, reaching a peak around mid-lactation, and declined sharply in glands from post-lactating animals. At mid-lactation, glucosidase II α and β subunits mRNA level increased 4-fold relative to the virgin stage. The immunoreactive protein of the two subunits also had 5 and 7-fold increases, respectively. The glucosidase II activity increased nearly 5-fold in mid-lactation compared to virgin stage. These data suggest possible transcriptional and post-transcriptional modulation of glucosidase II during development of the mouse mammary gland. Further, the striking similarity in the regulation of this enzyme and the previously studied glycosyltransferases, when combined with the data on the developmental profile of glucosidase I, indicates that common regulatory signaling cascades may control the enzymes of the glycosylation machinery in the mammary gland. (Supported by N.I.H. grant GM59943.)

Key Words: Glycosylation, Glucosidase II, Mammary gland

Growth & Development

W34 Impact of 5α-dihydrotestosterone on musculoskeletal status of mature laying hens. T. D. Faidley*, S. E. Nicolich, and D. R. Thompson, *Merck Research Laboratories, Somerville, NJ.*

Genetic selection for improved egg production has resulted in aged laying hens that are fragile and depleted of muscle. Selective androgen receptor modulation may offer potential to improve musculature and skeletal structure of these birds. "Spent hens" have become more of a liability than an asset to the industry. We hypothesized that compounds such as 5α- dihydrotestosterone (DHT) may result in muscle and bone gain, thus improving the health and value of aged layers. Subcutaneous injections of 3 mg/kg DHT (5X weekly) were compared to saline injections in mature laying hens (n=10). Hens were housed individually in cages and allowed unlimited access to feed and water. After 3 weeks, DHT treatment decreased ($P<0.05$) egg production (0% vs. 60%), feed consumption (72 g/d vs. 126 g/d), weight gain (-13 g vs. 58 g), and breast fillet as a % of carcass weight (7.2% vs. 8.1%). DHT treatment increased ($P<0.05$) comb redness (a*, 20 vs. 13); and weights of comb (31.2 g vs. 2.2 g), heart (10.6 g vs. 8.1 g), thigh muscle (72.9 g vs. 64.9 g), and metatarsus (23.1 g vs. 21.6 g). DHT treatment had no significant effect on weight of carcass (1337 g vs. 1227 g), whole breast (302 vs. 325), or femur (9.8 g vs. 9.3 g). Breast fillet weight tended to decrease ($P<0.1$) with DHT treatment (97 g vs. 103 g). In summary, DHT treatment was successful in halting egg production and in decreasing feed consumption, however, musculoskeletal effects were inconclusive. Further research is needed to determine if anabolic treatment of aged laying hens can improve welfare and/or economics of egg production.

Key Words: Androgen, Anabolic, Laying hens

W35 Fetus growth at day 78 of gestation in nutrient restricted ewes. M. M. Schwope*, W. J. Means, A. W. Wolf, B. W. Hess, and S. P. Ford, *University of Wyoming, Laramie WY/USA.*

ABSTRACT: Under-nutrition during early gestation can affect muscle development. Our purpose was to determine if fetal growth was affected by nutrient restriction of the gestating ewe. Control (C) ewes were fed 100% of the National Research Council (NRC) recommended diet for gestating ewes. Nutrient restricted (NR) ewes were fed 50% of NRC recommendations during days 28 to 78 of gestation. Control and NR ewes were euthanized (d 78 gestation) prior to removal of gravid uteri. The head and internal organs were removed after the fetus(s) were taken from the uterus. Eviscerated ewes and fetuses were hung by the *Achilles* tendon for 24 to 34 h at 4°C or 15°C, respectively. Subsequently, ewe and fetus *Longissimus dorsi* (Ld) and *Semitendinosus* (St) were removed. Whole body, eviscerated body, Ld, and St weights were recorded. Whole body weight tended ($P = 0.07$)to be lower in NR ewes, although ewe eviscerated weight was not different($P = 0.13$). Fetal whole body ($P = 0.49$) and eviscerated weights ($P = 0.58$) were not different. However, fetal Ld weight as percentage of fetal whole body weight and as percentage of eviscerated fetal weight were different because Ld weights of NR fetuses tended to be heavier ($P = 0.10$) than C fetuses, 3.34 and 2.92 g, respectively. This relationship was not found for fetal St ($P = 0.51$). Ewe Ld and St weights were not different ($P > 0.10$) as percentage of ewe whole body and eviscerated weight. Nutrient restriction of ewes during 28 to 78 d of gestation causes differential changes in muscle development.

Key Words: Fetus, Nutrient restriction, Muscle growth

W36 Dietary supplementation of nucleosides in late pregnant and lactating rats. C. M. De Jesus Arias*, C. E. Oliver, W. L. Keller, and C. S. Park, *North Dakota State University, Fargo ND/USA.*

The objective of this study was to evaluate if the inclusion of nucleosides in the diet of pregnant and lactating rats increases pup performance and immune status. Thirty-two female Sprague-Dawley rats, approximately 14 wk of age and 14 d of gestation, were randomly assigned to either control (nucleotide-free semi-purified diet; Purina Basal Diet # 5755, Ralston Purina, Richmond, IN) or nucleoside (control diet with nucleosides) treatments. The nucleosides were suspended in water by weight in the following proportions: adenosine (1.11), guanosine (1.17), uridine (1.01), cytidine (1.01), and thymidine (1.00). Rats were dosed by gavage daily beginning on d 14 of gestation through d 19 of lactation. Control rats received water, and treatment rats received nucleoside suspension at 0.64 mg/g body weight per d. Dams were weighed every 3 d during gestation and lactation. Feed intake was recorded every other day. On d 3 of lactation, litters were adjusted to 8 pups per dam. Litters were weighed every 3 days through d 19 of lactation. Upon sacrifice, blood was collected from dams (control, 1 dam; treatment, 2 dams) and pups on d 3, 10, 15, and 19 of lactation. Milk yield was estimated on d 15 of lactation. Milk was collected by miniaturized suction apparatus on d 3, 10, 15, and 19 of lactation. Serum and milk immunoglobulin G_{2a} (IgG_{2a}) concentrations were measured by ELISA. The average daily feed intake of the dams was not different between groups (control, 25.7 ± 9.4 g; treatment, 25.6 ± 10.4 g). The average daily gain from d 3 to d 15 of treatment pups was approximately 20% higher than that of control pups. Milk yield and IgG_{2a} in serum of the dams (averaged over the trial) were not different between groups. In the treatment group, a significant ($P = 0.02$) correlation ($r = 0.61$) existed between pup serum concentrations of IgG_{2a} (averaged over the trial) and milk IgG_{2a} (averaged over the trial). Our results indicate that nucleoside supplementation affects pup performance and serum IgG_{2a} concentration.

Key Words: Nucleosides, Pup performance, IgG_{2a}

W37 Effects of specific conjugated linoleic acid (CLA) isomers on growth characteristics in obese Zucker (fa/fa) rats. S. R. Sanders*[1], M. K. Teachey[1], A. Ptock[2], K. Kraemer[2], O. Hasselwander[2], E. J. Henriksen[1], and L. H. Baumgard[1], [1]*University of Arizona, Tucson AZ,* [2]*BASF AG, Ludwigshafen, Germany.*

Growing female obese Zucker (fa/fa) rats were treated (via intra-gastric gavage) for 21 d with either 1) vehicle [corn oil; 2 ml/kg body weight (BW)], 2) CLA mixture [50:50; *trans*-10, *cis*-12 and *cis*-9, *trans*-11 CLA], 3) *cis*-9, *trans*-11 CLA, or 4) *trans*-10, *cis*-12 CLA [all at 1.5 g CLA/kg BW]. Average daily gain (g/d) was significantly ($P<0.05$) reduced by *trans*-10, *cis*-12 CLA and the CLA mixture (2.50, 1.95, 2.69 and 1.39, for treatments 1, 2, 3 and 4, respectively). There was no treatment effect on average whole-body (minus heart and liver) composition (dry matter basis); fat (70.2%), protein (21.0%) and ash (4.3%). Compared to *cis*-9, *trans*-11 CLA, Zucker rats treated with *trans*-10, *cis*-12 and the CLA mixture had more carcass water (38.0, 40.8, 37.0 and 39.0% for treatments 1, 2, 3 and 4). There was no treatment effect on soleus and plantaris muscle weights. Treatment had no effect on heart or liver weight, nor heart or liver weight as a percentage of body weight, but *trans*-10, *cis*-12 CLA significantly increased liver lipid content (23.6, 22.0, 24.4 and 31.0% for treatments 1, 2, 3 and 4). Carcass fatty acid analysis indicated *cis*-9, *trans*-11 CLA content averaged 0.2, 2.0, 1.9 and 0.5 and *trans*-10, *cis*-12 CLA averaged <0.1, 1.2, 0.5 and 1.7 g/g of fat for treatments 1, 2, 3 and 4. Liver fatty acid analysis indicated *cis*-9, *trans*-11 CLA averaged 0.2, 1.3, 1.6 and 0.7 and *trans*-10, *cis*-12 CLA averaged <0.1, 0.7, 0.5 and 1.4 g/g of fat for treatments 1, 2, 3 and 4. Ratios of $C_{16:0}/C_{16:1}$ and $C_{18:0}/C_{18:1}$ (a proxy of Δ^9-desaturase capability) were not affected in hepatic lipids (9.8 and 1.8, respectively). The palmitate ratio was unaffected in carcass fats (4.3) but *trans*-10, *cis*-12 increased the ratio of $C_{18:0}/C_{18:1}$ (0.14, 0.12, 0.13 and 0.17 for treatments 1, 2, 3 and 4). Similar to previous reports, CLA increased hepatic lipid content, but the ability of CLA to alter body composition in obese Zucker rats remains questionable.

Key Words: CLA, Zucker Rat, Body Composition

W38 Body composition and carcass fatty acid profiles in hybrid striped bass treated with recombinant bovine somatotropin (rbST). S. R. Sanders*[1], J. L. Collier[2], L. H. Baumgard[1], and R. J. Collier[1,2], [1]*University of Arizona,* [2]*AquaTrophics Inc., Tucson, AZ.*

Eleven hybrid striped bass initially weighing 10 g were injected with passive integrated transponder tags and sorted into two 160 L tanks housed in an unheated greenhouse for 196d. Fish were randomly assigned to either IP injections of 0.5 ml rbST (100 mg/g body weight [BW]) or normal saline 4x during the first 33d. After d33, both groups were untreated, managed identically and harvested on d196. Fish were fed floating steelhead pellets 2x/d to achieve a total daily intake of 3-5% BW. Immediately after the 4th IP injection, due to ambient temperature changes, water temperature decreased from 22 to 17C, resulting in all fish consuming little if any feed. Feed intake resumed as temperatures returned to 22C (54d post 4th IP injection). Overall (d1-196) average daily gain (ADG) was not affected by treatment (557 mg/d), but ADG during IP injections (d1-56) was increased 42% by rbST, although not significant ($P>0.1$). Overall fish length gain was not altered by treatment (5.1 mm/d) however, during the IP injection phase, rbST increased ($P<0.001$) fish length gain (9.1 vs. 6.8 mm/d). Whole body composition analysis 140d post rbST administration indicated no difference in carcass dry matter (30.6%), fat (35%), protein (47.6%) or ash (16.6% [fat, protein and ash reported on a dry matter basis]). Fatty acid analysis indicated fish treated with rbST tended ($P=0.11$) to have a higher unsaturated fatty acid content (71.5 vs. 68.5%) and reduced *de novo* fatty acid contribution (C_{12}-$C_{14:1}$; 62 vs. 70 mg/g of fat). Fish treated with rbST had increased ($P=0.05$) proportions of long chain PUFA ($\geq C_{20:1}$; 177 vs. 129 mg/g fat), but no difference in the Δ^9-desaturase index ($C_{14:0}/C_{14:1}$, $C_{16:0}/C_{16:1}$, $C_{18:0}/C_{18:1}$). Body composition analysis indicates the beneficial effects of rbST on nutrient partitioning in young hybrid striped bass are lost or diluted over time (140d) following rbST treatment cessation; preliminary data suggest rbST enhances ADG and has beneficial effects on carcass fatty acid profile.

Key Words: rbST, Fish, Body composition

W39 Effect of restricted post-weaning growth resulting from reduced floor and feeder space on pig growth performance in a wean-to-finish system. B. F. Wolter[1], M. Ellis[2], J. M. DeDecker*[2], B. P. Corrigan[2], S. E. Curtis[2], E. N. Parr[3], and D. M. Webel[3], [1]*The Maschhoffs LLC, Carlyle, IL/USA,* [2]*University of Illinois, Urbana, IL/USA,* [3]*United Feeds, Inc., Sheridan, IN/USA.*

The effect of reduced post-weaning growth resulting from restricted floor and feeder-trough space on subsequent growth to slaughter was investigated in a wean-to-finish system. The study was carried out from weaning (5.5 0.01 kg BW; 17 d of age) to end of wk 25 post-weaning. Pigs (n =1,728) were used in a randomized block design with a 2 x 2 x 2 factorial arrangement of treatments: 1) floor space (High [0.630 m^2/pig] vs Low [0.315 m^2/pig]), 2) feeder-trough space (Unrestricted [4 cm/pig] vs Restricted [2 cm/pig]), and 3) duration of floor- and feeder-trough-space treatment (12 vs 14 wk post-weaning). The study was carried out in two periods; Period 1 was from weaning to the end of the treatment period (i.e. wk 12 or wk 14 post-weaning); Period 2 was from the end of the treatment period to wk 25, during which pigs on all treatments had the same floor and feeder space. During Period 1 both Low floor space and Restricted feeder space reduced ADFI ($P < 0.05$), but ADG was only reduced by Low floor space ($P < 0.01$). Pigs on treatment for 14 compared to 12 wk had higher ($P < 0.01$) ADG and ADFI. Neither feeder space nor treatment duration affected growth performance during Period 2. However, during Period 2 pigs on the Low compared to High floor space had increased ADG and G:F with the difference being greater for pigs on treatment for 14 than 12 wk (floor space x treatment duration interaction; $P < 0.05$). However, Low floor-space pigs tended ($P = 0.06$) to be lighter than High floor-space pigs at the end of Period 2. Carcass measures at end of Period 2 were not influenced ($P > 0.05$) by any treatment. In summary, pigs with restricted growth due to Low floor space until 12 or 14 wk post-weaning had increased growth and feed efficiency in the subsequent period to wk 25 post-weaning.

Key Words: Feed trough, Floor space, Pigs

W40 Refolding and purification of unprocessed porcine myostatin expressed in *E. coli*. H. J. Jin, Y. S. Kim*, and M. A. Dunn, *University of Hawaii, Honolulu HI*.

Myostatin is a growth and differentiation factor that suppresses skeletal muscle growth. Like many other TGF-β family member proteins, it is expressed as a prepropeptide that yields a mature form of myostatin after proteolytic processing at the paired basic residues (Arg-Lys-Arg-Arg). Since unprocessed pure myostatin is not currently available, the objective of this study was to purify unprocessed, refolded, porcine myostatin expressed in *E. coli*. Recombinant myostatin inclusion bodies harvested from *E. coli* were solubilized (1 mg/ml) in a buffer solution (50 mM CAPS, pH 11.0 containing 0.3% N-lauroylsarcosine and 1 mM DTT). Then, the inclusion body solution was diluted 100 times with refolding buffer (10 mM Tris buffer containing reduced and oxidized glutathionine, pH 8.5) and incubated at 4°C for 7 days. After dialysis in 20 mM Tris buffer (pH 8.5), the myostatin containing solution was subjected to anion exchange chromatography, and fractions containing the recombinant refolded myostatin were collected and combined. The combined solution was subjected to size exclusion chromatography to further purify the refolded myostatin. The purified myostatin formed a monomer under reduced conditions, and a dimmer under non-reduced conditions in SDS-PAGE analysis. Upon incubation with furin, an endopeptidase cleaving the paired basic residues, the unprocessed recombinant myostatin (50 kD) yielded 37 kD and 15 kD proteins, corresponding respectively to the prodomain and mature form of myostatin. Based on the current biochemical results, it is concluded that the refolded native form of unprocessed myostatin could be obtained from *E. coli* expressed inclusion bodies with high efficiency (15% yield) and that the unprocessed myostatin is a substrate for furin.

Key Words: Protein purification, Myostatin, Furin

W41 Effect of flax supplementation and a combined trenbolone acetate and estradiol implant on muscle satellite cell activity in beef cattle. J. D. Dunn*, A. T. Waylan, J. P. Kayser, E. K. Sissom, and B. J. Johnson, *Kansas State University, Manhattan*.

Objectives of this study were to evaluate the effects of 5% ground flaxseed (FLAX) and a combined TBA/E_2 growth promotant, Revalor-S, (IMP) on muscle satellite cell proliferation and differentiation. Sixteen yearling crossbred steers (initial BW = 397 kg) were randomly assigned to one of four treatments: 1) FLAX/IMP, 2) No FLAX/IMP, 3) FLAX/No IMP, 4) No FLAX/No IMP. Steers were allowed ad libitum access to a 93% concentrate diet for the entire study. Biopsy samples (3.5 g) were obtained from the longissimus muscle on d 0, 14, and 28. Satellite cells were isolated from the biopsy samples by enzymatic digestion and differential centrifugation. Satellite cells from each steer were resuspended in Dulbecco's Modified Eagle Medium (DMEM) with 10% fetal bovine serum and plated on two wells of two four-well tissue culture plates coated with reduced growth factor matrigel. Cultures from each steer were stained 24 h post-plating with Hoechst 33342 and nuclei were counted. At 96 h post-plating, cells from each steer were put into a fusion-promoting media of DMEM with 3% horse serum and 1.5 μg/mL BSA-linoleic acid. At 192 h, cultures were stained and counted for total and myotube nuclei. FLAX or IMP had no effect on satellite cell activity. However, nuclei at 24 h post-plating increased ($P<0.001$) from d 0 to 28 whereas total nuclei 192 h post-plating were unchanged ($P>0.10$). Myotube nuclei increased ($P<0.05$) from d 0 to 28 and thus fusion percentage also increased ($P<0.05$) from d 0 to 28. Cell yield per g of muscle tissue also increased ($P<0.05$) from d 0 to 28 while number of doublings decreased ($P<0.001$). These data suggest satellite cells were activated *in vivo* over the 28 d period and that the cells lost proliferative capacity when placed in culture. Also, the increases in myotube nuclei and fusion percentage over time indicate that isolated satellite cells became more inclined to differentiate into muscle over the feeding period regardless of FLAX or IMP.

Key Words: Satellite cell, Beef cattle, Trenbolone acetate

W42 Walking temporal variables of the sound and lame dairy cow. M. C. Nicodemus* and A. M. Chapa, *Mississippi State University, Mississippi State, MS*.

Lameness in dairy cattle is associated with milk production loss emphasizing the importance of early lameness detection. The human eye is limited in detecting subtle lameness so that additional detection methods are needed. Kinematic analysis has been effective in measuring subtle equine lameness, but research in dairy cattle is lacking. The objectives of this study were to determine sound and lame walking temporal variables of dairy cows. 5 sound lactating dairy cows and 5 lame cows with a lameness score between 3-5 were freely walked at a consistent velocity (1.2-1.4 m/s) through an enclosed, calibrated runway. 4 consistent, straight strides with easily detected hoof impacts were used from each cow. 60 Hz frame-by-frame analysis determined stride duration and the following temporal variables, which were calculated as percent of stride: stance durations, limb supports, and advanced placements and lift-offs. Means (SD) were calculated and paired t-tests performed to determine significant differences between left and right variables ($P<0.05$) in which variables were collapsed if no significant differences were found. The sound and lame walks were 4-beat stepping gaits with a lateral footfall sequence and alternating periods of bipedal and tripedal support. The sound walk was symmetrical as the left and right variables were insignificantly different while the lame walk demonstrated asymmetry. Stride duration was similar for both walks (sound: 1302+66 ms; lame: 1332+157 ms). In both walks the forelimbs spent 69+2% of the stride in stance and 67+3% in the hind with a 4+2% increase in stance in the lame limb. The majority of the stride in both gaits was spent in tripedal support (sound: 71+2%; lame: 78+4%) with equal bipedal support in the sound walk (diagonal: 13+2%; lateral: 16+3%) and unequal in the lame (diagonal: 7+4%; lateral: 15+5%). Advanced placements and lift-offs were regular in the sound walk, but the lateral and diagonal advanced lift-offs were irregular for the lame (lateral: RH-RF=23+1%, LH-LF=25+4%; diagonal: RF-LH= 31+1%, LF-RH=33+13%). Understanding the sound and lame walking temporal variables of the dairy cow will assist in the early detection of lameness.

Key Words: Dairy cow, Temporal variables, Lameness

W43 Effect of melengestrol acetate (MGA) on bovine muscle satellite cell proliferation and differentiation. E. K. Sissom*, J. P. Kayser, A. T. Waylan, J. D. Dunn, and B. J. Johnson, *Kansas State University, Manhattan*.

Melengestrol acetate (MGA) increases growth rate and inhibits estrus in feedlot heifers, but the effect of MGA on skeletal muscle growth and differentiation has not been studied. The purpose of these experiments was to investigate the effects of MGA on cultured bovine muscle satellite cell proliferation and differentiation. Satellite cells were used to assess the effects of MGA in a dose titration (0, 1 nM, 10 nM, 100 nM, 1 μM, 10 μM, and 100 μM) study on [^{3}H]-thymidine incorporation (TI). Cells were plated in Dulbecco's Modified Eagles Medium containing 10% fetal bovine serum. MGA was added at 0 or 48 h after plating. At 72 h, [^{3}H]-thymidine was added and incubated for 3 h. Cultures were allowed to differentiate, and nuclei were stained at 168 h with Hoechst 33342 to determine the effect of MGA (10 nM and 100 μM) addition the first 48 h on extent of differentiation and absolute myotube nuclei number. MGA addition resulted in a dose-dependent decrease ($P<0.05$) in DNA synthesis as measured by TI. The addition of 1 nM MGA did not affect ($P>0.05$) TI in bovine satellite cells as compared to a control medium (no MGA). The addition of 10 nM, 100 nM, and 1 μM MGA to cultures of proliferating bovine satellite cells reduced TI approximately 27, 25, and 28%, respectively, as compared to a control medium. MGA doses of 10 and 100 μM further reduced TI approximately, 50 and 57%, respectively, as compared to control cultures. MGA addition (10 nM) did not alter ($P>0.10$) the extent of differentiation or myotube nuclei number at 168 h. However, 100 μM MGA addition reduced ($P<0.05$) both fusion percentage and myotube nuclei number as compared to control cultures. These data obtained with concentrations $\geq$ 10 nM, a concentration several orders of magnitude greater than observed *in vivo*, suggest that MGA has pharmacological effects on bovine muscle cell proliferation and differentiation. This *in vitro* test system may be useful for evaluation of mechanism for anabolic compounds.

Key Words: Melengestrol acetate, Bovine, Muscle

W44 Ontogenetic changes in fatty acid profiles from different tissues in growing Holstein bull calves. H. C. Hafliger, III*, P. C. Gentry, S. R. Sanders, L. H. Baumgard, and R. J. Collier, *University of Arizona, Tucson, AZ*.

Holstein bull calves were euthanized at 4 wk (n=6) or 12 wk (n=5) of age. Calves were fed milk replacer until 12 d of age, then a corn-based starter feed was offered ad libitum. At slaughter, abdominal (kidney) fat, skeletal muscle and hepatic tissue were snap frozen in liquid nitrogen, then stored at -80°C until assayed. In skeletal muscle and liver tissue, few differences between specific fatty acids, besides the trans profile, or Δ^9-desaturase ratios due to age were detected. In skeletal muscle, age significantly increased the content of *trans*-10, *trans*-11, and *trans*-12 from 5.0, 1.7 and 1.1 to 26.3, 3.2 and 2.1 mg/g of fat, respectively. Furthermore, skeletal muscle *trans*-10, *cis*-12 CLA content was increased (P<0.09) from <0.1 to 0.5 mg/g at wk 4 and 12, but *cis*-9 *trans*-11 CLA was unaffected by age and averaged 1.2 mg/g of fat. In hepatic tissue the trans profile remained stable with increasing age averaging 1.3, 2.3, 35.1 and 5.3 mg/g for *trans*-6-8, *trans*-9, *trans*-10 and *trans*-11 $C_{18:1}$ respectively, but *trans*-12 $C_{18:1}$ increased (P<0.05) from 1.9 to 3.0 mg/g from wk 4 to 12. Hepatic *trans*-10, *cis*-12 and *cis*-9, *trans*-11 CLA content did not change with age and averaged 2.8 and 2.3 mg/g of fat. In abdominal fat, *cis*-9, *trans*-11 and *trans*-10, *cis*-12 CLA increased (P<0.05) from wk 4 to 12 (1.4 to 2.1 and <0.1 to 1.0 mg/g of fat). Similar to hepatic tissue and skeletal muscle, the trans profile markedly increased with age and this was especially true for *trans*-10 $C_{18:1}$ which increased from 18 to 47 mg/g of fat respectively. Adipose ratios of $C_{14:0}/C_{14:1}$, $C_{16:0}/C_{16:1}$, and $C_{18:0}/C_{18:1}$ (proxy for Δ^9-desaturase) increased with age (P<0.05) suggesting an increase in rumen biohydrogenation and/or a decrease in the Δ^9-desaturase system. Concentrations of $C_{12:0}$, $C_{14:0}$, and $C_{14:1}$ decreased (P>0.05) symptomatic of a decrease in *de novo* synthesis and/or an increase in long chain fatty acid (>$C_{16:1}$) incorporation, which was observed. Overall as calves aged, products of rumen biohydrogenation tended to accumulate in tissues while *de novo* synthesized fatty acids decreased in content.

Key Words: Fatty acid, CLA

W45 Tissue deposition rates and empty body composition of purebred and crossbred Nellore bulls. A. Berndt[1], G. M. da Cruz[2], G. F. Alleoni[2], M. Alencar[3], and D.P.D. Lanna*[1], [1]*ESALQ/USP, Piracicaba, SP, Brazil,* [2]*CPPSe, EMBRAPA, Sao Carlos, SP, Brazil,* [3]*IZ, Nova Odessa, SP, Brazil*.

Nellore (NE) and crossbred Canchim x Nellore (CN), Angus x Nellore (AN) and Simental x Nellore (SN) young bulls with initial empty body weight of 294.3 kg were fed for 92-161 days. The diet had 60% corn silage and 40% concentrate, 13.8% CP and 71.5% TDN on a dry matter basis. Daily empty body gains (kg/day) were 1.34 (AN), 1.12 (CN), 1.39 (SN) and 1.03 (NE). To obtain baseline body composition 14 animals of the same group were slaughtered before feedlot. Animals were slaughtered when estimated hot carcass weight was greater than 225 kg and ultrasound backfat thickness over 4 mm. Results are presented on table 1. Data were analysed by GLM proceeding of SAS (SAS, 2001). Crossbreeding greatly improved growth rates and protein deposition rates, particularly for Angus and Simental. Nellore purebred and Canchin crossbred had the fattest gain. Angus and Simental were leaner at the same empty body weight. Crossbreeding improves the potential for carcass production from Nellore cows, however calves have increased net protein and energy requirements.

Table 1:	AN	CN	SN	NE
Empty Body Composition(%)				
Water	55.69^b	54.21^b	57.64^a	52.00^c
Ether Extract	20.70^b	22.30^b	18.59^c	24.68^a
Protein	18.94^b	18.84^b	19.06^a	18.70^c
Ash	4.67^b	4.65^b	4.71^a	4.62^c
Energy (Mcal/kg)	3.02^b	3.16^b	2.82^c	3.38^a
Period gain rates (kg/day)				
Water	0.63^a	0.44^b	0.70^a	0.36^b
Ether Extract	0.41^a	0.44^a	0.37^a	0.45^a
Protein	0.25^a	0.20^b	0.26^a	0.18^c
Ash	0.066^a	0.055^b	0.068^a	0.050^b
Energy (Mcal/day)	5.25^a	5.22^a	4.98^a	5.24^a
Empty Body Gain Composition (%)				
Water	46.59^a	38.18^b	49.83^a	33.38^b
Ether Extract	30.21^b	39.24^a	26.78^b	44.39^a
Protein	18.29^a	17.73^b	18.51^a	17.41^b
Ash	4.91^a	4.85^{ab}	4.88^a	4.81^b
Energy (Mcal/day)	3.87^b	4.69^a	3.56^b	5.16^a

Key Words: Body composition, Tissue deposition rates, Nellore crossbred

W46 Morphological, behavioral and physiological measurements and their relationships with growth in beef cattle. K. Uetake*[1], T. Ishiwata[1], N. Abe[2], and T. Tanaka[1], [1]*School of Veterinary Medicine, Azabu University,* [2]*Faculty of Agriculture, Tamagawa University*.

The objective of this study was to determine the important parameters that regulate skeletal and longissimus muscle growth of beef cattle. Thirty-five crossbred (Japanese Black X Holstein) steers transported to a farm at 6-10 mo of age were managed under pen conditions. Each of the three pens (6.0 m X 9.5 m each) consisted of 11-12 steers. Serum and plasma samples from the jugular vein (concentrations of 7 hormones and 5 nutrients), ultrasonic images between the 6th and 7th rib (longissimus muscle area (LMA) and beef marbling score (BMS)), physical measurements (body weight and 10 parts of measurements), temperament scores at 5 different handling conditions, and behavioral observations using the instantaneous sampling with 10-min intervals for 2 h after morning and evening feedings (17 behavioral categories) were collected 1, 3, 5 mo after their entry into the farm. The average daily gain (ADG) and increase in LMA (ILMA) were also determined. A factor analysis with principal components and orthogonal varimax rotation determined 8 common clusters of measurements. As for growth-related measurements, ADG, the body weight 1 mo later, chest width, and the frequency of investigative behavior constituted a cluster. ILMA clustered with triglyceride and total cholesterol concentrations, LMA 1 mo later, and temperament scores at blood sampling and ultrasonic recording. ADG was not correlated with ILMA. BMS, leptin concentrations, thurl width, and the frequencies of lying and eating hay clustered together. Vitamin A concentrations entered a cluster of cathecholamine and cortisol concentrations, the frequency of grooming with pen facilities, entry order into the crush, and a temperament score on the scales. Vitamin A concentrations also tended to be correlated with insulin (r = 0.31, P = 0.07) and leptin (r = 0.27, P = 0.12) concentrations. Vitamin A may play an important role in the hormonal system(s) that regulate stress responses and longissimus muscle growth in the cattle.

Key Words: Beef cattle, Growth, Hormonal system

W47 Parameters for a refined model of ruminant growth and composition. J. W. Oltjen*[1], A. B. Pleasants[2], T. K. Soboleva[2], and V. H. Oddy[3], [1]*University of California, Davis, California,* [2]*Ag Research, Hamilton, New Zealand,* [3]*Meat and Livestock Australia, Sydney, Australia*.

We have refined the prediction system for ruminant animal growth and composition developed previously (Oltjen et al., 2000, Modelling Nutrient Utilization in Farm Animals, pp. 197-209, CABI Publishing, New York). The model represents body protein in two pools, viscera (v) and non-viscera (m). Using sheep datasets (Ferrell et al., 1986, Brit.

J. Nutr. 56:595) and New South Wales (unpublished), we have simplified the adjustments in the model for protein gain and loss of body fat (f) at near maintenance feeding, and more precisely estimated variable maintenance parameters. In the model muscle and viscera each have an upper bound (m* and v*, respectively). For muscle m* is genetically fixed; however, v* is affected by energy intake and muscle (protein) mass. Net energy intake above maintenance (NEG) is used for m and v gain before its use for fat accretion. The model is expressed in terms of energy (kJoules), with parameters k_m (0.353), c_m (1340 kJ d^{-1}), k_v (0.050 d^{-1}), cs_1 (0.314 d) and cs_2 (0.0416). Our new work has allowed simplification of previous equations so that the adjustment allowing gain of muscle or viscera at zero retained energy is f_a with e2 (3.4), and the previous equations for visceral growth have been simplified: $dm/dt = k_m$ (NEG + $c_m f_a$) (1 - m/m*); $dv/dt = k_v$ (v* - v); df/dt = NEG - dm/dt - dv/dt; $f_a = (1\text{-}m/m^*)^{e2}$; $v^* = cs_1$ MEI + cs_2 m. Maintenance energy (HP_{maint}) includes a variable coefficient on body weight: $HP_{maint} = \alpha_t$ $EBW^{0.75}$; $\alpha_t = \alpha_0$ (1 + b (MEI_t/MEI_0 - 1)(1-$e^{-t/\tau}$)) which results in a lag in change of maintenance requirements after intake changes from MEI_0 to MEI_t. Here EBW is empty body weight (kg), t is time (days), b (0.116) and τ (20.0 d) are constants; MEI_0 and α_0 are original values of intake and the maintenance coefficient. Sheep growth and composition is more accurately predicted with the revised model, and the model predicts sheep (Ferrell et al., 1986) empty body weight and fat content ($\pm$ 2.1 kg and 2.3%-units, respectively) more accurately than the current Australian feeding system. New additions refine predictions at levels of energy intake at or below maintenance.

Key Words: Growth, Composition, Mathematical modeling

W48 A dynamic model to predict the composition of fat-free matter gains in cattle. C. B. Williams*, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

Composition of empty BW (EBW) was described in terms of ether-extractable lipid (FAT) and fat-free matter(FFM) and the terms dEBW, dFAT, and dFFM were used to represent daily gains in these components. The dFFM is composed of protein, water, and ash, and a model was developed to predict the composition of dFFM. The conceptual approach used in model development was based on experimental data that showed as cattle grew from birth to maturity: a) the water content of FFM decreased and the protein and ash content increased, b) the protein content of FFM increased at a decreasing rate, and c) the protein:ash ratio in the FFM dry matter was fixed. These results suggest that as cattle grow and mature, gains in FFM would contain increasing amounts of protein, and the protein content of dFFM would increase at a decreasing rate as the dFFM content of dEBW decreased. Mathematical functions were formulated to represent these concepts, and a set of equations were derived to predict composition of dFFM. The protein content of dFFM was predicted as a function of the fraction of dEBW that was dFFM, FAT content of EBW, and dFFM. A fixed protein to ash ratio of 4.26:1 was used to calculate the amount of ash, and water was obtained as a residual. Gain in EBW, dFAT, and dFFM of Hereford x Angus steers from birth to 500 kg BW was simulated with a previously published model, and the above model was used to predict composition of dFFM. Predicted response curves of the EBW components over the growing period were similar in shape to observed data. Regression analysis was used to investigate the relationship between protein weight and FFM weight. Results showed a linear relationship with no evidence for curvilinearity in the predicted data and two experimental data sets. The coefficient on FFM in the predicted data was 0.249 (SE=0.0008), and in the two sets of experimental data, the coefficients on FFM were 0.247 (SE=0.003) and 0.25 (SE=0.004). These results support the conclusion that the model is capable of accurately representing the real system.

Key Words: Model, Body Composition, Protein

W49 The effect of nitrogen and forage source on feed efficiency and structural growth of prepubertal Holstein heifers. . P. J. Kononoff*[1], A. J. Heinrichs[1], and M. T. Gabler[1], [1]*Department of Dairy and Animal Science, The Pennsylvania State University.*

Eighty Holstein heifers averaging 189.6 + 6.8 kg of BW were used to evaluate the effects of forage level and rumen degradable nitrogen source on feed efficiency, structural growth, and body condition score (BCS). A randomized complete block design was used with heifers blocked according to weight (> 136.1 kg and < 136.1 kg). Heifers were assigned one of four treatment diets that were arranged in a 2 X 2 factorial. Treatments were constructed with two levels of forage (65 or 75%) and two protein sources. Forage sources were a mixture of corn silage and chopped timothy hay. Protein sources were either soybean meal (SBM) or a slow release urea product (Optigen 1200 , CPG Nutrients, Syracuse, NY), which was fed at 1.8 % of diet DM on low forage diets and 1.3 % of the diet DM on high forage diets. Body weight was measured weekly on two consecutive days and used to adjust intake to be approximately 2.2% of BW on a DM basis. Diets were fed as a TMR using the Calan Door System for measuring individual DMI. To determine change in structural growth, wither/hip height, hip width, and heart girth were measured weekly. In addition, blood samples were collected weekly 4 hr post feeding, to determine plasma urea nitrogen concentration. Average daily gain and feed efficiency did not differ between rations of different forage level or nitrogen source, averaging 0.87 + 0.05 kg and 7.4 + 0.5 respectively across treatments. Similarly, no differences were observed in change of wither/hip height, hip width, or heart girth. No differences were observed in plasma urea nitrogen, which averaged 12.3 + 0.4 mg/dl across treatments. Results of this experiment suggest that feeding moderately different levels of forage along with either SBM or Optigen 1200, does not result in any significant differences in main or interactive effects in feed efficiency or structural growth. Optigen 1200 can be used in heifer diets to effectively replace SBM as a nitrogen source in either high or low forage rations.

Key Words: Heifer growth, Feed efficiency, Slow release urea

W50 Effects of Prepubertal Growth Rate and POSILAC® Treatment of Replacement Dairy Heifers on Subsequent Milk Production and Economics. J. L. Vicini*[1], D. T. Galligan[2], S. E. Bettis[1], C. R. Bilby[1], S. C. Denham[1], R. L. Hintz[1], J. L. Holst[1], T. H. Klusmeyer[1], E. D. Plunkett[1], B. A. Crooker[3], W. J. Weber[3], and M. E. Van Amburgh[4], [1]*Monsanto Co, St. Louis, MO,* [2]*University of Pennsylvania, Kennett Square, PA,* [3]*University of Minnesota, St. Paul, MN,* [4]*Cornell University, Ithaca, NY.*

Holstein heifers (N = 715) at AZ, ID, MN and NY were used to determine if prepubertal growth rate and bST affect subsequent milk yield. Heifers were assigned randomly to pens and each site had 2 pens/treatment. Treatments were in a 2X3 factorial arrangement of three feed management programs with or without POSILAC (bST; 500 mg/14 d). Feed management programs were restricted intake of a control diet (CECP) to achieve an ADG of 0.6 to 0.8 kg/d, ad lib intake of a high energy diet (HECP), and ad lib intake of a high energy and high metabolizable protein diet (HEHP). Intake of CECP-bST heifers was matched to their CECP counterparts. The HECP and HEHP diets contained more energy than CECP and HEHP had more MP than CECP or HECP. At treatment initiation, BW averaged 162 (range: 135 to 189) kg and age averaged 172 (range: 128 to 211) d. After the 140-d treatment period, all heifers within a site were fed CECP for an ADG of 0.6 to 0.8 kg until 4 to 6 wks prior to calving. Lactation management was by normal site procedures and 634 heifers calved. Mean milk yield during the 252-d lactation was 28.4, 27.0, 27.5, 28.5, 27.9 and 26.1 kg/d for CECP, HECP, HEHP, CECP-bST, HECP-bST and HEHP-bST cows. Milk yield of HECP cows was less than CECP, as has been reported previously. Yields of CECP and HECP-bST cows did not differ. The reason HEHP-bST cows produced less milk is not known. Annual cost of producing 35 heifers per treatment was compared to CECP after correcting for change in number of replacements and accounting for feed costs and difference in milk yield. Costs were -2548, -3973, -443, -2692 and -2272 $US for HECP, HEHP, CECP-bST, HECP-bST and HEHP-bST. BST increased production of HECP cows to values similar to that of CECP cows, but the magnitude of change did not economically justify the use of bST.

Key Words: Heifers, Economics, bST

W51 Effects of feed management program and POSILAC® on prepubertal growth rate of replacement dairy heifers. J. L. Vicini*[1], S. E. Bettis[1], C. R. Bilby[1], S. C. Denham[1], R. L. Hintz[1], J. L. Holst[1], E. D. Plunkett[1], B. A. Crooker[2], W. J. Weber[2], H. Chester-Jones[2], and M. E. Van Amburgh[3], [1]*Monsanto Co., St. Louis, MO,* [2]*University of Minnesota, St. Paul, MN,* [3]*Cornell University, Ithaca, NY.*

Holstein heifers (N = 715) at AZ, ID, MN and NY were used to determine effects of bST and feeding additional energy and metabolizable protein (MP) on growth of replacement dairy heifers. Heifers were assigned randomly to pens and each site had two pens per treatment. Treatments were in a 2X3 factorial arrangement of three feed management programs with or without POSILAC (bST; 500 mg/14 d). Feed management programs were restricted intake of a control diet (CECP) to achieve an ADG of 0.6 to 0.8 kg, ad libitum intake of a high-energy diet (HECP), and ad libitum intake of a high energy and high MP diet (HEHP). Intake of CECP-bST heifers was matched to that of their CECP counterparts. The HECP and HEHP diets contained more energy than CECP. Diet CP content varied but HEHP had more MP than CECP or HECP. At treatment initiation, BW averaged 162 (range: 135 to 189) kg and age averaged 172 (range: 128 to 211) d. After the 140-d treatment period, all heifers within a site were fed CECP for an ADG of 0.6 to 0.8 kg until 4 to 6 wks prior to calving. During the 140-d treatment period, ADG for CECP, HECP, HEHP, CECP-bST, HECP-bST and HEHP-bST heifers was 0.77, 1.13, 1.21, 0.81, 1.13 and 1.29 kg, respectively. From the end of the treatment period to the first post-calving body weight, ADG was 0.52, 0.61, 0.63, 0.56, 0.64 and 0.64 kg, respectively. The percentage of heifers that became pregnant was 90.5, 89.1, 88.4, 95.9, 90.8 and 94.9% for CECP, HECP, HEHP, CECP-bST, HECP-bST and HEHP-bST heifers, respectively. Age at calving was 25.2, 22.4, 21.9, 24.9, 22.6 and 21.7 mo for CECP, HECP, HEHP, CECP-bST, HECP-bST and HEHP-bST heifers, respectively. HECP and HEHP increased ADG and decreased age at calving. BST did not significantly affect ADG. High-energy diets and bST did not adversely affect percent of heifers that became pregnant.

Key Words: Heifer, Growth, bST

W52 Associations between first lactation milk yields and pepubertal and peripubertal growth rates of Holstein heifers fed diets with different concentrations of protein and energy, protein:energy ratios and injected with bST. T.I. Belloso*, M. Liboni, M.S. Gulay, M.J. Hayen, K.C. Bachman, and H.H. Head, *University of Florida.*

Holstein heifers that completed 150 DIM were used to evaluate effects of diet, season of calving (SEA), and bST on milk yield (MY), body weight (BW) and body condition score (BCS). They were from a group of 121 heifers raised on four diets and bST in a 2x2x2 factorial arrangement of treatments. Diets fed from 100-120 d of age to 341 Kg BW contained 14%(L) or 19% (H) CP with energy at 100% (L) or 110% (H) of NRC (1989) to give four protein-energy diet groups LL (n=27), LH (n= 21), HL (n=24) and HH (n=20) that contained 50, 55, 65, and 73 g of CP/Mcal ME, respectively. Half the heifers in each group were injected biweekly with bST (POSILAC®, 500 mg bST/1.4 mL): 0.2 mL to 181 kg BW, 0.3 mL from 182-273 Kg BW, and 0.4 mL above 273 Kg BW to provide about 5.1, 7.6 and 10.2 mg bST/d, respectively. At 341 Kg BW all heifers were fed the same diet and bST was discontinued. Average daily BW gains (ADGs) to 341 kg BW were 0.894, 0.972, 1.007 and 0.989 kg/d. Diet affected days to reach final BW, ADG and height at withers ($P < 0.01$). ADG of bST injected heifers was about 4.1% greater but no effects of bST were detected for other growth measures. No differences in number of inseminations, calving age, or BW and BCS at calving were detected due to diet, bST or SEA. Mean MY through 150 DIM were 29.8 (LL), 30.3 (LH), 29.9 (HL) and 29.5 (HH) kg/d; means did not differ (P=0.9475) and no effects of bST (29.7 vs. 30.0 kg/d; P= 0.6731) or bST*SEA interaction (P=0.4545) were detected. There was a significant effect of SEA on mean MY ($P< 0.0112$); heifers that calved in cooler months produced more milk (2.8 kg/d) but the two- and three-factor interactions among diet, SEA and bST were not significant. During lactation BW and BCS did not differ due to diet, ADG, or bST. Overall, no positive or negative effects of feeding diets with different protein to energy concentrations and ratios or injecting bST were detected on breeding or calving traits or on MY.$\leq leq$

Key Words: Heifers, Milk yield, Growth rates

W53 IGF binding protein-2 reduces the mitogenic effect of IGF-I, but not des-IGF-I, in MAC-T bovine mammary epithelial cells. B. E. Etchebarne* and M. J. VandeHaar, *Michigan State University.*

Insulin-like growth factor-I is a potent mitogen of mammary epithelial cells. The IGF binding proteins (IGFBP) alter IGF bioactivity and can affect mammary cells directly. Very little work has been done with IGFBP-2, although it is the major IGFBP synthesized by mammary epithelial cells in vitro. Our objective was to determine the effect of IGFBP-2 on proliferation of bovine mammary epithelial cells. The MAC-T bovine mammary cell line was used in this study with cells plated at 5000 cells/well in 24-well plates coated with collagen. Cells were first incubated with 10% FBS for 24 h, then serum-free media for 48 h, and then with treatments for 72 h with one change of media at 48 h. In one study, treatments were 0, 1, 10, or 100 ng of IGF-I/ml along with 0, 10, or 100 ng of IGFBP-2. In a second study, treatments were no IGF-I, 1 ng/ml IGF-I, 1 ng/ml des-IGF-I, or 0.5 ng/ml betacellulin along with 0, 10, or 100 ng IGFBP-2. Cell proliferation was assessed by measuring incorporation of 3H-thymidine included in the media for the final 2 h of treatment. Both IGF-I and des-IGF-I at 1 ng/ml increased 3H-thymidine incorporation to 300% that of cells in control media ($P < 0.01$) and higher doses caused no further stimulation. In cells treated with 1 ng of IGF-I, IGFBP-2 at 100 ng (25 molar ratio excess) abolished 75% of the mitogenic effect of IGF-I ($P < 0.01$), and IGFBP-2 at 10 ng decreased proliferation slightly. Neither 10 nor 100 ng of IGFBP-2 had any effect in cells treated with 10 or 100 ng of IGF-I. IGFBP-2 also did not alter cell proliferation in cells treated with 1 ng of des-IGF-I, indicating that binding of IGFBP-2 to IGF-I was critical for its inhibitory effect. IGFBP-2 caused only a small decrease in basal cell proliferation. Betacellulin increased cell proliferation 25% and was not inhibited by IGFBP-2. In conclusion, IGFBP-2 decreases the mitogenic effect of IGF-I in cultured mammary epithelial cells, and the likely explanation for this effect is that it binds IGF-I, thereby preventing its interaction with the IGF-I receptor.

Key Words: Mammary epithelial cells, IGF-I, IGFBP-2

W54 Changes in plasma leptin from birth to puberty in dairy cattle. S. S. Block*, J. M. Smith, R. A. Ehrhardt, M. C. Diaz, R. P. Rhoads, M. E. Van Amburgh, and Y. R. Boisclair, *Cornell University.*

Leptin is thought to play a critical role in regulating energy metabolism throughout mammalian life. In growing dairy cattle, plasma leptin has been proposed as a partial mediator of the effects of nutrition on reproductive and mammary development. However, the developmental stage at which the plane of nutrition increases plasma leptin has not been well defined. Further, it is unknown whether the onset of puberty is affected by plasma leptin concentration in dairy cattle. To investigate these questions, two studies were performed. In the first study, neonatal calves were fed a milk replacer at levels supporting an average daily gain of 570 g/d (LOW) or 1210 g/d (HIGH). Weekly blood samples were obtained until slaughter at 105 kg body weight. Plasma leptin and adiposity remained constant in the LOW calves, but started to increase by the third wk of age in the HIGH calves. In the second study, 3-5 mo old heifers were fed a TMR supplemented with either calcium salts of palm fat or conjugated linoleic acids at levels sustaining an average daily gain of approximately 1.0 kg/d. Blood samples were obtained until the third post-pubertal luteal phase. The fat source had no effects on growth parameters, body composition, age at puberty or plasma leptin. Therefore, plasma leptin was reanalyzed as a function of age from start of treatment until slaughter. The plasma concentration of leptin remained nearly constant at 2.3 ng/ml until 1 yr of age when a rise in plasma leptin became obvious. Puberty occurred with equal frequency either around 1 yr of age when plasma leptin was nearly constant or later when leptin was rising rapidly. We conclude that plasma leptin is regulated by nutrition in early postnatal life, but that a sudden increase in plasma leptin is not required for the onset of puberty in dairy cattle.

Key Words: Leptin, Cattle, Puberty

W55 Calf socialization, non-forage fiber supplementation and rumen development in white and pink veal production systems. C. W. Cruywagen*[1] and L. C. Hoffman, [1]*University of Stellenbosch, South Africa*.

Thirty Holstein calves were used to compare pink (early weaning) and white (all-milk) veal production systems. Treatments were included where calves were able to socialize, while the effect of a non-forage fiber supplement (malt pellets) on abnormal oral behavior and rumen development was also investigated in the white veal system. Treatments were (i) white veal, milk replacer only, individual housing (WMI), (ii) white veal, milk replacer plus malt pellets (200 g/d), individual housing (WSI), (iii) white veal, milk replacer plus malt pellets, group housing (WSG), (iv) pink veal, early weaning (5 weeks), individual housing (PEI) and (v) pink veal, early weaning, group housing (PEG). All the white veal calves received milk replacer at an increasing level (3 L per day at 4 d, 18 L per day at 18 weeks). All calves were slaughtered at 18 weeks of age. Treatment had no effect on final body weight (P=.56) or total body weight gain (P=.45). Final body weights were 159.7, 169.2, 157.5, 166.2 and 161.2 kg and total body weight gains were 116.3, 128.9, 114.9, 125.0 and 120.2 kg for WMI, WSI, WSG, PEI and PEG, respectively. Carcass weight (P<.01) and dressing percentage (P<.001) were significantly affected by treatment, favoring the white veal treatments. Carcass weights were 90.3, 97.0, 86.6, 80.3 and 82.0 kg and dressing percentages were 56.6, 57.4, 55.0, 48.3 and 50.9 % for WMI, WSI, WSG, PEI and PEG, respectively. No rumen papillae development was observed in the all-milk treatments. Papillae development was negligible in white veal calves receiving supplemental malt pellets, but supplementation appeared to decrease tongue rolling. In the pink veal treatments, calf starter and finishing rations had a significant effect on the development of rumen papillae. Papillae length in these treatments varied between 4.5 and 11 mm and papillae density between 34 and 82 papillae cm^{-2}. It was concluded that the ability to socialize had no beneficial effect on any of the measured parameters and that supplemental malt pellets to prevent abnormal oral behavior had no effect on rumen development.

Key Words: Calves, Veal production, Rumen development

W56 Glucose metabolism in neonatal calves: effects of glucocorticoids and dependence on colostrum feeding. S. N. Sauter, J. W. Blum, and H. M. Hammon*, *University of Berne, Berne, Switzerland*.

Plasma glucose concentrations in new-born calves are influenced by colostrum (C) feeding and by glucocorticoids. We have tested the hypothesis that a high glucocorticoid status after birth as well as C feeding influence glucose metabolism in association with an increase of hepatic expression and activities of phosphoenolpyruvate carboxykinase (PEPCK; EC 4.1.1.32) and pyruvate carboxylase (PC; EC 6.4.1.1), two key enzymes of the hepatic gluconeogenesis. Calves (n=7, each group) of $GrFD^-$ and $GrFD^+$ were fed a milk-based formula (F), whereas calves of $GrCD^-$ and $GrCD^+$ were fed C. Dexamethasone (DEXA; 30 μg/[kg body weight × d]) was injected to calves of $GrFD^+$ and $GrCD^+$. Calves were fed C or F for the first 3 d, milk replacer on d 4, and were euthanized on d 5 of life. On d 1, 2, 4 and 5, plasma concentrations of glucose and insulin were measured, and on d 5 mRNA concentrations and activities of PEPCK and PC were measured in liver. Plasma glucose concentrations were higher ($P < 0.01$) in DEXA-treated calves than in controls on d 1, 2, 4, and 5 and were higher ($P < 0.05$) in C-fed than in F-fed calves on d 4. Plasma insulin concentrations were higher ($P < 0.001$) in DEXA-treated than in non-treated calves with a greater DEXA effect in C-fed calves on d 4 and 5. Mitochondrial PEPCK mRNA was higher ($P < 0.05$) in C-fed than in F-fed calves, but cytosolic PEPCK mRNA showed no group differences. Expression of PC was lower ($P < 0.001$) in DEXA-treated than in non-treated calves and tended to be lower ($P < 0.1$) in C-fed than in F-fed calves. Activities of PEPCK on d 5 decreased ($P < 0.001$) after DEXA treatment. PEPCK activities were higher ($P < 0.1$) in $GrCD^-$ than in $GrFD^-$. Activities of hepatic PC were lower ($P < 0.1$) in DEXA treated than in non-treated calves. Elevated plasma glucose concentrations after DEXA treatment did not result from increased hepatic gluconeogenic activities, because DEXA did not stimulate hepatic gluconeogenic enzymes. However, C feeding increased glucose concentrations possibly in part due to elevated hepatic gluconeogenesis.

Key Words: Neonatal calf, Gluconeogenesis, Dexamethasone

W57 Effects of age and accelerated growth on circulating concentrations of β-carotene and vitamins A, E, and D in milk replacer-fed calves. M. R. Foote*[1], B. J. Nonnecke[2], M. A. Fowler[3], B. L. Miller[3], T. E. Johnson[3], D. C. Beitz[1], and R. L. Horst[2], [1]*Iowa State University, Ames, IA,* [2]*National Animal Disease Center, ARS, USDA, Ames, IA,* [3]*Land O'Lakes Inc., Webster City, IA*.

Effects of feeding intensified diets to neonatal calves on growth performance and protein utilization have been described. However, effects of accelerated growth on other nutritional parameters, including vitamin utilization have not been described. The current study evaluated effects of age and plane of nutrition on the plasma concentrations of β-carotene and vitamins D (25-hydroxyvitamin D_3), A (retinol), and E (RRR-α-tocopherol) in milk replacer-fed calves. Twenty-two Holstein bull calves were fed a standard (0.57 kg/d of a 22% CP, 20% fat milk replacer, n=11) or an intensified (1.14 kg/d of a 28% CP, 20% fat milk replacer, n=11) diet from 1 through 7 wk of age. Texturized calf starter was fed ad libitum to calves fed the intensified diet, but limit-fed to calves on the standard diet to target an average daily weight gain of 0.36 kg. Average daily weight gain of the intensified calves (0.58 kg) was greater ($P < 0.05$) than that of the standard calves (0.26 kg). For all calves, β-carotene, retinol, and RRR-α-tocopherol concentrations in plasma decreased markedly ($P < 0.05$) from wk 1 to wk 2 of the study. 25-Hydroxyvitamin D_3 concentrations increased ($P < 0.05$) from wk 1 to wk 2. Concentrations of 25-hydroxyvitamin D_3 in calves fed the standard diet, however, decreased after wk 6, and were lower ($P < 0.05$) than intensified calves by wk 8. Unlike calves on the standard diet, calves fed an intensified diet had decreased ($P < 0.05$) concentrations of retinol and RRR-α-tocopherol by wk 8. These results suggest that feeding an intensified diet during the neonatal period may increase the demand for retinol and RRR-α-tocopherol. These demands are likely associated with increased growth. These age and dietary related changes in vitamin status may impact maturation of neonatal immune function ultimately affecting the neonatal calf's susceptibility to infectious disease.

Key Words: Calves, Vitamins, Growth

W58 Cell proliferation, apoptosis and B- and T-lymphocyte numbers in gut-associated lymphoid tissue and thymus of neonatal calves: Effets of dexamethasone (DEXA) and colostrum feeding. J. Norrman*, C. W. David, S. N. Sauter, H. M. Hammon, and J. W. Blum, *University of Berne, Berne, Switzerland*.

Glucocorticoids influence immune reactions. We have tested whether an enhanced glucocorticoid status induced by DEXA influences proliferation, apoptosis and B- and T-lymphocyte numbers in Peyer's patches (PP) of ileum and thymus. Calves fed colostrum (C) or a formula (F) that contained no immunoglobulin G, hormones and growth factors. DEXA (30 micrograms/kg body weight × d for 4 d) was i.m. injected to $GrFD^+$ and $GrCD^+$. On first 3 d calves of $GrCD^{--}$ and $GrCD^+$ were fed C and of $GrFD^{--}$ and $GrFD^+$ were fed F. On d 4 all calves received a milk replacer. There were significant effects ($P < 0.05$) of DEXA treatment (decrease of cell proliferation rates in follicles of PP and thymus, increase of apoptotic rate in follicles of PP and thymus, decrease of B-lymphocyte numbers in follicles of PP, increase of B-lymphocyte numbers in domes of PP, increase of T-lymphocyte numbers in follicles of PP and decrease of intraepithelial T-lymphocyte numbers). There were significant effects ($P < 0.05$) of C feeding (decrease of cell proliferation rates in follicles of PP, of B-lymphocyte numbers in interfollicular areas, domes and follicular-associated epithelium of PP; increase of cell proliferation rate in thymus). A DEXA × feeding interaction ($P < 0.001$) was found on cell proliferation rate of the thymus. In conclusion, DEXA treatment decreased cell proliferation rates in follicles of PP and thymus and enhanced apoptotic rates in follicles of PP, but DEXA effects on B- and T-lymphocyte numbers in PP compartments were not uniform. C feeding decreased cell proliferation rates in follicles of PP and numbers of B-lymphocytes in domes, in follicular-associated epithelium and in interfollicular areas of PP, but enhanced cell proliferation rates in thymus. Furthermore, C feeding selectively modulated DEXA effects in the thymus.

Key Words: Immune system, Lymphocyte, Neonatal calf

W59 Growth hormone, insulin, and glucose responses to infusion of amino acids in developing dairy calves. C. C. Williams*, I. A. Norris, C. C. Stanley, L. R. Gentry, D. L. Thompson, Jr., H. G. Bateman, and D. T. Gantt, *Louisiana State University Agricultural Center, Baton Rouge, LA*.

Twenty-four female Holstein calves were randomly assigned to one of 4 treatments to evaluate the efficacy of amino acids as growth hormone (GH) or insulin secretagogues in neonatal dairy calves and to monitor the changes in these responses as calves undergo the transition to becoming functional ruminant animals. Treatments consisted of physiological saline (SAL); arginine (ARG, 0.5 g/kg BW); aspartic acid (ASP, 0.5 g/kg BW); and ornithine (ORN, 0.5 g/kg BW). Challenges were conducted at 1 month of age (prior to weaning) and again at 3 months of age. After an overnight period of feed deprivation, calves were fitted with indwelling jugular catheters, and approximately 1 hour later treatment solutions were infused. Samples of blood were collected via catheters at -30, -20, -10, 0, 10, 20, 30, 40, 50, 60, 75, 90, 105, and 120 min relative to onset of infusions for measurement of plasma GH. Samples collected at minutes -10 through 60 were analyzed for plasma glucose and insulin concentrations. In addition, baseline plasma samples obtained at 0 min were analyzed for thyroxine (T4), albumin, and urea nitrogen (PUN). An acute release of GH was induced ($P < 0.05$) by ASP in calves at 1 and 3 months of age. Peak concentrations of GH in response to ASP were greater ($P < 0.05$) in calves at 1 month of age. There was a treatment by time interaction ($P < 0.05$) in response to ARG and ORN for insulin concentrations, with increases observed 10 to 20 min post infusion. Consequently, glucose concentrations were decreased ($P < 0.05$) 30 min after infusion in calves infused with ARG and ORN. Baseline concentrations of PUN and albumin were similar for all calves ($P > 0.05$). Concentrations of T4 were lower ($P < 0.05$) in SAL treated calves, but no biological significance of this effect could be determined. These data indicate that ASP is effective in eliciting a GH response in young dairy calves, while ARG and ORN stimulate insulin release.

Key Words: Growth hormone, Insulin, Secretagogue

W60 Cell proliferation and apoptosis rates and B- and T-lymphocytes numbers in gut-associated lymphoid tissues, thymus, and lymphnodes of pre-term and full-term calves. C. W. David, J. Norrman, H. M. Hammon, and J. W. Blum*, *University of Berne, Berne, Switzerland*.

Morbidity and mortality due to insufficient immune functions are high in neonatal calves, especially if born pre-term. We have studied cell proliferation and apoptosis rates and B- and T-lymphocyte numbers in Peyer's patches (PP) of ileum, thymus, and mesenterial and prescapular lymphnodes (LM and LP) in unfed pre-term calves (GrP; born 13 d before normal term) on d 1 and in unfed full-term calves on d 1 (GrF) and on d 5 of life after feeding colostrum (C) for 3 d (GrC). In GrF compared with GrP there were higher ($P<0.05$) numbers of proliferating and apoptotic cells in interfollicular areas of PP, of T-lymphocytes in follicles and interfollicular areas of PP and within villus epithelia, of proliferating and apoptotic cells in LM and LP, of B-lymphocytes in paracortex and follicles of LM and LP, and of proliferating cells in cortex and medulla of thymus. In GrF compared with GrC there were higher ($P<0.05$) numbers of proliferating cells in follicles, interfollicular areas and domes of PP, but lower ($P<0.05$) numbers of apoptotic cells in follicles, interfollicular areas and domes of PP, and lower numbers of T-lymphocytes in follicles and interfollicular areas of PP and within villus epithelia. In thymus cortex and medulla numbers of proliferating cells were higher ($P<0.05$) in GrC than in GrF. In conclusion, studied lymphoid sites differed with respect to ontogenetic changes. Apoptotic rates were generally smaller at all sites of PP in GrC than in GrF and proliferation rates increased from GrP to GrF and from GrF to GrC in all tissues. Numbers of T-lymphocytes in PP were higher in GrF than in GrP, but lower in PP in GrC than in GrF, except in the domes. Numbers of B-lymphocytes did not change in PP despite of high proliferation and low apoptotic rates, suggesting that they leave PP during the first days of life. Interestingly, C feeding decreased T-lymphocyte numbers and increased apoptotic rates in PP.

Key Words: Immunology, Lymphocytes, Neonatal calf

W61 Effects of dexamethasone (DEXA) and growth hormone (ST) on glucose production in calves. H. M. Hammon*[1], J. W. Blum[1], and S. S. Donkin[2], [1]*University of Berne, Berne, Switzerland,* [2]*Purdue University, West Lafayette, IN*.

The hypothesis was tested that DEXA and ST increase glucose production in calves by stimulating hepatic gluconeogenesis and glycogenolysis. Calves (n=24) were randomly divided in 4 groups and were treated from d 3 to d 42 of life. CNTL received saline, DX was daily treated with DEXA (30 μg/kg body weight; Azium, Schering-Plough, Terre Haute, IN), GH was treated with 500 mg recombinant bovine ST (rbST; Posilac, Monsanto, St. Louis, MO) every 14 d, and DXGH was treated with DEXA and rbST; dosages were as in DX and GH. Blood samples (d 3, 7, 14, 28, 42) and liver samples (d 7, 14, 28, 42) were analyzed for glucose and insulin in blood plasma and mRNA and activities of phosphoenolpyruvate carboxykinase (PEPCK; EC 4.1.1.32) and pyruvate carboxylase (PC; EC 6.4.1.1) as well as glycogen content in liver. Glucose concentrations in DXGH were highest ($P < 0.01$) on d 14 and were higher ($P < 0.05$) in DXGH than in DX on d 42. Insulin concentrations in DXGH were higher ($P < 0.05$) than in CNTL on d 7 and were higher ($P < 0.05$) than in all other groups from d 14 to d 42. Insulin concentrations in DX were higher ($P < 0.05$) than in CNTL from d 7 to d 28 and were higher ($P < 0.05$) in DX than in GH on d 28. Expression of PEPCK was lower ($P < 0.05$) on d 7 and 28 in DX and DXGH than in CNTL and GH and on d 14 and 42 was lower or tended to be lower in CNTL than in DX ($P < 0.05$) and DXGH ($P < 0.1$). Expression of PC was lower ($P < 0.05$) on d 7 in DX and DXGH than in CNTL and GH and on d 14 tended to be lower ($P < 0.1$) in DXGH than in CNTL. Activities of PEPCK were higher ($P < 0.05$) on d 14 and tended to be higher on d 28 ($P < 0.1$) in DXGH than in CNTL and DX. PC activities on d 14 and 28 were lower ($P < 0.05$) in DX and DXGH than in CNTL and GH. Glycogen content in liver was reduced by DEXA and ST alone and in combination. The data indicate age-dependent expression of mRNA and activity of gluconeogenic enzymes and an age-dependent response to DEXA and the combination of DEXA and ST, but no response to ST alone.

Key Words: Glucocorticoids, Gluconeogenesis, Growth hormone

W62 The response of the somatotropic axis to growth hormone (ST) and dexamethasone (DEXA) in calves. H. M. Hammon*[1], H. Sauerwein[2], J. W. Blum[1], and S. S. Donkin[3], [1]*University of Berne, Berne, Switzerland,* [2]*Bonn University, Germany,* [3]*Purdue University, West Lafayette, IN*.

Glucocorticoids inhibit postnatal growth, but stimulate the somatotropic axis around birth. We have studied effects of DEXA treatment on the somatotropic axis and on the response of the somatotropic axis to ST. Calves (n=24) were randomly divided in 4 groups and were treated from d 3 to d 42 of life. CNTL received saline, DX was daily injected DEXA (30 μg/kg body weight [BW]; Azium, Schering-Plough, Terre Haute, IN), GH was treated with 500 mg recombinant bovine ST (rbST; Posilac, Monsanto, St. Louis, MO) every 14 d, and DXGH was treated with DEXA and rbST; dosages were as in DX and GH. Blood samples (d 3, 7, 14, 28, and 42) and liver biopsy samples (d 7, 14, 28, and 42) were analyzed for ST, insulin-like growth factor (IGF)-I, and IGF binding protein (IGFBP)-3 in blood (by RIA or EIA) and ST receptor (STR) and IGF-I mRNA in liver (by Northern blot). BW increased ($P < 0.05$) in CNTL and GH up to d 42 and in DX and DXGH up to d 28, but then decreased ($P < 0.05$) up to d 42. Plasma ST concentrations were highest ($P < 0.01$) in GH on d 7 and 14 and were higher ($P < 0.05$) in DXGH than in CNTL and DX on d 7. Plasma IGF-I concentrations in DXGH were higher ($P < 0.05$) on d 7 and 14 than in CNTL and DX and were higher ($P < 0.05$) on d 28 than in all other groups. IGF-I concentrations on d 42 were lowest ($P < 0.05$) in DX. Plasma IGFBP-3 concentrations were higher ($P < 0.05$) on d 7 in DXGH than in CNTL and on d 14 and 28 in DXGH than in all other groups. IGFBP-3 concentrations were higher ($P < 0.05$) on d 28 in GH than in DX and on d 42 were lowest ($P < 0.05$) in DX. STR mRNA increased ($P < 0.05$) on d 14 in DXGH and decreased ($P < 0.05$) on d 42 in DX and DXGH. IGF-I mRNA increased ($P < 0.05$) on d 7 and 14 in GH and DXGH and decreased ($P < 0.05$) on d 42 in DX and DXGH. In conclusion, DEXA depressed postnatal growth, but not before d 42. There was a weak response of the somatotropic axis to ST, but DEXA greatly enhanced the response of the somatotropic axis to ST.

Key Words: Veal calves, Glucocorticoids, Somatotropic axis

W63 Small intestinal and colon morphometry, epithelial cell proliferation, and absorptive capacity in neonatal calves fed milk-derived insulin-like growth factor-I (IGF-I) or a colostrum extract. B. Roffler[1], A. Fäh[1], S. N. Sauter[1], H. M. Hammon[1], P. Gallmann[2], G. Brem[3], and J. W. Blum*[1], [1]*University of Berne, Berne, Switzerland,* [2]*Swiss Federal Dairy Research Station, Liebefeld, Switzerland,* [3]*University of Vienna, Vienna, Austria*.

Concentrations of non-nutritional factors, such as insulin-like growth factor-I (IGF-I), in bovine colostrum (C) are high and can modulate neonatal intestinal development and function. In neonatal calves we have investigated effects on intestinal epithelial cell morphology, proliferation, apoptosis, and absorption of feeding milk-born human IGF-I (hIGF-I) or a bovine C extract. Calves were fed a milk-based formula containing amounts of nutrients comparable as in C for the first 3 d and a milk replacer from d 4 on. Formula and milk replacer contained only traces of non-nutritional factors such as IGF-I and insulin. In experiment 1, supraphysiological amounts of hIGF-I (3.8 mg/L formula; secreted by transgenic rabbits with their milk) were added to the formula. Xylose appearance in blood (after feeding xylose on d 5) and intestinal parameters (after euthanasia on d 8) did not differ between groups. In experiment 2, an extract of first-milked bovine C that provided physiological amounts of IGF-I (0.50, 0.15 and 0.09 mg IGF-I/L formula on d 1, 2, and 3, respectively and 0.09 mg IGF-I/L milk replacer on d 4) was added to formula or milk replacer. Plasma xylose concentration in the control group was transiently higher than in calves fed the C extract. On d 5 (after euthanasia) villus circumferences and heights in small intestine and epithelial cell proliferation rate in intestine were higher in calves fed the C extract than in controls. In conclusion, orally administered hIGF-I from transgenic rabbits had no effect on the intestinal tract. However, feeding a bovine C extract enhanced intestinal villus size, although it appeared to transiently decrease the absorptive capacity.

Key Words: Growth factors, Intestine, Neonatal calves

W64 Effect of a short-term fast on intestinal disaccharidase activity and villus morphology in piglets suckling insulin-like growth factor-I (IGF-I) transgenic sows. J. L. Hartke*, M. H. Monaco, M. B. Wheeler, and S. D. Donovan, *University of Illinois, Urbana, IL*.

We have shown that oral IGF-I increases lactase (LPH) activity in piglets compared to non-IGF-I treated pigs. Differences in LPH activity were greatest when piglets were killed in a post-absorptive state. Further, stable isotope tracer studies suggest that IGF-I up-regulates LPH activity by suppressing proteolytic degradation of LPH and its precursor (proLPHh). The current study was conducted using transgenic sows that over-express IGF-I in milk. We hypothesized that LPH activity would be maintained at a higher level in piglets suckling IGF-I transgenic sows (IGF-I) than piglets suckling non-transgenic sows (CON) following a short-term fast. Following farrowing, litters were normalized to 10 piglets. On d6, 30 piglets suckling IGF sows and 30 piglets CON sows were randomly assigned to 3 treatments: fed piglets (0h) remained with the sow until euthanasia; fasted piglets were removed from the sow 6 (6h) or 12 hours (12h) prior to euthanasia on d7. Serum IGF-I and IGF-I binding proteins (IGFBP) were measured. Intestinal weight, length, protein and DNA content, disaccharidase activity and villus morphology were assessed. Serum IGF-I did not differ between CON and IGF-I, but was lower at 12h compared to 0h ($p<0.05$). Serum IGFBP-4 was lower at 12h compared to 0h and IGFBP-1 was higher at 12h vs. 0h or 6h ($p<0.02$). No effects of IGF-I or fasting were noted for jejunal protein or DNA content. Jejunal villus height and width were greater at 6h and 12h compared to 0h ($p<0.05$). Crypt depth differed between all groups and increased over time ($p<0.05$). Disaccharidase activity was unaffected by fed state, however IGF-I piglets had greater jejunal LPH ($p<0.01$) and sucrase ($p=0.025$) activities. In summary, short-term fasting reduced serum IGF-I, but increased villus surface area. Piglets suckling IGF-I sows exhibited increased disaccharidase activity regardless of fed state. (Funded by the USDA CSREES under project NRICGP 00-35206).

Key Words: IGF-I, Fasting, Disaccharidase

W65 Temporal and spatial expression of MUC1 mRNA along the gastrointestinal tract. C. Liu*, A. K. Erickson, and D. R. Henning, *South Dakota State University, Brookings SD/USA*.

MUC1, a heavily glycosylated membrane-associated mucin, is a major component of milk fat globule membranes (MFGM). The role that MUC1 from MFGM plays in the milieu between mother and offspring is not well understood. One possible role for milk MUC1 may be to mimic intestinal MUC1 on the surface of the epithelial cells lining the gastrointestinal (GI) tract in order to block the binding of bacteria to host epithelial cells. To begin to evaluate this possibility, we needed to know the MUC1 expression pattern along the GI tract, especially its distribution in the neonatal GI tract. Consequently, the current study was designed to evaluate temporal and spatial expression of MUC1 mRNA along the porcine GI tract. We used a reverse-transcription polymerase chain reaction (RT-PCR) approach with primers based on conserved sequences between human and mouse MUC1 to obtain the sequence of a 603 bp segment of porcine MUC1 cDNA from porcine lactating mamary gland. Using these same primers, we developed a quantitative RT-PCR procedure, with normalized beta-actin mRNA expression as an internal control, to assess the level of expression of MUC1 mRNA in different sections of the GI tract (stomach, duodenum, jejunum, ileum, and colon) from pigs of different ages (1-day, 3-weeks, 6-weeks, and 6-months). Our results indicate that MUC1 mRNA was expressed in a tissue-specific manner in porcine GI tracts with high expression in the stomach, moderate expression in the duodenum and colon, and virtually undetectable expression in the jejunum and ileum. No obvious age-related difference in MUC1 mRNA expression was detected.

Key Words: Porcine MUC1, mRNA expression, Gastrointestinal tract

W66 Cloning and characterization of the bovine class 1 and class 2 insulin-like growth factor-I mRNA . Y. Wang*, S. E. Price, D. E. Eversole, and H. Jiang, *Virginia Polytechnic Institute & State University*.

Insulin-like growth factor-I (IGF-I) is an important regulator of growth, development, and metabolism, and is the primary mediator of the growth-promoting activity of growth hormone (GH). The IGF-I polypeptide has been indicated to be generated from two classes of IGF-I mRNA containing either exon 1 (class 1IGF-I mRNA) or exon 2 (class 2 IGF-I mRNA) as the leader exon in several species. The objective of this study was to identify class 1 and class 2 IGF-I mRNA in cattle and compare their expression in different tissues, at different developmental stages, and in response to GH, as well as their translatability. Three class 1 IGF-I complementary DNA (cDNA) corresponding to three different transcription start sites in exon 1 and one class 2 IGF-I cDNA were identified from adult cattle liver using 5′ rapid amplification of cDNA ends (5′ RACE). The expression of these four IGF-I mRNA variants were further confirmed by ribonuclease protection assays (RPAs). The RPAs also revealed the presence of two additional class 1 and one additional class 2 IGF-I mRNA variants in bovine tissues. Both classes of IGF-I mRNA were expressed in all tissues examined, including adipose, brain, adrenal gland, heart, kidney, liver, lung, skeletal muscle, rumen, small intestine, pituitary, and spleen, with the highest level in liver and with class 1 being more abundant than class 2 IGF-I mRNA. The levels of both class 1 and class 2 IGF-I mRNA were higher in adult liver than in fetal liver ($P < 0.05$) and were coordinately increased in the liver of steers in response to GH administration ($P < 0.05$). In vitro translation analyses indicated that the luciferase reporter mRNA fused to a class 1 IGF-I 5′-untranslated region (5′-UTR) was translated approximately four times efficiently as the luciferase reporter mRNA fused to a class 2 IGF-I 5′-UTR. These results together suggest that as in several other species, IGF-I gene is also expressed as class 1 and class 2 transcripts in cattle, with class 1 IGF-I mRNA contributing more to the IGF-I polypeptide than class 2 IGF-I mRNA and that the expression of both classes of IGF-I mRNA is sensitive to developmental and hormonal (i.e. GH) factors.

Key Words: Cattle, Insulin like growth factor, 5′ Untranslated region

W67 Effects of fasting on serum insulin-like growth factor I and liver insulin-like growth factor I and growth hormone receptor mRNA in cattle . Y. Wang, S. Eleswarapu, W. E. Beal, W. S. Swecker, R. M. Akers, and H. Jiang*, *Virginia Polytechnic Institute & State University*.

Nutritional deprivation decreases blood insulin-like growth factor I (IGF-I) concentrations in a variety of species. In this study we tried to understand the underlying mechanism by determining the effects of fasting on the levels of total IGF-I and total GHR mRNA, as well as the levels of individual IGF-I and GHR mRNA variants in the liver of young steers. Fasting for nearly three days decreased the levels of serum IGF-I by 63% ($P < 0.01$) and this decrease was associated with a 75% decrease ($P < 0.01$) in total IGF-I mRNA in the liver. Fasting-induced decrease in liver IGF-I mRNA was further found to be caused by an equal decrease in the levels of both class 1 and class 2 IGF-I mRNA. In addition to IGF-I mRNA, fasting also decreased the levels of total GHR mRNA in the liver ($P < 0.05$) and this decrease was associated with a decrease in the levels of GHR mRNA variants 1C3 ($P < 0.05$) and 1A ($P = 0.08$). Fasting did not affect the levels of two other major GHR mRNA variants, 1B and 1C2. These results together suggest the following mechanism for fasting-induced decrease in blood IGF-I: fasting decreases the levels of GHR mRNA variants 1C3 and 1A in the liver, thereby decreasing GHR number, thereby decreasing GH-induced expression of IGF-I mRNA, thereby decreasing IGF-I secretion from the liver, and thereby decreasing blood IGF-I.

Key Words: Cattle, Insulin like growth factor, Liver

W68 The bovine growth hormone receptor promoter 1 is positively regulated by hepatocyte nuclear factor 4γ via the same element for hepatocyte nuclear factor 4α. H. Jiang*[1], M. C. Lucy[2], and Q. Xu[1], [1]*Virginia Polytechnic Institute & State University*, [2]*University of Missouri*.

Transcription of growth hormone receptor (GHR) gene is directed by multiple promoters. One promoter, named GHR P1, is responsible for liver- and postnatal stage-specific expression of the GHR mRNA variant 1A. We previously found that the region between nucleotide -218 and nucleotide -151 (relative to the transcription start site) of GHR P1 plays a role in regulating the promoter activity, through interactions with a transcription factor named hepatocyte nuclear factor 4α (HNF-4α). Deoxyribonuclease I footprint analyses and electrophoretic mobility shift assays indicated that the -218/-151 region might bind additional transcription factors in the liver. The objective of this study was to identify these additional transcription factors. Using the yeast-one hybrid system with the -218/-151 region as bait, we have isolated dozens of putative clones from a bovine liver cDNA library. Nucleotide sequencing identified several of the clones as hepatocyte nuclear factor 4γ (HNF-4γ) in addition to HNF-4α. Sequence analyses indicated that HNF-4γ and HNF-4α were encoded by different genes. Electrophoretic mobility shift assays revealed that HNF-4γ bound to the same element consisting of direct repeats of GGTCA between nucleotide -196 and nucleotide -178, to which HNF-4α had been found to bind. Ribonuclease protection assays indicated that like HNF-4α, HNF-4γ mRNA was highly expressed in liver, absent in most tissues, and more abundant in adult liver than in fetal liver. Co-transfection analyses demonstrated that HNF-4γ was able to enhance the GHR P1 activity in the presence or absence of HNF-4α and that this enhancement was dependent on the GGTCA repeats in the -196/-178 region. These results together suggest that HNF-4γ is another transcription factor for the liver- and postnatal stage-specific GHR P1, which positively regulate the GHR P1 activity via the same element for HNF-4α.

Key Words: Transcription factor, Growth hormone receptor, Liver

W69 Gender differences in serum insulin-like growth factor (IGF)-I and IGF binding proteins in eight exotic species. K.E. Govoni*, D. Goodman, R.M. Maclure, and S.A. Zinn, *University of Connecticut, Storrs, CT*.

The somatotropic axis is important in the regulation of growth. Increased concentrations of IGF-I and IGF binding protein (BP)-3 and decreased concentrations of IGFBP-2 are associated with increased growth rates in cattle and swine, however limited experiments have been done to examine the somatotropic axis in exotic species. The overall objective of this experiment was to determine serum concentrations of IGF-I, IGFBP-2 and IGFBP-3 in eight different exotic species. Serum samples were collected from male (M) and female (F) Java Banteng (5M; 3F), Bongo (5F; 3M), Addra Gazelle (4M; 4F), Giant Eland (6M; 2F), Nile Lechwe (5M; 3F), Roan Antelope (4M; 4F) and White Rhinoceros (4M; 4F). Blood samples were collected at two different time points, from each animal. At each time point, on average, F were older than M for all species except Nile Lechwe and White Rhinoceros. In addition, one sample was collected from eight (5M; 3F) Asian Elephants. Concentrations of IGF-I were determined by RIA and concentrations of IGFBP-3 and -2 were determined by Western Ligand Blot. Concentrations of IGF-I, IGFBP-3 and IGFBP-2 were detectable in all species. Average concentrations of IGF-I, IGFBP-3 and IGFBP-2, for all species, range from 17 to 442 ng/mL, 17 to 178 arbitrary units (AU) and 10 to 61 AU, respectively. In general, average concentrations of IGF-I and IGFBP-3 were greater in M and concentrations of IGFBP-2 were greater in F. Concentrations of IGF-I were greater in M than F ($P < 0.05$) in Java Banteng and in Nile Lechwe. There was a trend for greater concentrations in M than F ($P < 0.10$) in Bongo, Roan Antelope and White Rhinoceros. Concentrations of IGF-I increased with age in Java Banteng ($P = 0.08$) and in M Nile Lechwe ($P < 0.05$) and decreased in White Rhinoceros ($P = 0.07$) and F Nile Lechwe ($P < 0.05$). Concentrations of IGFBP-3 in Java Banteng were greater in M than F ($P < 0.01$) and increased with age ($P < 0.01$). Concentrations of IGFBP-2 were greater in F than M in Elephants ($P < 0.05$) and in Roan Antelope ($P = 0.08$). Although relatively few samples were collected, gender and age differences were observed, in some of the species, which parallel differences observed in domestic species.

Key Words: Insulin-like growth factor binding proteins, Insulin-like growth factor-I, Exotic species

Meat Science & Muscle Biology: Manipulation of Meat Quality

W70 Antioxidant effects of rosemary extract and whey powder on the oxidative stability of wiener sausages during 10 months frozen storage. S. A. Coronado[1], F. R. Dunshea[2], and N. P. Shah[1], [1]*Victoria University, Melbourne, Australia*, [2]*Victorian Institute of Animal Science, Werribee, Australia*.

Lipid oxidation is a major problem encountered in meat processing. Fishmeal is added directly to pig feed in order to provide protein or energy and to increase dietary vitamin A and D. However, high levels of fish oil render the animal fat more prone to oxidation while introducing fishy odors into the meat product. The aim of this study was to investigate the stability of wiener sausages prepared from pork obtained from pigs fed diets containing vitamin E (10 or 200 mg α-tocopheryl acetate per kg feed) and fish-meal (0 or 5%) and manufactured with or without an antioxidant (0.03% rosemary extract or 2.5% sweet whey). Twelve (Large White x Landrace) gilts were randomly allotted to four dietary treatments containing two levels of vitamin E (10 or 200 mg/kg) and two levels of fish meal (0 or 5%) using a 2 x 2 factorial design. Wiener sausages were manufactured from meat obtained from animals after slaughter and stored for 5 days at 4°C with or without antioxidants. The oxidative stability of the wieners was examined over ten months of frozen storage. Lipid oxidation in the product was measured by means of thiobarbituric acid reactive substances (TBARS) and fluorescence shift. Sensory evaluation of the product to detect oxidative changes was also carried out. No lipid oxidation as measured by TBARS, fluorescence shift and sensory analysis was observed in wieners stored at -20°C for ten months. The oxidative stability of wieners was unaffected ($P > 0.05$) by dietary treatments or by the addition of antioxidants. Dietary vitamin E lowered TBARS values and helped retard lipid oxidation.

Key Words: Antioxidant, Oxidation, Wiener

W71 Chemical composition and meat quality of pale, soft and exudative, and red, firm and non-exudative pork meat. F. Figueroa*[1], C. Perez[1], A. D. Alarcon[2], F. J. Solis[2], J. A. Jimenez[2], and G. Erosa[2], [1]*Universidad Autonoma de Baja California,* [2]*Universidad Autonoma de Chihuahua*.

The objective of this study was to evaluate the composition and meat quality of pale, soft and exudative (PSE) and red, firm and non-exudative (RFN) pork meat in twenty samples of Semimembranosus muscle (8 PSE and 12 RFN). The carcass measurements included weight of hot carcass with head (HCW), meat pH at 45 min (pH45) and at 24 h post mortem (pH24), the color coordinates L* (luminosity), a* (redness), and b* (yellowness) determined at 24 h post mortem. Measurements in meat included ash, organic matter (OM), water, dry matter (DM), crude protein (CP), water holding capacity (WHC), and free water (FW). PSE carcasses had similar HCW but lower pH45 that RFN, pH24 was similar in both types of meat. L* and b* were significantly ($P<0.05$) higher in PSE carcasses than RFN. There were no differences ($P>0.05$) in redness of meat. Water, DM, and CP contents were similar in both types of meat but PSE meat had higher ash and lower OM percentage. Both types of meat showed a negative correlation between water content and pH45, and between WHC and water content. WHC, L*, a*, and b* of PSE meat showed a negative correlation with pH45 while WHC of the same meat had a positive correlation with L*, a* and b*. A positive association between FW and pH45 of RFN meat was observed, as well as, between WHC and a*. It was concluded that PSE and RFN meat had similar chemical composition and meat quality except for ash content and meat yellowness which were higher in PSE meat.

Key Words: Meat quality, PSE pork meat, RFN pork meat

W72 SDS-PAGE profile of sarcoplasmic and myofibrillar proteins of pale, soft and exudative and red, firm and non exudative pork meat. F. Figueroa*[1], C. Perez[1], A. D. Alarcon[2], F. J. Solis[2], J. A. Jimenez[2], and G. Erosa[2], [1]*Universidad Autonoma de Baja California,* [2]*Universida Autonoma de Chihuahua*.

The objective of the study was to characterize the sarcoplasmic protein profile and myofibrillar components of pale, soft and exudative (PSE) and red, firm and non-exudative (RFN) pork meat. Three samples of Semitendinosus muscle from each type of meat were taken 24 h post mortem and analyzed by SDS-PAGE. Sarcoplasmic proteins recognized in both types of meat were phosphorylase, creatine kinase, enolase, α-glyceraldehyde phosphate dehydrogenase, phosphoglucomutase, pyruvate kinase, phosphoglycerate kinase, and a polypeptide of phosphofructokinase, and one of aldolase. The 84 and 27 kDa bands were observed only in RFN meat and attributed to phosphorilase-β-kinase and triase phosphate isomerase respectively. The myofibrillar proteins identified in both types of meat were a polypeptide of myosin, β-actinin, actin, and the ϵ-actinin. The proteins observed only in RFN meat were a polypeptide of α-actinin, a 58 kDa, and troponin I as well as two high molecular weight (MW) bands and four low MW components, whereas those found only in PSE meat were four low MW and two high MW non identify proteins. It was concluded that the main difference between PSE and normal or RFN meat are the 58 kDa myofibrillar component, as well as the 54 and 27 kDa sarcoplasimc protein found only in RFN meat, and the 73 and 33 kDa protein of PSE meat.

Key Words: PSE and RFN pork meat, Sarcoplasmic protein, Myofibrillar protein

W73 Structure and ultrastructure of pale, soft and exudative and red, firm and non-exudative pork meat. F. Figueroa*[1], C. Perez[1], A. D. Alarcon[2], F. J. Solis[2], J. A. Jimenez[2], and G. Erosa[2], [1]*Universidad Autonoma de Baja California,* [2]*Universida Autonoma de Chihuahua*.

Twelve samples of Semimembranosus muscle from pork were used to characterize the structure and ultrastructure of pale, soft and exudative (PSE) and red, firm, and non-exudative (RFN) pork meat. Observations from a scanning electron microscope showed that RFN fibers had a polygonal and straight shape with a lower interfibrillar and myofibrillar space than PSE fibers which showed an angular and flat shape with higher interfibrillar and myofibrillar space, and the absence of nuclei. Vast degradation of connective tissue was also observed in PSE meat. Differences between both types of meat were not clear when samples were examined under the optic Axiomat and the transmission electron microscopes. It was concluded that PSE meat has higher degradation of fibers, myofibrils and connective tissue than RFN muscle.

Key Words: PSE and RFN pork, Electron microscopy, Structure and ultrastructure

W74 Oxidative stability, shear force, and color of stored pork from pigs heterozygous for Rendement Napole and/or Halothane genes and consuming magnesium through drinking water. B. R. Frederick*, E. van Heugten, and M. T. See, *North Carolina State University, Raleigh, NC*.

Sixty-four pigs (117±0.7 kg BW) representing 1) non-carriers (NN/rn^+rn^+), 2) Rendement Napole carriers (NN/RN^-rn^+), 3) Halothane carriers (Nn/rn^+rn^+), and 4) carriers of both mutations (Nn/RN^-rn^+) in a factorial arrangement were individually penned and provided ad libitum access to feed (0.12% Mg) and water. Pigs were randomly allotted to receive 900 mg of Mg/L of drinking water from $MgSO_4$ for 0 or 2 d before harvest. Longissimus dorsi (LD) and Semimembranosus (SM) chops were placed on trays, wrapped, and stored at 4°C to simulate retail display for 8 d. The posterior LD was split, vacuum packed, and stored at 4°C for 25 or 45 d. The RN carriers, regardless of the Halothane gene ($N\_/RN^-rn^+$), had higher ($P<0.05$) initial lipid oxidation of SM (117 vs 98±3 μg malonadehyde (MDA)/kg of tissue), oxidation of LD and SM after 8 d of displayed storage (322 vs 159±14 and 399 vs 157±16 μg MDA/kg of tissue, respectively), LD Minolta L* (lightness) after 25 and 45 d of vacuum packed storage (61.6 vs 56.3±0.8 and 62.3 vs 56.7±0.7, respectively), LD Minolta a* (redness) after 25 d of vacuum packed storage (11.28 vs 10.06±0.15), and lower ($P<0.05$) LD shear force (3.05 vs 3.94±0.10 kg) than normal rn^+ pigs ($N\_/rn^+rn^+$). Halothane carriers, regardless of the RN gene ($Nn/rn^+\_$), had higher ($P<0.05$) LD Minolta L* after 25 d of vacuum packed storage (60.6 vs 57.3±0.8), cooking loss (29.3 vs 25.9±0.8%), and LD shear force (3.71 vs 3.28±0.10 kg) than Halothane normal ($NN/rn^+\_$) pigs. A genotype interaction was present for LD Minolta a* after 45 d of vacuum packed storage (9.81, 10.88, 9.64, and 12.95±0.3 for genotypes 1, 2, 3, and 4, respectively). Magnesium did not affect quality characteristics reported. However, the Napole mutation increased lipid oxidation of loin and ham muscles, tenderness of displayed loins and paleness and redness of vacuum packed loins. The Halothane mutation increased cooking loss and toughness of displayed and paleness of vacuum packed loins.

Key Words: Rendement Napole, Halothane, Magnesium

W75 The influence of dietary protein on market barrows and gilts supplemented creatine monohydrate in conjunction with a high glycemic carbohydrate. C. A. Stahl*[1], B. R. Wiegand[2], M. S. Carlson[1], D. L. McNamara[1], T. B. Schmidt[1], and E. P. Berg[1], [1]*University of Missouri, Columbia, MO,* [2]*Illinois State University, Normal, IL*.

Forty-eight Q-Max X Premier T-100 barrows and gilts (91 kg) were blocked by both weight and sex and assigned to one of 12 pens (four pigs/pen, 16 pigs/treatment) using a completely randomized design. Treatments 1 (basal diet consisting of a ground corn-soybean base) and 2 (basal diet supplemented with 0.92% creatine monohydrate (CMH) and 2.75% dextrose) were formulated to meet or exceed all NRC recommendations, while treatment 3 (basal diet supplemented with 0.92% CMH and 2.75% dextrose) was formulated to contain a minimum of 16% CP. All test diets were isocaloric and the CP ratio between barrows and gilts remained constant so that the synthetic levels of lysine were consistent within each treatment. Animal weight and feed disappearance was recorded at 7d intervals throughout the 28d testing duration to determine ADG and feed efficiency. In addition, real-time ultrasound was used to determine fat accretion and lean tissue development at the tenth rib. Upon completion of the growth study (d1-28), animals remained on experimental diets for an additional 5d to reach market weight. Treatment 3 barrows gained the least tenth rib fat (0.69; 0.43; 0.15; +/- 0.05cm; $P<0.0001$) and expressed the highest percentage fat free carcass lean (50.58; 52.22; 54.09; +/- 0.66%; $P=0.001$) after 28d on test. In addition, dietary treatment decreased the first (1.6; 1.7; 1.45 +/- 0.15cm; $P=0.02$), tenth (2.25; 2.03; 1.66 +/- 0.16cm; $P=0.03$) and last (2.50; 2.36; 1.75 +/- 0.20cm; $P=0.02$) rib fat depth of treatment 3 barrows after 33d supplementation. Conversely, no significant treatment differences were noted in the fat and lean tissue accretion of gilts. Moreover, diet did not significantly affect the meat quality parameters of barrow

and gilt carcasses measured at one and 21d postmortem. In conclusion, the data suggest that an increase in dietary CP significantly affects the body composition of barrows fed a combination of 0.92% CMH and 2.75% dextrose.

Key Words: Creatine, Lysine, Pigs

W76 Improving pork tenderness using hydrodynamic pressure. M. B. Solomon* and V. Pursel, *USDA-ARS, Beltsville, MD USA*.

Pork producers have implemented management strategies that have resulted in today's pork having less fat and more lean tissue which in turn have negatively influenced meat tenderness. The objective of this study was to determine whether hydrodynamic pressure processing (HDP) could improve pork tenderness. The longissimus (LM) muscles (left side) from 17 pork carcasses were excised within 1 h post-slaughter, vacuum packaged and aged (4 C) for 5 d then frozen (-10 C) for 3 months. A 15 cm frozen section (sirloin end) was removed from each LM and thawed (4 C) for 24 h. These sections were in turn divided in half and designated as anterior and posterior halves and randomly assigned to either HDP or control (C) treatment. HDP treatment consisted of a 1.3 cm thick flat steel plate fitted to the bottom of a 115-L plastic container filled with water. A 100 g of binary explosive was suspended 38 cm above the steel plate. Eight pork samples designated for HDP were vacuum packaged in one bag and placed on the steel plate and HDP treated. The remaining nine samples designated for HDP were vacuum packaged in one bag and placed on the steel plate and HDP treated. Two chops (2.5 cm thick each) were cut after HDP treatment from both the HDP treated and C sections for shear force evaluation. The HDP treatment consisting of eight samples improved 18.4% in shear force (C=7.08kg vs HDP=5.76kg). Percent improvement ranged from a low of -5.9% to a high of 35.3%. The HDP treatment consisting of nine samples improved 26.4% in shear force (C=7.51kg vs HDP=5.50kg). Percent improvement ranged from a low of 4.6% to a high of 46.1%. The combined average shear force improvement for HDP treatments was 22.6%. Results indicate that HDP enhances pork tenderness, however, a variability in meat sample response to HDP treatment exists.

Key Words: Pork, Tenderness, Hydrodynamic pressure

W77 Densitometric analysis of myofibrillar proteins in muscle samples from Angus bulls with high or low blood serum IGF-I concentration. A. Yilmaz[1], M. E. Davis*[1], R. C. M. Simmen[2], and M. Yamaguchi[3], [1]*Department of Animal Sciences, The Ohio State University,* [2]*Department of Animal Science, University of Florida,* [3]*Department of Veterinary Biosciences, The Ohio State University*.

The objective of this study was to determine possible changes in expression of myofibrillar proteins in muscle samples from bulls with high or low blood serum insulin-like growth factor I **(IGF-I)** concentration. Data were obtained from an experiment involving Angus beef cattle divergently selected on the basis of blood serum IGF-I concentration at the Eastern Ohio Resource Development Center. Selection was based on the mean IGF-I concentration of three blood samples taken at d 28, 42, and 56 of the 140-d postweaning test. Muscle samples were collected from carcasses of 43 bulls (21 high and 22 low line). Age at slaughter ranged from 374 to 443 d. Myofibrils were prepared using differential centrifugation and loaded on SDS-PAGE gels. Densities of each of the myofibrillar protein bands were determined using a laser scanning densitometer. Data were analyzed using SAS. All models used in this study included the fixed effect of year-line-season and the random effect of sire nested within year-line-season. Contrast analysis showed that a 35.2 32.1 ng/mL difference ($P < 0.28$) in mean IGF-I concentration of the high and low IGF-I line bulls did not result in line differences in density of the myofibrillar proteins, except that myosin light chain 2 was higher in low line than in high line bulls ($P < 0.05$) and troponin C density was higher in high line than in low line bulls ($P < 0.05$). Previous research, however, has shown that increasing amounts of troponin C loaded on a gel did not result in linear increases in the density of this molecule. A significant residual correlation between density of troponin T and IGF-I concentration measured at d 28 of the postweaning test was found (r = -0.44; $P = 0.05$). Significant cubic relationships of 32 kDa protein, myosin heavy chain, and alpha-actinin with mean IGF-I were detected. These results suggest that divergent selection for blood serum IGF-I concentration is not associated with changes in expression of most of the myofibrillar proteins, but some phenotypic relationships exist among these variables.

Key Words: Insulin-Like Growth Factor I, Myofibril, SDS-PAGE

W78 Effect of fish oil and/or canola oil supplementation to beef cattle fed finishing diets on animal performance, carcass quality, and fatty acid composition. M. H. Gillis*, S. K. Duckett, B. Jacob, K. R. Smith, and C. E Realini, *The University of Georgia, Athens*.

Twenty-four Angus x Hereford steers (387 kg) were used to determine the effect of fish oil and/or canola oil supplementation in a finishing diet on animal performance, meat quality and tissue fatty acid composition. Steers were randomly allotted to one of three diets: 1) basal high concentrate diet (NONE; 88% concentrate, 12% grass hay), 2) basal diet plus 4% canola oil (CA), or 3) basal diet plus 3% canola oil and 1% crude fish oil (FISHCA). All steers were implanted with Synovex-S at the initiation of the study and fed the basal diet (NONE) for the first 41 d. After 41 d on feed, animals were gradually switched to treatment diets over a two-week period. From d 56 to harvest (d 106), all steers received their appropriate treatment rations. At 24 h postmortem, carcass data was collected, and samples were removed from each carcass for subsequent fatty acid, sensory, shear force and lipid oxidation analyses. Data were analyzed with dietary treatment in the model. Average daily gain tended ($P = 0.07$) to be greater for FISHCA than NONE or CA during the final 50 d on feed when treatment diets were fed. Hot carcass weight, dressing percentage, fat thickness, ribeye area or yield grade did not differ ($P > 0.05$) between treatments. Marbling score and quality grade were higher ($P < 0.05$) for CA and FISHCA than NONE. Lipid oxidation (TBARS, mg malonaldehyde/kg sample) was greater ($P < 0.05$) for FISHCA than CA or NONE, and TBARS values increased ($P < 0.05$) over storage time in all treatments. Warner-Bratzler shear force (WBS) values tended ($P= 0.06$) to be higher for CA than FISHCA, with NONE being intermediate. Sensory panelist off-flavor scores were greater ($P < 0.05$) for FISHCA ground beef compared to NONE or CA, which did not differ ($P > 0.05$). Ground beef samples from steers fed NONE or FISHCA received higher ($P < 0.05$) juiciness and tenderness scores from sensory panelists compared to CA. Concentration of the cis-9, trans-11 CLA isomer was higher ($P < 0.05$) in ground beef from FISHCA than NONE or CA, which were similar ($P > 0.05$). Feeding supplemental oils increased marbling score and quality grades. Addition of fish oil with canola oil increased CLA concentration, lipid oxidation, and off-flavors of ground beef.

Key Words: Beef, Fish oil, CLA

W79 Effect of genotype and diet on daily weight gain and carcass quality traits. I. Holló[1], E. Szücs[2], G. Holló[2], J. Seregi[1], Z. Andrássy[1], Cs. Abrahám*[2], and I. Repa, [1]*University of Kaposvár, Kaposvár H-7401,* [2]*Szent István University, Gödöllö H-2103*.

The effect of feeding extensive (E) vs. intensive (I) diets on performance and carcass quality was compared using Holstein-Friesian (HF) and Hungarian Grey (HG) growing-finishing bulls (N=40). Means for initial weight and age for HF and HG were 293±36 kg and 321±69 day, respectively. Half of the breed groups were fed either grass silage/grass and low concentrate (E) or maize silage and high concentrate (I) based rations. The dietary energy levels in groups E and I were 73.7 and 92.7 MJ/kg DM, respectively (P<0.001). Live weight was recorded at monthly intervals and daily feed intake was measured. In group E and I days on feed lasted for 221 and 201, respectively. The highest ADG (1332±115 g/d, P<0.001) was recorded in the intensively fed group after the whole growing-finishing period. ADG of HF bulls in group E was lower, than that of their HG counterparts (764±91 vs. 837±102 g/d, P<0.001). The highest growth rate was recorded in the E of HG groups (1098±409 g/d, P<0.001) in the first 64 days of feeding, with lower ADG of their HF counterparts from between 0 - 93 days on feed (785±143 g/d, P<0.001). Within the E group, higher relative growth rate was recorded in HG than HF (P<0.001). Higher final weights were recorded in I group in comparison with that of group E (HF 564±12 and HG 546±49 kg vs. HF 473±20 and HG 467±61 kg, P<0.001 respectively). Carcass weight and length, amount of perinephric and trimmed fat were higher in group I (P<0.01), as well. Higher carcass lean meat content was recorded in HG breed. For treatments E and I means were 71.0 and 67.5%, respectively. The ratio of carcass bone varied in line with the four feet weight. Findings reveal that considerations on the utilization of the native HG

breed on development of novel beef cattle production systems especially on roughage based diets seems to be justified.

Key Words: Feeding intensity, Breed difference, Carcass quality

W80 Evaluation of marbling by US scoring system and video image analysis. J. Tözsér[1], I. Holló[2], G. Holló[2], E. Szücs*[1], R. Zándoki[1], J. Seregi[2], and I. Repa[2], [1]*Szent István University, Gödöllö, H-2103,* [2]*University of Kaposvár, Kaposvár H-7401.*

The visible proportion and distribution of intramuscular fat in M. longissimus dorsi, called marbling, is the most important factor influencing quality grade in the United States and Canada (Boggs et al, 1995). In Europe carcass value is determined by conformation and fatness traits, in spite of it, marbling is often demanded as a primary quality trait of beef by consumers or in labeled products (Chambaz et al, 2002). There have been several methods developed to evaluate intramuscular fat content (Baker, 1986; Rekaya et al, 1999; Hassen et al, 1999; Chambaz et al, 2002). The aim of this research was to determine the correlation between results received by subjective scoring (USA, 1-6) and by video image analysis (VIA). Native Hungarian Grey (HG), and Holstein-Friesian growing-finishing bulls were housed in confinement on deep litter and fed on corn silage, hay and concentrate (6 kg/day) based diets for 210 days in two groups with 10 head of each. Average age and weight at slaughter for HG and HF were 552 and 474 days, and 545 and 578 kg, respectively. Pictures of longissimus muscle cross section were taken by video camera and analyzed by software Terlet V 7.0 developed by Mosoni (2000). Marbling is evaluated using brightness of picture taken. Surfaces with more than 200 brightness units were measured in two replications. Data processing was made with SPSS10 statistical program package. Marbling score for HG bulls was 1.5 when evaluated by subjective scoring and 1.29% determined by VIA. For HF bulls, the values were 1.1 scores and 0.43%, respectively. In terms of marbling significant differences ($P<0.01$) were established between breeds using VIA, while no significant differences were recorded by subjective scoring ($P<0.1$). Correlations between the two marbling evaluation procedures for both breeds (HG: VIA=0.1133+0.7878*USA, r=0.71; HF: VIA=-0.7556+1.0778*USA, r=0.86) suggested the appropriateness of both methods in the evaluation of marbling in beef.

Key Words: Marbling, VIA, Cattle breeds

W81 Evaluation of ultrasonic estimates of fat thickness and *longissimus* muscle area in de-haired hanging beef carcasses at chain speed. T. Perkins* and A. Rimal, *Southwest Missouri State University.*

The objective of this study was to evaluate the accuracy of real-time ultrasound measurements of *longissimus* muscle area (REAU) and 12th-rib fat thickness (FTU) in hanging de-haired beef carcasses at regular plant chain speed. A certified ultrasound technician took measurements on 387 head of slaughter cattle using an ALOKA 500V ultrasound unit and Beef Image Analysis (BIA) image interpretation computer software. Carcasses were ultrasounded immediately after de-hairing at a pace of one carcass every 12-15 seconds in a hanging position on the rail. Carcass ribeye area (REAC), carcass fat thickness (FTC) and calculated yield grade (CYG) were collected 24 hours after harvest and scanning. Means for hot carcass weight (HCW), REAU, FTU, REAC, FTC, and CYG were 368.5 32.9 kg, 83.44 9.96 cm^2, 1.10 0.36 cm, 83.79 10.5 cm^2, 1.08 0.46 cm and , respectively. Pearson correlations for REAU and REAC, FTU and FTC, REAC and CYG, REAU and CYG, FTC and CYG, and FTU and CYG were 0.53, 0.72, -0.77, -0.39, 0.86 and 0.65, respectively. These data suggest that ultrasound can accurately assess carcass compositional differences in hanging beef at chain speed. However, the removal of hair prior to scanning is a must to keep up with the speed of the carcass movement every twelve to fifteen seconds.

Key Words: Ultrasound, De-haired, Beef

W82 Effect of breed, sex, and slaughter weight on meat quality of lambs. J. Peinado*[1], P. De Miguel[2], D. García[3], M. Cortés[1], and M.I. Gracia[1], [1]*Imasde Agropecuaria, S.L., Spain,* [2]*GRUPO CARNICO MAGNUS, S.A., Spain,* [3]*Estacin Tecnolgica de la Carne de Guijuelo, Spain.*

A total of 480 lambs was used to study the influence of breed, sex, and slaughter weight (SW) on meat quality. There were eight treatments arranged factorially with two breeds (Castellana *vs* Merino), two sexes (female *vs* male), and two SW (26 *vs* 31 kg). Each treatment was replicated six times and ten lambs penned together formed the experimental unit. All the lambs received a common pelleted diet based on barley, wheat, and soybean meal. Wheat straw was offered *ad libitum*. Following slaughter, carcasses were stored for 24 h at 2 ± 1 C. Then, samples from the *longissimus* muscle from the left side of two lambs per replicate were obtained and divided into two portions. Water holding capacity, chemical composition, and color were measured in the first portion (L1, 6th to 10th dorsal rib) and shear force was measured in the second portion (L2, 11th to 13th dorsal rib). Samples from L1 were stored at -20 C, whereas samples from L2 were previously stored for three d at 4 C and then frozen. Loins from Castellano lambs had more fat content than loins from Merino lambs (4.6 *vs* 4.2 %; $P < 0.05$), and loins from females had more fat content than loins from males (4.8 *vs* 4.0 %;$P < 0.05$). Loins from females had lower a* and higher L* values ($P < 0.05$), and had less cooking losses (21.3 *vs* 19 %; $P < 0.05$) than loins from males. An increase in slaughter weight increased fat content of the loin (5.30 *vs* 3.49 %; $P < 0.05$). Loins from lambs slaughtered at 31 kg had greater cooking losses (21.4 *vs* 18.9 %; $P < 0.05$), and higher a* but lower L* values ($P < 0.05$) than loins from lambs slaughtered at 26 kg. Also, SW tended to increase shear force (Warner-Bratzler values of 7.67 and 6.74 kp; $P < 0.10$). It is concluded that meat quality of lambs can be adapted to different markets by manipulating breed, sex, and weight at slaughter.

Key Words: Lambs, Slaughter weight, Meat quality

W83 Cholesterol level and sensory evaluation of lambs of various hair x wool sheep crosses. S. Wang*, T. D. Bunch, R. C. Evans, C. P. Brenand, D. R. Whittier, and B. J. Taylor, *Utah State University, Logan, Utah, USA.*

The cholesterol level and sensory evaluation were compared in six lambs from each of the following genotypes: 1) St. Croix hair sheep, 2) St. Croix x wool sheep, 3) Callipyge wool x St. Croix, 4) Dorper hair sheep x St. Croix, 5) Dorper x wool, Callipyge wool x wool, and 6) wool x wool. Meat cholesterol was extracted by chloroform-methanol mixture and the cholesterol levels were determined by spectrophotometric measurement of the color generated by the reaction of cholesterol with glacial acetic acid-$FeSO_4$-H_2SO_4. A 9-point hedonic ballot ranging from 9 (like extremely) to 1 (dislike extremely) was used for the sensory evaluation based on the following index: flavor, tenderness, juiciness and overall quality. The general linear model (GLM) ANOVA procedures and Fisher's LSD multiple-comparison test were used to determine the difference among genotypes. Cholesterol levels (mg/100g fresh meat) were 249.6, 170.1, 73.2, 130.7, 149.2, 50.4 and 116.5, respectively. The cholesterol level in the hair sheep (St. Croix) is significantly higher ($P < 0.05$) than all the other genotypes and the lowest is in the Callipyge crosses. Significant differences ($P < 0.05$) existed between genotypes for every sensory characteristic measured. St. Croix had the highest overall sensory acceptance rating (6.8) and the lowest in the Callipyge wool x wool. As cholesterol correlates to fat composition of the tissue these differences may account for the differences found between crosses in the sensory evaluation data.

Key Words: Cholesterol, Sensory evaluation, Sheep

Breeding & Genetics

W84 Estimation of correlations of reproductive traits with blood serum IGF-I concentration in Angus beef cattle. A. Yilmaz[1], M. E. Davis*[1], R. C. M. Simmen[2], and H. C. Hines[1], [1]*Department of Animal Sciences, The Ohio State University,* [2]*Department of Animal Science, University of Florida.*

The objectives of this study were to obtain estimates of heritabilities and genetic (rA1A2), environmental (rE1E2), and phenotypic (rP1P2) correlations of insulin-like growth factor I (IGF-I) concentration with scrotal circumference (SCR), percentage of motile (MOT) and morpho-

logically normal (NORMAL) sperm cells, calving rate (CR), and age of heifers at first calving (AFC). Data were obtained from an ongoing experiment that involves Angus beef cattle divergently selected on the basis of blood serum IGF-I concentration at the Eastern Ohio Resource Development Center. Selection was based on the mean IGF-I concentration of three blood samples taken at d 28, 42, and 56 of the 140-d postweaning test. Data were analyzed using SAS and MTDFREML. Fixed effects, which included birth year, IGF-I line effect, season of birth, age of dam, sex, mating number and on-test age, were tested for significance and only significant effects were included in the subsequent analyses. (Co)variance estimates were obtained using an animal model that did not include maternal genetic or permanent environmental effects. Calving rate was coded as either 1 (conceived) or 100 (did not conceive) and was treated as a repeated measure. Environmental correlations of calving rate with mean IGF-I concentration for matings other than the first were ignored, because including IGF-I measurements for each mating resulted in non-permissible heritability estimates for IGF-I measurements. Correlations with mean IGF-I concentration were small, except that genetic correlations of mean IGF-I with SCR, MOT, and CR were moderate to high. These results suggest that selection for blood serum IGF-I concentration should result in a decrease in age at first calving and increases in all remaining variables.

				Mean IGF-I	
Variable	N	h2	rA1A2	rE1E2	rP1P2
Mean IGF-I	1,848	0.32			
SCR	825	0.51	0.35	0.01	0.14
MOT	596	0.09	0.43	0.02	0.07
NORMAL	765	0.43	0.00	0.09	0.07
CR	2,092	0.13	-0.41	0.02	-0.06
AFC	294	0.26	0.14	-0.09	-0.10

Key Words: Insulin-Like Growth Factor I, (Co)variance Component Estimation, Reproduction

W85 Molecular characterisation of myostatin gene in mexican Beefmaster cattle. A. M. Sifuentes-Rincon[1], X. F. De la Rosa-Reyna*[1], A. Del Bosque [2], and H. A. Barrera-Saldana[1], [1]*Centro de Biotecnologia Genomica-IPN,* [2]*Fac. de Agronomia. UANL.*

The production of animals with superior muscle structure is of great importance to food animal agriculture. Dysfunction of myostatin gene has been reported in mammals. In bovine the loss of this gene activity have been associated to double-muscled phenotype present in some european cattle breeds. Beefmaster is one of the main breeds in Tamaulipas, Mexico. Due to the role of myostatin gene in muscle development, the objective of this study was to analyze a coding region containing mutations which potentially altering the myostatin gene expression. Eighty-seven individuals of Beefmaster cattle were blood- sampled and the DNA extracted was used to amplify a 548-bp from exon II. Mutation analysis of this region was achieved using both Base Excision Sequencing Scanning and nucleotide sequencing. We detected some sequence variations in our tested population: nt 374-51 (T-C Transition); nt 374-50 (Transition G-A); nt 414 (Transition C-T); nt 374-16 (Deletion 1). The nucleotide changes founded were grouped in three haplotypes A,B and C. The first one does not contain mutations, whereas B and C present the 3 transitions and the deletion changes, respectively. The data from this study indicate that mutations founded in Beefmaster were identical to those previously reported in other non double-muscled breeds. Therefore exon II from myostatin gene does not make a useful molecular marker to selection of those individuals with superior muscle mass in Beefmaster cattle.

Key Words: Myostatin, Beefmaster cattle, Mutation

W86 Association between promoter region insulin-like growth factor-I polymorphism and genetic merit for production traits in Holstein sires. G. W. Kazmer*[1], [1]*University of Connecticut.*

DNA was extracted from blood samples from dairy sires at the time of enrollment into a progeny test program. Of these animals, genetic merit information based on at least 40 daughters eventually became available on 309 sires, from which population means and standard deviations (SD) were calculated. 204 bulls were found to be either one SD greater than or one SD less than the mean for either one or more of the following traits: milk yield (MY), fat yield (FY), fat percent (F%), protein yield (PY) and protein percent (P%) and were included in subsequent analysis. A 264bp fragment spanning a polymorphic site 512 bp upstream from initiation site of insulin-like growth factor-I (IGF-I) was amplified using 5'-ATTACAAAGCTGCCTGCCCC-3' as forward and 5'-CACATCTGCTAATACACCTTACCCG-3' as reverse primers. Bulls were genotyped using single strand conformation polymorphism techniques. Two distinct alleles were found in this population and designated in accordance with previous reports. Genotypic frequencies were compared between +1 and -1SD groups for each trait using the Frequency procedure of SAS. Further, trait means for AA, AB and BB genotypes were compared using GLM procedure. Genotypic distribution was different between -1SD and +1SD groups F% and P% ($p<.05$ and $p<.02$, respectively), as more BB genotypes were present in -1SD than in +1SD groups for both traits. Comparing trait means among -$1SD_{P\%}$ and +$1SD_{P\%}$ indicated that BB genotypes had less P% than AA or AB genotypes (-0.013% vs 0.041% or 0.044%, $P<.01$). Further in that same subpopulation of bulls, BB genotypes had greater milk yield than AA or AB genotypes (883 vs 520 or 401 lbs, $P<.01$). A similar pattern of differences among genotypes occurred when comparing means among -$1SD_{F\%}$ and +$1SD_{F\%}$ bulls, as components were less in BB animals while milk yield was greater ($P<.03$). Results were slightly different among -$1SD_M$ and +$1SD_M$ bulls, as milk yield only approached significance ($P=.07$), while components again were less among BB than AA or AB animals ($P>.03$). Data indicate that BB genotype may be associated with increased milk yield and decreased fat and protein percentage in dairy animals.

Key Words: IGF-I, Polymorphism, Yield Traits

W87 Genetic polymorphism at the kappa casein locus in Holstein and Iranian native cattle Sarabi by use of PCR-SSCP. A. G Tahvildarzadeh[1], J. Shoja[1], M. Torchi[2], A. M. Tahmasbi*[1], and S. Alijanii[1], [1]*Dept. of Animal Sci. Tabriz University,* [2]*Dept of Plant Breeding and Genetic, Tabriz University, Iran.*

Methods have been devised for detecting polymorphism in the bovine k-casein genes using the polymerase chain reaction (PCR) followed rather by restriction enzyme digestion (to reveal a RFLP) or by single strand conformation polymorphism and to demonstrate CSN3 polymorphism in blood sample of Iranian native cattle (Sarabi n=66) and Holstein-Frisian (n =102). The PCR products (453 bp) were heat-denatured, loaded onto non-denaturing polyacrylamide gels, and Ethidium Bromide stained. Each variant yielded patterns clearly distinguishable from the others. Reference DNA sample from cows and bulls, which were previously genotyped at DNA level with PCR-RFLP, were used to develop the optimal conditions of PCR-SSCP. The optimal condition for SSCP were 8 % polyacrylamide gels (49:1 acrylamid: bis-acrylamid ratio), with 5 % glycerol and constant running temperature of 4oC. Estimated gene frequencies of Holstein and Sarabi were 0.8284 ±0.0265, 0.1716 ±0.0265 and 0.7652 ±0.0361, 0.2348 ±0.0361 for A and B alleles respectively. The observed heterozygosity for Sarabi and Holstein were 0.3484 0.452 and 0.2843 0.452 respectively .The estimated gene diversity from sum of squares of allele frequency represented by Bruce, for Sarabi and Holstein were 0.3593 ±0.053 and 0.2843 ±0.053 respectively. Based on information at this locus and based on chi-square test statistic, no evidence was found of disequilibrium in two populations. Comparison of allele frequencies in this study with other cattle breeds indicates that there was no significant difference between observed and expected frequencies in both Sarabi and Holstein populations. The only significant differences observed are those between the two breeds of this study with Jersey and Brown Swiss from other study.

Key Words: Single strand conformation polymorphism, PCR-RFLP, Sarabi cattle

W88 Type trait evaluations and heritabilities of Holstein dairy cattle in northeastern Iran. M. Jafarikia*, F.E. Shahroudi, and A.A. Naserian, *Ferdowsi University of Mashhad, Mashhad, Iran.*

This study was conducted to evaluate measures of type traits and their relationships and heritabilities for Holstein dairy cows by using data from 520 dairy cows of Kenebist Farm (Astan Ghods Razavy, Mashad, Northeastern Iran). Type traits were divided into two categories. First, the traits that classifiers measure were stature, size, pin set, rump length, pin width, rear udder height,rear udder

width and teat length; their means (and standard deviations) were 140.93(3.98),198.60(9.44),2.31(2.20),52.35(2.54),20.17(1.79),26.08(4.37) ,16.43(2.57), 5.19(0.99) cm, respectively. Second, the traits that classifiers estimate in a scale from 1 to 9 were chest width, loin, body depth, rear leg side view, foot angle, fore udder attachment, suspensory ligament, udder depth, front teat placement, rear teat placement,and angularity; their means (and standard deviations) were 5.33 (1.40), 4.94 (1.00), 6.93 (0.98), 5.44 (0.85), 5.77 (1.26), 5.98 (1.66), 6.38 (1.76), 5.04 (1.21), 4.16 (1.37), 5.99 (1.43), and 6.92(0.85) respectively. Heritabilities of traits were based on a derivative-free restricted maximum likelihood (DFREML) method with an animal model. The estimated heritabilities for pin set, pin width, rear udder height, rear udder width, and rump length were 0.23, 0.37, 0.27, 0.25, and 0.24, respectively.

Key Words: Type trait, Heritability, Dairy cattle

W89 Performance of Holsteins that originated from embryo transfer or twin births. H. D. Norman, J. R. Wright*, and R. L. Powell, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*.

Concern has continued on possible bias in genetic evaluations of animals from embryo transfer (ET) due to preferential management. Performance of ET Holsteins was documented and compared with that of Holsteins from single and twin births. Of particular interest was the milk, fat, and protein yields, somatic cell score (SCS), and productive life (PL). The first ET animal recorded in the Holstein Association USA herdbook was in 1962. During the 1960s, 1970s, 1980s, and 1990s, number of ET Holsteins was 18, 1947, 103,436, and 269,064, respectively; numbers peaked in 1993 and have declined since. Of those ET animals registered, 88, 82, 85, and 66%, respectively, were female. Pedigree merit of ET cows registered was superior to population mean for milk, fat, and protein yields by 133, 7, and 5 kg, respectively, and pedigree merit of ET bulls was superior by 339, 13, and 12 kg. Females were >98% of registered twins. Pedigree merit of registered offspring from parents having twins was nearly identical to population mean for cows (difference of 3, 0, and 1 kg for milk, fat, and protein), but pedigree superiority for twin bulls was 113, 5, and 4 kg, probably indicating selective registration. Means for ET cows (n = 10,277; mean of 1.02 full sisters per ET cow) and their full sisters were virtually identical for standardized yield, yield deviation, and genetic merit for milk, fat, and protein. If ET cows were treated preferentially, their full sisters received equal preference. Mean SCS of ET cows (3.1) did not differ from their full sisters or the population mean, but PL of ET cows was high, and even 0.6 mo longer than their full sisters. Mean yield deviations for twins (n = 6514; mean of 1.02 full sisters resulting from single births per twin) were 93, 5, and 3 kg less for milk, fat, and protein, respectively, than those of their full sisters from single births; this could be due to smaller size at birth and calving. Mean twin SCS (3.1) did not differ from their full sisters, but mean twin PL was 0.4 mo shorter. Genetic merit of ET bulls (n = 3512; mean of 1.3 full brothers per ET bull) differed little from their brothers for all yield and component percentages, SCS, and PL. ET animals have contributed positively to genetic improvement, but the number of these animals is declining.

Key Words: Embryo transfer, Genetic evaluation bias, Twin

W90 Measures of lactation persistency for Iranian Holstein dairy cattle. M. B. Montazer Torbati*[1], M. Moradi Shahrbabak[1], S. R. Mirae Ashtiani[1], and M. B. Sayadnezhad[2], [1] *Tehran University, Karaj, Iran,* [2] *Animal Breeding Center of Iran, Karaj, Iran*.

The four persistency measures used in this study were 1) partial yield from day 100 to 305 divided by accumulated production for the total 305 d, 2) PD = 110[(m60 - m280) - (y60 - y280)], 3) ratio of yield at day 60 to yield at day 280 of lactation, and 4) MAME (maxiumum/mean). A univariate model was applied for the first three lactations; for first lactation, a multivariate model also was used. Heritabilities based on the univariate model for milk, fat and protein were 0.286, 0.165, and 0.301; 0.208, 0.194, 0.163; and 0.168, 0.109, 0.142 for first, second and third lactations, respectively. Heritabilities of persistency measures from the univariate model were estimated to be 0.068 to 0.107, 0.071 to 0.136, and 0.064 to 0.083 for milk; 0.032 to 0.047, 0.031 to 0.058, and 0.028 to 0.046 for fat; and 0.038 to 0.086, 0.081 to 0.086, and 0.070 to 0.096 for protein for first, second, and third lactations, respectively. Heritabilities of 305-d yield based on the multivariate model for first lactation were the same as from the univariate model. Heritabilities increased for some measures when using the multivariate model and ranged from 0.067 to 0.132, 0.076 to 0.098, and 0.048 to 0.095 for milk, fat, and protein, respectively. Genetic correlations between measures of persistency and 305-d yield were 0.038 to 0.764., 0.100 to 0.450, and 0.127 to 0.461 for milk, fat, and protein, respectively. Phenotypic correlations had similar trend to genetic correlations.

Key Words: Lactation persistency, Iran, Dairy cattle

W91 Genetic correlations between boar semen traits. S.-H Oh*[1], M. T. See[1], T. E. Long[2], and J. M. Galvin[2], [1] *North Carolina State University, Raleigh, NC,* [2] *NPD USA, Roanoke Rapids*.

Currently boars selected for commercial use as AI sires are evaluated on grow-finish performance and carcass characteristics. If AI sires were also evaluated and selected on semen production, it may be possible to reduce the number of boars required to service sows thereby improving the productivity and profitability of the boar stud. The objective of this study was to estimate genetic correlations between boar semen traits; total sperm cells (TSC), volume collected (SV), number of extended doses (ND), and acceptance rate of ejaculates (AR). Semen collection records for 842 selected boars and two generations of pedigree data were provided by NPD USA. Genetic parameters were estimated using animal models and MTDFREML software. Breed, farm and contemporary group were included as fixed effects, and were significant ($P < .0001$) in all four traits. Heritability estimates were .44 for TSC, .44 for SV, .46 for ND and .16 for AR. The genetic correlations between TSC and SV, TSC and ND, and TSC and AR were .75, .98 and -.06, respectively. Genetic correlations between SV and ND, SV and AR, and ND and AR were .70, -.04 and -.02, respectively. Boar producing ejaculates with greater volume had more total sperm cells and produced more extend doses. The acceptance rate of ejaculates was not genetically correlated with the other recorded semen traits.

Key Words: Heritability, Semen, Pig

W92 Effect of selection for testosterone production on testicular morphology and daily sperm production in pigs. S. Walker*, O. W. Robison, C. S. Whisnant, and J. P. Cassady, *North Carolina State University, Raleigh, NC*.

The objective of this study was to measure indirect responses in morphological testicular characteristics and daily sperm production to divergent selection for testosterone. Duroc boars from lines divergently selected 10 generations for testosterone production in response to GnRH challenge followed by random selection were used. In generation 21 endogenous testosterone in the high (H, n=54) and low (L, n=44) testosterone lines averaged 490 ng/ml and 278 ng/ml ($P<0.01$), respectively. Plasma FSH concentrations did not differ significantly between the lines. Boars from generation 20 were castrated at 211 d of age and 97 kg. After adjustment for body weight, average paired testicular weights for H (n=46) and L (n=13) were 417 g and 457 g ($P<0.01$), respectively. Testicular tissue samples were used to determine volume density of Sertoli cells, sperm per gram of testis, total daily sperm production, and total testicular sperm. No significant differences were detected between lines for volume density of Sertoli cells, sperm per gram of testis, total daily sperm production, or total testicular sperm adjusted for age. Selection for testosterone concentration in response to a GnRH challenge is an effective method of changing testosterone concentration. However, indicators of male fertility did not differ significantly between lines. Thus, selection for testosterone is not recommended as a method of improving sperm production in pigs.

Key Words: Selection, Reproduction, Pigs

W93 Effect of selection for high or low mature weigth and its reciprocal crossing on reproductive response in Japanese quail. J. J. Portillo*, R. Barajas, I. V. Ferrer, and F. G. Ríos, *FMVZ-Universidad Autónoma de Sinaloa (México)*.

To determine the effect of selection for high or low mature weight and its reciprocal crossing on reproductive response in Japanese quail. Two hundred eighty Japanese quail breeders (240 females and 40 males) were grouped in four genotypes that consist 1) Quails selected for high mature (HH); 2) Quails selected for low mature (LL); 3) Reciprocal crosses from

males HL with females LL (HL); and 4) Reciprocal crosses of males LL and females HH (LH). The quails were allocated in groups of batteries with five levels and four cages by level and were fed with a diet containing 21% CP and 2,900 kcal of ME/kg. During 10 weeks, egg production, egg weight, feed intake, and feed efficiency were measured daily. During weeks 3, 6, and 9, the hatchability and fertility were measured. Preplanned contrasts of HH vs. LL, pure vs. crosses, and HL vs. LH were performed. During weeks 1 to 2, the crosses had higher (P<0.03) hatchability than pure breeds improved (P<0.05) feed efficiency. During weeks 3 to 7, eggs production of crosses was lower (P<0.01) than pure breeds. Crosses increased (P<0.01) egg weight, and decreased weight, and feed intake, and improved (P<0.04) feed efficiency. Hatchability of HH pure breed quails was lower (P<0.01) than other treatments. In week 8 to 10, the crosses increased (P<0.01) egg weight over pure breed quails. Fertility of the cross LH was higher (P<0.01) than other treatments. It is concluded that the crosses between Japanese quails selected for high and low mature weight have shown a little advantage for reproductive purposes.

Key Words: Crosses, Japanese quail, Hatchability

W94 Effect of selection of high or low mature weight and its reciprocal crossing on egg quality characteristics in Japanese quail.

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To determine the effect of selection for high or low mature weight and its reciprocal crossing on egg quality characteristics in Japanese quail breeders (240 females and 40 males), four genotypes were grouped in 1) Selected for high mature weight (HH); 2) Selected for low mature weight (LL); 3) Reciprocal crosses from males HH with females LL (HL); and 4) Reciprocal crosses of males LL with females HH (LH). The quails were allocated in seven groups (one male and six females), placed in metal wire cages as part of two cages batteries with five levels and four cages by level, and fed with a diet containing 21% CP and 2,900 Kcal of ME/kg. During 10 weeks, 20 eggs from each treatment were weekly collected. The following traits were measured: weight, egg length and width, dense albumin height, yolk height and width, and shell weight. From this data, shape index, yolk index, and Haugh units were calculated. Preplanned contrasts of HH vs. LL, pure vs. crosses, and HL vs. LH were performed. During the ascending part of hatching curve, the crosses had higher (P<0.02) egg weight. The cross HL had higher (P<0.02) yolk height and yolk width. During the plateau phase, the crosses increased (P<0.05) egg weight, shell weight, and albumin height. The cross HL improved (P<0.05) shell weight and yolk width over the cross LH. In the end of hatching curve, the crosses increased (P<0.05) egg weight, and egg wide over pure breeds. The cross HL increased (P<0.02) egg width, yolk width and yolk height over the cross LH. It is concluded that the crosses between quails selected for high and low mature weight improves some egg quality characteristics, and in those crosses, the main benefit is obtained using males selected for high mature weight.

Key Words: Selection by weight, Japanese quail, Egg quality

W95 Heritability estimates for semen charcteristics of inbred and non-inbred Hereford bull.

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Our objectives were to determine the influence of inbreeding on post-thaw semen characteristics measured by computer assisted sperm analyzer (CASA) and determine if post-thaw semen characteristics are heritable. Frozen semen samples were obtained from two inbred (Line1, n= 11 and Prospector, n= 7) and a non-inbred line (n= 9) of Hereford bulls. Average inbreeding level of each group was 0.27, 0.45, and 0.0 respectively. Semen samples were collected from 1978 to 2000. For CASA analysis four straws (0.5 ml) from each bull were evaluated. Cells were analyzed by mixed model analysis using a model that contained line and age at collection as fixed effects and individual bull as a random effect. No significant differences between groups of bulls were found for motility or progressive motility (Table 1). For average path velocity (VAP), cell elongation (ELON), and cell area (AREA) significant differences were between bull groups. Mean separation (Table 1) indicated that Line1 had larger cell area and were not as elongated as the Prospector and non-inbred group cells. The higher VAP for Line1 bulls is an indicator that Line1 cells are faster moving and perhaps more robust. Method R for a single trait was used to estimate heritability for semen characteristics. The heritability estimates would indicate relatively large amount of additive genetic variation present across bull groups, which could be utilized in a selection program. The lack of significant differences for motility and progressive motility across bull groups was surprising and indicates no inbreeding depression was exhibited for post-thaw semen characteristics. One explanation for this could be that indirect selection pressure was placed on these characteristics as inbreeding was increased.

Table 1. LS means and heritabilities of semen characteristics

	Line 1	Non-inbred	Prospector	Heritability
Motile (%)	0.90±0.03	0.91±0.02	0.90±0.02	.82±.01
Progressive (%)	0.31±0.04	0.29±0.03	0.25±0.03	.79±.01
VAP (mm/sec)	91.23 ± 12.57^{a}	69.17 ± 9.64^{b}	57.37 ± 8.46^{b}	.36 pm0.04
ELON (%)	43.02 ± 1.31^{a}	45.15 ± 1.00^{b}	45.95 ± 0.87^{b}	.34±0.0 5
AREA (mm)	7.08 ± 0.33^{a}	6.44 ± 0.25^{b}	6.3 ± 0.22^{b}	.33±0.04

^{ab} Within a row, different superscripts differs at the p< 0.1 level.

Key Words: Semen characteristics, Heritability, Inbreeding

W96 Estimates of genetic parameters os carcass traits in limousin cattle.

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The current genetic evaluation of carcass traits for the North American Limousin Foundation (NALF) utilizes bivariate analyses. This study used NALF field records to estimate variance components to develop a multivariate evaluation. Weaning weight (WW), carcass weight (CW), ribeye area (REA), back fat (BF) and marbling score (MS) were analyzed with MTDF-REML (derivative free restricted maximum likelihood) using bivariate and trivariate linear models. Contemporary group and AOD (age of dam) were fit as fixed effects and age at slaughter and at weaning as covariates. Six analyses were performed (CW-WW; REA-MS; MS-BF; CW-REA and WW-CW-REA, WW-BF-MS). Random maternal and permanent environment effects were included for WW. A total of 31,063 pedigree records and 18,368 performance records were used. Heritability estimate for CW in the bivariate analysis of CW and WW were 0.41. The genetic correlations between CW and WW were 0.77. Heritabilities estimates for BF and MS were 0.37 and 0.31, with genetic correlation of -0.07. For CW and REA, the heritabilities were 0.30 and 0.34, with genetic correlation of 0.45. The REA and MS heritabilities were 0.35 and 0.33 and genetic correlation of -0.37. For trivariate WW-CW-REA analysies heritabilities were 0.43 for CW and 0.34 for REA, with genetic correlation between CW and REA of 0.50. For WW-BF-MS analysis heritability for BF was 0.38 and 0.30 for MS, with genetic correlation of 0.13 between BF and MS. The heritability for CW increased when estimated in a model that included WW. The genetic correlation between BF and MS was small, therefore selection for marbling can be implemented without increasing fatness. The genetic correlation between REA and MS was moderately negative. Further work is required to determine the impact on variance component estimates of including ultrasound data along with carcass and growth data.

Key Words: Carcass traits, Maternal effects, Heritabilities estimates

W97 Colorado State University Center for Genetic Evaluation of Livestock: Current approaches to performing large scale beef cattle genetic evaluations.

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The purpose of this paper is to review methodology for conducting beef cattle genetic evaluations performed by the Colorado State University Center for Genetic Evaluation of Livestock (CSU-CGEL). This methodology includes the specification of the type of model used, components that make up the model and solutions reported for each analysis. The CSU-CGEL performs contract genetic evaluations world wide for 15 different clients including breed associations, private ranches, and composite and pure-bred mating system cooperatives. These evaluations consist of the traits birth weight, weaning weight, yearling weight, docility, stayability, heifer pregnancy rate, calving ease, mature cow maintenance energy requirements, pulmonary arterial pressure, fat thickness, marbling score, rib eye area, carcass weight and quality grade that can be placed in the categories of growth, reproduction, carcass, longevity and behavior. The approach used to determine criteria for inclusion in the statistical model is the same for all analyses, even though the

actual model for a given analysis differs for each category. For example, the growth traits birth weight and weaning weight are analyzed in a bivariate model as well as weaning weight and yearling weight, but weaning weight EPD reported are from the birth weight/weaning weight analysis. These traits are run together because they are genetically correlated and the increased amount of information adds accuracy to the prediction. Weaning weight is included in the carcass analysis, but for a different reason than it was included in with the growth traits. Weaning weight is analyzed with carcass traits to account for selection bias seen when calves are either selected as replacements or as slaughter animals. The production of EPD is its own unique puzzle, but if done properly provides producers with the most advanced tools currently available to help them increase the profitability of their operation.

Key Words: Beef cattle, Genetic evaluation, Expected progeny differences

W98 Identification and characterization of an AFLP marker for protein yield in Canadian Holsteins. B. S. Sharma*[1], Z. Jiang[2], and G. B. Jansen[1], [1]*Department of Animal and Poultry Science, University of Guelph, Canada,* [2]*Department of Animal Science, Washington State University, USA*.

A total of 200 cows, including 100 high and 100 low EBV for protein yield were used for genome-wide screening of QTL (quantitative trait loci) linked markers for protein yield in Canadian Holsteins using selective DNA pooling and amplified fragment length polymorphism (AFLP) approaches. These cows were selected from an experimental population of 5445 animals and used to form 5 high and 5 low performance pools with 20 animals per pool. AFLP analysis was performed on these pools using 80 selective primer combinations. The PCR products of selective amplifications were electrophoresed and electropherogram readings were standardized by dividing the sum of peak heights of standard length fragments. Standardized peak heights of AFLP fragments were log transformed and compared between high and low pools. A 288 bp fragment, generated using the E-ACG/T-CAT primer combination, was found to differ most significantly (P¡0.001). The difference was also confirmed by AFLP genotyping of individual cows. The AFLP fragment was then extracted from the gel and sequencing analysis revealed a C/T substitution responsible for this AFLP polymorphism. This marker was genotyped on all high and low performance animals using a Bi-PASA (bi-directional PCR amplification of specific allele) technique along with approximately equal addition of new animals into each pool from both tail of EBV distribution. Allele "C" was twice as frequent in low than in high performance animals (0.28 vs. 0.14, P¡0.01). A BLAST search against GenBank databases showed evidence that this AFLP marker is orthologous to an intron region of the human *TCF7L2* gene. Based on comparative maps between human and bovine genomes, we genotyped two additional markers in this AFLP marker region on a bovine/hamster RH panel. RHMAP analysis assigned this AFLP marker and the bovine *TCF7L2* gene on bovine chromosome 26 (BTA 26).

Key Words: AFLP, Selective DNA pooling, Dairy cattle

Nonruminant Nutrition

W99 Enzyme addition as a tool to improve early postweaning piglet performance. E. Gómez[1], M. Cortés[2], J. Sánchez[2], F.J. Guzmín[2], and P. Medel*[2], [1]*Centro de pruebas de porcino, Hontalbilla, Spain,* [2]*Imasde Agropecuaria, S.L., Spain*.

A total of 192 crossbreed piglets (Pietrain*Large white x Large white*Landrace), 50 % male and 50 % female, weaned at 21 days and weighting 6.5 kg were used to determine the effect of addition of an enzymatic complex (CE n 34) containing 275 U/kg of endo-1,3(4)-β-glucanase (E.C. 3.2.1.6), 400 U/kg of endo-1-4-β-xylanase (E.C. 3.2.1.8) and 3,100 U/kg of α-amylase (E.C. 3.2.1.1) to diets on performance. There were two experimental treatments based on enzyme supplementation (500 mg/kg) to a basal diet. The experimental design was applied in both the prestarter (21 to 40 d of age) and the starter diet (40 to 60 d of age). Nutritive value of the diets was 10.08 MJ NE/kg and 14.7 g/kg lysine for Prestarter and 10.03 MJ NE/kg and 13 g/kg lysine for Starter, and were based on barley, wheat and maize. Each treatment was replicated 8 times and 12 piglets caged together formed the experimental unit. Data were analyzed by using the GLM procedure of SAS. At 40 d of age, piglets fed the enzyme supplemented diet showed higher body weight (9.34 vs 8.35 kg, P<.01); daily gain (124 vs 72 g/d, P<.05); feed intake (247 vs 193 g/d, P<.05); and better feed conversion (2.05 vs 2.83 kg/kg, P<.05) than animals fed the unsupplemented diet. However, from 40 to 60 d control animals showed better feed conversion (1.44 vs 1.56 g/g, P=.03) and similar growth rate than enzyme supplemented piglets (528 vs 428 g/d, P>.05), so that, global differences (21 to 60 d of age) on performance were not significant. In addition, piglets fed the enzyme supplemented diet tended to be cleaner (5= very good, 0=very poor) than control animals at 40 d of age (3.31 vs 2.81, P=.07), but differences disappear thereafter. In conclusion, enzyme addition improved piglet performance in the prestarter period, but for the global period these differences disappeared, probably due to compensatory growth.

Key Words: Enzyme supplementation, Piglets

W100 Xylanase, glucanase and amylase supplementation to piglet diets. P. Medel*[1], M. I. Gracia[1], E. McCartney[2], A. Knox[3], and J. McNab[3], [1]*Imasde Agropecuaria, Spain,* [2]*Pen & Tec Consulting, Spain,* [3]*Roslin Nutrition, Scotland*.

A study was designed to assess the efficacy of an enzyme complex (CE n 34) containing 275 U/kg of endo-1,3(4)-β-glucanase (E.C. 3.2.1.6), 400 U/kg of endo-1-4-β-xylanase (E.C. 3.2.1.8) and 3,100 U/kg of α-amylase (E.C. 3.2.1.1), supplemented at 3 doses (T2: 400, T3: 500 and T4: 600 mg/kg) to a pelleted diet based on cereals (wheat, maize, barley) on the performance of newly-weaned piglets, in comparison with a negative control group (T1, 0 mg/kg). The experimental diets were fed in two phases: as prestarter pellets from weaning (21 d) to 42 d and as starter pellets from 42 to 63 d of age, to 16 replicates of 10 piglets per treatment. The prestarter and starter diets, respectively, were formulated to contain 12.5 MJ ME/kg and 15 g/kg lysine and 12.6 MJ ME/kg and 13.5 g/kg lysine. Data were analyzed as a completely randomized block design using the GLM procedure of SAS. For the overall period of growth, piglets fed on T3 (500 mg/kg of enzyme complex) gained more weight than piglets fed on either T1 or T4, with the piglets fed on T2 having an intermediate value (17.51, 18.09, 18.49, 17.55 kg for T1 to T4, respectively, P<.05). Feed intake was not affected by dietary treatment, but piglets fed on T3 had better feed conversion ratios than those fed on T4, with pigs fed on both T1 or T2 having intermediate values (1.601, 1.584, 1.536, 1.614 g feed/g gain for T1 to T4, respectively, P<.05). Neither mortality nor piglet uniformity was affected by dietary treatment. It was concluded that i) the addition of the enzyme complex to a diet for piglets improved their growth, and ii) the dietary concentration of the enzyme complex resulting in the optimal performance was 500 mg/kg.

Key Words: Enzymes, Piglets

W101 Enzyme supplementation to piglet diets. A. Morillo[1], D. Villalba[2], E. McCartney[3], M. I. Gracia[4], and P. Medel*[4], [1]*Test & Trials, Spain,* [2]*U de Lleida, Spain,* [3]*Pen & Tec Consulting, Spain,* [4]*Imasde Agropecuaria, S.L.*.

A study was designed to assess the efficacy of an enzyme complex (CE n 34) containing 275 U/kg of endo-1,3(4)-β-glucanase (E.C. 3.2.1.6), 400 U/kg of endo-1-4-β-xylanase (E.C. 3.2.1.8) and 3,100 U/kg of α-amylase (E.C. 3.2.1.1), when added at 2 concentrations (T2, 500 and T3, 600 mg/kg) to a pelleted diet based on cereals (wheat, maize, barley) on the performance of newly-weaned piglets, in comparison with a negative Control group (T1, 0 mg/kg). Diets were fed in 2 phases: Prestarter from weaning (21 d) to 35 d and Starter from 35 to 57 d of age, to 15 replicates of 10 piglets per treatment, in 3 blocks (weanings). Nutritive value of the diets was 10.55 MJ NE/kg and 16.1 g/kg lys for Prestarter and 10.37 MJ NE/kg and 12.5 g/kg lys for Starter. Data were analyzed as a completely randomized block design by using the GLM procedure of SAS. Piglets fed enzyme supplemented diets were heavier than Controls at 35 (9.2, 9.7 and 9.7 kg, P<.01) and at 57 d of age (18.2, 19.2 and 19.2 kg for T1, T2 and T3 respectively, P<.01). Enzyme addition improved piglet growth by 16% from 21 to 35 d (195, 227 and 226 g/d, P<.01), by 5% from 35 to 57 d (404, 426 and 424 g/d, P<.01), and by 8% from 21 to 57 d of age (322, 349 and 347 g/d for T1, T2 and T3 respectively, P<.01). Enzyme supplementation also induced improvements in feed intake from 21 to 35 d, from 35 to 57 d and for the overall period (445,

477 and 487 g/d for T1, T2 and T3 respectively, P<.01). Finally, enzyme complex reduced feed conversion ratio by 4% from 21 to 35 d of age (1.23, 1.20 and 1.17 g/g for T1, T2 and T3 respectively, P=.01). No significant differences were found between 500 mg/kg and 600 mg/kg. There were no significant differences among treatments in piglet body weight uniformity, cleanliness, incidence/severity of diarrhoea, veterinary treatments or mortality. In conclusion, the addition of 500 or 600 mg/kg of an enzyme complex containing glucanase, xylanase and amylase to a barley wheat and maize-based diet of weaned piglets improved growth performance.

Key Words: Feed enzymes, Piglets

W102 Activity of disaccharidase in small intestinal membranes of piglets as influenced by age. Q. M. Yang*[1,2], D. F. Li[1], and S. Y. Qiao[1], [1]*College of Animal Science and Technology, CAU, Beijing, P.R. China,* [2]*Southern Research and Outreach Center, University of Minnesota.*

The objective of this study was to determine the activities of disaccharidase in the small intestinal membrane of pigs. Thirty-nine pigs from eight litters were creep fed from d 28 and weaned on d 35. On d 0 (day of farrowing), d 7, 14, 21 and 28, three pigs were selected and d 35, 42, 49 and 56, six pigs were selected and prepared for membrane collection of jejunum and ileum on ice cold plate to determine the activity of disaccharidase in the membranes. The results indicated that the activities of lactase, sucrase and maltase were 1.91±0.65, 0.14±0.11 and 0.32±0.14 U/g membrane of the middle jejunum, respectively, on d 0 before sulking. The average activity of lactase was 4.16±1.54 U/g membrane during 1 to 4 weeks, however, it decreased (P<0.05) to 2.23±1.20 U/g membrane on week 5 and to a low level (P<0.01) of 0.68±0.45 U/g membrane after week 6. The activity of lactose was higher in ileum in the first week and in the proximal region of the jejunum. The average activity of sucrase in the membrane of small intestine was, respectively, 1.63±0.65, 2.09±0.66, 2.91±1.09, 5.71±2.2, 7.05±3.43, 2.04±1.00, 3.72±1.90 and 3.34±1.91 U/g membrane from week 1 to week 8. The activity of sucrase decreased after weaning (P<0.01). The average activity of maltase in the membrane of small intestine was only 1.23 1.58 U/g during week 1 to week 3 and increased (P<0.01) to 9.43±2.09 U/g membrane at 4 weeks old. However, it decreased (P<0.01) to 1.37±1.33 U/g membrane on week 6 of weaning, and then increased to 4.39 4.55 U/g membrane at week 7 and week 8. The activity of lactase coincided with the ability to digest lactose from milk before week 4, and then the decrease on week 5 when the pigs increased solid feed intake, and dropped to a very low level after weaning. The activity of sucrase was developed continuously, and reached its peak on week 5, but decreased at weaning. The activity of maltase developed on week 4, but was dramatically affected by weaning. In conclusion, the activity of lactase was due to the presence of milk, and the activities of sucrase and maltase were developed when pigs were growing, but decreased due to weaning.

Key Words: Piglets, Small intestinal membrane, Diasaccharidase

W103 Effects of feeding flaxseeds on the production traits of sows. S. K. Baidoo*[1,2], G. Azunaya[1], and A. Fallah-Rad[1], [1]*Department of Animal Science, University of Manitoba,* [2]*Southern Research and Outreach Center, University of Minnesota.*

A feeding trial using sows was conducted to determine the effects of dietary supplementation of flaxseeds (FS) during gestation and lactation on the production traits of sows and litter performance. Two hundred and forty three multi-parous sows (Camborough 15, PIC, Acme Alberta, Canada) were allotted to this study in a commercial 3000 sow farrow to wean facility. The sows were assigned to two dietary treatments, 0% and 5% FS immediately after breeding and fed through gestation and lactation. Individual sow or each pen of piglets was an experiment unit. Measurements in different gestational phases were treated as repeated measurements. The data were statistically performed by ANOVA using the GLM procedures of SAS. The body weight of sows fed the 5% flaxseed (FS) supplemented diet was higher (P<0.05) than sows fed 0% FS diets during gestation (249.4 vs 234.3 sem=2.7 kg). Sows fed 5% FS lost 28% more body weight at weaning than the control fed sows (219.5 vs. 211.3; sem=5.2kg). There was no dietary effect (P>0.05) on backfat thickness in sows during gestation and lactation. Litter size born alive was not influenced (P>0.05) by dietary treatments. Litter size weaned was higher (P<0.05) in the sows fed the 5% FS compared to control (10.4 vs. 9.05; sem= 0.03). Piglet birth weight (1.65 vs. 1.45; sem= 0.07 kg) and weaning weights (4.80 vs. 4.30; sem= 0.04 kg) were higher for sows fed the 5% FS compared to the control. The conception rate from first service was 89.3% for the sows fed the control diet, and 100% for the sows on the 5% FS diet. In conclusion, the production traits of sows were improved by the supplementation of 5% flaxseeds in diets of pregnant and lactating sows.

Key Words: Sows, Flaxseed, Production traits

W104 Dietary effects of flaxseed and vitamin E on the concentration of serum progesterone and vitamin E in sows. S. K. Baidoo*[1,2], A. Fallad-Rad[1], and Q. Yang[2], [1]*Department of Animal Science, University of Manitoba,* [2]*Southern Research and Outreach Center, University of Minnesota.*

The objective of this study was to determine the effects of flaxseed and vitamin E on serum progesterone concentrations (PGC) of sows and vitamin E levels of sows and piglets. Forty-eight Cotswold gilts were allotted to six dietary treatments for both gestation and lactation periods with 8 gilts per dietary treatment. The experimental design was a split-plot design with repeated measurements. Three levels of flaxseed (FS) (0%, 5% and 10% FS) and two levels of vitamin E (40 IU/kg and 80 IU/kg) were 2 factors in the factorial arrangements and were applied to the main plots. Individual sow or piglet was an experiment unit. Measurements in different gestation and lactation phases were treated as repeated measurements applied to the subplots. Serums were from blood samples collected from vena cava puncture for all the sows and three piglets per litter. The progesterone concentrations (PGC) in the serum of gestation sows on d 30 (20.4 ng/ml) and 60 (19.6 ng/ml) of gestation were higher than in the serum of sows on d 90 (16.4ng/ml), 109 (15.0 ng/ml) of gestation and d 1 (0.83 ng/ml) of farrowing (SEM=0.62; P<0.05). The PGC on d 90 and d 109 of gestation were also higher (P<0.05) than those on d 1 of gestation and all the days post parturition. The diets with 0 and 5% FS increased (P<0.05) PGC in the serum of gestation sows compared to the 10% FS diet (9.9 & 9.5 vs. 8.4 ng/ml, SEM=0.38). Vitamin E had no effect (P>0.05) on serum PGC in both gestation and lactation. The serum PGC of sows at farrowing (0.83ng/ml) was higher (P<0.05) than on d 8 (0.24 ng/ml) and d 16-post parturition (0.37 ng/ml). The vitamin E concentration (VEC) in the milk of sows on d 1 was higher (P<0.01) than on d 8 and d 16. The serum VEC (IU/ml) of pigs was 0.8 on d 1, 6.7 on d 8 and 5.3 on d 16 (P<0.05, respectively). The diet with vitamin E at 80 IU/kg increased (P<0.05) VEC in sera of pregnant and lactating sows, pigs, and in body tissue of pigs compared to diets with vitamin E at 40 IU/kg. In conclusion, the progesterone concentration (PGC) in the serum of sows was influenced by phase of pregnancy. High levels of VE and 10% FS in the diet increased VE in milk and body tissue of pigs.

Key Words: Sows, Flaxseed, Vitamin E

W105 Dietary effects of flaxseed and vitamin E on lipid profiles of sows. S. K. Baidoo*[1,2], A. Fallad-Rad[1], and Q. M. Yang[2], [1]*Department of Animal Science, University of Manitoba,* [2]*Southern Research and Outreach Center, University of Minnesota.*

The objective of this study was to determine the effects of flaxseed and vitamin E on serum lipid profile of sows. Forty-eight Cotswold gilts were allotted to six dietary treatments for both gestation and lactation periods with 8 gilts per dietary treatment. The experimental design was a split-plot design with repeated measurements. Flaxseed (FS) with three levels (0%, 5% and 10% FS) and vitamin E with two levels (40 IU/kg and 80 IU/kg) were 2 factors in the factorial arrangements and were applied to the main plots. Individual sow or piglet was an experimental unit. Measurements in different gestation and lactation phases were treated as repeated measurements applied to the subplots. Serum from blood samples were collected via vena cava puncture from all the sows and three piglets per litter. All the saturated free fatty acids (SFFA) and unsaturated free fatty acids (UFFA) in the serum of sows and pigs were not different (P>0.05) among dietary treatments. The total n3 FFA in serum of piglets from sows fed diets with 10% FS were higher (P<0.05) than the piglets from sows fed control diets (14.1% vs. 8.7%; SEM=1.5). The serum of pigs had higher (P<0.05) n3 FFA at birth than on d 8 after farrowing and at weaning (13.4% vs. 10.7%; SEM=0.7). The amount of SFFA, UFFA, SFFA: UFFA, n3 FFA and n6 FFA in milk were different (P<0.01) among diets and phases of gestation, but not different (P>0.05) between the dietary vitamin E contents. There were interactions (P<0.01) between diets and phases of gestation for n3 FFA and n6

FFA. The concentrations of n3 FFA and n6 FFA in sow milk decreased (P<0.05) from farrowing (17.5% and 21.9%; SEM=0.3) to d 8 (7.4% and 12.1%; SEM=0.3) and to d 16 (6.2% and 10.1%; SEM=0.3). FS supplementation to sows before farrowing will be advantageous for sows (to maintain backfat) and piglets (to increase in milk fats). An increase of FS in diets reduced SFFA (P<0.05) and increased UFFA (P<0.01) in milk. The 10% FS and 5% FS diets had 7.9% and 4.4% more (P<0.05) UFFA, respectively, in milk than control diet. In conclusion, The diet supplemented with 10% FS fed to sows increased n6 FFA in the serum of sows, UFFA, n3 and n6 FFA in the milk, and n3 FFA in the serum of pigs at birth.

Key Words: Sows, Flaxseed, Fatty acids

W106 Carry over effect of dietary protein supplied to pregnant sows on protein utilization during lactation. P. K. Theil*, H. Jorgensen, and K. Jakobsen, *Danish Institute of Agricultural Sciences, Denmark*.

Lowering the supply of dietary protein in swine diets has been in focus the last decade in order to minimize nitrogen (N) excretion to the environment. This experiment was conducted to quantify the protein metabolism in 8 sows fed low (LP) or standard (SP) dietary protein during pregnancy and either low (LF) or high (HF) dietary fat during lactation. The experimental setup was a crossover design between pregnancy diets (LP, SP) and lactation diets (LF, HF). The dietary change occurred at the day of farrowing. Diet formulation and feeding level were in accordance with Danish recommendations. This implied an elevated feeding level during the last month of pregnancy, while lactating sows were fed according to litter size. The LP and SP diets supplied 7.39 and 10.29 g fecal digestible protein/MJ ME, respectively, while LF and HF diets supplied 10.18 and 10.04 g fecal digestible protein/MJ ME. Nitrogen balance was quantified in three balance periods during lactation by total collection of feces and urine on days 9-12, 16-19, and 23-26. Milk production, determined during the balance trials by D_2O dilution, increased from 831 g/piglet/d (d 10) to 1151 g/piglet/d (d24) (P<0.001), with no effect of pregnancy diets (P=0.73). Milk contained 17.7 % of DM and milk protein content (N x 6.38) was 28.1 % of DM, with no effect of stage of lactation (P=0.89). As the milk production increased, milk protein yield increased (P<0.01) as lactation progressed, whereby the protein retention (N x 6.25) decreased concomitantly (P<0.05). The LP and SP sows were supplied with comparable amounts of metabolized protein during lactation. The data show that sows fed the LP diet during pregnancy retained considerable amounts of protein during lactation at the expense of milk protein yield.

Item	LP[a]	SP[a]	SEM	P
N balance of lactating sows (g/d)				
Intake	141	151	11.8	0.59
Feces	24	27	2.4	0.45
Urine	38	46	3.8	0.16
Milk	66	78	6.9	0.27
Retention	13	0	2.9	<0.01
Milk production (kg/d)	9.02	9.54	1.00	0.72
Litter size	9.0	9.5	0.73	0.64
Litter gain (kg/d)	1.86	2.03	0.12	0.35

[a] Pregnancy diet

Key Words: N utilization, Milk protein, Balance experiment

W107 A dynamic computer-model to estimate the changes of body composition during lactation in sows. J. G. Kim* and K. Y. Whang, *Korea University, Seoul, Korea*.

A lactating sow model was developed to estimate body composition changes and nutrient flow based on body weight (BW), P2 back fat depth (P2), and litter size (LS) and to propose the nutrient requirements to support ideal body condition. Input variables were BW, P2 at farrowing, feed intake (FI) during lactation, number of suckling piglets, piglets weights at farrowing and weaning. The BW and P2 were used to determine body composition. Difference of piglet weight between farrowing and weaning (PWC) was employed to determine average daily gain and daily milk requirement for piglets. General feed intake pattern (FIP) was also modeled to reach maximum feed intake at 7 day post-farrowing. The model showed body composition of sow (fat, protein, water, and ash), BW, and P2. An example of model (BW:200 kg; P2: 20 mm; LS: 9; PWC: 5.5 kg; FI: 120 kg; FIP: 7 days) showed that fat and protein contents and BW of sow decreased until 5 d post-farrowing and increased after on. A reversed pattern showed in P2. Estimated values of this model indicated that piglet body weight change was main factor that affected body composition and BW of sow. Feed intake was also important factor on body composition and BW of sow. But effects of feed intake pattern of sows were relatively less important than weight change of piglets.

Item	Fat 7 day	Protein	BW	P2	Fat 21 day	Protein	BW	P2
PWC(kg)								
4.5	29.50	43.25	191.39	20.55	32.14	45.24	204.83	19.81
5.5	28.39	42.64	185.99	21.83	29.63	44.01	192.75	20.89
6.5	27.21	41.96	180.18	21.44	26.78	42.50	178.93	22.05
FI(kg)								
110	28.07	42.25	184.18	21.00	28.48	42.89	186.62	21.07
120	28.39	42.64	185.99	21.83	29.63	44.01	192.75	20.89
130	28.70	43.01	187.73	20.97	30.72	45.06	198.58	20.72
FIP(days)								
5	29.16	43.58	190.30	20.98	29.89	44.42	194.31	20.94
7	28.39	42.64	185.99	21.83	29.63	44.01	192.75	20.89
9	27.67	41.75	181.93	21.00	29.38	43.61	191.28	20.83

Input valuables of standard lactating model were BW: 200 kg; P2: 20 mm; LS: 9 pigs; PWC: 5.5 kg; FI: 120 kg; FTP: 7 days

Key Words: Sow, Computer model, Body composition

Animal Behavior & Well-Being: Social and Physical Environments

W108 Analysis of the effect of gestation housing systems on fertility and piglet death. L. Anil*, S. Baidoo, J. Deen, R. Walker, S. Anil, and R. Morrison, *University of Minnesota*.

Records of 1426 litters from 664 sows of parity 1-4 were analyzed to compare the production performance in terms of farrowing rate and piglet deaths/litter among sows housed in individual stalls and pens with electronic sow feeder during gestation and farrowing in crates. A major cause of piglet death, death due to laid-on, which is related to housing systems was also compared. The means in each group were compared using Independent-samples T test. Farrowing rate was significantly (P <0.001) higher among sows housed in individual stalls during gestation compared to sows housed in pens with electronic sow feeder during gestation (86.22 and 79.49 respectively). There was no significant difference in mean percentage of pig death/born alive (7.94 ± 0.46 and 7.60 ± 0.42 per litter in stalls and pens respectively), average number of mummies/litter (0.22 ± 0.02 in both) and average number of stillborn/litter (0.56 ± 0.04 and 0.53 ± 0.04 in stalls and pens respectively) among sows housed in the two systems. Piglet death per litter due to laid-on was also similar in the two housing systems (0.20 ± 0.020 in both), indicating that factors such as previous experience in stalls or muscle weakness due to stall-housing are not critical in determining piglet death due to laid-on. The results indicate that in terms of the production parameters studied, neither system is superior to the other.

Key Words: Housing, Gestation, Fertility

W109 Effect of a cooling system to reduce heat stress during the dry period. L. Avendao-Reyes*[1], D. Alvarez-Valenzuela[1], F. Rivera-Acua[1], R. Hurtado-Durn[1], A. Correa-Caldern[1], S. Saucedo-Quintero[1], J. Verdugo-Zarate[1], and P. H. Robinson[2], [1]*ICA, Universidad Autonoma de Baja California, Mexicali, Mexico,* [2]*UCCE, Dept. of Anim. Sci., UC Davis, Davis, CA.*

Thirty five multiparous Holstein cows were blocked by body condition score and assigned to one of two treatments 60 d prior to their anticipated calving date in two consecutive summers (24 cows in year 1; 11 cows in year 2). Treatments for both years were: (1) no cooling system and, (2) with a cooling system based on fans with water spray. The cooling system operated from 10:00 to 18:00 h daily during the entire dry period of the cows, which consisted of the hot summer months (extreme low and high temperatures of 18° C and 48° C) in both years. Cows were fed a totally mixed ration ad libitum twice daily at 7:00 and 14:00 h consisting of alfalfa hay (60% of dry matter), wheat straw (18%), wheat grain (15%), wheat bran (5%), and a vitamin/mineral premix (2%). Rectal temperatures and respiration rates were recorded twice daily at 9:30 and 14:30 h on Tuesday and Friday each week. There was a third measurement of both variables at 18:00 h during year 2 only. Body condition was scored weekly and calf birth weights were recorded. After calving, all cows were moved to the same pen, which was provided with shades, but had no fans or misters, and fed a ration appropiate for cows in early lactation. Cows were milked twice daily at 5:00 and 17:00 h and milk yield was recorded weekly through week eight. Data were analyzed by linear models with the fixed effects of year, treatment and year x treatment interaction. During the dry period, interaction year x treatment was not significant (P>.05) on rectal temperatures or respiration rates at 9:30 h. However, cooled cows in year 2 had lower (P<.05) respiration rate (66.5 ± 2.2 breaths/min) and rectal temperatures (38.9 ± 0.06 ° C) at 14:30 h. Body condition score was higher (P<.05) for cooled cows in year 1 (4.03 ± 0.02), but the interaction was not significant (P>.05) for calf birth weight and milk production. Cooling dry cows using fans with water spray reduced heat stress and increased cow comfort under these very hot conditions, as indicated by afternoon respiration rates and rectal temperatures, but had little impact on subsequent postpartum productivity.

Key Words: Hot weather, Respiration rate, Rectal temperature

W110 Validation of 24h Polar RR Recorder for measuring heart rate variability in pigs. R. M. Marchant-Forde*[1], D. J. Marlin[2], and J. N. Marchant-Forde[3], [1]*De Montfort University, Lincoln, UK,* [2]*Animal Health Trust, Newmarket, UK,* [3]*USDA-ARS, West Lafayette, USA.*

Measures of heart rate variability (HRV) can yield important information about the functioning of the autonomic nervous system, and are potentially powerful tools in the assessment of animal well-being. The equipment necessary for data collection has been difficult to obtain and use, but recently an ambulatory monitor designed to collect 24h of data has been developed but not validated for use in animals. Our objectives were to measure the accuracy of the Polar RR Recorder using gold standard ECG and to examine and categorise occurring anomalies and to ascertain their impact on the outcome of HRV analysis. Five one-year-old gilts were socially isolated from their pen mates and cardiac activity was simultaneously measured using 2 systems, a Polar RR Recorder and a telemetric ECG system, for 20 min. The Polar data was manually assessed both against and in isolation of the ECG data to identify anomalous beats, which were then assigned to one of 5 identified error categories. The anomalies in the Polar data were corrected and statistical comparisons were performed between the 3 data sets to evaluate the effects of anomalies on HRV analysis. Bland-Altman analysis was used to measure the level of agreement between the ECG, uncorrected Polar, and corrected Polar data. No anomalies or ectopies were found in the ECG data but 46 (0.81% of total interbeat intervals [IBIs]) were located in the Polar uncorrected data. Manual identification and editing procedures reduced this error to 0.018%. Mean heart rate and IBI parameters were unaffected by error (P>0.05). SD and RMSSD were 45 and 50% higher when anomalies were present in the data (P<0.001). The mean difference between the ECG and uncorrected Polar data was 1.36ms (limits of agreement - 69.03 to 71.74ms). This was greatly improved to 0.36ms (limits of agreement - 5.37 to 6.10ms) after editing. Overall, just a small proportion of error can bias the outcome of HRV analysis. This bias is greatly reduced by correcting the anomalous beats. Bland-Altman analysis demonstrated that when there is error present in the Polar data it cannot be used interchangeably with the ECG data. However, if there are no anomalies present or if anomalies are classified and corrected then the 2 systems can be used interchangeably.

Key Words: Swine, Heart rate variability, Well-being

W111 Use of digital infrared thermography to assess thermal temperature gradients and pathologies of the bovine claw. S. J. Schmidt*[1], S. D. Bowers[1], K. B. Graves[1], R. Carroll[2], J. White[1], and S. T. Willard[1], [1]*Mississippi State University, Mississippi State, MS,* [2]*Carroll Trimming, Palastine, TX.*

Lameness is a major problem in dairy cattle, and alternative methods for assessing claw health are needed. In this study, digital infrared thermal imaging (DITI) of regions of the bovine claw (Holstein cows; n = 21) were acquired following routine claw trimming procedures to determine whether thermal gradients of the claw exist that might be related to lameness. Using WinTES software, rectangular transects were drawn through thermal images of the claws and temperatures quantified (MAX, AVG, MIN and standard deviation, (SD); °C) relative to the bulbar, prebulbar, subapical and apical regions. The medial and distal digits of the claw were analyzed separately for each fore- and hind-limb. A lameness data capture form was used to document any detectable pathologies of each claw (e.g., laminitis, abscesses, infections), and a severity score assigned (1 = mild/slight; 3 = severe). Data were analyzed comparing thermal gradients among respective claw regions. Across all claws examined, a temperature gradient was observed with AVG bulbar, prebulbar, subapical and apical temperatures as follows: 29.4 ± 0.21, 29.8 ± 0.19, 30.7 ± 0.21 and 30.02 ± 0.21 °C, respectively. AVG center claw medial and distal digit temperatures were higher (31.08 ± 0.23; P < 0.05) than outer claw laminar surface temperatures (28.42 ± 0.15 °C). The highest temperatures of the claw were observed in the subapical region (32.63 ± 0.24 °C), while the lowest temperatures were observed in the prebulbar region (27.59 ± 0.15 °C). All regions of the claw were highly correlated with one another (r = 0.71 to 0.94; P < 0.0001), as were center and laminar surface temperatures (r = 0.77; P < 0.0001); suggesting that while temperatures differed by region they changed proportionately to one another. The greatest amount of variability in temperatures was observed (as determined by SD values) in the subapical region (1.21 ± 0.04 °C), and the least variability observed in the region of the bulb (0.69 ± 0.03 °C). Where case studies (pathologies) were identified, an association between lameness score and anomalies in claw temperature were evident. These data indicate that thermography may be a useful tool for assessing claw abnormalities, pathologies, and other predisposing factors to bovine lameness.

Key Words: Bovine, Lameness, Digital infrared thermography

W112 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: Immune measures. Leslie Dabovich*[1], Julie Morrow[2], Anthony Rudine[1], Lindsey Hulbert[1], Barbara Smith[1], and John McGlone[1], [1]*Texas Tech University,* [2]*USDA-ARS.*

Seventy nine Camborough-22 (PIC USA) gilts with know estrous dates were used to determine the effects of two penning systems (5 crates vs. pens of 5) and two feeding systems (drop fed vs. trickle fed) on immunity. The four treatments were arranged in 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop. Trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period. Immune measures were collected five to six weeks before expected farrowing. Data were analyzed as a randomized complete block design with a 2 X 2 factorial arrangement of treatments. Immune measures were collected including total number of white blood cells (WBC), differential counts, red blood cell numbers, hemoglobin, hematocrit, lymphocyte proliferation under phytohemaglutinin and lipopolysaccaride mitogens, neutrophil chemotaxis, and neutrophil phagocytosis. The interaction between penning and feeding systems was statistically significant for percent phagocytosis (77.97, 97.00, 91.04, and 74.16, SEp = 5.01, P < 0.05 for DROP-Crate, DROP-Pen, TRICKLE-Crate, and TRICKLE-Pen, respectively) and average number of beads phagocytized (5.38, 5.61, 5.55, and 5.11, SEp = 0.07, P < 0.05, respectively). In general, the efficiency of neutrophil phagocytosis (measured by both % of neutrophils that phagocytized and the numbers of beads phagocytized) was higher among Crated gilts that were Trickle-fed than Drop-fed; however, among penned gilts, the neutrophil efficiency was reduced among

Trickle-fed gilts compared with Drop-fed gilts. Generally, all other immune measures and plasma cortisol were not different among treatments or their interactions. In conclusion, most immune measures were not influenced by the penning or feeding systems evaluated. However, neutrophil phagocytosis efficiency may be improved for crated gilts that are trickle rather than drop fed. Among penned gilts, trickle feeding reduced neutrophil efficiency compared with neutrophils from gilts that were drop fed.

Key Words: Pig, Welfare, Immunity

W113 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: behavioral measures. L. Hulbert*[1], J. Morrow[2], J. Dailey[2], and J. McGlone[1], [1]*Texas Tech University,* [2]*USDA-ARS.*

Seventy-eight Camborough-22 (PIC USA) gilts in mid gestation were used to determine the effects of two penning systems (crates vs. pens of 5) and feeding system (drop fed vs. trickle fed) on gilt behavior. The four treatments were arranged in a 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop at 0730 h. Trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period at 0730 h. Gilts with a known estrus date and a predicted next estrus date were randomly selected and moved from their acclimation group pen to their assigned treatment. Behavioral measures were collected from time lapse video recordings made over a 24-h period from d 50 to 70 of gestation. Measures of reproductive performance and physiology will be reported elsewhere. Behaviors recorded and summarized included standing, lying, sitting, drinking, feeding, social interactions and oral/nasal/facial (ONF) behaviors. The statistical model was a randomized complete block design with a 2 X 2 factorial arrangement of treatments, four complete blocks and a split plot over time (4 h time periods over a 24-h day). Overall activity levels of gilts were statistically similar ($P > 0.10$) among treatments. However, gilts in some treatments expressed different durations of behaviors at certain times of day. Gilts in Pen-DROP showed more ($P < 0.05$) ONF around 1200 h than gilts in the other treatment groups. Over the entire 24-h period, ONF duration was not different among treatments. Crated gilts showed less ($P < 0.01$) standing but more ($P < 0.05$) sitting than penned gilts (for Crated and Penned gilts, respectively, standing: 0.25 vs. 0.06 ± 0.024 h and sitting: 0.10 vs. 0.04 ± 0.17 h). Crated gilts spent more ($P = 0.05$) time feeding than penned gilts (0.09 vs. 0.07 ± 0.007 h) while the time to feed was not significantly different between Drop- and Trickle-fed gilts. Agonistic and non-agonistic social interactions did not differ ($P > 0.10$) among treatments during this mid gestation sample period. In conclusion, while overall behavioral activity levels were statistically similar among treatments, pregnant gilts expressed different forms of activity depending on the available space.

Key Words: Pig, Welfare, Behavior

W114 Effect of mixing and transportation on behavior and cortisol response in relation to Salmonella infection in swine. D. C. Lay Jr.*[1], T. J. Stabel[2], M. J. Toscano[1], and B. A. Vote[2], [1]*ARS-USDA, Livestock Behavior Research Unit,* [2]*ARS-USDA, National Animal Disease Center.*

When apparently healthy swine are transported, it is not uncommon for a small portion of them to be shedding Salmonella. It is theorized that some 'non-shedders' start to shed. Our goal was to identify characteristics of those individuals that shed Salmonella and those that do not shed Salmonella. Thus, we experimentally created transportation stress in order to induce recrudescence of Salmonella in pigs. Two experiments were conducted using 30 pigs in each experiment. Experiment 1 (Exp. 1) differed from Experiment 2 in that Exp. 1 established catheters in the pigs while catheters were not established in Exp. 2. Salmonella-free pigs were inoculated intranasally with 5×10^5 or 1×10^6 cfu of Salmonella choleraesuis/pig 3 weeks prior to mixing and transport. Fecal samples were collected and cultured for S. choleraesuis at various time points post inoculation: 8h, 24h, 48h, 7d, 14d, 21d (pre-stress), 21d (post mixing/transport), 21d (post mixing/transport/mixing), 22d (1d post stress), and 23d (2d post stress). Ileocecal lymph node samples were collected 23d post inoculation (2d post stress), and cultured for S. choleraesuis. Pigs were mixed for 2 h, transported for 2 h, placed back in a pen together for 2 h, and then return to their individual pens. During the initial mixing, the number and individuals engaged in agonistic behavior was recorded. Blood samples were collected at 0, 3, 5, 7, 24, and 48 h for cortisol analysis. Upon necropsy the body condition was given a score to indicate degree of wounds due to fighting. Data were analyzed in relation to the expression of Salmonella infection. Pigs were classified as positive for Salmonella in the feces, lymph nodes, or combinations there of. In both Exp. 1 and 2 we found no differences in the number of fights, degree of wounds on body due to fighting, or plasma cortisol concentrations in relation to the Salmonella status of the pigs ($P > .10$). In each experiment, we had only one pig that was considered a persistent shedder. Interestingly, both of these had plasma cortisol concentrations that were below the mean and median for the group. It was thought that shedders would be more stressed, thus this observation is interesting and warrants further investigation.

Key Words: Stress, Swine, Salmonella

W115 Effects of an environmental enrichment on the behavior, physiology and growth of beef cattle. T. Ishiwata*[1], K. Uetake[1], N. Abe[2], and T. Tanaka[1], [1]*School of Veterinary Medicine, Azabu University,* [2]*Faculty of Agriculture, Tamagawa University.*

To determine the effects of an environmental enrichment on behavior, physiology and growth, 35 9-mo-old Japanese Black X Holstein steers were allocated to 3 pens (6.0 X 9.5 m each): Pen C consisted of a feeding alley, a trough and a water bowl (control, n=11); Pen D included a drum (58 X 90 cm) containing hay (n=12); Pen GD included a drum with a plastic carpet (30 X 120 cm) for grooming (n=12). Behavioral observations were made for 2 h at 10 min intervals after morning and evening feedings for 3 d in 5 successive mo. Agonistic behavior was observed for 1 h after both feedings to assess the dominance order (DO). Jugular vein blood samples were collected and body weight recorded every 2 mo. ANOVA and post-hoc test, and correlation analysis were performed. The effect of the pen was significant in the evening observations, but that of the plastic carpet was not significant. The steers continued frequent access to the drum for 3 mo after its installation (in both Pen D and GD, 0-3 mo: 4 mo after installation, $P<0.05$). The installation of a drum increased the frequencies of active behaviors especially eating, and reduced those of self-grooming, licking bar, and inactive behaviors (resting and rumination) for 5 mo (for all behaviors, Pen D, GD: C, $P<0.05$). The average daily gain (ADG) was not different between pens, but it was correlated with eating hay at the drum in Pen D from 2 to 4 mo after installation ($r_s=0.63$, $P<0.05$). In Pen C, ADG was correlated with eating hay at the trough from 2 to 4 mo after installation ($r_s=0.76$; $P<0.05$). DO was correlated with access to the drum in Pen GD ($r_s=-0.73$; $P<0.05$). Plasma dopamine concentrations were higher in Pen D than in Pen C ($P<0.05$). Serum triglyceride concentrations were higher in Pen C than in Pen GD ($P<0.05$). Although social factor affected the steers' access to the drum with a plastic carpet, the drum kept the steers attracted, and promoted their growth by encouraging their eating and activity for several months.

Key Words: Beef cattle, Environmental enrichment, Behavior

W116 Age and castration stress influence the thermal nociceptive response of calves. S. T. L. Ting[1,2], B. Earley[1], I. Veissier[3], S. Gupta*[1,2], and M. A. Crowe[2], [1]*Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland,* [2]*Faculty of Veterinary Medicine, University College Dublin, Belfield, Dublin 4, Ireland,* [3]*INRA, Centre Clermont-Ferrand-Theix, F-63122 Saint Genes Champanelle, France.*

To determine the effect of age and castration stress on the thermal nociceptive (or pain) threshold (TPT) of calves, and the presence of stress-induced hypoalgesia (i.e., increased thermal pain threshold) following castration, 60 Friesian calves were allocated to one of six treatments (n=10/treatment): Sham controls at 21 wk of age (C), burdizzo castration at 6 (6-wk), 10 (10-wk), 14 (14-wk), 19 (19-wk) and 22 (22-wk) wk of age. The TPT of each calf was assessed 72 h before treatment, and at 12, 24 and 48 h after treatment using a far infrared (10600 nm) CO_2 laser device (MPB Lamsor Inc., Dorval, QC, Canada). The CO_2 laser beam (5.5 watt) was applied to a shaved area of the skin on the caudal aspect of the metatarsal. The latency of each calf to react by moving the leg at which the CO_2 beam was aimed was recorded. Two alternated measurements were taken from each leg of the calves, with at least 30 s between the two measurements. Mean latencies for the four measurements were calculated. At -72 h before treatment, there were no

differences (P>.20) in the TPT between C calves and the 10- to 22-wk-old calves. However, 6-wk-old calves had higher TPT than C at -72 h (P=.0001), and at 24 (P=.002) and 48 h (P=.0004) after treatment, but the values were not different at 12 h (P=.06). While the overall TPT (mean of 12 to 48 h data) after treatment were higher in 10-wk (P=.004), 14-wk (P=.0001), 19-wk (P=.0001) and 22-wk-old (P=.03) calves than their respective values at -72 h, the TPT values did not change with time in C (P=.07) and 6-wk-old calves (P=.94). In conclusion, calves at 6 wk of age are less sensitive to thermal pain than older calves (10- to 22-wk), and their sensitivity to pain is not modified by castration. The TPT of the older calves (10- to 22-wk) increased following castration, indicating the presence of stress-induced hypoalgesia.

Key Words: Cattle, Castration, Hypoalgesia

W117 Effects of age at transport on development of neonatal dairy calves. T. A. Johnson*[1], S. D. Eicher[2], J. N. Marchant-Forde[2], and A. G. Fahey[1], [1]*Purdue University, West Lafayette, IN,* [2]*USDA-ARS, West Lafayette, IN.*

Transportation stress at an early age can influence performance and the developing immune system. The purpose of this study was to evaluate the effects of age at transport on growth and health of neonatal calves. Holstein calves (n=47) were randomly assigned to treatments that were by age at transport; 2-3 d (A), 4-5 d (B), or 6-8 d (C) within a completely randomized design. Colostrum was given for the first 24 h after birth and followed by 2 daily feedings of milk replacer (4 L/d) and ad libitum grain-based dry feed. Calves were transported (6 h) and then placed in outdoor individual hutches. Weights were collected pre- and post-transport then on d 7, 14, 21, 28, 35, and 42. Clinical and fecal scores, and nasal and ocular discharge were evaluated five times a wk for each calf. Repeated procedures in Mixed Models of SAS were used to analyze the data. Calf weights decreased from d 0 through post-transport for all treatments, then increased throughout the rest of the study (P< .05). Intake also increased over time (P<.05). Fecal scores were affected by treatment and time (P<.05), with group C having lower fecal scores throughout the 5 wk and all group scores decreasing over time. Additionally, the B group had greater (worsened) fecal scores at wk 2 than group C (P<.05) and tended to have greater scores than group A (P=.10). Eye lacrimation increased over time (P<.05), but was not different among treatments. Nasal discharges were different over time (P<.05), and tended to be different by treatment (P=.06). The A group had greater nasal discharge scores compared to the C group at wk 1 to 5, and than group B at wk 5 (P<.05) and tended to be greater (P=.07) than group B at wk 1 and 2. Clinical scores were different over time (P<.05), and at wk 5 the A clinical score was less than that of the C group (P<.05) and tended to be less than that of the B group (P=.06). These data suggest that calves may have increased susceptibility to intestinal disease when transported at 4 to 5 d-of-age and respiratory disease when transported at 2 to 3 d-of-age.

Key Words: Dairy calves, Transport, Stress

Goat Species: Forage/Browse Utilization

W118 Goat kid preference for forage. T. W. White*, H. G. Bateman, C. C. Williams, and S. Alford, *Louisiana State University Agricultural Center, Baton Rouge, LA.*

Six Boer x Spanish wether kids (mean BW = 18.7 ± 0.68 kg) were used in a preference experiment comparing alfalfa hay (AH), Coastal bermudagrass hay (CBH), fresh cut wheat (W), oat (O), white clover (WC), crimson clover (CC), rape (R), mustard (M), or turnip (T) forage. Fresh forages were cut daily, and all forages were sampled prior to feeding at 0800. Samples of each forage were composited weekly for analysis. Kids were exposed to each forage for 2 d prior to beginning the experiment. During the experiment, each kid was randomly offered known weights of two forages simultaneously in every combination for 2 d. After 3 h, remaining forages were removed and weighed and DMI calculated for each forage. Kids had access to grass hay until the next day. Data were analyzed by ANOVA with preplanned contrasts. Average DM consumption of the respective forages was 235, 195, 97, 113, 9, 15, 79, 32, and 37 g per day. As fed consumption was 260, 213, 560, 589, 48, 88, 569, 265, and 299 g per day. Average consumption as fed was higher ($P < 0.01$) for fresh forage than hay; however, on DM basis this was reversed ($P < 0.01$). Kids preferred AH ($P < 0.01$) to CBH on DM basis. Preference for fresh forages was similar when expressed on fresh and dry basis. Consumption of O and W was higher ($P < 0.01$) than for M, R and T or CC and WC. Kids preferred R ($P < 0.01$) to M or T. Kids consume relatively high amounts of O, W, and R but will ingest more DM in a given time when fed hay.

Key Words: Goats, Forage, Preference

W119 Effect of feeding shrub and tree leaves on carcass characteristics in growing goat kids. M. Guerrero-Cervantes, A. S. Juarez-Reyes, F. Rios-Rincon, and M. A. Cerrillo-Soto*, *Universidad Juarez del Estado de Durango. Durango, Dgo. Mexico..*

Foliage from shrubs and trees is an important source of protein, vitamins and minerals in arid regions specially during the dry season when other sources of food are scarce. Therefore, a study was undertaken to evaluate the effect of supplementing *Quercus grisea*, *Quercus eduardii*, *Acacia shaffneri*, and *Opuntia spp.* leaves to an oat straw-based diet on performance and carcass traits in male kids. Twenty intact male kids (14.9 ± 0.7 kg BW) were blocked by weight and randomly assigned to one of five treatments, four supplements and one control. The leaves were included in a proportion of 15% of the diet (isonitrogenous, CP = 14.2%). The kids were fed in individual stalls for an average of 120 days before they were humanely slaughtered. Analysis of variance (SAS) was conducted for a completely randomized design using live weight as covariate. Slaughter weights were similar for all treatments (P>0.05). Hot carcass weights were similar in kids supplemented with *Q. eduardii*, *Q. grisea* and *A. shaffneri* but were heavier than for kids fed *Opuntia* or control diets (P<0.05). Kids supplemented with *Q. eduardii* had the heaviest empty body weight (P<0.05). Kids fed *Q. grisea* and *A. shaffneri* had similar empty body weight (P>0.05) but values were greater than for kids fed *Opuntia* or control diets (P<0.05). A similar tendency was noted for rib eye area. Dressing percentages were similar among treatments (P>0.05). It is concluded that feeding leaves from shrubs and trees commonly consumed by range animals might improve goat production via enhanced carcass characteristics.

	Treatments				
Item	*Querus eduardii*	*Quercus grisea*	*Acacia shaffneri*	*Opuntia spp.*	Control
Initial weight (kg)	15.7±2.4	15.2±1.91	15.1±1.3	14.6±1.1	14.1±0.7
Slaughter weight (kg)	25.2±3.6	23.2±1.8	24.5±2.7	20.7±2.0	20.7±3.3
Hot carcass weight (kg)	11.3±1.9^a	11.0±1.8^a	10.9±1.2^a	8.9±1.0^b	9.0±1.8^b
Dressing (%)	46.8±1.9	44.4±1.4	43.9±0.7	43.0±1.2	43.0±1.6
Empty body weight (kg)	21.0±3.3^a	18.7±2.2^b	19.5±2.3^b	17.1±2.0^c	16.4±2.7^c
Rib eye area (cm^2)	13.5±2.4^a	12.2±2.3^{ab}	11.0±1.3^{ab}	7.5± 0.6^b	10.0±1.1^{ab}

^{abc}Means within rows with same superscript differ (P<0.05).

Key Words: Goat kids, Shrubs, Trees

W120 Effects of method of exposure of crossbred Boer wether goats to Eastern red cedar foliage on cedar consumption. G. Animut*[1,2], A. L. Goetsch[1], R. C. Merkel[1], G. Detweiler[1], L. J. Dawson[3], R. Puchala[1], T. Sahlu[1], and R. E. Estell[4], [1]*E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK,* [2]*Animal Science Department, Oklahoma State University, Stillwater, OK,* [3]*School of Veterinary Medicine, Oklahoma State University, Stillwater, OK,* [4]*USDA ARS Jornada Experimental Range, Las Cruces, NM.*

This study was conducted to determine effects on present and future consumption of Eastern red cedar (*Juniperus virginiana*) foliage (CF) by goats of stepwise increases in dietary level of CF compared with a constant relatively high level and subsequent availability of low-quality forage. Twenty-four yearling wethers (23.5 ± 2.31 kg initial BW) were penned individually in Phases 1 and 3. In Phase 1 (8 wk), a concentrate-based diet (12.6% CP and 35.5% NDF) was offered at approximately

85% of the maintenance energy requirement alone (Control) or with weekly stepwise (Step) increases in substitution of CF for concentrate (0, 1.25, 2.5, 5, 10, 15, 20, and 25% in wk 1-8, respectively; DM basis) or substitution of 25% CF in wk 2-8 (Set). Wethers grazed grass pasture in Phase 2 (6 wk). In Phase 3 (2 wk), all wethers were offered the 75% concentrate, 25% CF diet, without or with separate free-choice offering of prairie hay. CF was harvested weekly from male trees and refrigerated; CF and concentrate were hand-mixed prior to feeding. In Phase 1, average total DMI was similar among treatments. Intake of CF as a percentage of that offered was greater ($P < 0.05$) for Step vs Set in wk 3-8 (wk 3: 86 and 48; wk 4: 89 and 56; wk 5: 94 and 71; wk 6: 96 and 81; wk 7: 93 and 63; wk 8: 96 and 84), although CF intake as g/d was greater ($P > 0.05$) for Set vs Step in all but wk 7 and 8. In Phase 3, concentrate intake was similar among treatments, and hay intake when offered averaged 149, 134, and 124 g/d for Step, Set, and Control, respectively. For wethers not receiving hay, CF intake as g/d for Step was greatest among treatments ($P < 0.05$) but was not different from treatments offered hay (67, 37, 30, 55, 53, and 56 g/d for Step, Set, Control, Step+hay, Set+hay, and Control+hay, respectively; SE = 7.1). Similarly, CF intake as a percentage of offered CF ranked ($P < 0.05$) Step > Set > Control without hay, but was not different between Step without hay and treatments with hay (78, 41, 34, 61, 57, and 60 for Step, Set, Control, Step+hay, Set+hay, and Control+hay, respectively; SE = 7.6). In conclusion, gradual increases in dietary level of CF deserve further research as a potential means of elevating present and future CF consumption, with attention also directed to type and level of other feedstuffs offered.

Key Words: Eastern Red Cedar, Goats, Adaptation

W121 Evaluation of tropical legume forages (*Medicago sativa*, *Dolichos lablab*, *Leucaena leucocephala*, and *Desmanthus virgatus*) for growing goats.

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A feeding trial of 56 d was conducted to evaluate the effect of supplementing with legume forages (*Medicago sativa*, *Dolichos lablab*, *Leucaena leucocephala*, and *Desmanthus virgatus*) on growth and feed performance. Castrated kids (n=24) with an average initial age of 135 d and live-weight of 18.72 kg were used in the study. Kids were of predominantly Boer or Spanish crossbreeds, which were randomized across diet groups. Four diets were composed of *Sorghum bicolor* (sudangrass hay) supplemented by one of four legume hay forages, calculated on a DM basis, and corn (200 g/d per goat). On the basis of 100 g/d gains, each animal was limit fed 0.4 and 0.6 kg of legume to sudangrass each day. A split-plot design was employed, with diets as main plots, and pens as subplots (consisting of 3 pens as replicates per diet). Each pen contained two goats. In addition, for growth traits, data were blocked for the effects of breed-type, litter size, parity of dam, and initial age as a linear covariate. Interactions between main effects were never significant. Initial body weights were the same (20.6 kg) for Boer and Spanish crossbreds ($P>0.05$). Also, Boer compared to Spanish crossbred kids had similar weight gains (4.26 and 4.52 kg; $P=0.719$), although Boer crossbred kids tended to be heavier ($P<0.10$) than Spanish crossbred kids (23.8 and 21.4 kg) at the end of the study. Total body weight gains over the 56-d trial were not significantly influenced by diet (4.61, 4.28, 5.26, and 3.41 kg for alfalfa, lablab, leucaena, and desmanthus, respectively; pooled SE of 0.71). Final body weights (recorded at approx. 9:00 am) were also not affected by diet ($P>0.05$). Voluntary total feed intake was higher by 3.71 kg ($P<0.001$) in pens of two goats receiving the alfalfa control diet compared to the average of pens receiving the experimental legume forage diets (28.3, 25.9, 29.5, and 18.4 kg for alfalfa, lablab, leucaena, and desmanthus, respectively). Intake of lablab compared to desmanthus forage was higher by 7.51 kg ($P<0.001$), demonstrating relatively poorer palatability for desmanthus. Diet tended to influence ($P=0.062$) feed conversion efficiency (ADG/DMI) with diet means of 0.097, 0.100, 0.127, and 0.087 for alfalfa, lablab, leucaena, and desmanthus forages, respectively (pooled SE of 0.0088). In conclusion, our research results did not show significant effects of legume forage diet on growth performance.

Key Words: Goats, Legumes, Tropical agriculture

W122 Cell wall degradability of the diet consumed by grazing goats in North Mexico.

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The degradation characteristics of a feed, particulary rate of degradation and effective degradability, provide an estimate of its rumen digestibility, which to a large extent influences intake and productivity of livestock. However, there is very little information available on degradation characteristics of forage consumed by grazing goats. The aim of this study was to determine the *in situ* degradability of the cell wall content of the diet consumed by grazing goats in a thorn scrubland in North Mxico. Three ruminal and esophageal cannulated goats were used to obtain samples during the 1999 dry season (February-June) and a month (July) of the rainy season . The extrusa samples collected from the previous month were incubated in the rumen of the same animals for 0, 3, 7, 12, 24, 48, 72 and 96 h. The degradation of the cell wall content of the samples was described by using the equation $p = a + b\ (1\text{-}e^{-ct})$. The values obtained for the fractions: (a), soluble fraction, (b) insoluble but fermentable fraction, (a+b) potencial degradability, (c) constant rate of degradation, and (ED) effective degradability were analyzed according to a randomized block experimental design using Proc GLM (SAS). The fractions (a), (b), (c), (a+b) and (ED) differed among months ($P<0.05$). July had higher values for (a), (c), (a+b) and (ED), except for (b) ($P<0.05$), for which March had the highest value (53.6%), indicating shrub regrowth. Results indicated that variations in quality and availability of the forage consumed by grazing goats may be detected by measuring both the rate (c) and the effective degradability (ED).

	Fractions (%)				
Months	a	b	a+b	c	ED
February	0.8^{d}	36.5^{b}	37.3^{cd}	5.0^{ab}	17.6^{bc}
March	1.9^{cd}	53.6^{a}	55.5^{ab}	2.7^{b}	20.4^{bc}
April	8.0^{c}	37.3^{b}	45.4^{bc}	3.8^{ab}	24.3^{b}
May	9.2^{b}	34.7^{b}	44.0^{c}	4.6^{ab}	25.9^{b}
June	-1.3^{d}	33.7^{b}	32.4^{d}	3.6^{ab}	12.8^{c}
July	22.8^{a}	39.6^{b}	62.5^{a}	6.1^{a}	44.6^{a}
Mean	6.9	39.2	46.2	4.3	24.3
SEM	1.7	3.6	2.6	0.0098	2.4

^{a,b,c,d} Means within columns with the same superscript do not significantly differ ($P<0.05$).

Key Words: Goats, Cell wall degradability, Grazing

W123 Effects of different quality diets consumed continuously or after a lower quality diet on characteristics of growth of young Spanish goats.

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Spanish wether and doeling kids (n=38; 4.5 mo of age; 13.4 kg initial BW) were used to determine influences of different quality diets consumed continuously or after a lower quality diet on characteristics of growth. The experiment consisted of two 9-wk periods. Diets were low quality forage (L; prairie hay supplemented with soybean meal), high quality forage (H; dehydrated alfalfa pellets), and 70% concentrate (C). Kids on two treatments consumed L in Period 1, with half switched to C and half to H in Period 2 (LC and LH, respectively). The CC treatment entailed C consumption in both periods, and HH kids were fed H in both periods. For HC, H was fed in Period 1 followed by C in Period 2. Dry matter intake ranked ($P < 0.05$) LC and LH < CC < HC and HH in Period 1 (502, 352, 386, 610, and 636 g/d) and CC and LC < LH, HC, and HH in Period 2 (652, 621, 833, 808, and 836 g/day for CC, LC, LH, HC, and HH, respectively). Average daily gain was lowest among treatments ($P < 0.05$) for LC and LH in Period 1 (78, 1, -1, 84, and 80 g) and was 53, 82, 112, 92, and 73 g in Period 2 for CC, LC, LH, HC, and HH, respectively (SE = 11). Empty body fat concentration at the end of Period 1 was greatest for the C diet and lowest for L ($P < 0.05$; 12.2, 6.4, and 9.0% for C, L, and H, respectively), and protein concentration was greatest among treatments ($P < 0.05$) for L (16.8, 20.1, and 18.1% for C, L, and H, respectively). At the end of Period 2, empty body fat concentration was 22.0, 15.9, 14.4, 20.1, and 15.2% (SE = 1.94), and protein concentration was 16.8, 16.9, 17.9, 16.5, and 17.6%

(SE = 0.35) for CC, LC, LH, HC, and HH, respectively). In summary, kids on the L diet in Period 1 mobilized fat to accrete a small amount of protein. Continuous consumption of C resulted in high fat accretion relative to H in both periods. Consumption of H in Period 1 followed by C in Period 2 resulted in growth characteristics slightly different from those with continual intake of C, with a lower concentration of protein in accreted tissue for HC. The diet in Period 2 for kids previously consuming L did not markedly affect tissue accretion. In conclusion, the nature of the diet consumed by young Spanish goats can impact current and subsequent rate and composition of BW gain.

Key Words: Goats, Diet quality, Growth

W124 Effects of diet quality and age of meat goat wethers on early subsequent growth while grazing wheat forage. A. L. Goetsch*, G. Detweiler, T. Sahlu, R. Puchala, R. C. Mekel, and S. A. Soto-Navarro, *E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.*

Thirty-six meat goat wethers (3/4 Spanish and 1/4 Boer), born in the previous Spring (initial age and BW of 8.5 mo and 17 ± 0.6 kg) or Fall (initial age of 2.5 mo and 13 ± 0.8 kg), were used to determine effects of ad libitum consumption of different quality diets and age on early subsequent growth while grazing wheat forage. The experiment was 14 wk long, with 9 wk in the winter consuming prairie hay (5% CP and 71% NDF) supplemented with 0.125% BW of soybean meal (PH), alfalfa pellets (AP), or a 70% concentrate diet (CD), and 5 wk in the spring grazing wheat forage. Average daily gain in Period 1 (28, 54, and 81 g; SE = 14.0) and Period 2 (123, 137, and 100 g for PH, AP, and CD, respectively; SE = 13.8) was similar among dietary treatments and greater for Spring vs. Fall wethers (Period 1: 72 vs 37 g, $P < 0.05$; Period 2: 131 vs 108 g, $P < 0.09$). There was not a discernible pattern of change in ADG as week of grazing wheat forage advanced (wk 1: 65 and 22 g; wk 2: 236 and 188 g; wk 3: 65 and 105 g; wk 4: 49 and 23 g; wk 5: 249 and 215 g for Spring and Fall, respectively). Body composition (estimated from shrunk BW and urea space) on d 42 and 98 and composition of gain were similar among dietary treatments. Differences between ages ($P < 0.05$) in protein mass on d 42 (2.92 and 2.65 kg for Spring and Fall, respectively) and 98 (3.72 and 3.36 kg for Spring and Fall, respectively) were similar in magnitude, although that in fat mass on d 98 (4.60 and 3.31 kg) was considerably greater than on d 42 (2.39 and 1.96 kg for Spring and Fall, respectively). In accordance, protein accretion from d 42 to 98 was similar between ages (14.3 and 12.6 g/d for Spring and Fall, respectively; SE = 0.86), whereas rate of fat accretion was greater ($P < 0.05$) for Spring vs Fall wethers (39.6 vs 24.1 g/d). In conclusion, the nature of the diet consumed ad libitum did not impact subsequent growth by 3/4 Spanish wethers, regardless of age, when grazing wheat forage.

Key Words: Goats, Age, Wheat forage

W125 Spatial-temporal relationships of grazing goats and sheep and their guardian dog monitored by global positioning system collars. T.A. Gipson*, M. Villaquiran, J. Joseph, and A. L. Goetsch, *E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.*

Guardian animals such as dogs, donkeys, and llamas are commonly used to protect small ruminants from predators. However, data on their spatial relationships are lacking. The objectives of this research were to examine spatial relationships of goats (G), sheep (S), and guard dogs (D) over time and to determine circadian rhythms. In a group of 12 G and 12 S confined in a 1.6 ha pasture, Global Positioning System (GPS) collars were fitted to three G, two S, and the sole D. GPS fixed longitude and latitude every 30 min for 2 wk. After post-differential correction, minimum distance traveled between consecutive fixes (4,097 observations) and distance between any two animals at the same fix time (7,097 observations) were calculated using spherical geometry. The repeated measures, mixed model included animal identity, species, and fix time, with identity nested within species as a random effect. At night, S traveled least between fixes (17.2 ± 1.30 m) and D most (21.9 ± 1.94 m) with G intermediate (17.6 ± 1.10 m). However, during day, D traveled least (29.0 ± 1.64 m) and G most (48.3 ± 0.87 m) with S intermediate (41.0 ± 1.02 m). For distances among species at the same fix, closest distance was at night among G (11.2 ± 1.21 m) and greatest distance at night between the D and S (93.0 ± 1.45 m), which was not different ($P>.10$) from the distance during day between D and S (91.5 ± 1.21 m) or distance at night between G and S (90.2 ± 0.81 m). Distance among G was greater ($P<.05$) during day (14.8 ± 1.01 m) than at night (11.2 ± 1.21 m). Distance between S was greater ($P<.01$) during day (28.6 ± 1.40 m) than at night (14.1 ± 1.80 m). Distance between G and D during day was 52.6 ± 1.04 m and at night was 17.5 ± 1.21 m. During day distance between G and S was 66.9 ± 0.66 m. The three species exhibited definite spatial relationships and preferences; however, further study is needed to ascertain causal effects for these preferences.

Key Words: Goats, Sheep, GPS

W126 Global positioning system for monitoring spatial relationships of grazing goats within and across pastures. M. Villaquiran*, T. A. Gipson, J. Joseph, and A. L. Goetsch, *E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.*

Herd dynamics for goats are not as well understood as for other grazing species, especially how differing genotypes affect spatial aspects or how herds in adjacent pastures interact spatially. The objective of this study was to investigate spatial relationships in a herd of mixed genotype goats. In one 2-ha pasture (East, E) containing 30 Angora (A) and Boer-cross (B) goats, global positioning system (GPS) collars were fitted to one A, two B, and their guard dog (D). In the adjacent 2-ha pasture (West, W) also containing 30 A and B, GPS were fitted to one A and one B. GPS fixed longitude and latitude every 30 min for 2 wk. D had access to both pastures. After post-differential correction, minimum distance traveled between consecutive fixes (3,922 observations) and distance between any two animals at the same fix time (4,265 observations) were calculated using spherical geometry. The repeated measures, mixed model included animal identity, genotype, pasture location, and fix time with identity nested within genotype as a random effect. During the day D (60.9 +/- 2.32 m) traveled more ($P < 0.01$) than goats (A: 36.4 +/- 1.58 m; B: 36.9 +/- 1.26 m, respectively). At night, A, B, and D traveled less ($P < 0.05$) during day (22.5 +/- 2.07, 18.3 +/- 1.67 and 21.7 +/- 2.85 m, respectively). Within pasture, A-B goat distance (19.9 +/- 3.91 m) was not different from the B-B distance (12.7 +/- 6.79 m). During day, distance among goats was 21.5 +/- 3.55 m and 16.6 +/- 3.54 m at night. Distances of D with goats in W were greatest ($P < 0.01$) during day (100.7 +/- 2.17 m) and least at night (75.1 +/- 2.08 m) and distances of D with goats in E were greatest ($P < 0.05$) during day (40.4 +/- 1.98 m) and least at night (35.2 +/- 1.82 m). Genotype of goat did not affect spatial relationships; however, time of day did, with distance traveled and distance between animals greater during day than at night.

Key Words: Goats, Dog, GPS

Physiology

W127 Metabolizable protein requirements for maintenance, gain, and mohair fiber growth by Angora goats. J. Luo*, A. L. Goetsch, and T. Sahlu, *E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.*

A database of treatment mean observations from the literature was constructed for Angora goats to estimate metabolizable protein (MP) requirements for maintenance, gain, and mohair fiber growth. Observations were categorized as preweaning, growing, mature (not lactating or pregnant), lactating, and pregnant goats; however, due to limited numbers of observations, data for preweaning, lactating, and pregnant goats were removed. Intake of MP (MPI) was estimated from feed intake, diet composition, and protein degradability properties with methods similar to those of AFRC. Data set 1 (n = 124) was used to determine MP requirements for maintenance and whole body gain (i.e., ADG; tissue and fiber) by simple linear regression; data set 2 (n = 88) was employed to estimate MP requirements for maintenance, tissue gain, and mohair fiber growth by multiple regression. Variables, scaled by kg $BW^{0.75}$, were MPI (g/d), ADG (g), non-fiber, tissue gain (TG; g/d), and clean fleece growth rate (CFGR, g/d). Because there were no differences (P

> 0.05) between growing and mature goats in intercepts or regression coefficients of equations derived from data sets 1 or 2, observations were pooled. Data set 1 was then split into subsets for equation development (n = 73) and evaluation (n = 51). The initial equation for the regression with the development subset was MPI = 4.52 (SE = 0.349) + (0.336 (SE = 0.0568) × ADG) [n = 73; R^2 = 0.33]; the final equation after removing five observations with residuals greater than 1.5 times the residual SD was MPI = 4.30 (SE = 0.286) + (0.318 (SE = 0.0471) × ADG) [n = 68; R^2 = 0.41]. Regressing observed against predicted values with the evaluation subset resulted in an intercept and slope not different (P > 0.05) from 0 and 1, respectively. The equation with data set 2 was MPI = 3.63 (SE = 0.475) + (0.292 (SE = 0.0583) × TG) + 1.49 (SE = 0.430) × CFGR) [n = 88; R^2 = 0.41]. Similarly, after removing observations with residuals greater than 1.5 residual SD, the final equation was MPI = 3.35 (SE = 0.440) + (0.281 (SE = 0.0486) × TG) + (1.65 (SE = 0.394) × CFGR) [n = 83; R^2 = 0.46]. In conclusion, predicted MP_m for Angora goats was 4.30 and 3.35 g/kg $BW^{0.75}$ with 0 ADG and 0 TG and CFGR, respectively, and MP requirements for ADG, TG, and CFGR were 0.318, 0.281, and 1.65 g/g, respectively.

Key Words: Metabolizable protein, Angora goats, Mohair

W128 Adrenal and metabolic response to exogenous ACTH stimulation in pregnant and non-pregnant Angora and Spanish does.

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Angora goats are suspected of aborting under nutritional and(or) cold stress due to an impaired ability to mobilize body reserves to maintain blood glucose levels. We used non-pregnant (NP; n=6/breed) and pregnant (PREG; n=6/breed; 4 singles, 2 twins/breed) Angora (ANG) and Spanish (SPA) does in their third trimester. We tested metabolic response to a 26 h fast, followed by a 7 h ACTH infusion (0.015 IU/(kg BW.min)). Blood samples were collected at -60, -30, -1, and 30 min, and hourly from 1 to 7 h during infusion. After the 26 h fast (baseline values), plasma levels of cortisol and glucose were similar between ANG and SPA does and between number of fetuses. Concentration of NEFA was similar between breeds, but lower in PREG than NP does (x 10^2; 5.1 ± 0.3 vs. 6.1 ± 0.4 μM; P=0.03). Plasma urea N (PUN) level was higher in ANG than SPA does (13.6 ± 0.6 vs. 11.1 ± 0.6 mg/dL; P=0.03). To adrenal stimulation with exogenous ACTH, the integrated cortisol response above baseline was similar between breeds, but across breeds, was lower in PREG than NP does (x 10^3; 54.6 ± 3.6 vs. 71 ± 5.2 ng/(mL.min); P<0.01). Glucose peak response and time to peak were similar across breeds and fetuses. The integrated glucose response was similar between breeds, but lower in PREG than NP does (x 10^3; 4.4 ± 1.6 vs. 10.7 ± 1.7 mg/(dL.min); P=0.01). After the start of the ACTH infusion, NEFA decrease from baseline was shorter (32.6 ± 4.4 vs. 42.5 ± 4.5 min; P=0.02), and smaller (181 ± 36 vs. 195 ± 25 μM; P=0.03), in PREG than NP does respectively. Total increase in plasma NEFA after the minimum was similar in all groups. The integrated PUN response was similar between breeds, but higher in PREG than NP does (x 10^2; 14.8 ± 3.3 vs. 5.1 ± 1.3 mg/(dL.min); P=0.03). In conclusion, in response to a 26 h fast and to a 7 h administration of exogenous ACTH, ANG and SPA does mounted similar metabolic responses. Metabolic responses in both breeds were greatly altered by pregnancy.

Key Words: Stress, Gestation, ACTH

W129 Heat production by Alpine, Angora, Boer, and Spanish wether goats consuming different quality diets at a maintenance level of intake.

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Six Alpine (AL; 38.4 ± 3.0 kg), Angora (AN; 23.1 ± 2.7 kg), Boer (BO; 40.75 ± 4.5 kg), and Spanish (SP; 33.6 ± 2.16 kg) wethers (1.5 yr of age) were used to determine effects of genotype and diet quality on heat production (HP) when fed near maintenance and fasting. The experiment consisted of four simultaneous crossovers, with 21 d for adaptation before measures. Diets were 60% concentrate (CON; 14% CP and 12.04 MJ ME/kg DM) or ground alfalfa hay (HAY; 18% CP and 10.17 MJ ME/kg DM). Heat production was determined from O_2 consumption and production of CO_2 and CH_4 with a head-box respiration calorimetry system (Sable Systems, Las Vegas, NV), along with urinary N excretion, over 2-d periods in fed and fasting states (4-d fast). Heat production was expressed on the basis of average BW during HP measurement periods. There were no interactions between genotype and diet. Intake of ME was similar among genotypes and between diets. Neither diet (358 and 354 kJ/kg $BW^{0.75}$ for CON and HAY, respectively; SE = 5.7) nor genotype (359, 361, 346, and 358 kJ/ kg $BW^{0.75}$ by AL, AN, BO, and SP, respectively; SE = 8.8) influenced fed HP (P > 0.10). Fasting HP was similar between diets but was greatest among genotypes (P < 0.05) for AL (253, 227, 219, and 226 kJ/ kg $BW^{0.75}$ by AL, AN, BO, and SP, respectively; SE = 7.25), which may have been due to a greater level of activity exhibited by AL than other genotypes during fasting. Efficiency of utilization of ME for maintenance was similar (P > 0.10) between diets (0.68 and 0.67 for CON and HAY, respectively; SE = 0.01). The ME requirement for maintenance, estimated by regressing HP against ME intake, was similar (P > 0.10) between diets (341 and 346 kJ/kg $BW^{0.75}$ for CON and HAY, respectively; SE = 10.5) and among genotypes (352, 354, 321, and 346 kJ/kg $BW^{0.75}$ for AL, AN, BO, and SP, respectively; SE = 14.8). In summary, with a level of intake near maintenance, the energy need for maintenance appears similar for AL, AN, BO, and SP 1.5 yr-old wethers goats regardless of diet quality. Supported by USDA Project No. 0003835.

Key Words: Goats, Energy, Maintenance

W130 Effecs of genotype, diet, and feed intake on the relationship between energy expenditure and heart rate in goats.

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Heart rate (HR) holds promise as an indirect means of estimating energy expenditure (EE) by ruminants. Therefore, an experiment was conducted to determine effects of genotype, diet, and feed intake on the ratio of EE:heart rate in yearling wether goats. Six Alpine (41 ± 6.3 kg), Angora (23 ± 4.0 kg), 7/8 Boer (39 ± 4.4 kg), and Spanish (36 ± 1.3 kg) wethers (1.5 yr of age) were fed chopped alfalfa hay (18% CP and 10.2 MJ ME/kg DM) or a 60% concentrate diet (14% CP and 12.0 MJ ME/kg DM) at a level of intake near maintenance followed by a 4-d fast in a crossover design experiment. Energy expenditure was measured in a head box respiratory calorimetry system (Sable System, Las Vegas, NV) based on O_2 consumption and production of CO_2 and CH_4 with the Brouwer equation in 2-d periods while being fed and at the end of fasting. To monitor HR, stick-on ECG electrodes were attached to the chest just behind and slightly below the left elbow and at the base of the jugular groove on the right side of the neck. The human S610 HR monitor (Polar Electro, Woodbury, NY) was used to record HR at 1- min intervals. Heart rate per minute was affected by level of intake (60.7 and 38.9 for maintenance and fasting, respectively; SE = 0.9; $P < 0.05$) and a genotype × feed intake interaction (maintenance: 60.8, 63.6, 59.0, and 59.2; fasting: 42.1, 39.6, 38.3, and 35.6 for Alpine, Angora, Boer, and Spanish, respectively; SE = 1.7; $P < 0.05$). The ratio of daily EE (kJ/kg $BW^{0.75}$) to average HR per minute was not affected by genotype (6.01, 5.72, 5.87, and 6.24 for Alpine, Angora, Boer, and Spanish, respectively; SE = 0.22), diet (5.96 and 5.96 for hay and concentrate, respectively; SE = 0.13), level of intake (5.90 and 6.01 for maintenance or fasting, respectively; SE = 0.13), or their interactions. The absence of these effects on EE:HR suggest potential use of HR to estimate EE by goats. Supported by USDA project No. 0003835.

Key Words: Goats, Heart rate, Energy expenditure

W131 Interactions among body condition, protein supplementation, serum insulin levels and ovarian activity in goats.

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A reduction in either nutrient intake or body condition may compromise ovarian activity (OA). Previous results showed that protein supplementation and a high body condition increased OA without differences in serum LH and GH between treatments. This study evaluated the effect of by-pass protein supplementation level upon OA and serum insulin (INS) concentrations in Criollo x Alpine-Sannen goats, 19 months old, with divergent body condition (BC). Goats with low BC (LBC, n=16; BW=28.71.0 kg, BCS=2.010.2) or high BC (HBC, n=16; 38.461.0 kg, BCS= 3.080.2) received one of two levels of by-pass protein (PROT; blood meal): Non-PROT (NP, 0 g hd d-1) or PROT (HP, 125 g hd d-1)

during 40 d prior to ovulation. Goats had access to water, shade, mineral salts, and a basal diet of alfalfa hay (2.0% BW, 14.8% CP). Once synchronized (PGF2a, 2 injections 11 d apart), blood samples were collected 36 h later at 15-min intervals during a 6-h period to evaluate serum INS levels. On d 15 post-ovulation, OA was evaluated by transrectal ultrasonographic scanning. Overall means for total follicles (TF), corpus luteum (CL), and total ovarian activity (TOA; TF+CL) were 2.31, 2.34 and 4.65, respectively. While TF was not affected (P>0.05) by BC, both CL (P=0.03) and TOA (P=0.01) favored HBC-goats. Similarly, HP goats showed higher values for TF (P=0.04), CL (P=0.06) and TOA (P=0.01). While HBC-goats had greater serum INS than LBC goats (1.92 vs. 0.81 ng mL-1), HP-goats had greater INS values than NP goats (1.04 vs. 1.69 ng mL-1), and INS and CL were positively correlated (r=0.46; P<0.01). Results suggest that high serum INS levels may have prevented atresia and enhanced ovarian activity in both the high body condition and the protein supplemented goats.

Key Words: Goats, Insulin, Ovarian activity

Management

W132 Performance of lactating does fed different levels of ruminally undegradable intake protein.

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The objective of this study was to evaluate effects of supplemental ruminally undegradable intake protein (UIP; derived from mixtures of blood, fish, and soybean meals) on BW change, DM intake, serum insulin concentration and milk yield and composition in lactating Alpine does. Twenty-five does (BW 46.6 ± 5 kg, 10 ± 3 d of lactation) were stratified by age, day of lactation, and BW, and randomly assigned to supplements with different levels of UIP (UIP: 0, 25, 50, 75 100 g/d; CP: 0, 73, 101, 130, and 179 g/d). Does were individually fed (*ad libitum* intake) a basal diet (44.1% alfalfa hay, 18.5% corn stover, 20.7% flaked corn grain,7.8% ryegrass hay, 7.4% molasses, and 1.5% minerals; 12% CP, 2.42 Mcal ME/kg) for 58 d. Diets CP and UIP contents were 12.1, 13.0, 13.8, 14.8, and 15.6%; 3.7, 4.1, 4.8, 5.6, and 6.2% for 0, 25, 50, 75, and 100 g/d of UIP, respectively. Data were analyzed as a completely randomized design. No significant treatment differences were detected in BW ($P = 0.20$; 44.7 ± 1.05 kg) or DM intake ($P = 0.40$; 5.8 ± 0.17% BW). Milk yield increased quadratically ($P < 0.05$) as UIP increased in the diet (3.41, 4.01, 4.36, 4.34, and 4.17 kg/d for 0, 25, 50, 75, and 100 g/d of UIP, respectively; SE = 0.193). Milk concentrations of protein, lactose, fat, solids non-fat, and total solids, and serum insulin concentration were not affected by UIP level ($P > 0.05$). In summary, with a diet containing 12% CP and 70% forage, milk yield was greatest with 50 to 75 g/d of supplemental UIP. Addition of UIP in the diet of lactating does may result in greater milk production when fed to animals and diets similar to this trial.

Key Words: Goats, Milk, Undegradable intake protein

W133 Effect of recombinant bovine somatotropine (rBST) on milk production in goats of the North of Mexico.

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The ability of recombinant bovine somatotropin (rBST) to enhance milk production is well established in cows. However, there is a lack of information about the effect of rBST in goats. In order to evaluate the effect of rBST on milk production in dairy goats raised in northern Mexico (26°06' NL, 103°26' WL, 1092 masl), 56 does were used in two groups, balanced by days in milk and number of previous kiddings. One group (BST) was administrated 169 mg of recombinant bovine somatotropin at 14-d intervals, three consecutive times, whereas, the control group (CON) did not receive the rBST. Milk production was measured on the first experimental day and 7, 14 and 21 days after of the first rBST administration. Data was analyzed with the GLM procedure to evaluate the treatment effect on milk production and the interactions of production by days in milk, by number of previous kiddings, by measurement day and by goat. Treatment with rBST did not affect milk production (P>0.10), which was 1.51 L by the BST group and 1.58 L by the CON group. Nor was there an effect (P>0.10) of days after kidding or of measurement day on milk production. However, there was an effect of number of kiddings on production (P<0.001), with greater production in multiparous than in primiparous goats. Any of the studied interactions were not significant (P>0.10), which is congruent with the absence effect of treatment on milk productions. This finding suggests that goats don't respond to rBST in a similar fashion than cows, and that several factors that were not controlled in this experiment, for example, body condition and the individual feed consumption, might have an effect.

	Treatment			
	BST	Con	SE[1]	OSL[2]
Overall milk production	1.51	1.58	0.050	0.23
Milk production by days in milk				
40 to 55 d	1.50	1.56	0.056	0.48
56 to 83 d	1.53	1.59	0.056	
Milk production by previous kidding				
Primiparous	1.17	1.32	0.107	0.001[3]
Multiparous	1.86	1.83	0.095	

[1]SE, most conservative standard error is presented. [2]Observed significance level. [3]Significance between primiparous and multiparows goats

Key Words: Recombinant bovine somatotropine, Milk, Goats

W134 Growth performance by Alpine, Angora, Boer, and Spanish wether goats consuming 50 or 75% concentrate diets.

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Forty-six weaned wether goats (12 Alpine, 12 Angora, 10 Boer [87.5%], and 12 Spanish) were used to determine differences in growth performance with consumption of a 75% concentrate diet for 24 wk (75C) or for 12 wk subsequent to 12 wk of feeding a 50% concentrate diet (50C). Initial BW was 20.2, 12.2, 20.7, and 19.2 kg (SE = 0.73) for Alpine, Angora, Boer, and Spanish, respectively. There were no interactions between genotype and dietary treatment in DM intake, ADG, or gain efficiency in wk 1-12 or 13-24. Dry matter intake in wk 1-12 ranked (P < 0.05) Alpine and Boer > Spanish > Angora (703, 436, 689, and 567 g/d) and in wk 13-24 was greater (P < 0.05) for Alpine and Boer vs Angora and Spanish (712, 515, 702, and 456 g/d for Alpine, Angora, Boer, and Spanish, respectively). Dry matter intake as g/d was similar between dietary treatments. Average daily gain in wk 1-12 was greatest among genotypes (P < 0.05) for Boer (59, 59, 90, and 49 g); in wk 13-24 ADG was lowest among genotypes (P < 0.05) for Spanish and tended to be greater (P < 0.10) for Boer vs Alpine (58, 63, 82, and 25 g for Alpine, Angora, Boer, and Spanish, respectively). Gain efficiency (ADG:DM intake) was greater (P < 0.05) for Angora and Boer than for Alpine and Spanish in wk 1-12 (85, 132, 127, and 85 g/kg), and in wk 13-24 was lower (P < 0.05) for Spanish than for Angora and Boer (80, 121, 104, and 51 g/kg for Alpine, Angora, Boer, and Spanish, respectively). Average daily gain and gain efficiency were greater (P < 0.05) for 75 vs 50% dietary concentrate in wk 1-12 (ADG: 73 and 55 g; gain efficiency: 122 and 92 g/kg), and tended to be greater (P < 0.11) for 50C than for 75C in wk 13-24 (ADG: 49 and 65 g; gain efficiency: 77 and 101 g/kg for 75C and 50C, respectively). In conclusion, a moderate vs high dietary concentrate level did not impact differences among Alpine, Angora, Boer, and Spanish wether goats in growth performance.

Key Words: Goats, Growth performance, Dietary concentrate level

W135 Economical feedstuffs for on-farm meat goat diets.

S. Schoenian*[1], N. C. Whitley[2], and E. Johnson[1], [1]*Maryland Cooperative Extension, Keedysville, MD,* [2]*University of Maryland Eastern Shore, Princess Anne, MD.*

Eighteen intact male crossbred Boer meat goats were utilized to demonstrate the use of barley (an inexpensive, alternative local grain) as the primary feedstuff in an economical on-farm meat goat diet. At approximately 161.0 ± 1.3 days of age and 28.4 ± 0.5 kg body weight, goats were placed into two groups for a 14-day adjustment period and fed 17%

CP diets consisting of a pelleted commercial goat feed (COM; 17% Goat Feed, Southern States, Inc.; n = 9) or a barley-based feed mixed on-farm (BAR; n=9) with ad libitum grass hay and water. The BAR diet was 76.2% barley, 20% protein supplement pellet (40% CP) and 3.8% medicated mixing pellet (Deccox). At the end of the adjustment period, 3 goats were placed in 4.6 x 1.5 m pens with 3 pens per treatment. Animals were hand fed pre-weighed diets (twice daily) and grass hay (once daily) at levels adjusted to provide approximately 110% of the amount previously fed. Body weights were measured and recorded weekly for 42 days. There was no effect of diet on body weight, with average weights increasing ($P < .01$) from 29.7 ± .86 kg (week 1; day 0) to 35.7 ± .95 kg at the end of the study (week 6; day 42). Hay consumption was not influenced by treatment and averaged 0.54 ± .02 kg/d. Average daily gain was also similar between diets, averaging approximately 0.16 ± .06 kg/d. Feed intake (measured as feed offered) was influenced by week only ($P < .01$), increasing ($P < .01$) from 1.0 ± .09 kg/d to 1.5 ± .09 kg/d per goat from the first to the last 2-week period, respectively. Cost of feeding hay was not influenced by treatment but overall grain cost per goat per day was influenced by a treatment by week interaction ($P < .01$) in which cost was higher ($P < .01$) for all 2-week periods for the COM compared to BAR diets. Average cost per goat per day was \$0.17 ± .03, \$0.26 ± .03 and \$0.23 ± .03 for BAR and \$0.30 ± .03, \$0.43 ± .03 and \$0.50 ± .03 for the COM for the first, second and third 2-week periods, respectively. In this study, the barley-based diet provided similar gains for meat goats but was more economical than the commercial diet tested.

Key Words: Barley, Goat, Feed Costs

W136 Effect of breed type and feed level on production efficiency in meat goats.

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Feed intake was measured in goats, fed at an *ad libitum* level of intake (100%) or at restricted levels of 85% and 70% of *ad libitum* intake, from weaning to 13 mo of age. There were a total of 72 kids of three breeds: 24 Boer (BR), 24 Spanish (SP) and 24 Tennessee Stiff-legged (TS). Goat breeds were classified as large (BR), intermediate (SP) or small (TS) in size. Weights were taken biweekly. Cost of feed supplied over the period (calculated at \$0.22 per kg), change in weight from weaning until slaughter, and sale price per kg of live weight (based on the San Angelo livestock auction prices, estimated at \$1.98 per kg live weight), were used in evaluating revenue. The objective was to perform cost analysis of feed intake when three breeds of goats were raised at three different levels of a formulated ration. Average weaning ages for BR, SP and TS breeds, respectively, were 81, 77 and 88 days. Significant differences ($P<.01$) existed in 13 mo cumulative feed intake between BR (198.87 kg), SP (121.85 kg) and TS (146.39 kg). Goats fed at the 100%, 85% and 70% levels consumed 189.98 kg, 148.86 kg, and 128.27 kg, respectively. Revenue was calculated as: (selling price per kg x change in weight) - feed cost. Revenue calculated for the BR breed at the 100%, 85% and 70% dietary levels, respectively, were: \$28.42, \$29.26 and \$24.82; for the SP breed at the same levels, respectively, were: \$30.07, \$16.23, and \$16.47, and for the TS at the same levels, respectively, were: \$17.13, \$21.05 and \$16.36. ADG, from weaning to 13 mo slaughter, at 100%, 85% and 70% levels, respectively, for BR were: 0.120, 0.104, and 0.089 kg/d ($P<.01$), for SP at the same levels, respectively, were: 0.103, 0.068, and 0.064 kg/d ($P<.01$), and for TS at the same levels, respectively, were: 0.088, 0.080, and 0.066 kg/d ($P<.05$). Differences ($P<.01$) were also observed in ADG, averaged over all dietary levels over the 13 mo period, for BR (0.104 kg), SP (0.078 kg) and TS (0.078 kg). Significantly higher ($P<.05$) revenue could be generated in a production system using BR when compared to a system using SP or TS breeds. A production system using SP and TS breeds would generate about equal amounts of revenue.

Key Words: Boer Goats, Tennessee Stiff-legged, Goat Revenue

W137 Effect of level of dietary copper on the copper status of lactating does and their nursing kids.

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This study was conducted to evaluate the effect of feeding free-choice minerals containing 3 levels of dietary copper (Cu) on the Cu status of lactating does (halfblood and 3/4 Boer) and of their offsprings. Fifty-one pregnant does (BW: 56 kg) were separated into 6 equal groups 6 wk prior to kidding, assigned to 3 experimental treatments (free-choice minerals containing either 0, 1,000 or 3,000 mg Cu/kg DM) and pen-fed hay and a grain mix for 4 wk. Goats were then grazed on three separate perennial pastures starting 2 wk before the start of the kidding season (March 21 - April 17) until weaning (July 8). Intake of free-choice minerals by pregnant and lactating does was monitored weekly throughout the trial. Blood samples for the determination of plasma Cu were taken by jugular venipuncture from 24 pregnant does at the start of the trial, and from the same does and 15 kids at weaning. Kids were harvested at weaning and liver samples taken for the determination of liver Cu concentrations. From the start of the trial until the end of kidding, does consumed daily 22.3, 20.1, and 20.9 g free-choice minerals, corresponding to respective Cu intakes of 0.0, 20.1, and 62.6 mg/d. While grazed with nursing kids, does consumed daily 22.4, 23.4, and 21.9 g free-choice minerals, corresponding to Cu intakes of 0.0, 23.4, and 65.7 mg/d, respectively. Blood plasma Cu of does at the start of the trial (avg: 1.37 mg/L) and at weaning (avg: 1.27 mg/L), and of kids at weaning (avg: 1.15 mg/L) were not affected by treatment. Kid birth weight (avg: 3.6 kg), weaning weight (avg: 20.5 kg), daily gain from birth to weaning (avg: 160 g/d), live and carcass grade at weaning (avg 1.2; USDA scale), carcass weight (avg: 10.2 kg), and carcass yield (avg: 49.6%) were not affected by treatment. Liver Cu concentrations increased ($P < .01$) linearly with increasing dietary CU (110, 182, 247 mg/kg DM, respectively), but liver lesions were minimal and not affected by addition of Cu. Feeding these levels of Cu for 6 mo were not detrimental to does or their lactating kids and did not affect kid performance.

Key Words: Goat, Performance, Copper

W138 Evaluation of goat eye mucous membrane scoring for determination of the need for anthelmintic treatment.

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The major gastrointestinal parasite of goats in the southern U.S. is *Haemonchus contortus*, which is hematophagus, causes anemia, and therefore affects eye mucous membrane color (EMMC). The objective of this study was to evaluate EMMC as an indicator of the need for anthelmintic treatment. EMMC on the inside of the lower eyelid was scored using a color chart with four gradations of color (1 = dark, 4 = pale). EMMC was also captured with a digital camera with the values for red, blue and green determined from a selected digital picture area. Goats (n = 167) on a variety of pasture studies were evaluated for packed cell volume (PCV; microhematocrit) and fecal egg count (FEC; eggs/gram [epg]; McMaster). Data were analyzed by X^2 analysis and GLM procedures. Fecal egg counts averaged 212, 596, 816, and 2077 epg for the scores 1 through 4, respectively and were greater ($P < 0.01$) for a score of 4 than for other scores. EMMC scores correctly identified 22 of 30 animals with FEC greater than 2,000 (sensitivity 73%) but included 47 animals with FEC less than 2,000 (specificity 70%). Goats with score of 4 had lower PCV than scores of 3 or less ($P < 0.01$; 23, 26, 29, and 29%, respectively). Eye scores of 4 correctly identified 19 of 25 animals with PCV < 20% (sensitivity of 76%), but also included 50 animals with PCV > 20% (specificity of 75%). The red, blue, and green digital values from the image were poorly correlated to FEC or PCV ($R^2 < 0.11$). In conclusion, scoring EMMC with a chart correctly identified most animals needing anthelmintic treatment, but included a significant proportion not requiring treatment.

Key Words: Internal parasites, Mucous membrane, Anemia

W139 WITHDRAWN. , .

W140 Effect of transport stress on hair sheep moving from a subtropical to a semiarid climate in north-central Mexico. S. Franco-Shaffer, R. Batista-Díaz, R. M. Rincon, F. Echavarria, R. Bañuelos, and C. F. Arechiga*, *UAMVZ-Universidad Autonoma de Zacatecas. Zacatecas, Mexico.*

A decline in sheep-wool prices has shown the establishment of alternative ovine productive systems as hair sheep in arid environments. The purpose of present work was to evaluated the effect of transport stress on hair sheep (Black-belly X Pelibuey) exposed to a trip along 200 km during 3 h in a van vehicle, moving from a subtropical to a semiarid climate, with an altitude variation from 1,380 to 2,153 m passing into a maximum of 2,480 m above the sea level. The study included 6-months old hair ewes (n = 35), randomly allotted into 2 groups: 1) Control Group (i.e. without transportation, n = 18); 2) Transport Group (n = 17). Blood samples were obtained every hour just before and during transportation of the ewes included in both groups, to determine serum levels of cortisol, sodium (Na) and potassium (K). Once the ewes arrived to the semiarid environment, blood samples were taken every 3 h during 72 h. Transported hair ewes had shown greater serum levels of cortisol than non-transported ewes (i.e., control ewes) (2.53 vs 0.96 mg/L; P $<$ 0.001). A greater difference was immediately shown after the first hour of transportation (3.11 vs.1.10 mg/L) but a statistical difference remained during the 3 h trip (P$<$ 0.001). Sodium (Na) levels, decreased in transported ewes (P = 0.06). A greater decrease of Na was shown during the first hour of transportation. Serum potassium (K) levels showed no statistical difference within 3 h of transportation (P$>$0.10). In conclusion, hair ewes exposed to transport stress had shown greater serum levels of cortisol and lower levels of sodium, primarily during the first two hours of transportation, while no difference was found on serum levels of potassium (K).

Key Words: Hair sheep, Transport stress, Cortisol

W141 Effect of pre- and post-mating FGA-intravaginal sponges on estrous synchronization and embryo recovery in hair ewes. E. Avila-Hernandez[2], H. Rodriguez-Frausto[1], R.M. Rincon[1], J.J. Chavez[1], R. Bañuelos[1], and C. F. Arechiga*[1], [1]*UAMVZ-Universidad Autonoma de Zacatecas, Zacatecas, Mexico.*, [2]*FMVZ-Universidad Autonoma de Nayarit, Nayarit, Mexico.*

Intravaginal sponges containing fluorogestone acetate (FGA) were used before and after mating in hair ewes. Pubertal hair ewes (n=20) with an age of 5.5 mo and average body-weight of 21.1 2.3, were randomly distributed in a 2x2 factorial design (n=5/group). First, duration of FGA treatment (12 vs 6 d) was evaluated for estrous synchronization, according to a established protocol reported by Rangel, 1999 (i.e., sponge FGA 0-12d; d 10, 500 IU eCG; d 12, 75 mg PGF2α; d 13 & 14, natural breeding or insemination), and was compared to a shorter protocol including a FGA exposition of 6 d only (ie., sponge FGA 0-6d; d 4, 500 UI eCG; d 6, 75 mg PGF2α; d 7 & 8, natural breeding). Secondly, after natural breeding with hair rams, it was determined the effect of a FGA sponge from d 1 to 7 post mating on embryo collection. The effect of FGA on reproductive tract for 12 d increases the number of ewes showing estrus (12 d=100% vs. 6 d=70%), as well as number of embryos collected from hair ewes using FGA for 12 d compared to 6 d (30 vs. 9 embryos) (P$<$0.05). However, hair ewes exposed to FGA for 12 d showed a greater number of embryos when no FGA sponge was used compared to the FGA treatment after mating (no FGA=18 vs. FGA=12 embryos). Embryo collection efficiency (%) [(total number of embryos collected/total number of corpora lutea) x 100], was 20% greater when FGA was used after mating (i.e, 75 vs 55%; FGA12d/FGA post mating vs. FGA12d/No FGA post mating, respectively). In conclusion, a FGA-sponge treatment for 12 d increases estrous synchronization of hair ewes and FGA treatment post mating (d 1-7) tended to increase embryo-collection efficiency.

Estrous synchronization with FGA sponge	FGA 1–7 d post-mating	Percentage of estrus (%)	No. of corpora lutea per group	Embryo recovery (No. of embryos per group)	Corpora lutea per ewe (mean ± SD	Embryos per ewe (mean ± SD
FGA 6 d	No FGA	60 %	13	5 (38.5%)	2.6 2.7	1 1
FGA 6 d	FGA	80 %	24	4 (16.7%)	4.8 3.1	0.8 0.8
FGA 12 d	No FGA	100 %	33	18 (55%)	6.6 3.0	3.6 2.1
FGA 12 d	FGA	100 %	16	12 (75%)	3.2 1.3	2.4 3.2

Key Words: Hair sheep, Estrous synchronization, Embryo recovery

W142 Luteal function of pubertal hair ewes exposed to estrous synchronization and laparoscopic insemination in a semiarid climate in north-central Mexico. A. Muro-Reyes, H. Rodriguez-Frausto, R. M. Rincon, R. Bañuelos, J. I. Aguilera, and C. F. Arechiga*[1], *Universidad Autonoma de Zacatecas, Zacatecas, Mexico.*

The purpose of present study was to determine luteal function through 2 weekly measurements of serum progesterone in hair ewes (n=37), exposed to an estrous synchronization program by intravaginal sponges with fluorogestone acetate (FGA) from d 0-12, induction of multiple ovulation with 500 IU of eCG at d 10 and laparoscopic insemination, at their first autumn of life (i.e., reproductive season). 86.5% of hair sheep retained the intravaginal sponge (32/37). 28 ewes with retained sponge and 2 more without retention of the sponge showed estrus (i.e., 30/37; 87.5%). During the period of FGA exposure (12 d), 43.2% of hair ewes (16/37), had serum progesterone (P4) levels greater than 1 ng/ml. The rest, (56.8%; 21/37), had diminished luteal function or were in the follicular phase of the estrous cycle. By the end of the study, total average of serum progesterone was 5.46 ng/ml and serum-progesterone average after laparoscopic insemination was 7.96 ng/ml. 100% of hair sheep showed luteal function after laparoscopic AI. 91.9% (i.e., 34/37) showed estrous ciclicity evidence through an estrous-cyclic pattern of progesterone secretion. There was a conception rate of 10% (3 pregnancies out of 30 inseminations), and a pregnancy rate of 8.11% (3 pregnancies out of 37 ewes included in the study), even though hair ewes had a minimal average daily gain in body weight of 28.7 g/d during the last two months including the experimental protocol. Further research is required for the establishment and implementation of effective protocols for estrous synchronization and laparoscopic artificial insemination in pubertal hair ewes at semiarid climates.

Key Words: Hair sheep, Estrous synchronization, Laparoscopic insemination

W143 Assesment of different extenders for ovine semen cryopreservation. M. A. Lopez*[1], C. F. Arechiga[1], M. A. Castillo-Pecina[1], M. Perez[2], and J. Gutierrez[2], [1]*UAMVZ-Universidad Autonoma de Zacatecas, Zacatecas, Mexico.*, [2]*FZ-Universidad Autonoma de Chihuahua, Chihuahua, Mexico.*

A first trial was carried out to assess the capacity of five extenders: CY (sodium citrate-egg yolk-fructose); M (skim-milk-fructose); BFS (bovine fetal serum-fructose); SOP (Artificial saliva-Opuntia ficus indica extract-fructose) and AV (aloe vera gel-sodium citrate-fructose); and its combinations in 1:1 (v/v) proportion (better proportion in preliminary investigations), as mediums for ovine sperm subjected to chilling and freezing processes. Sperm motility and viability were evaluated in three periods: After cooling at 5 C, 48 h after freezing and 90 days after freezing. Fifteen extenders and a Tris-based extender as control were tested. CY diluent was superior (P $<$ 0.05) due to its capacity for cell preservation in the three periods. CY combinations had acceptable rates for motility and viability. Although skim milk is used frequently as extender for sperm freezing, in our trial, it demonstrated a capacity of inferior protection, specially during long-periods storage. Egg yolk absence was the limitant factor in extenders that do not contain it, as these extenders had a clearly inferior performance. In a second trial, extenders CY, CY:AV and CY:SOP were selected for validation based in their celular protection capacity, cost and availability. Cooling and freezing process were similar in all senses than in the first trial, but, also

included acrosomal integrity (Giemsa staining) and membrane biochemical functionality (hypoosmotic swelling test). In conclusion, extenders such as CY, CY:AV and Tris-based were equally effective (P > 0.05) to preserve sperm motility, viability, acrosomal integrity and functionality of plasma membranes in ovine sperm subjected to chilling and freezing process.

Key Words: Ram, Semen, Freezing

W144 Evaluation of synchronized-ovulation (Ovsynch) schemes to be implemented in programmed breeding of hair sheep.

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The purpose of present work was to evaluate the effect of three schemes to synchronize ovulation in hair ewes to be included in programmed breeding using natural mating with hair rams. The study included 30 pubertal hair ewes of 5.5 mo of age and 20.7 kg. of average body weight randomly allotted in three groups. Ewes were sampled twice a week for serum progesterone determination by radioimmunoanalysis. Results have shown that an Ovsynch protocol complemented with a FGA sponge from d 0-7 and a ECP injection previous to mating, had a greater proportion of estrus and mating (9/11 ewes; 81.2% estrus and mating). However, when ECP was not included in the protocol (i.e., Ovsynch + FGA), a lower number of hair ewes showed estrus and were mated (5/11ewes; 45.5% estrus and mating), and even more when the Ovsynch protocol was used (i.e., no FGA sponge, nor ECP) (0/11ewes; 0% estrus and mating). The number of corpora lutea was 8, 11 and 12 for groups 1, 2 and 3, respectively. In conclusion, a greater number of hair ewes are mated by hair rams when the Ovsynch protocol is complemented with a FGA sponge and a ECP injection. We imply that a regular Ovsynch protocol is not recommended to be used for natural breeding.
Synchronized Ovulation Schemes

		Group 1	Group 2	Group 3
Day	Hour	Ovsynch	Ovsynch + FGA	Ovsynch + FGA + ECP
0	22:00	GnRH	GnRH + FGA	GnRH + FGA
7	22:00	PGF2a	PGF2α (FGA release)	PGF2α (FGA release)
9-11	08:00	Mating	Mating	Mating
9	22:00	GnRH	GnRH	GnRH + 2 mg ECP

GnRH: 0.1 mg Gonadorelin. Fertagyl (Intervet de Mexico, Edo. de Mexico, Mex.). PGF2a : 37 mg Cloprostenol. Prosolvin C (Intervet, Edo. de Mexico, Mexico). FGA: 40 mg Fluorogestone Acetate; Chronogest (Intervet, Edo. de Mexico, Mexico). ECP: 2 mg Estradiol Ciprionate. ECP (Pharmacia & Upjohn, Mexico, D.F.). Hormones were generously provided by Intervet de Mexico S.A. de C.V., through Drs. Garces-Yepez and Ramirez Martin del Campo.

Key Words: Hair sheep, Synchronized ovulation, Programmed breeding

W145 Estimation of the supply of metabolizable protein in diets consumed by grazing sheep in a semiarid region of North Mexico.

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Protein systems developed in the last decades permit allocate more precisely the nutrient supply. An accurate understanding of the quality of the forage consumed by grazing animals is necessary to alleviate nutritional constraints. The objective of this study was to determine the metabolizable protein content originated from the energy and protein of the diet using the French PDI protein system. Three criollo sheep (BW = 52±6.6) fitted with rumen and esophageal cannulae belonging to a flock of 100 animals were used. The animals grazed on a zone with low grass covering and scattered semisucculent trees. Mean rainfall was 450 mm. Extrusa and rumen fluid samples were collected from August to December 2002. Data used to fit the PDI system were: dietary CP content, *in situ* degradability of CP (5g DM were placed in nylon bags and incubated in sheep fed alfalfa hay and a commercial concentrate (70:30) for 0, 3, 6, 12, 24, 48, 72 and 96 h), organic matter fermented in the rumen (estimated from the digestible organic matter)and the digestibility of the feed protein in the small intestine (from tables provided in the literature). Data was analyzed using a randomized block design (Proc GLM, SAS). Escape protein was different between months (P<0.05) with a mean of 53 g/kg DM. Data indicate that the potential production of microbial protein originated from dietary nitrogen is higher (mean = 89 g/kg DM) (P<0.05) than originated from dietary energy (mean = 29 g/kg DM) which leads to a mean of metabolizable protein (escape + microbial protein from dietary energy) content of 82 g/kg DM. It is concluded that the forage consumed by sheep require a supply of energy to alleviatte the unbalance with protein during the rainy season.

Months	escape	Microbial from dietary N*	Microbial from dietary E*	Escape + microbial from dietary N*	Escape + microbial from dietary E*
August	60^{a}	123^{a}	29^{ab}	183^{a}	89^{a}
September	51^{b}	110^{b}	26^{bc}	161^{b}	77^{b}
October	60^{a}	70^{d}	33^{a}	130^{c}	93^{a}
November	64^{a}	50^{e}	22^{c}	114^{d}	89^{a}
December	30^{c}	90^{c}	34^{a}	120^{cd}	64^{c}
Mean	53	89^{a}	29^{b}	141^{a}	82^{b}
SEM	2.53	2.29	2.06	4.10	3.17

$^{a-d}$Means within columns with the same superscript do not significantly differ (P<0.05).
* g/kg DM

Key Words: Sheep, Grazing, Metabolizable protein

W146 Effects of the energy source (rendered beef fat or sugar cane molasses) on performance in lambs of hair sheep breeds fed whole rations.

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The effect of the energy source (rendered beef fat, BF or sugar cane molasses, SCM) was measured on the productive performance of ewe (n = 52) and ram (n = 51) lambs of hair sheep breeds, such as the Saint Croix (SC, n = 28), Pelibuey (PB, n = 34) and Blackbelly (BB, n = 41), fed whole rations. After an adaptation period of 14 days, all lambs were weighted every 14 days, until the end of the trial. All lambs were identified, and received ivermectin and ADE, B complex; one half of the lambs on each sex-breed-ration group were treated with nandrolone decanoate (ND). The lambs were distributed by ration, breed and sex into 12 lots. Three rations were used, BF, SCM and control, rations were formulated to contain 14.7and 3.08 Mcal/kg of feed. A GLM procedure of SAS was used to evaluate the effects of sex, rations and breeds and of the initial weight as covariable, and its interactions, on daily gain (DG) and final weight (FW). The DG was affected (P¡0.01) by sex and diet. The DG was greater (P¡0.05) in the males (158.5 g) that in the females (118.4 g), the DG for the rations were 150.2, 127.1 and 135.9 g for BF, SCM and control, respectively. The breed did not affect DG, the average for breeds were 148.2, 141.3 and 129.0 g for SC, PB and BB lambs, respectively. The interaction sex x ration was significant (P¡0.01). Similar results were observed whit FW, sex, diet and initial weight affected this variable. The average FW was 28.0 4.9 kg, ramlambs were heavier (by 4.52 kg), than the ewelambs. The breed did not affect FW, the average for the breeds were 26.9, 28.1 and 28.6 kg, for the SC, PB and BB, respectively. Treatment with ND did not affect DG. Results indicated that BF and SCM are alternative sources of energy and can be used to feed lambs of hair sheep breeds, without affecting their performance.

Key Words: Hair sheep breeds, Energy source, Lamb performance

W147 Feed efficiency, growth rates, carcass evaluation and sensory evaluation of lambs of various hair x wool sheep crosses.

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Feed efficiency, growth rates, carcass evaluation and sensory evaluation were compared in six lambs from each of the following genotypes: St. Croix hair sheep, St. Croix x wool sheep, Callipyge wool x St. Croix, Dorper hair sheep x St. Croix, Dorper x wool, Callipyge wool x wool,and wool x wool. The general linear model (GLM) ANOVA procedures and

Fisher's LSD multiple-comparison test were used to determine the differences among genotypes. Feeding efficient varied from 5.20 to 6.87, with the highest feed efficiency in St. Croix lambs. Standardized daily live weight gain ranged from 0.34 to 0.55 kg, with the highest rate of gain in the Callipyge wool x St. Croix lambs. Whole sale weight (kg) was the highest in the Callipyge wool x wool (19.26) and lowest in the St. Croix (15.38). Quality grade among the seven genotypes of lambs ranged from 5.5 to 7.6, with the St. Croix and St. Croix x wool lambs having the higher values. The highest value for the percent wholesale body weight was observed in the Callipyge wool x wool (64.1) while the value for St. Croix was the lowest (55.6). Percent loin eye of carcass weight was the highest in the Callipyge wool x wool (4.5) and the lowest is the St. Croix (3.0). The overall sensory acceptance rating was the highest in the St. Croix (6.8) and the lowest in the Callipyge wool x wool.

Key Words: Carcass evaluation, Feed efficiency, Sheep

Beef Species: Beef cattle performance and genetic relationships in the feedlot

W148 Genetic relations among carcass fat, tenderness, and age at slaughter in beef cattle managed under a constant finishing program. T. L. Fernandes*[1], J. W. Wilton[1], I. B. Mandell[1], and C.J.B. Devitt[2], [1]*University of Guelph, Department of Animal and Poultry Science,* [2]*Beef Improvement Ontario.*

Objectives were to estimate genetic parameters on carcass fat traits, tenderness at 7 days of aging (Angus x Simmental cows), and age at slaughter. Data on 744 crossbred animals from 3 research herds, fed at the Elora Beef Research Centre. Each year throughout the five-year period, the cattle were fed either a high-energy diet from start to finish or a haylage based diet the first 112 days and then a high-energy diet. All animals were targeted to finish at a constant backfat thickness of 8 mm, as determined by ultrasound measurements taken every 28 days. Forty sires were included, with a range of 8 to 34 progeny per sire. Carcass fat traits included: subcutaneous fat % and intermuscular fat % as measured from a rib section dissected into lean, fat (subcutaneous, body cavity, and intermuscular fat), and bone. Subcutaneous fat (SUBQ) % and intermuscular fat (INTER) % were calculated as percentages of overall rib weight. Chemical fat was determined by ether extraction of the dissected lean. Marbling score was determined subjectively. Tenderness was measured using Warner-Bratzler shear force with samples aged for 7 days. A multiple trait model was used to analyze the data with the model including regression on breed proportion, the covariate carcass backfat, fixed effects of herd of origin and contemporary group (year, nutritional treatment, and sex), and the random effect due to animal. Heritability estimates were 0.42, 0.44, 0.23, 0.53, 0.22, and 0.22 for marbling, SUBQ %, INTER %, chemical fat, shear force and age at slaughter, respectively. The genetic correlation between marbling score and chemical fat was 0.90 indicating that subjective marbling score is a good indicator of intramuscular fat. Marbling had a genetic correlation of -0.08 with shear force, and 0.02 with INTER. Selection for marbling should not affect carcass quality for tenderness and intermuscular fat.

Key Words: Beef, Meat-quality, Selection methods

W149 Effects of growth promotant (Revalor-G) implantation on feed efficiency and meat quality in Korean native cattle. S. Sun*[1], B. Ahn[1], K. Myung[1], Y. Cho[2], and K. C. Olson[3], [1]*Chonnam national Univeristy, Gwangju, Korea,* [2]*National Livestock research Institute, Namwon, Korea,* [3]*University of Missouri, Columbia, MO.*

The objectives of this study were to examine improving feed efficiency and meat quality by implantation of growth promotant in Korean native cattle. Fourteen steers (Korean beef cattle, BW 250+10kg, 14-month-old) were randomly assigned to either a control and implanted group. Steers were castrated at 3 months of age. Growth promotant (Revalor-G, 120 mg TBA + 24 mg estradiol benzoate) was implanted subcutaneously in the ear of seven steers at 15 months old. Animals were managed in a feedlot unit and slaughtered locally. Concentrate ration was fed 1.5kg per animal per day from 14 to 20 months, and then fed at 1.0kg per animal per day from 21-28 months of age. Rice straw was fed ad libitum. The implanted group was slaughtered at 24 months old (BW 638±14kg) and the control group was slaughtered at 28 months old (BW 635±17kg). Live weight was measured every 60 d and feed consumption was calculated daily. Daily weight gain and feed consumption were increased 53.3% and 18.9%, respectively, but feed requirement was decreased 22.6% by growth promotant implantation ($P < 0.05$). Plasma glucose content was enhanced, but urea-N was diminished by treatment. Also, serum cholesterol level was decreased significantly ($P < 0.05$) by the treatment. Carcass weight and yield grade were slightly increased in treatment group. These results indicated that growth promotant implantation improved daily weight gain and feed efficiency, but meat quality was decreased in Korean native cattle.

Key Words: Korean native cattle, Growth promotant, Meat quality

Ruminant Nutrition: Dairy and Beef

W150 Ruminal and intestinal protein digestion of tropical alfalfa and corn silage measured by mobile nylon bag technique in steer. A. Taghizadeh, M. Danesh Mesgaran*, R. Valizadeh, and F. Eftekhar Shahroodi, *Ferdowsi university,Mashhad,Iran.*

The ruminal and intestinal disappearance of dry matter (DM) and crude protein (CP) of tropical (Iranian) alfalfa and corn silage were measured in three steers (370±16), with ruminal and intestinal canulae, using mobile nylon-bag technique. The experimental samples, 18 replicates, were placed in nylon bags (3 x 6 cm, pore size 47μm), then incubated in the rumen of steers for 12 h prior to being inserted into the intestine. Dry matter and crude protein disappearances in the rumen, intestine and total tract were calculated as the difference between the each nutrient in the intact feeds and the remaining after incubation in the rumen and intestine. The disappearance of DM in the rumen, intestine and total tract for alfalfa and corn silage was 410 and 380, 190 and 460, 540 and 810 g kg-1, respectively. The disappearance of CP in the rumen, intestine and total tract for alfalfa and corn silage was 510 and 290, 730 and 890, 870 and 730 g kg-1, respectively. the results of intestinal and total tract DM disappearance of alfalfa were significantly different from the corn silage data ($p< 0.05$). The alfalfa CP disappearance in the rumen, intestine and total tract was significantly higher compared with corn silage ($p< 0.05$). The disappearance resuts of DM and CP of alfalfa and corn silage may related to the growing condition, species ans conservative processing.

Key Words: Dry matter, Nylon bag, Intestine

W151 Influence of low-level protein supplementation on forage intake, diet digestion and selection by beef steers grazing tallgrass-prairie range during the fall. D. A. Llewellyn*, R. C. Cochran, T. T. Marston, C. G. Farmer, and T. A. Wickersham, *Kansas State University, Manhattan.*.

An experiment was conducted to evaluate the effect on forage utilization of providing a limited quantity of a high-protein (45.5% CP, DM basis) supplement to beef cattle grazing tallgrass-prairie during the fall period. Sixteen ruminally fistulated Hereford x Angus steers (BW = 259 kg) were blocked by weight and randomly assigned to one of two treatments (i.e., fall supplementation or no fall supplementation) in a two-period study to evaluate the effect of low-level supplementation on forage intake and digestion during September and November. Within each treatment, four steers were used for measuring diet selection (by ruminal evacuation) and four were used for total fecal collection (via fecal bags). Each period consisted of a 15-d diet adaptation, a 4-d diet sample collection period, and a 6-d period in which total feces production was measured. The diet to feces ratio of the internal marker acid detergent insoluble ash was used to calculate diet digestibility and this

value, in combination with measured fecal output, was used to calculate intake. Steers were individually fed the high-protein supplement at a rate of 0.14% of BW/d (as-fed basis) but prorated and delivered 3 d/wk. The effect of fall supplementation on diet selection, intake, and digestion was not dependent on the period in which the characteristics were measured. The quality of diet selected decreased as season progressed (CP decreased, P<0.01; NDF tended to increase, P = 0.08; ADF increased P<0.01) and as a result, digestible OM intake and total tract OM digestion were significantly lower (P = 0.04 and P = 0.02, respectively) during November. Fall supplementation did not significantly influence the quality of diet selected or forage intake but supplemented steers tended (P = 0.06) to digest their diet to a greater extent. In conclusion, although seasonal effects on intake and digestion were evident, little impact of low-level fall supplementation was observed.

Key Words: Beef cattle, Protein, Diet selection

W152 Rumen digestibility of five forages estimated from the *in situ* degradation and rate of passage.

M. Murillo-Ortiz*[1], F. O. Carrete-Carreon[2], and O. Ruiz-Barrera[3], [1]*Juarez University of Durango State,* [2]*INIFAP-DGO.,* [3]*University of Chihuahua.*

The objective was to estimate the ruminal dry matter digestibility (RDMD) of five forages from the potential degradability and the rate of passage. Forages evaluated are: alfalfa hay (AH), a mixture of oat and alfalfa hays (MH), ryegrass hay (RGH), beans straw (BS), and Sudan grass hay (SGH). Dry matter degradability was estimated introducing polyester bags with 5g of ground sample in the rumens of four sheep for periods of 3, 6, 9, 15, 24, 48, and 72h. The rate of passage was obtained introducing forage marked with ytterbium in the rumens of four sheep and collecting feces samples of each animal at 0, 4, 8, 12, 16, 20, 24, 30, 36, 48, 60, 72, and 96h post-dose. The model Y= a + b(1-e^{-kd*t}) was fit to the degradation data; where: Y= degradation at time t; a= soluble fraction that is quickly degraded; b= insoluble but potentially degradable fraction; and kd =degradation rate of b fraction (h^{-1}). Marker concentrations in feces were described by the model: Y= Ae$^{-k1(t-TT)}$ - Ae$^{-k2(t-TT)}$; where: Y= marker concentration in all the feed particles at time t; A=marker concentration in the compartment at dosing time; k1= rate of passage of particles through the rumen (h^{-1}); k2= rate of passage through the cecum and colon (h^{-1}); TT= transit time. RDMD was obtained with the model: RDMD (%)= a+b*(kd/(kd+k1)). RDMD was analyzed by analysis of variance using a completely randomized design. RDMD of AH (60.0%) and of RGH (55.6) were not different (P>0.05). RDMD of AH was different (P<0.05) to RDMD of MH (53.8%). There were not differences between the RDMD of RGH (55.6%) and SGH (44%) (P>0.05). RDMD of BS and SGH were different to the RDMD of AH, RGH, and MH (P<0.05). These results suggest that the combination of the parameters of ruminal degradation with the rate of passage let us to estimate the RDMD of forages with different nutritive value.

Key Words: Rumen, Degradability, Models

W153 Mean ruminal residence time of five forages estimated from the degradation and passage rates.

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The objective was to estimate the mean residence time (MRT) of dry matter in rumen, using the characteristics of ruminal degradation and the rate of passage of five forages. *In situ* degradation of alfalfa hay (AH), oat hay (OH), ryegrass hay (RGH), oat straw (OS), and corn stover (CS) was determined. Polyester bags containing 5g of ground samples were introduced in the rumens of four sheep, and incubated for 3, 6, 9, 15, 24, 48, and 72h. Marked hay was introduced in the rumen and feces samples were collected at 0, 4, 8, 12, 16, 20, 24, 30, 36, 48, 60, 72, and 96h post dose to estimate the rate of passage. The degradability profiles of dry matter were described by the model: Y=a+b(1-e^{-kd*t}); where: Y=degradation of dry matter at time t; a=soluble fraction of dry matter that is rapidly degraded; b= insoluble but potentially degradable dry matter fraction; e= base of natural logarithms; and kd = degradation rate of fraction b (h^{-1}). Data of marker concentration in feces were described and parameters estimated by the model: Y=Ae$^{-k1(t-TT)}$ - Ae$^{-k2(t-TT)}$; where: Y=total concentration of the marker in all the particles at time t; A=marker concentration in the compartments at dosing time; k1=rate of passage of particles in rumen (h^{-1}); k2=rate of passage of particles through cecum and colon (h^{-1}), and TT=transit time. MRT of 1 kg of dry matter was obtained with the model: MRT (h)= (1-a-b/k1) + (b/(kd+k1)). Statistical analysis of MRT consisted on analysis of variance using a completely randomized design. The largest MRT was observed in OS (26.6 h) which was no different to CS (23.4 h) (P>0.05). MRT for OH, RGH, and AH were 14.8h, 13.6h, and 12.9h, respectively (P>0.05). MRT of OS and CS were different to MRT of the other forages (P<0.05). Different MRT among forages can be explained from the morphology and chemical composition of the forages. These results indicate that the combination of ruminal degradation characteristics with the rate of passage are good estimators of the MRT of forages.

Key Words: Rumen, Models, Degradability

W154 Effect of urea treatment and Fibrozyme® addition on *in situ* dry-matter degradability of corn bran.

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Present work try to compare the effect of urea or hemicellulase (Fibrozyme®) on the *in situ* degradability of corn bran. Animals received a total-mixed ration based on oat hulls (33%), flaked corn (29%), alfalfa hay (20%), cotton-seed meal (16%), salt (1%), and a mineral premix (1%). A 4x4 latin-square design included 4 rumen-fistulated Holstein steers, under 4 different treatments: C) Control corn bran; CU) corn bran treated with 4% urea; CF) corn bran with Fibrozyme® (15 g/d); and CUF) corn bran treated with 4% urea and Fibrozyme®. Nylon bags containing 5 g (as dry matter basis) of each one of the treatments were immersed at 0, 6, 12, 24, 48, 72 and 96 h in the ventral rumen of the steers. Effective degradability was adjusted in the following model p=a + b (1 - e^{-ct}) considered in the Neway computer software. All treatments showed a 95% rumen degradability by 72 and 96 h. However, there were statistical differences in rumen degradability within treatments from 6 to 48 h of incubation. Specifically, at 12h, values were: C= 46.4%; CU= 50.52%; CF= 57.3%; and CUF= 38.78%. At 24 h C= 61.5%; CU= 62.2%; CF= 73.8%; and CUF= 46.0%. Effective degradability at 5% of outflow rate was 52.9, 50.1, 59.1 and 42.8% for C, CU, CF and CUF, respectively. Ruminal availability of corn bran was influenced by urea and/or Fibrozyme®. While Fibrozyme® addition enhanced effective degradability of corn bran, combination with urea or urea by itself tend to reduce it. Both, Fibrozyme® and urea treatments could provide a healthier ruminal environment feeding high levels of corn bran, by either accelerating or slowing down ruminal degradability, respectively.

Key Words: Corn bran, Urea treatment, Exogenous enzyme

W155 Effect of urea treatment and Fibrozyme® addition on *in situ* dry-matter degradability of oat hulls.

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Present work try to compare the effect of urea or hemicellulase (Fibrozyme®) on the *in situ* degradability of corn bran. Animals received a total-mixed ration based on oat hulls (33%), flaked corn (29%), alfalfa hay (20%), cotton-seed meal (16%), salt (1%), and a mineral premix (1%). A 4x4 latin-square design included 4 rumen-fistulated Holstein steers, under 4 different in situ treatments: O) Control oat hulls; OF) oat hulls with Fibrozyme® (15 g/d); OU) oat hulls treated with 4% urea; and OF) oat hulls with Fibrozyme® and 4% urea. Nylon bags containing 5 g (as dry matter basis) of each one of the treatments were immersed at 0, 6, 12, 24, 48, 72 and 96 h in the ventral rumen of the steers. Effective degradability was adjusted in the following model p=a + b (1 - e^{-ct}) considered in the Neway computer software. Dry matter availability in rumen by 96 h was 42.6, 43.5, 62.5 and 60.4% for O, OF, OU and OFU, respectively. There was a statistical differences within treatments from 12 to 96 h of incubation, as well as for effective degradability at 5% of rumen outflow (38.7, 39.8, 47.5 and 46.6% for O, OF, OU and OFU, respectively. Urea treatment enhance the effective degradability of oat hulls. Whereas Fibrozyme® had no effect.

Key Words: Oat hulls, Urea treatment, Exogenous enzyme

W156 Effect of exogenous fibrolytic enzyme on digestibility of ammoniated or non-ammoniated bluegrass seed straw fed to beef cattle. J. I. Szasz*[1], C. W. Hunt[1], L. R. Kennington[1], and K. A. Johnson[2], [1]*University of Idaho,* [2]*Washington State University.*

Disposal of grass seed straw has become an environmental challenge, resulting in greater interest in enhancing its nutritive value for ruminants. Four ruminally cannulated primaparous beef heifers (mean BW 450 kg) were used in a 4 x 4 Latin square design experiment to determine the impact of an exogenous fibrolytic enzyme preparation on intake and digestibility of ammoniated and non-ammoniated bluegrass seed straw (2 x 2 factorial treatment arrangement). The exogenous enzyme contained xylanase and cellulase activity and enzyme activity was 676 μmol reducing sugars/g CP/min (20.9% CP). Heifers allocated to enzyme diets received straw treated with enzyme by hand spraying freshly prepared enzyme solution onto straw at a rate of 0.22 g enzyme (4.4 IU xylanase)/kg. Ammoniation resulted in greater ($P < 0.05$) *in situ* DM degradability at 8, 16, 24, 36, 72, and 96 h of ruminal incubation. Similarly, *in situ* NDF degradability was greater ($P < 0.05$) for ammoniated compared with non-ammoniated straw diets at 48 and 96 h of ruminal incubation and tended ($P < 0.10$) to be greater at 16, 24, 36, and 96 h. Total tract NDF and ADF digestibility was greater ($P < 0.01$) for ammoniated than non-ammoniated straws. No treatment effects were detected for DMI; however, heifers fed ammoniated straws consumed greater ($P < 0.05$) amounts of NDF than those fed non-ammoniated straws. Ammoniation resulted in lower ($P < 0.05$) ruminal fluid acetate, isobutyrate, and acetate:propionate, and greater propionate concentration at 0, 2, 8, 12, 16, and 18 h post-feeding. Addition of enzyme resulted in greater ($P < 0.05$) butyrate concentration at 0, 2, and 18 h post-feeding. No other enzyme effects ($P > 0.10$) were observed. For the diets evaluated in this experiment, optimum fiber digestibility appeared to have been achieved by the ruminal microorganisms without the complement of exogenous enzymes. Ammoniation improved digestibility of grass seed straw; however, exogenous enzyme was not effective for the conditions of this study.

Key Words: Forage, Xylanase, Rumen fermentation

W157 Effect of exogenous fibrolytic enzymes (Fibrozyme) on dry matter and cell wall *in vitro* digestibility of Guinea grass (*Panicum maximum.* var Mombasa) hay. J. H. Avellaneda-Cevallos[1], S. S. Gonzalez*[2], J. M. Pinos-Rodriguez[3], A. Hernandez[2], R. Barcena[2], M. Cobos[2], D. Hernandez-Sanchez[2], and O. Montanez-Valdez[2], [1]*Universidad Tecnica Estatal de Quevedo, Ecuador,* [2]*Colegio de Postgraduados, Mexico,* [3]*Universidad Autonoma de San Luis Potosi, Mexico.*

This study was performed to evaluate the effect of exogenous fibrolytic enzymes (enzyme; Fibrozyme) on *in vitro* digestibility of dry matter (DMIVD), neutral (NDFIVD) and acid (ADFIVD) detergent fiber of Guinea grass (*Panicum maximum* var. Mombasa) hay cut 35 or 90 d after regrowth. Experimental design was completely randomized with a 2x4x6 factorial arrangement of treatments (forage cutting, enzyme dose, incubation time); means were compared using Tukey test. First phase of Tilley and Terry method (3, 6, 12, 24, 48 and 72 h) was used. Medium (40 mL McDougal saliva and 10 mL ruminal liquid) was placed in a 100 mL tube with 500 mg ground hay (1 mm mesh) dried at 60°C during 24 h, with or without 0.5, 1.0 and 1.5 g enzyme/kg DM hay. DMIVD (72 h) was larger (P<.05) for 35 d than for 90 d Guinea. Enzyme increased (P<.05) NDFIVD (3, 6 and 12 h) for 90 d Guinea; at 12 h there was no difference (P>.05) between control (no enzyme) and 0.5 or 1.0 g enzyme for 35 d Guinea. At 24, 48 and 72 h, NDFIVD and ADFIVD were larger (P<.05) for 35 d than for 90 d Guinea. NDFIVD was larger (P<.05) for 1.5 g enzyme at 48 h for 35 d Guinea and at 72 h for 90 d Guinea. Besides, enzyme increased (P<.05) ADFIVD for 35 d Guinea (3, 6, 12, 24, 48 and 72 h) and 90 d Guinea (24 and 72 h). Therefore, these exogenous fibrolytic enzymes have a positive effect on *in vitro* digestibility of fiber fractions of Guinea grass hay cut 35 and 90 d after regrowth.

Key Words: Fiber fractions, Exogenous fibrolytic enzymes, Tropical grass

W158 Effect of exogenous fibrolytic enzymes (Fibrozyme) on *vitro* digestibility of dry matter and cell wall of *Brachiaria* cultivars hays. J. H. Avellaneda-Cevallos[1], S. S. Gonzalez*[2], J. M. Pinos-Rodriguez[3], A. Hernandez[2], R. Barcena[2], M. Cobos[2], D. Hernandez-Sanchez[2], and M. Crosby-Galvan[2], [1]*Universidad Tecnica Estatal de Quevedo, Ecuador,* [2]*Colegio de Postgraduados, Mexico,* [3]*Universidad Autonoma de San Lius Potosi, Mexico.*

This study was done to evaluate the effect of exogenous fibrolytic enzymes (enzyme; Fibrozyme) on in vitro digestibility of dry matter (DMIVD), neutral (NDFIVD) and acid (ADFIVD) of hays of five cultivars of *Brachiaria* (*brizantha* var. Toledo (BT); *ruziziensis x brizantha* CIAT 46024 (RB); *decumbens* var. Seal (DS); *ruziziensis x brizantha* CIAT 36061 cv. Mulato (RBM); *brizantha* var. Insurgente (BI) cut 35 d after regrowth. The experimental design was completely randomized with a 5x2x6 factorial arrangement of treatments (cultivars, enzyme dose, incubation time); means were compared using Tukey test. First phase of Tilley and Terry method (3, 6, 12, 24, 48 and 72 h) was used. Medium (40 mL McDougal saliva and 10 mL ruminal liquid) was placed in a 100 mL tube with 500 mg ground hay (1 mm mesh) dried at 60° during 24 h, with or without 1.5 g enzyme kg/DM hay. DMIVD at 48 and 72 h, with or without enzyme, was larger (P<.05) for BT (50.24 and 49.36 %; 58.22 and 56.18 %) and BI (47.14 and 45.61 %; 57.05 and 55.82 %) than for RB (42.71 and 41.04 %; 49.41 and 50.1 %), DS (37.45 and 36.63 %; 43.56 and 43.67 %) and RBM (37.15 and 39.15 %; 48.47 and 49.44 %). Enzyme did not change (P>.05) DMIVD for the five *Brachiaria* cultivars. NDFIVD, at 48 and 72 h, was larger (P<.05) for BT (45.68 and 45.10 %; 58.25 and 58.29 %) and BI (47.44 and 51.03 %: 54.73 and 58.49 %), than for RB (37.15 and 41.70 %; 42.41 and 49.26 %), DS (38.18 and 43.05 %; 42.80 and 44.64 %) and RBM (39.51 and 41.42 %; 49.57 and 50.94 %). Enzyme increased (P<.05) NDFIVD at 72 h for RB. Also, ADFIVD was increased (P<.05) by enzyme for BT (7.52 vs 14.73 %) at 12 h; BT (12.80 vs 21.35 %) and DS (11.42 vs 19.49 %) at 24 h; BT (32.43 vs 39.21 %), RB (21.07 vs 28.68 %) and BI (38.85 vs 45.62 %) at 48 h. Therefore, these exogenous fibrolytic enzymes increase *in vitro* degradation of cell wall fraction of *Brachiaria* cultivars hays.

Key Words: Cell wall fractions, Exogenous fibrolytic enzymes, *Brachiaria* cultivars

W159 Effect of Leucaena (*Leucaena leucocephala*) supplementation on Aleman-grass (*Echinochloa polystachya*) ruminal degradability. J. Vergara-Lopez*[1], A. Rodriguez-Petit[2], A. Atencio[2], and C. Navarro[2], [1]*Instituto Nacional de Investigaciones Agrcolas (INIA),* [2]*Universidad Experimental Sur del Lago (UNESUR).*

In order to evaluate the supplementation effect of Leucaena on ruminal degradability, potential degradability of DM (PD), initial degradation (ID), maximum degradability (MD), degradation rate and ruminal pH of Aleman-grass an experiment was carried in a humid tropical forest in Venezuela. The evaluated treatments were: T1, Aleman-grass (pA) + 2 kg commercial concentrate (AC); T2, pA + 2 kg Leucaena once a day and T3 pA + 2 kg Leucaena twice a day (1 kg at 0800 h and 1 kg at 1500 h). Three Criollo Limonero steers fistulated with permanent rumen cannulas were exposed to treatments by a 14 days adaptation period before sampling (F1). Samples were taken during 5 days (F2). During F2, nylon bags were incubated 0, 6, 12, 24, 48, 72 and 96 h, while rumen contents pH were measured on 0, 3, 6, 9, 12 and 24 h post feeding. Ruminal degradability data was evaluated by non-linear model procedure and a switch-over design was used for statistical analysis. PD was higher (P<0.05) in T3 (62.91%) than T1 (58.31%) or T2 (59.17%). ID not shown statistical differences between treatments. Ruminal pH on T3 (6.74) was higher (P<0.05) than T1 (6.66) and T2 (6.65). We concluded that Leucaena supplied twice a day, increases DM degradability of Aleman-grass.

Key Words: Ruminal degradability, *Leucaena leucocephala*, *Echinochloa polystachya*

W160 Effect of barley varieties harvested for forage on backgrounding steer performance and diet digestibility. A. L. Todd*, J.G.P. Bowman, L.M.M. Surber, M. A. Thompson, J. J. Kincheloe, M. F. McDonnell, and P. F. Hensleigh, *Montana State University, Bozeman, MT*.

Barley harvested as hay is a significant source of winter forage for livestock producers in Montana. Limited data is available using hay barley as a roughage source for backgrounding steers. Ninety-six Angus cross steers were allotted to 16 pens in a randomized complete block design. The objectives of this study were to 1) determine the effects of four barley varieties on animal performance and diet digestibility, and 2) determine the effects of feeding awned vs. hooded head type barley. MT 981060, Westford, and Haybet are all hooded forage barley varieties while Valier is an awned feed barley variety. Steers were given ad libitum access to their roughage source, 2.6 kg head^{-1}d^{-1} of cracked feed barley, and 0.45 kg head^{-1}d^{-1} of a commercial 32% CP supplement. All roughage was chopped to 5.1 cm. Pen was the experimental unit in the 60 d trial. Steers were weighed and diet, ort, and fecal samples were obtained on d 28 and upon completion (d 60) of the trial. Diet and fecal samples were composited by pen and analyzed for DM, OM, N, NDF, ADF, and AIA. Acid insoluble ash was used to estimate fecal output. Steers fed MT981060 and Valier had 55% greater ($P < 0.01$) ADG when compared to steers fed Haybet and Westford barley (avg 3.29 vs. 2.75 kg/d, respectively). Dry matter intake was greatest ($P < 0.01$) for steers fed MT 981060 and Valier, intermediate for Haybet and least for Westford (avg 10.06 vs. 9.61 and 8.08 kg/d, respectively). Steers fed MT981060, Valier, and Westford barley had 14.4% improvement ($P < 0.01$) in feed efficiency (FE) when compared to steers fed Haybet barley (avg 15.07 vs. 12.9 kg gain / 100 kg feed, respectively). Feeding an awned variety did not impact DMI, ADG, or FE. MT981060 had superior feeding value for backgrounding steers and is scheduled for release by the Montana Agricultural Experiment Station.

Key Words: Backgrounding steers, Forage barley varieties, Barley

W161 Continuous culture fermentation of three fescue varieties supplemented at four energy levels. R. E. Vibart*, S. P. Washburn, V. Fellner, and J. T. Green, *North Carolina State University, Raleigh*.

Eight dual-flow continuous cultures (700 ml) were used to compare effects of endophyte-infected (E+), endophyte-free (E-), and nontoxic endophyte-infected (EN) (MaxQ) Jessup tall fescue (Festuca arundinacea L.) on rumen fermentation in a grazing simulation at four levels of concentrate supplementation (ground corn). For each of the fescue varieties (E+, E-, and EN), forage to concentrate ratios of 100:0, 85:15, 70:30, and 55:45 were used for a total of 12 experimental diets in a randomized incomplete block design with two replicates. Vegetative grasses were used with compositions as follows: E+ (12.3% CP, 59.9% NDF, 29.2% ADF), E- (13.4% CP, 60.7% NDF, 29.4% ADF), and EN (10.4% CP, 63.2% NDF, 31.4% ADF). Rumen cultures were adapted for 48 h before experimental diets were fed and then gradually adjusted to the final diets. Each culture vessel was offered a total of 15 g of DM per day including: four equal portions of grass (fed at 0300, 0900, 1500, and 2100 h); and two equal portions of corn (fed at 0900 and 2100 h). The fractional dilution rate was set at 6.25% per hour. Headspace gas and liquid samples were analyzed for methane, rumen culture pH, volatile fatty acids, and ammonia-N concentration to assess the rumen environment from the pasture-based diets. Methane concentrations were higher ($p < 0.05$) for E+ compared to E- or EN. Methane was also higher ($p < 0.05$) for E- than for EN but only when sampled after feeding corn. Ammonia-N concentrations also varied by grass: EN had lower ($p < 0.05$) values compared to E+ and E-. Rumen pH values, ammonia-N (mg/100 ml), acetate concentrations (mM), and the acetate:propionate ratio decreased linearly with increasing levels of energy supplementation, whereas propionate and butyrate increased linearly. Interactions of feeding time by grass and energy by grass were observed for concentrations of ammonia-N. Although some differences were observed among fescue varieties, fermentation responses were generally similar at similar levels of energy supplementation.

Key Words: Festuca arundinacea, Endophyte, Energy supplementation

W162 Effect of field peas inclusion on in situ disappearance rate of grass hay, soybean hulls, and field peas in beef steers fed medium concentrate diets. S. A. Soto-Navarro*, G. J. Williams, M. L. Bauer, G. P. Lardy, D. Landblom, and J. S. Caton, *North Dakota State University, Fargo*.

Four ruminally and duodenally cannulated steers (703.4 ± 41 kg initial BW) were used in a 4 x 4 Latin square to evaluate effects of field peas inclusion on in situ disappearance rate (%/h) of grass hay, soybean hulls, and filed peas in beef steers fed 55% concentrate diets. Steers were fed ad libitum at 0700 and 1900 daily and were allowed free access to water. Diets consisted of 45% grass hay (6.8% CP) and 55% concentrate mixture. Treatments consisted of: 1) control, no peas; 2) 15% peas; 3) 30% peas; and 4) 45% peas in the total diet, with peas replacing wheat middlings, soybean hulls, and barley malt sprouts in the concentrate mixture. Steers were adapted to diets for 9 d. Grass hay was incubated in situ, beginning on d 10, for 0, 2, 5, 9, 14, 24, 36, 72, and 98 h; and field peas and soybean hulls for 0, 2, 5, 9, 14, 24, 36, 48, and 72 h. Linear, quadratic, and cubic contrasts were used to compare increasing field pea levels. In situ DM and NDF disappearance rates of grass hay and soybean hulls decrease linearly ($P \leq 0.05$) with increasing field peas. Rate of grass hay in situ ADF disappearance also decrease linearly ($P \leq 0.05$) with increasing field peas. In situ DM disappearance rate of field peas demonstrated a quadratic effect ($P \leq 0.01$; 5.9, 8.4, 5.5, and 4.9 0.52 %/h, for 0, 15, 30, and 45% filed peas in the diet, respectively) with increasing field peas level. Rate of in situ CP disappearance responded quadratically ($P \leq 0.09$) for grass hay (4.2, 4.7, 2.7, and 2.2 ± 0.24 %/h), soybean hulls (7.0, 7.5, 7.6, and 5.7 ± 0.61 %/h), and field peas (6.7, 7.5, 7.5, and 5.8 ± 0.19 %/h for 0, 15, 30, and 45% of field peas inclusion, respectively). Inclusion of up to 45% field peas into medium concentrate diets consumed by beef steers reduces rates of in situ DM, NDF, and CP disappearance.

Key Words: Field Pea, Digestion Rate, Cattle

W163 Effects of sun-curing, formic acid-treatment or microbial inoculation on ruminal kinetic parameters of timothy. R. Martineau*[1], H. Lapierre[2], D. R. Ouellet[2], D. Pellerin[1], and R. Berthiaume[2], [1]*Universite Laval, Quebec, Canada,* [2]*Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada, Lennoxville, Quebec, Canada*.

Effects of three methods of conservation on ruminal kinetic parameters of timothy (*Phleum pratense L.*) were investigated. Treatments were : 1) sun-cured hay (**H**: 48 h wilting), 2) formic acid-treated silage (**F**: 6 L of 85% formic acid per ton of fresh forage; 24 h wilting), or 3) microbial inoculated silage with *Lactobacillus plantarum* LPH-1 and *Pediococcus cerevisiae* PCH-3 (**I**: 1.25 X 10^{11} total CFU per ton of fresh forage; 20 h wilting). Percent DM were 84.9, 36.1 and 35.5 (SEM=1.34) and percent CP were 10.4, 13.6 and 15.1 (SEM=0.30) for treatments **H**, **F** and **I**, respectively. Six ruminally cannulated Holstein cows in mid lactation, consuming 15.9 kg DM per day (SEM=0.98; P=0.15), were randomly assigned to treatments. CP disappearance was estimated with the *in situ* nylon bag technique after a 40 day-adaptation period (forage:concentrate ratio = 56:44; incubation times = 0 up to 72 h in triplicate; bag pore size = 41.6 x 52 μm). Soluble fraction (A), total potentially degradable fractions (A+B), degradation rate (Kd) and estimated rumen degradable protein (RDP) at Kp 4% were lower for treatment **H** than for treatments **F+I** ($P \leq 0.01$). Fraction B was higher for treatment **H** than for treatments **F+I** ($P<0.01$). Treatment **F** decreased fractions A ($P<0.01$) and A+B (P=0.03) but increased fraction B (P=0.01) when compared to treatment **I**. Results suggest that formic acid-treatment limits protein breakdown in silage (lower fraction A and higher fraction B) when compared to microbial inoculation. However, formic acid-treatment is not as effective as sun-curing for limiting proteolysis.

		Treatments			Contrasts (P)	
Parameters	**H**	**F**	**I**	SEM	**H** vs **F+I**	**F** vs **I**
A (% CP)	16.7	36.6	49.1	0.88	<0.01	<0.01
B (% CP)	63.0	47.4	37.4	1.30	<0.01	0.01
A+B (% CP)	79.7	84.0	86.4	0.43	<0.01	0.03
Kd (% h^{-1})	7.2	13.7	11.8	0.79	0.01	0.18
RDP (% CP)	56.8	71.4	73.6	1.49	<0.01	0.38

Key Words: *in situ* Disappearance, Formic acid-Treatment, Microbial Inoculation

W164 The effects of distillers dried grain with solubles as the protein source in a creep feed. P. Lancaster*, J. Williams, J. Corners, L. Thompson, and M. Ellersieck, *University of Missouri-Columbia, Columbia, Missouri*.

A study was conducted to evaluate the effect of Corn Distillers dried grains with solubles (D) vs. soybean meal (S) as a protein source in a creep feed. Thirty-six steer calves (avg. 160.7 kg + 2.8; 2 groups / treatment) were used in a completely randomized design to compare the effects of D and S on the performance of calves to traditionally weaned (C) calves prior to (68 d) and after weaning (112 d). Steers were allotted by age (avg. 122.5 d + 2.5) to 1 of 6 endophyte-free tall fescue pastures with dams. The dietary supplements consisted of a cracked corn / soyhull mix with the protein source and were formulated to contain 14.2% CP and 1.39 Mcal/kg of NEg. Calves were placed in open drylots and adjusted to a receiving diet of cracked corn, soyhulls, and fescue hay with D and S treatments continued, while the C treatment received S as the protein source. During phase 2, the cracked corn was replaced with shelled corn and increased in the diet. During phase 3, steers were placed on a common diet of shelled corn, soyhulls, and fescue hay. Diets for phase 1, 2, and 3 were formulated to provide 13.5, 13.2, and 12.0% CP and 1.08, 1.23, and 1.27 Mcal/kg of NEg, respectively. Weight and ultrasound measurements were taken intermittently throughout the feedlot phase. Treatments D and S had greater ($P < .05$) ADG than C (1.06, 1.00 vs. 0.72 kg, respectively). The feed / extra gain was similar among treatments, while cost / kg of extra gain for D was lower ($P < .05$) than S ($0.88 vs. $1.89, respectively). For phases 1 and 2, weight of all treatments increased in a linear ($P < .01$) fashion, but the quadratic response differed between C vs D and S ($P < .05$). DMI was similar among treatments but ADG between C vs. D and S differed ($P < .01$) during phase 1. Feed / gain among treatments was similar for phase 1; during phase 2, all treatments differed ($P < .01$) with D being the highest and C the lowest. For phases 1 and 2, backfat depth and ribeye area for all treatments increased in a linear ($P < .01$) fashion, while the backfat depth of C also increased in a quadratic ($P < .05$) fashion. Final performance and carcass data will be presented later. In conclusion, protein source had no effect on ADG, however DDGS reduced cost / kg extra gain.

Key Words: distillers dried grains with solubles, performance, creep

W165 Sodium and magnesium sulphates reduce water consumption by beef cattle. A. S. Zimmerman*[1], D. M. Veira[2], D. M. Weary[1], M.A.G. von Keyserlingk[1], and D. Fraser[1], [1]*University of British Columbia Animal Welfare Program*, [2]*Agriculture and Agri-Food Canada*.

Sulphate salts are present in many water sources found on rangeland and negatively affect water intake by cattle. The objective of this work was to determine water consumption by beef cattle when they were given access to water containing a range of concentrations of Na_2SO_4 and $MgSO_4$. In Exp. 1, 5 beef heifers (300-400 kg) were offered either *ad lib* access to tapwater (8 ppm SO_4) or water containing 3000 ppm SO_4 for two wks and restricted access (twice daily) for two wks. Exp. 2 was conducted as a taste test for 2 d where 8 animals were given water twice daily containing tapwater (11 ppm SO_4), Na_2SO_4 or $MgSO_4$ at 1500, 3200, or 4700 ppm SO_4. Each test was separated by 2 d of access to tapwater. Data was analyzed using paired t-tests in Exp. 1 and by Wilcoxon paired sample tests in Exp. 2. In Exp. 1 animals drank less ($P \leq 0.05$) water when it contained Na_2SO_4 (4.37 $\pm$ 0.90 kg/drink) compared to tapwater (9.00 $\pm$ 0.83 kg/drink) when given *ad lib* access. When access was restricted, average drink intake was 21.88 $\pm$ 2.15 kg for tapwater and 11.19 $\pm$ 2.89 kg for water containing Na_2SO_4 ($P \leq 0.01$). Average daily intake of tapwater was less ($P \leq 0.05$) when water access was restricted (44.26 $\pm$ 4.13 kg) compared to *ad lib* access (55.42 $\pm$ 5.62 kg); however, average daily intake of the SO_4 water was not different ($P \geq 0.05$) for *ad lib* (25.52 $\pm$ 5.16 kg) and restricted access (21.53 $\pm$ 5.74 kg). In Exp. 2 there was no difference ($P \geq 0.05$) between average water intake for $MgSO_4$ (20.71 $\pm$ 0.50 kg/drink) and Na_2SO_4 (18.78 $\pm$ 1.74 kg/drink) treated water at 1500 ppm SO_4; however at 4700 ppm SO_4 the average intake of $MgSO_4$ treated water was 6.70 $\pm$ 3.05 kg/drink compared to 15.38 $\pm$ 1.81 kg/drink for Na_2SO_4 ($P \leq 0.05$). There was considerable variation in intake between animals, particularly at higher SO_4 concentrations. These results suggest that guidelines for maximum allowable limits of SO_4 in cattle drinking water need to consider the associated cation and the variability in sensitivity between animals.

Key Words: Beef cattle, Water quality, Sulphate

W166 Kinetic parameters of digesta flow in calves under different herbage allowances of *Panicum maximum* cv. Tanzania-1. M. M. Gontijo Neto[1], D. Nascimento Júnior[2], V.P.B. Euclides[1], A. J. Regazzi[2], J. C. Pereira[2], L. F. Miranda*[3], D. M. Fonseca[2], and O. G. Pereira[2], [1]*Embrapa Gado de Corte, Brazil*, [2]*Universidade Federal de Viçosa, Brazil*, [3]*FEAD-Minas, Centro de Gestao Empreendedora, Brazil*.

The objective of the present study was to assess the kinetic parameters of digesta flow in calves under different herbage allowances of Tanzania grass (*Panicum maximum* cv. Tanzania-1). A randomized block design was used with two replications per block, four treatments, defined by average levels of herbage allowance (HA), and two blocks (sampling periods). Average herbage allowances (HA) were 6.1 $\pm$ 0.59; 11.1 $\pm$ 0.77; 18.0 $\pm$ 1.24 and 23.9 $\pm$ 1.15 kg DM green leaf blades/100 kg LW/day. Complex Cr-NDF was supplied to three Nelore calves (average weight: 245 kg) in each replication and stools were collected at 0, 12, 18, 24, 30, 36, 42, 48, 60, 72, 96, 120 and 144 hours. Chromium concentration data for each replication were adjusted by non-linear regression (Dhanoa et al., 1985) and the effects of herbage allowance were interpreted by regression analysis. Changes in herbage allowances of Tanzania grass directly affected the passage rate of digesta in the rumen (%/h) ($k_1 = 1.875 + 0.041$**HA; $r^2 = 0.991$), had no impact on passage rate in post-rumen ($k_2 = 15.383$ %/h), and generated a negative effect on mean retention time of digesta (h) (MRT = 67.21 - 0.481**HA; r^2 =0.905).

Key Words: Passage rate, Tropical forage, Beef cattle

W167 Comparison of commercial White and Yellow Corn from Sinaloa Mexico, on starch composition, in vitro digestibility, and physical characteristics. O. G. Lozano*[1], M. Chaidez-Ibarra[1], A. Sanchez-Bautista[1], X. Perales-Sanchez[1], C. Mora-Uzeta[1], and E. Vazquez-García[1], [1]*Universidad Autonoma de Sinaloa. Mexico*.

The objective of this experiment was to determinate the differences between White Corn (WC) and Yellow Corn (YC) for ruminant nutrition purpose. Six WC and five YC, commercial heterogeneous varieties from different companies, were sampled form Sinaloa Mexico. One YC, imported from USA, was included. The physical analysis were; density (g/L), weight of 1000 kernels (g), water absorption in 30 min (%), DM solubility (%), and PC solubility (%). The chemical analysis were; PC (%), and starch composition (α-amylase/amyloglucosidase kit; Methods AOAC 996.11 and AACC 76.13). The digestion analysis were, DM in vitro digestibility (DMIVD) at 4, 6, 8, 12, 24, and 48 h (Ankom DAISY) and rate of degradation (%/h).The experimental model was a completely random desing, with two treatments; WC and YC. There are not differences ($P>0.05$) between the WC and YC on: density (mean = 723 g/L 23.5); kernels weight (mean = 379 g, 30); water absorption (mean = 6.12 %, 0.6); DM solubility (mean = 7.99 %, 1.7); CP solubility (mean = 17.44 %, 3.4); and CP composition (mean = 9.78 %, 0.68). YC had a tendency of high starch concentration ($P=0.08$) than WC (74.18 % vs 71.37 %, respectively). DMIVD were not different ($P>0.05$) between WC and YC at all the hours. The rate of degradation was similar ($P>0.05$) among the grains (WC= 0.98, YC=0.96 %/h). As individual grains, the YC from USA and the WC of Pionner, in relation to the twelve grains (T-test analysis), presented a higher ($P<0.05$) DMIVD 48 h (means = 90.93 %, 1.54; 94.03 %, and 93.23 %, respectively) and higher water absorption (7.5 %; and 6.7 %, respectively). In general, there are not differences among commercial WC and YC in the physical, chemical, and digestive analysis presented in this experiment, however, must be considered that individual grains, white or yellow, showed higher DMIVD.

Key Words: White corn, Starch, Digestibility

W168 Fractionation and in vitro degradation kinetics of carbohydrates constituents of sugar cane with different cycles of production and three cut times. A. Fernandes*[1], A. Queiroz[2], E. Pereira[3], L. Cabral[4], and A. Alex[3], [1]*Universidade Estadual do Norte Fluminense,* [2]*Universidade Federal de Viçosa,* [3]*Universidade Estadual do Oeste do Paraná,* [4]*Universidade Federal do Mato Grosso*.

The objective of this work was to determine the fractions and rates of digestion of the carbohydrates for sugar cane, with different cycles of production (early and intermediate), in three cut times (426, 487 and 549 days). The total carbohydrates (TC), non-fibrous carbohydrates (NFC), fractions potentially digestible (B2) and indigestible (C) of the neutral detergent fiber (NDF), corrected for ashes and protein (NDFcp), were obtained. The kinetic parameters of NFC and fraction B2 were obtained from the technique of gas production in vitro. The contents of TC and fraction B2 did not differ among varieties, even though the early ones presented larger contents of the fraction C and smaller of NFC. By establishing a relationship between concentration of obtained lignin and observed C fraction, with adjustment of equation of simple linear regression, without intercept, it was obtained the value of 4.38 that differed of 2.4, suggested by the Cornell system. Therefore, for sugar cane, the fraction C could be estimated from the lignin multiplied by 4.38. The progress of the cut time caused linear increase of the C fraction and reduction of B2, without interaction with the cycle of production; although it has been linear, the increment was relatively small, 6 percentage of the fraction C, when compared to the other tropical gramineas, with the same cut time. The kinetic parameters, didn't present differences among varieties; however, the estimated average digestion rates for NFC were lower than the suggested by the Cornell system. The adjustment of the curve of cumulative gas production (bicompartimental system) was shown appropriate because the sugar cane has fractions of available carbohydrate very different with relationship to the digestion rate (CNF and B2). By presenting high content of NFC (sucrose) and low rate of digestion of the B2 fraction, researches with different sources of N to supplement sugar cane based diets are necessary.

Key Words: Carbohydrate digestible fraction, Digestible rate, Sugar cane

W169 Digestion of alfalfa and alfalfa:sainfoin mixture preserved as hay or as silage. Y. Wang*[1], B. P. Berg[2], L. R. Barbieri[1], and T. A. McAllister[1], [1]*Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB,* [2]*Alberta Agriculture, Food and Rural Development, Lethbridge, AB*.

Total tract digestibilities of alfalfa (A) and mixed alfalfa:sainfoin (A:S) forages preserved as hay or as silage were studied using 10 mature, ruminally cannulated wethers ($n = 5$). Sainfoin was cross-seeded into one of two alfalfa pastures as a means to introduce condensed tannins into an alfalfa-based diet. Alfalfa and A:S mixture (35% sainfoin, DM basis), were harvested at late bud and preserved as hay (92% DM) or wilted to 33% DM and ensiled for 80 d. The wethers were fed A or A:S silage in a total mixed ration with 24% pelleted concentrate and mineral/vitamin supplement for 22 d, then were then switched to hay-based TMR. Total fecal collections and ruminal metabolite determinations began after 14 d on each diet. Intake of DM was higher ($P < 0.01$) with hay than with silage, but did not differ ($P > 0.05$) between A and A:S. Digestibilities of DM ($P < 0.01$), OM ($P < 0.01$), NDF ($P < 0.05$) and ADF ($P < 0.05$) were greater in A:S compared with A, but all were similar ($P > 0.05$) between hay and silage. Interactive effects of forage type and preservation method on DMI or nutrient digestibilities were not observed ($P > 0.05$). Compared with wethers fed A, those fed A:S digested more ($P < 0.05$) N when the forages were preserved as hay. When silages were fed, N digestibility was higher ($P < 0.05$) with A:S than with A. Nitrogen retention tended ($P = 0.08$) to be higher with A:S than with A. With hay and with silage, ruminal concentrations of ammonia N and soluble protein were lower ($P < 0.05$), but concentration of volatile fatty acids was higher ($P < 0.01$) in wethers fed A:S compared with those fed A, but their protozoal populations were similar ($P > 0.05$). Sainfoin included in alfalfa pastures increased the digestibility of the forage whether preserved as hay or as silage, and reduced protein degradation in the rumen. Introducing condensed tannins into alfalfa forage through sainfoin incorporation may have potential to improve forage N utilization.

Key Words: Condensed tannins, Sainfoin, Forage digestibility

W170 Evaluation of associative effects of feeds using in vitro gas production. G. Getachew*[1], P.H. Robinson[1], and J.W. Cone[2], [1]*Department of Animal Science, UC Davis,* [2]*ID TNO Animal Nutrition,Lelystad, The Netherlands*.

A ration formulated for ruminants is often a mixture of individual feeds. Its energetic value is generally calculated by summing the energy value of the individual feeds in it, on the assumption that the energy value of individual feeds will be the same when they are fed in combination with other feeds. The in vitro gas production technique was used to determine whether associative effects of feeds occur. Two sets of four feeds from California (alfalfa hay, AL; barley grain, BR; corn silage, CS; soybean meal, SM) and four feeds from The Netherlands (grass silage, GS; corn silage, CS; citrus pulp, CP; corn gluten meal, CG) were incubated alone, and in various combinations, in buffered rumen fluid using an in vitro gas technique (Menke and Steingass, 1988; Anim. Res. Dev. 28:7-55). The percent increase in gas production measured on combinations of feeds vs. the gas calculated to have been produced based upon incubation of individual feeds was used to assess the extent of the associative effects. Among the California samples, the AL: SM combination resulted in as high as a 9% increase in gas production at 6 h of incubation compared to values calculated from incubation of the individual feeds. The percentage increase in gas production at 24 h of incubation was less than that at 6 h and there was no increase in gas production in feed mixtures incubated for 72 h. The AL: BR mixture produced 20% more gas than individual feeds incubated for 6 h, and there was no increase in gas production at 72 h of incubation in any feed mixtures compared to feeds incubated individually. The three feed combination of AL: SM: CS also resulted in as high as an 11% increase in gas production at 24 h incubation vs. that calculated from incubation of individual feeds. The four feed combination of AL: BR: SM: CS increased in vitro gas production by about 10% at 6 h of incubation. The percent increase in gas production with mixtures of feeds from the Netherlands followed similar trends. Results suggest that feed digestibility and energy supply to ruminants can differ from values derived from calculations based on individual feed digestibility. The extent of these differences appears to vary with type and level of feed, and time of incubation.

Key Words: In vitro gas production, Associative effects

W171 Effect of condensed tannins on in vitro digestion of alfalfa and mixed alfalfa:sainfoin silages. Y. Wang*[1], Z. Xu[1], B. P. Berg[2], L. R. Barbieri[1], and T. A. McAllister[1], [1]*Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB,* [2]*Alberta Agriculture, Food and Rural Development, Lethbridge, AB*.

Freeze-dried, ground (1.0 mm) alfalfa, alfalfa:sainfoin and sainfoin silages were incubated in buffered ruminal fluid ± polyethylene glycol (PEG) to determine the effects of sainfoin condensed tannins on ruminal digestibility of the silages. Chopped alfalfa (*Medicago sativa* cv. AC Grazeland Br®) and sainfoin (*Onobrychis viciifolia*) forages were hand mixed in ratios of 100:0, 75:25, 50:50, 25:75 and 0:100 (%, fresh weight) and ensiled in laboratory-scale silos for 1 or 72 d. Silages were incubated for 12, 24 and 48 h at 39°C ($n = 3$), with a $2 \times 2 \times 5$ factorial arrangement of treatments (1- or 72-d silage; 0 or 0.243% (w/v) PEG; substrates A, A75, A50, A25 and S). Inoculum included 0.75 g/L $(^{15}NH_4)_2SO_4$ as a microbial N incorporation (MN) marker. With all silages, over 93% of DM disappearance (DMD) occurred during the first 12 h of incubation. Compared with the 72-d silages, forage ensiled for 1 d had higher ($P < 0.001$) DMD and acetate:propionate ratio (A:P) at all time points and higher MN ($P < 0.01$) at 12 and 24 h, but production of VFA and NH_3-N release were lower. Sainfoin incorporation had a quadratic effect ($P < 0.001$) on DMD and production of VFA, but linearly increased ($P < 0.01$) MN and NH_3-N release during the 48-h incubation. Including PEG in the incubation did not affect ($P > 0.05$) DMD from any substrate, but it increased ($P < 0.05$) gas production from A75, A50, A25 and S, and this effect was greater ($P < 0.05$) with the 1-d than with the 72-d silages. Including PEG reduced ($P < 0.05$) VFA and MN at 12 and 24 h, but not at 48 h. Interactive effects ($P < 0.01$) between PEG and substrate were observed on A:P ratio and NH_3-N release. These values were increased ($P < 0.05$) by PEG only with 1-d A50, A25 or S silages. In the 72-d silages, NH_3-N release was similar ($P > 0.05$) across substrates. Incorporating sainfoin into alfalfa silage increased the silage nutritive value, but the effect of sainfoin condensed tannins on N metabolism was reduced during ensiling.

Key Words: Condensed tannins, In vitro digestibility, Silage

W172 The effect of concentrate restriction on performance of Holstein steers fed only liquid whey instead of water. A. R. Bayat*, R. Valizadeh, and A. Naseian, *College of Agriculture - Ferdowsi University - Mashhad - Iran.*

This experiment was conducted to study the effects of concentrate restriction on liquid whey consumption, performance, rumen and blood parameters of the Holstein steers in a 100 days period. 12 Holstein steers with average body weight of 150 ±27 Kg were assigned to treatments. Experimental design was Completely Randomized Design with 3 treatments. Treatments were: I. Normal concentrate feeding (ad lib) II. Concentrate restricted at the level of 2/3 of concentrate intake of treatment I, III. Concentrate restricted at the level of 1/3 of concentrate intake of treatment I. Alfalfa hay was fed at the level of 0.7 % (DM Basis) of body weight. Liquid whey was given ad lib. No drinking water was provided. Diet was formulated based on NRC (1989) recommendations. Rumen liquor and blood samples (from jugular vein) were taken 3h after morning feeding. Acid insoluble ash (AIA) was used for apparent digestibility determination. Whey consumption of treatment III increased by 12.68 percent in comparison to treatments I and II (54.6, 48.5 and 48.5 Kg/d respectively SE=4.13). The steers in treatments I, II and III obtained 41.2, 49.3 and 55.7 percent of their daily dry matter intake (DMI) from whey respectively. There was a significant difference between total DMI ($p<0.05$)(6.38, 5.43 and 5.31 kg/d for treatment I, II and III respectively). Alfalfa intake in treatment III was higher than treatments I and II ($p<0.05$). Among the apparent digestibilities (DM, OM, CP, CF, NDF and ADF) only digestibility of ADF in treatment III was significantly increased in comparison to the control ($p<0.05$)(64 vs. 24%). Increasing concentrate restriction leads to linear decrease of average daily weight gain although it was not significant. There was no significant difference among feed conversion ratios. Rumen and blood pH and ammonia nitrogen (NH_3-N)of rumen liquor were similar among the treatments. Plasma urea nitrogen in treatments II and III were significantly ($p<0.05$) less than the control (14.87 and 18.60 vs. 25.15 mg/dl, SE = 1.637) ($p<0.05$). It can be concluded that along with liquid whey feeding, concentrate restriction can be used in steer feedlot without any adverse effect on performance. Although this conclusion is highly dependent on the market price of feed ingredients.

Key Words: Whey, Concentrate restriction, Steer

W173 Effects of dry and steam processing on in situ ruminal digestion kinetics of barley grain. A. Nikkhah and G. R. Ghorbani*, *Isfahan university of Technology, Isfahan, Iran.*

Effects of barley processing on rate and extent of digestion were evaluated with three ruminally cannulated ewes. Barley grain was processed with dry method (finely and coarsely ground), as well as it was steam rolled in four separate bulk densities. To distinguish four different degrees of steam-rolled barley, the processing index (PI) was measured as volume weight of barley after processing expressed as a percentage of its volume before processing which was 72.6. 63.8, 46.1, and 39.6 percent for coarse, medium, medium-flat, and flat flakes, respectively. The nylon bags containing 3 g of ground and steam-processed grains were incubated in rumen for 0, 2, 4, 8, 16, 24, and 48 h to estimate the kinetics of rumen degradation. The soluble fraction and fractional rate of DM and CP digestion were significantly higher for finely ground barley than those for other treatments. Among four degrees of steam-rolled barley grains, coarse and flat flakes had respectively the lowest and the highest soluble DM and CP as well as the fractional rate of digestion. The least amounts of slowly degradable DM and CP were for finely ground barley followed by flat, medium-flat, medium, and coarse flakes. In fact, raising the extent of both grinding and steam-rolling resulted in dramatic increase of effective degradability for DM and CP assuming two outflow rates of 5 and 8 percent h-1. The results of this study showed that steam processing can be more reliable than grinding of barley because it provides less amount of rapidly degradable fraction and more potential digestible DM in rumen. In other words, we can modulate the rate and extent of ruminal digestion more easily with steam processing rather than grinding of barley.

Key Words: Barley, Steam rolling, Degradability

W174 Effect of the processing method of soybean meal on production response of lactating cows. C. Leonardi*[1], W. Stockland[2], and L.E. Armentano[1], [1]*University of Wisconsin-Madison,* [2]*AG Processing Inc., Omaha, NE.*

The objective of this study was to evaluate production response of dairy cows fed soybean meal ruminally protected by three different methods. Treatments consisted of a control diet containing soybean meal (SBM) and three diets from which part of the soybean meal was replaced either by cooked-expelled soybean (EXP, SoyPlus®), or soybean meal non-enzymatically browned with xylose (CX, SoyPass®) or soybean meal cooked with soybean hulls and water (CSH, AminoPlus®). Twelve multiparous and four primiparous Holstein cows were utilized in a replicated 4 x 4 Latin Square design, with 21 d periods. Diets contained 22.5% alfalfa silage, 38.3% corn silage, 4.7% cottonseed and 34.5% concentrate (DM basis). Diets were formulated to be isonitrogenous (CP = 17.5%), isoenergetic and have similar NDF (29.6%) and fatty acids (4.6%) concentrations. The SBM diet was RUP deficient, while the other three were designed to have adequate and equal RUP levels. Contrasts tested RUP level (SBM vs. EXP, CX and CSH), method of ruminal protection: cooked-expelled vs. chemically treated (EXP vs. CX and CSH), and within chemical treatment the effect of different methods (CX vs. CSH). None of the tested contrasts were different for yield of milk fat, protein or DMI. Milk protein percentage was greater when feeding soybean meal vs. ruminally protected soybean products. Revenue ($/cow/d) was calculated for each cow within treatment, assuming $ 2.61 per kg of fat and $ 4.00 per kg of protein. Revenue 90% confidence interval (least squares means ± 1.64 x SED) was 7.92 ± 0.29 for SBM, 7.95 ± 0.29 for EXP, 7.94 ± 0.29 for CX, and 8.17 ± 0.29 for CSH.

	Diets					Statistical	Contrast	(P=)
	SBM (A)	EXP (B)	CX (C)	CSH (D)	SED	A vs. (B+C+D)	B vs. (C+D)	C vs. D
DMI,kg/d	23.0	23.7	22.7	23.4	0.5	0.52	0.14	0.18
Milk,kg/d	36.9	37.1	37.3	38.5	0.8	0.23	0.27	0.15
TP, %	2.93	2.91	2.89	2.89	0.02	0.05	0.36	0.84
TP, g/d	1081	1080	1078	1109	27	0.72	0.56	0.25
Fat, %	3.74	3.74	3.72	3.72	0.05	0.66	0.63	0.99
Fat, g/d	1377	1388	1388	1430	30	0.30	0.42	0.17

TP = True Protein

Key Words: Protein, Milk production

W175 Sugar cane fiber effectiveness in dairy rations. M.L.M. Lima*[1], W. Mattos[2], and L. G. Nussio[2], [1]*Escola de Veterinaria, Goiania - GO - Brazil* , [2]*Universidade de Sao Paulo, ESALQ, Piracicaba - SP - Brazil.*

Five ruminally and duodenally cannulated Holstein cows were used in a 5 x 5 Latin square design with 14-d periods to evaluate fiber effectiveness of sugar cane (SC) and sodium hydroxide (NaOH) treated sugar cane (SHSC). Low (LF) and high (HF) forage diets [14 and 22% of dietary DM from corn silage (CS) NDF, respectively] were compared to diets formulated to contain 14% CS NDF plus 8% of DM from SC NDF, SHSC NDF or alfalfa hay (AH) NDF. Forage particle size was determined using the Penn State Particle Size Separator on a wet basis. Concentration of indigestible NDF (INDF) in forage samples was determined by 144-h in vitro fermentation using the Ankom Daisy II technique. Potentially digestible forage NDF (DNDF) was determined as NDF-INDF. Forage retained on the upper and lower sieves and at the bottom pan was 26.7, 51.8 and 21.5%; 14.6, 66.0 and 19.4%; 14.6, 67.3 and 18.1% and 14.3, 24.5 and 61.2%, respectively for CS, SC, SHSC and AH. DNDF (% of NDF) was higher ($P < 0.05$) for CS (63.9) than SC (44.5), SHSC (55.1) and AH (49.7) and SC DNDF was increased ($P < 0.05$) by the NaOH treatment. Dry matter intake (17.0 kg/d), milk yield (18.2 kg/d) and milk fat (3.62 %) did not differ among diets. Mean rumen pH was higher ($P = 0.03$) for cows fed the SC and SHSC diets than for those fed the AH diet. Total VFA concentration did not differ ($P > 0.05$) among diets. Acetic acid (mol/100 mol) was higher and propionic acid (mol/100 mol) was lower for cows fed the SC and SHSC diets than for those fed HF and AH diets. This reflects the higher acetate:propionate ratio for cows fed the SC and SHSC diets. Ruminating (min/d and min/kg of DMI) and chewing (min/d and min/kg of DMI) activities were lower ($P < 0.01$) for cows fed the LF diet, but did not differ among HF, SC, SHSC and AH diets. Rumen mat consistency was lower ($P < 0.05$) for

cows fed the CS diets (LF and HF) than for those fed SC, SHCS and AH diets. NDF from SC, SHSC and AH were as effective as that from CS for maintaining milk fat test and stimulating chewing.

Key Words: Sugar cane, Corn silage, Fiber

W176 The effects of preweaning starter supplement and postweaning protein level on growth rates of Holstein heifers.

U. Moallem*, B. Erez, and R.A. Erdman, *University of Maryland, College Park*.

The study objectives were to test the effects of preweaning starter supplement and postweaning protein concentration on feed intake, body gain and skeletal growth rates from 4 to 180 d of age in dairy heifers. Forty two Holstein calves were individually housed and fed 4.5 kg/d milk replacer from 4 to 50 d age. Calves were fed starter supplements consisting of either a conventional calf starter mix (C) or a course starter mix (CS) containing 15% whole shell corn, 15% cottonseed, 15% ground alfalfa hay, 15% soybean meal, 15% ground corn and 25% whole barley plus minerals and vitamins (as fed basis). Beginning at 60 d, heifers were randomly assigned within pre-weaning groups to isocaloric (2.4 Mcal ME/kg DM) diets containing: low (L) (19.4% CP, 9.9% RUP); medium (M) (22.9% CP, 12.1% RUP); or high (H) (26.5% CP, 14.7% RUP) protein levels until 180 d age. Measurements included daily feed intake and weekly body weights, hip height and wither heights. Starter supplement had no effect on DM intake (0.70 vs 0.69 kg/d; C vs CS) prior to weaning. Postweaning DM intake was 3.75, 3.45, and 3.25 kg/d ($P < 0.001$) for the L, M, and H diets, respectively. There was a starter by protein interaction ($P = 0.06$) where calves fed the CS preweaning diet and L protein diet consumed greater DM postweaning than each of the other groups. Rates of body weight gain were decreased by the M and H diets ($P < 0.06$) while skeletal growth rates were unaffected. These results suggest that feeding a course starter supplement prior to weaning might encourage postweaning feed consumption. Although high dietary protein decreased feed intake and rates of body weight gain, skeletal growth rates were maintained, suggesting heifers fed the high protein diets had increased lean and decreased adipose tissue deposition.

	Protein Level				Treatment	Effects	($P <$)
Item	L	M	H	SEM	Starter (S)	Protein (P)	* S*P
Body weight gain, g/d	844	775	773	0.02	0.33	0.06	0.36
Wither height gain, cm/d	0.146	0.145	0.147	0.005	0.47	0.98	0.67
Hip height gain, cm/d	0.147	0.144	0.150	0.005	0.92	0.77	0.32

Key Words: Protein, Skeletal growth

W177 Physical and chemical properties and ruminal digestion of different corn grani genotypes in cows.

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Two trials were conducted to study physical and chemical properties and ruminal digestion of 39 corn grain genotype. In the first trial physical and chemical properties and ruminal dry matter (DM) and starch (S) degradability (28 h of incubation) of all hybrids ground to 2 mm were evaluated. Three dry Holstein cows (703 kg) fed with 40% alfalfa hay and 60% concentrate were used. Hybrids were classified in colours yellow (Y) orange (O) and red (R) of endosperm according to visual evaluations. Hybrids were tested for: test weight (TW), thousand grain weight (TGW), apparent density (AD), percent floating grain (PFG), milling ratio (MR), colours index of whole (CIW) or ground kernels (CIG) to 2 mm, vitreousness (in eight hybrids evaluated in second trial), CP, NDF, and S. The Y hybrids had less (P<0.05) TW and MR than the average of O and R (78.3 vs 80.2 kg/hl and 3.67 vs 4.62, respectively). The PFG, CIW and CIG was higher (P<0.05) in Y than in O and R (41.0 vs 17.1, 72.9 vs 69.1 and 85.3 vs 83.3, respectively). The Y and O hybrids had higher (P<0.05) TGW (average 354.5g) than R (308.0g). The O and R hybrids (average 83.2%) tended (P<0.10) to had higher vitreousness than Y (72.7%). The CP was lower (P<0.05) in Y (8.6%) than O and R (9.5%). The ruminal degradability of S was higher (P<0.05) in Y (87.0%) than in R (72.7%) while O (73.3%) hybrids was not different (P>0.05) from both. Regressions between grains properties were significant (P<0.05) but only explained about 50% of the variation of ruminal S degradability. In the second trial the kinetics of ruminal DM, CP and S digestion was evaluated (in situ technique) in three Y and R and two O hybrids ground to 2 mm selected according to degradability from the first trial. We used three Holstein steers (621 kg) cannulated in rumen consuming the same diet as the first trial. The Y hybrids had higher (P<0.05) soluble fraction of S (14.3%) than average of O and R (5.23%). The rate of starch digestion was higher in Y (5.77%/h) than R (4.43%/h) hybrids, while O (5.06%/h) was not different (P>0.05) from both. The Y genotypes with low proportion of horny endosperm (lower vitreousness) may have intrinsic features reflected in difference physical and chemical grain properties which also make them more susceptible to ruminal digestion respect to other corn genotypes.

Key Words: Corn grain, Physical, chemical properties, Ruminal digestion

W178 Effect of ground canola on milk fat composition and milk yield of lactating dairy cattle.

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The objective of this research was to investigate if blood metabolites and milk yield and composition are affected by adding raw, ground canola seed to the diet of early lactating cows. Twelve primiparous and multiparous Holstein cows (557.1 ± 60.4 kg BW; 28 ± 9 d in lactation) were assigned to one of two treatments: with and without raw canola seed. Diets were comprised of corn silage, alfalfa hay, soybean meal, bloodmeal, vitamins, and minerals and fed ad libitum as a total mixed ration. Canola meal and ground corn in the control diet was replaced by canola seed (14% of diet DM) in the treatment diet. Cows were milked twice daily, housed in tie stalls, and fed individually for 12 wk. Milk yield and DMI were recorded daily. Blood samples were collected at 3-wk intervals. Body weights and body condition scores (BCS) were also recorded at 3-wk intervals. Milk was sampled every 2 wk. Ruminal fluid was collected at the onset and at the end of the experiment. Data were analyzed using MIXED procedures of SAS. Fat corrected milk (3.5%), DMI, BW, and BCS were not different ($P > 0.05$) between treatments. Milk fat, protein, lactose, and solids-not-fat were not altered ($P > 0.05$). Serum glucose, urea nitrogen, and nonesterified fatty acids were not different ($P > 0.05$), whereas serum triglycerides were greater ($P = 0.05$) for cows fed canola seed. Ruminal pH was not different, although ammonia was lower ($P = 0.04$) in fluid from treatment cows. Adding 1.26 kg/d of raw, ground canola seed increases serum triglycerides without negatively affecting milk yield or composition.

Key Words: Canola seed, Lactation, Milk composition

W179 Evaluation of pet food grade poultry protein meal as supplement for lactating dairy cattle fed high fat and fiber rations.

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Twenty-four high producing Holstein dairy cows were used in a randomized complete block design experiment to determine the utilization of pet food grade poultry protein meal (PPM) as a ruminally undegraded protein (RUP) supplement. All cows were fed diets relatively high in both fat and fiber to accentuate the need RUP. Cows in early lactation ranging between 30 and 120 DIM, were blocked into six groups based on their level of milk production. One cow from each block was assigned to each treatment group. The diets contained approximately 55% wheat silage, 31% forage NDF, 15.5% CP and 6.5% fat on a DM basis. Treatments varied due to protein supplementation that are described as: 1)positive control (PC) composed of soybean meal (SBM) and a RUP blend of fish meal, blood meal, and dry distillers grains 2) negative control (NC) composed of only SBM; 3) 50% PPM composed of 50% pet food grade poultry protein meal (PPM) substituted for the RUP blend in treatment 1; and 4)100% PPM composed of 100% substitution of PPM for the RUP blend in treatment 1. Cattle were fed

behind Calan gates a common diet for two weeks and treatment diets for 12 weeks. Daily DM intake (21.9 ± .79 kg) was 10% lower (P <.01) and milk production, corrected to 4% fat (30.6 ± 1.1 kg) was 5.5% lower (P < .1) with cattle fed NC as compared to the other diets. Milk fat, fiber digestibility and body weight loss were all lower in cattle fed NC as compared to other diets. Digestible energy (2.85 ± .07 Mcal/kg) and net energy of lactation (1.54 ± .05 Mcal/kg) was 4.6 and 6.0% (P <.05), lower for NC as compared to the other diets. Efficiency of net energy use did not differ among treatments. Back fat accretion, detected from ultrasonography, was 68% greater in cattle fed NC (.02 vs. .11 cm; P <.05). Blood urea nitrogen (22.6 ± .58 mg/dl) was 3.5% higher in cattle fed NC. In-situ ruminal dry matter and crude protein degradation kinetics were determined on all dietary components. Pet food grade poultry protein meal had a CP k_d of 2.45%/h, a RUP of 58.5% and an intestinal digestibility of 85.4%. These results indicate that cattle fed high fat and fiber diets require more RUP and PPM is an economic alternative for other animal-protein based sources of RUP.

Key Words: Dairy cattle, Rumen undegradable protein

W180 Effects of physically effective NDF on rumen fermentation and digestion of dairy cows fed diets based on barley or corn silage. W. Z. Yang*[1] and K. A. Beauchemin[1], [1]*Agriculture and Agri-Food Canada, Lethbridge, Canada*.

Two studies were conducted to investigate the effects of physically effective (pe) NDF content in dairy cow diets on rumen fermentation and digestion with two forage source. Each study was a double 3 x 3 Latin square design using six lactating dairy cows with ruminal and duodenal cannulas. The treatments included three levels of peNDF (high, medium and low) measured using the Penn State Particle Separator. In study 1, three levels of peNDF were prepared by using original, chopping once or chopping twice of corn silage, which had peNDF content 16.0, 14.8 or 13.2%, for high, medium or low, respectively. In study 2, two cutting barley silages were prepared, coarse (3/8 " TLC) and fine (3/16" TLC). The high, medium or low peNDF diets were formulated using coarse, equal coarse and fine or fine barley silage with peNDF content, 16.1, 14.8 and 13.6%, respectively. Cows were offered ad libitum access to a TMR. Dry matter intake was not affected by the treatments regardless of silage fed. Digestibilities of nutrients in the total tract were significantly increased (P<0.01) (from 67.7 to 71.5% and from 48.5 to 57.5% for OM and NDF, respectively) with increased peNDF content of the diet for cows fed corn silage based diet. However, effect of peNDF content of the barley silage based diet on digestibility in the total tract was limited. Only a quadratic effect of peNDF level on NDF digestibility was observed (P<0.08) when barley silage was fed. In addition, A linear effect (P<0.04) of peNDF content was observed for rumen total VFA concentration and proportion of propionate for cows fed corn silage based diet. However, this effect was not appeared for cows fed barley silage diets. The results suggest that manipulation of the peNDF content of the diet can improve feed digestion and rumen fermentation. However, the magnitude of the improvement depends upon forage source fed to dairy cows.

Key Words: Physically effective NDF, Forage source, Digestion

W181 Increased concentrations of wet corn distillers grains in dairy cow diets. A. R. Hippen*[1], K. N. Linke[1], K. F. Kalscheur[1], D. J. Schingoethe[1], and A. D. Garcia[1], *South Dakota State University, Brookings*.

Sixteen multiparous Holstein cows were used in a replicated 4 × 4 Latin square design to measure the effects of increasing wet corn distillers grains in dairy cow diets. The forage portion of the diets was constant and consisted of (DM basis) 30% corn silage and 15% grass hay. Wet corn distillers grains (WDG) was included at 10, 20, 30, or 40% of the diet DM. The WDG replaced soybean meal, soybean hulls, and animal fat as inclusion rates increased. All diets were balanced to provide (DM basis): 1.65 mcal NEL/kg, 18% CP, 22.8% forage NDF, 20.9% ADF, and 6.5% ether extract. Ruminally undegradable protein was estimated to be near the high end of recommended inclusion rates. Diet DM decreased (46.9, 43.9, 39.4, and 36.5% for 10, 20, 30, and 40% WDG, respectively) as diet WDG increased. Dry matter intakes decreased (P < 0.01) as diet WDG increased (22.9, 23.0, 19.4, and 17.2 kg/d). Milk production also decreased (27.3, 26.9, 25.0, and 25.5 kg/d; P < 0.05) in respect to diet WDG concentration. Concentrations of fat (2.80, 2.90, 2.80, and 2.72%), protein (3.45, 3.55, 3.57, and 3.52%), urea nitrogen (14.9, 15.4, 14.9, and 14.4 mg/dl), and lactose (4.78, 4.86, 4.80, and 4.78%) in milk did not change (P > 0.10) with diets; however, yields of milk fat (0.72, 0.72, 0.68, and 0.67 kg/d), lactose (1.28, 1.25, 1.20, and 1.18 kg/d), and urea nitrogen (41.4, 40.2, 38.9, and 35.7 g/d) were decreased (P < 0.05) by increasing diet WDG. Increasing WDG above 20% of dry matter in diets of lactating dairy cows decreased DMI and yield of milk and milk components.

Key Words: Wet corn distillers grains, Dairy cow, Lactation

W182 Performance of lactating dairy cows fed wet corn gluten feed. G. D. Marx*[1], C. R. Dahlen[1], A. DiConstanzo[2], T. L. Durham[3], and R. T. Ethington[4], [1]*University of Minnesota, Crookston,* [2] *University of Minnesota, St. Paul,* [3] *ADM Corn Processing, Marshall, MN,* [4]*Kansas Feeds, Inc., Dodge City, KS*.

Sixty-nine lactating Holstein cows were used to determine the effects of dietary inclusion of wet corn gluten feed on milk production, component production, and DMI. The objective of the study was to determine the replacement value of CGF for corn grain and soybean meal. Cows were assigned to one of two treatments: 1) diet DM consisting of alfalfa haylage (25%), corn silage (25%), high moisture corn (32.5%), soybean meal (12%), sunflower seeds (3.2%), and a vitamin and mineral supplement; Control (n = 39), or 2) diet DM consisting of alfalfa haylage (23%), corn silage (23%), high moisture corn (20%), wet corn gluten feed (20%), soybean meal (8.5%), sunflower seeds (3.2%), and a vitamin and mineral supplement; CGF (n = 30). Cows were housed in an individual tie-stall barn. Feed was mixed in a truck-mounted TMR and delivered once daily. Milk production was measured daily and feed intakes and refusals were determined once weekly. Body weight and BCS were measured on d 0, 35, and 71 of the experiment. Cows were assigned to one of two dietary treatments based on body weight, BCS, milk production, DIM, and lactation number. Cows were adapted to their respective diet over a period of 14 d prior to the initiation of the 70d trial. General linear models of SAS were utilized to determine statistical significance of the data. Daily milk production, milk fat and milk protein for cows fed CGF were 38.34, 1.28 and 1.21 kg and control cows were 38.18, 1.29 and 1.21 kg. Milk production and milk components did not differ (P>0.05) between treatments. Daily DMI was similar (P>0.05) for both the CGF and control group with 22.65 and 22.04 kg. Average body weight gains during the experimental period for the CGF and control cows were 0.47 and 0.36 kg. Ending BCS of the CGF and control cows were similar with scores of 3.56 and 3.54. No unusual health conditions or nutritional disorders occurred with any of the cows. Results of this feeding trial indicate that the wet corn gluten feed was an acceptable component when fed at 20% of the ration dry matter for lactating dairy cows.

Key Words: Corn gluten feed, Lactating dairy cows, Byproduct feeding

W183 Total antioxidant capacity: A tool for evaluating the nutritional status of dairy heifers and cows. P. Mandebvu*[1,2], J. B. Castillo[1], D. J. Steckley[1], and E. Evans[1], [1]*Maple Leaf Foods Agresearch, Guelph, ON, Canada,,* [2]*W.H. Miner Agricultural Research Institute, Chazy, NY 12921, USA*.

The nutritional status of dairy heifers and multiparous cows in Nova Scotia and Ontario was evaluated by measuring the total antioxidant capacity (TAC) of antioxidants in plasma relative to a synthetic vitamin E analogue. In Nova Scotia 4 heifers, 5 dry cows and 50 lactating cows were fed a TMR containing corn silage, timothy-alfalfa haylage and concentrate for ad libitum intake during the winter, and allowed to graze pasture in addition to receiving supplementary feed in the late spring, summer and early fall. In Ontario 24 dry cows and 111 lactating cows were fed a TMR containing ingredients similar to the TMR fed in Nova Scotia for ad libitum intake throughout the year. Lactating cows had higher TAC levels compared to dry cows (P < 0.01). The TAC levels in cows were higher in Ontario compared to Nova Scotia (P < 0.001), and varied with seasons (P < 0.001). Animals fed different dietary regimes had different TAC levels, suggesting that TAC could be used as a tool to evaluate the nutritional status of animals when different diets or dietary ingredients are being fed, or to evaluate the general nutritional status of animals throughout the year or season.

Site	Season	Dry cows-n	Dry cows TAC mean	Dry cows TAC s.d.	Lact cows-n	Lact cows TAC mean	Lact cows TAC s.d.
Nova Scotia	Fall	5	0.878	0.214	50	0.837	0.163
	Winter	5	0.928	0.053	51	0.997	0.068
	Spring	3	0.923	0.032	44	0.972	0.040
	Summer	7	0.964	0.042	53	0.999	0.041
Ontario	Fall	31	0.956	0.105	193	1.028	0.085
	Winter	25	0.975	0.047	84	0.998	0.045
	Spring	23	1.106	0.054	78	1.127	0.080
	Summer	15	0.967	0.079	89	0.993	0.067

Lact denotes lactating. The mean TAC value forthe 4 heifers used in Nova Scotia was 0.860±0.106.

Key Words: Total antioxidant capacity, Nutritional status, Dairy cows

W184 Utilization of sugarbeet pulp and a high-sugar product for early lactation dairy cows. G. D. Marx*[1], C. R. Dahlen[1], and A. C. Cox[2], [1]*University of Minnesota, Crookston, MN,* [2]*Malt-O-Meal Company, Northfield, MN.*

In the first of two feeding trials, 40 early lactation primiparous and multiparous Holstein cows were assigned equally to either a diet containing 10% sugarbeet pulp (SP) or a control diet containing corn and forage (CF) at equal ration nutrient and DM content. The second trial utilized 18 early lactation cows with three equal treatment groups including a control (C), cows fed 0.45 (S1) or 0.90 kg (S2) of a 24.9% sucrose breakfast cereal product. The objective of these studies was to determine the ration substitution value of these byproducts. Both trials were conducted using a 1 wk standardization period followed by a 12 wk experimental period. Total mixed rations were fed once daily and balanced to meet NRC requirements for high producing cows. All cows were kept in individual tie stalls and fed to appetite plus 1.8 kg adjusted daily according to intake. Daily DMI and feed refusal were measured on each individual cow. General linear models of SAS were used to determine statistical significance of the data. Daily milk production, milk fat and milk protein for cows fed SP were 40.9, 1.34 and 1.24 kg and cows fed CF were 42.1, 1.30 and 1.30 kg and resulted in no differences (P>0.05) between treatments. Peak milk was 47 kg for both SP and CF fed cows. Average daily DMI did not differ between treatments and were 23.8 and 25.1 kg for the SP and CF cows. Average body condition scores were similar for both the SP and CF groups with scores of 3.22 and 3.35. Average daily BW gains of cows during the experimental period for both the SP and CF were 0.18 kg and 0.32 kg. In the second trial, average daily 4% FCM for the C, S1 and S2 treatment groups were 36.7, 34.6 and 34.4 kg. Milk production and milk components were not significant (P>0.05) between groups. Average daily DMI were similar (P>0.05) with 25.0, 24.3 and 24.2 kg for the C, S1 and S2 fed cows. No unusual health conditions or nutrient disorders occurred on either trial. These feeding trials indicate that 10% beet pulp in the diet can be substituted for equal nutrients from corn grain and forage and that a high-sugar breakfast cereal product can be a useful ingredient in lactating dairy cow rations.

Key Words: Sugarbeet pulp, Early lactation cows, Byproduct feeding

W185 The effect of corn silage particle size on eating behavior, chewing activities, and rumen fermentation in lactating dairy cows. P. J. Kononoff*, A. J. Heinrichs, and H. A. Lehman, *The Pennsylvania State University.*

The objective of this experiment was to evaluate effects of reducing corn silage particle size on eating behavior, chewing activity, and rumen fermentation in lactating dairy cows. Four cannulated, multiparous cows (110 ± 4 DIM; 675 ± 70 kg BW) were randomly assigned to a 4 × 4 Latin Square. During each of four periods, animals were offered one of four diets that were chemically similar but varied in corn silage particle size: short (SH), mostly short (MSH), mostly long (MLG), and long (LG). Reducing particle size increased dry matter intake (DMI) linearly (28.0, 26.8, 26.8, 25.7 kg/d for SH, MSH, MLG, and LG respectively). At 8, 16 and 24 h post feeding, the NDF concentration of feed remaining in the bunk decreased linearly with reduced particle size. Time spent eating or ruminating was not different across treatments, however, total chewing activity (TC; sum of time spent eating and ruminating) exhibited a quadratic response with highest chewing activities observed for diets with shortest and longest particle size. Eating or ruminating time per kg of DMI was not affected by corn silage particle size, but TC per kg of DMI decreased linearly with decreasing particle size. In comparison, when expressed as minutes per unit of NDF intake (NDFI), eating, ruminating, and TC were linearly reduced as particle size decreased. Rumen pH was not affected by corn silage particle size even though total concentration of VFA increased linearly from 89.1 mM/L to 93.6 mM/L as diet particle size decreased. The same linear effect was observed for acetate and butyrate concentrations, but propionate exhibited a quadratic effect with the highest concentration observed in animals consuming the shortest ration. Milk yield and protein were similar across diets and averaged 41.6 kg and 2.8%. However, 3.5% FCM showed a quadratic response, with highest production observed on MSH and MLG treatments. Results of this experiment suggest that reducing corn silage particle size may increase DMI, positively affect rumen fermentation, and reduce sorting behavior. Particle size measurement is useful in understanding some factors that affect feeding behavior and rumen fermentation of high producing dairy cows.

Key Words: Eating behavior, pH, Rumination

W186 Effect of forage to concentrate ratio on the efficiency of utilization of energy for milk production in dairy cows. E. Kebreab*[1], J. France[1], J.A.N. Mills[1], L. A. Crompton[1], R. E. Agnew[2], and T. Yan[2], [1]*The University of Reading, Reading, United Kingdom,* [2]*The Agricultural Research Institute of Northern Ireland, Hillsborough, United Kingdom.*

The objective of the study was to investigate the effect of quantity of concentrate in dairy cow diets on the efficiency of utilization of metabolizable energy intake (MEI) for milk production (k_l). A database containing 652 dairy cow observations was assembled from calorimetry studies in the UK. The dataset was subdivided into four sets containing diets with a forage:concentrate ratio of 0.10 to 0.39 (FC1), 0.40 to 0.74 (FC2), 0.75 to 0.99 (FC3) and 1.0 (all forage, FC4). The following equation was fitted to the dataset:
$E_l = a + b\ [MEI - (T_g/k_g)] - (T_l \times k_t) + \epsilon$,
where E_l is milk energy (MJ/kg $W^{0.75}$/d), a is the intercept and b is k_l. T_g and T_l (both in MJ/ kg $W^{0.75}$/d) are tissue energy gain and loss respectively, k_g and k_t are the efficiencies of utilization of energy for growth and body stores for milk production respectively, and ϵ is an error term. Meta-analysis of the data using a nonlinear mixed model procedure estimated the values of k_g and k_t to be 0.84 and 0.66 respectively, which were significantly different from previous reports of 0.6 for k_g and 0.84 for k_t. The value of k_l was estimated to be 0.60 (SE 0.0054), 0.59 (SE 0.0069), 0.60 (SE 0.0018) and 0.40 (SE 0.051) for FC1, FC2, FC3 and FC4 subsets, respectively. There was no significant difference in the estimate of k_l among forage:concentrate ratios of 0.1 to 0.99 (FC1, FC2 and FC3). However, there was a very significant difference in k_l when compared to cows fed diets containing forage only. It appears that dietary energy consumption is converted to milk energy with an average efficiency of about 60% in cows consuming diets containing concentrates but in cows fed concentrate free diets, the efficiency decreased by about 40%.

Key Words: Energy utilization, Dairy cows, Forage:concentrate ratio

W187 Estimation of mean ruminal retention time of DNDF in dairy cows based on combined data from rumen evacuations and marker excretion curves. P. Lund*, M. R. Weisbjerg, and T. Hvelplund, *Danish Institute of Agricultural Sciences, Denmark.*

Mean retention time (MRT) of digestible neutral detergent fiber (DNDF) has been determined *in vivo* in fistulated Holstein dairy cows, based on the ratio between rumen pool size determined using rumen evacuations and rumen output. However, uncritical use of this method for calculation of MRT of DNDF overestimates MRT, due to the contemporary digestion and passage, as the one compartment model does not account for selective retention. We propose that MRT of DNDF can be calculated as MRT_{COR} by solving the equation: $(k_d \cdot k_p)(y\text{-}y^2) \cdot MRT_{COR}{}^2 + k_p \cdot MRT_{COR} - 1 = 0$, based on an equation by Allen & Mertens (1988), and where fractional rates of digestion (k_d) and passage (k_p) of DNDF are obtained using the rumen evacuation method, and the distribution of MRT_{COR} between the first (y) and the second

compartment (1-y), y[0;1], can be estimated from duodenal excretion curves of ytterbium and MRT of INDF. MRT and MRT_{COR} of DNDF were evaluated in four 4x4 latin square experiments. Two hays [grass (GH) and alfalfa (AH)] and six silages [early cut grass (ECGS), late cut grass (LCGS), whole crop barley (WCBS), corn (CS), whole crop pea (WCPS) and clover/grass (CGS)] were fed *ad libitum* to dry cows or cows in late lactation as the only feed (Unsuppl.), or supplemented with concentrate (5.8 kg DM/day) high in starch and low in NDF and fed to cows in early or mid-lactation (Suppl.). DNDF was determined from 21 d rumen *in situ* incubations. MRT_{COR} varied from 59 h for CS (Unsuppl.) to 129 h for EGS (Unsuppl.). MRT estimated from the rumen evacuation method was overestimated with on average 46 h, equal to 47% compared to MRT_{COR}. MRT_{COR} for DNDF was on average 29 h higher than MRT for INDF, indicating a selective retention.

Unsuppl.[a]	ECGS	LCGS	WCBS	GH
MRT	213±33	144±33	111±33	177±33
MRT_{COR}	129±25	88±25	78±26	112±37
Suppl.[a]	ECGS	LCGS	WCBS	GH
MRT	117±4	97±3	72±3	98±3
MRT_{COR}	94±5	75±4	65±4	76±4
Unsuppl.[b]	AH	CS	CGS	GH
MRT	206±71	86±4	180±24	225±39
MRT_{COR}	108±26	59±3	103±10	130±14
Suppl.[a]	AH	CS	PS	GH
MRT	115±14	67±14	111±14	114±14
MRT_{COR}	70±10	51±10	92±10	81±10

[a]Lsmean [b]Mean

Key Words: Kinetics, NDF, Selective retention

W188 Prediction of Elephantgrass (*Pennisetum purpureum*, Schum.) dry matter intake and rumen-fill of lactating cows from degradation characteristics. J.P.G. Soares[1,4], L.J.M. Aroeira*[2], T. T. Berchielli[3], F. Deresz[2], R. S. Verneque[2], and P. Andrade[3], [1]*Embrapa Rondonia, Porto Velho-RO-Brasil,* [2]*Embrapa Gado de Leite, Juiz de Fora-MG-Brasil,* [3]*FCAVJ/UNESP , Jaboticabal-SP-Brasil,* [4]*Part of Ph.D. Thesis of the 1st author at FCAV/UNESP- Jaboticabal, Supported by FAPESP.*

The goal of this trial was to compare the DMI and NDF rumen fill, directly measured of fistulated crossbred cows, with milk production averaging 13.5 kg, with the results estimated by different equations based on elephantgrass rumen degradation parameters. The experimental design was a Latin Square (3 x 3), with three cows, three periods and three treatments (chopped elephant grass harvested at 30, 45 and 60 days, offered*ad libitum*). The Latin Square was repeated three times over time. Within each treatment a split-plot design was included four schedules of ruminal evacuation: 0, 2, 4 and 6 hours after feeding. Daily DMI were measured in a Calan Gates system by the difference between offered and refused feed. The different equations based on in situ degradation parameters were: DMI = -1.19 + 0.035 (a+ b) + 28.5c(**1**), DMI = [%FDN]*[NDFI]/[(1-a-b)/K_P+b/(c+ k_p)]/24](**2**),DMI= -0.822+0.0748(a+b)+40.7c (**3**)and DMI=[%FDN]*[consumption of FDN]/[(1-a-b)/K_P+b/(c+k_P)]/24]-(**using directly measured values**)(**4**). The equations overestimated the average DMI obtained directly (9.0 kg/cow/day) in Calan-Gates, except the equation (**3**) that underestimated (7.7 kg/cow/day). The mean elephantgrass DMI of 13.7 and 13.4 kg/cow/day obtained, respectively, in the equations (**1**) and (**2**) were similar (P>.05) and both are higher (P<.05) than the 9.7 kg/cow/day obtained in the equation (**4**). The values measured directly in Calan-Gates (9.0 kg/cow/day) were similar (P>.05) to the 9.7 kg/cow/day,obtained by the equation (**4**) and higher (P<.05) than the 7.7 kg/cow/day obtained by the equation (**3**). The average NDF rumen fill (7.5 kg) was higher (P<.05) than the mean value (5.2 kg) estimated by the equation (**2**). The prediction equations based on rumen degradation characteristics were not efficient in the DMI and NDF rumen fill estimations of chopped elephantgrass harvested with 30, 45 and 60 days of age.

Key Words: Elephant grass, Prediction equations, Rumen fill

W189 The effect of amylase on rumen development in neonatal dairy calves. A. M. Gehamn, A. J. Heinrichs*, M. R. Long, and K. E. Lesmeister, *The Pennsylvania State University.*

Fifteen Holstein bull calves were fed 0, 6, or 12 g/d of amylase (Amaize, Alltech Inc.) in calf feed to compare rumen development from birth to 5 weeks of age. Calves received milk replacer (20% all-milk protein, 20% fat) reconstituted to 12.5% dry matter twice daily at 10% of arrival body weight/d. Calf starter and water were fed once a day on an ad-lib basis. Body weight, heart girth, withers height, and hip width were measured at birth and weekly thereafter at 4 h post a.m. feeding. Fecal and health scores were monitored daily. Blood samples were taken at each weekly weighing via jugular venipuncture and analyzed for hematocrit and beta-hydroxybutyrate. Calves were euthanized at 35 d of age, and GI tracts and rumens were harvested. Papillae length, width, papillae per cm^2, and rumen wall thickness were measured in 9 regions to quantify development in the entire reticulorumen. Regions sampled included: caudal portion of the caudal ventral blind sac, right and left caudal dorsal blind sac, right and left cranial dorsal blind sac, right and left cranial ventral sac, and right and left caudal ventral blind sac. Milk and grain intake were similar for all treatments. Papillae length was greater ($P < 0.10$) for the 6 g treatment in 4 areas when compared to the 12 g treatment and one area compared to control. Papillae width was greater ($P < 0.05$) in 6 areas for the 6 g group compared to the control and greater in 4 areas compared to the 12 g treatment. Papillae length and width were similar in all regions for the 12 g group and control. Number of papillae per cm^2 was greater ($P \leq 0.05$) for the 6 g treatment than the control in 3 regions. More papillae per cm^2 were observed for the 12 g treatment compared to the 6 g treatment in 2 regions; the 12 g treatment also had more papillae per cm^2 than the control in 2 regions. Rumen wall thickness and blood beta-hydroxybutyrate were not affected by treatment. All animal growth measurements were similar for all treatments. When fed at 6 g/calf per d, amylase appeared to be beneficial in increasing rumen papillae length and width in 5-wk-old dairy calves. Results of feeding higher levels of amylase generally were not different from controls, except in papillae counts.

Key Words: Calves, Rumen development, Amylase

W190 Grain processing, forage:concentrate, and forage length effects on ruminal N degradation and flows of amino acids to duodenum in lactating dairy cows. W. Z. Yang*[1], K. A. Beauchemin[1], and L. M. Rode[2], [1]*Agriculture and Agri-Food Canada, Lethbridge, Canada,* [2]*Rosebud Technologies Development, Ltd. Lethbridge, Canada.*

The objectives of this study were to evaluate effects of dietary factors on rumen N degradation, microbial protein synthesis and amino acid (AA) flows to the duodenum. The experiment was a double 4×4 Quasi-Latin square with a 2^3 factorial arrangement of treatments. The dietary factors were extent of barley grain processing, coarse (processing index [PI]=75.5%) or flat (PI=60.2%); forage to concentrate (F:C) ratio, low (35:65) or high (55:45); and forage particle length (FPL), long (7.59 mm) or short (6.08 mm). Eight lactating cows with ruminal and duodenal cannulas were offered ad libitum access to a TMR. Passage of microbial protein to the duodenum was improved ($P<0.09$) with increased F:C of the diet but was not affected by grain processing or FPL. Ruminal digestibility of N was increased ($P<0.04$) by 21 or 18% with increased F:C or reduced FPL, respectively. Increased grain processing enhanced ($P<0.08$) duodenal flows of AA from 2.0 to 2.3 kg/d. In contrast, reducing FPL tended to lower ($P<0.15$) flows of AA to the duodenum. Increased F:C of the diet did not change flow of total AA (2.2 kg/d), but there was a reduced ($P<0.05$) flow of dietary AA (0.90 vs 0.60 kg/d) and increased ($P<0.05$) flow of microbial AA (1.27 vs 1.55 kg/d). An interaction between grain processing and FPL was detected for flows of AA. Diets formulated with flatly rolled barley plus long FPL consistently increased ($P<0.05$) Arg, His, Thr, Asp, Glu, Ser, Tyr, total, EAA and NEAA by more than 40% compared to other combinations of grain processing and FPL. The results indicate that manipulation of dairy cow diets can improve ruminal N degradation and flows of AA to duodenum. Combining dietary factors can be more beneficial than changing individual dietary factors for improving the delivery of AA to the small intestine.

Key Words: Grain processing, Forage particle length, Amino acid flow

W191 Grain processing, forage:concentrate, and forage length effects on intestinal digestibility of amino acids by lactating dairy cows. W. Z. Yang*[1], K. A. Beauchemin[1], and L. M. Rode[2], [1]*Agriculture and Agri-Food Canada, Lethbridge, Canada,* [2]*Rosebud Technologies Development, Ltd. Lethbridge, Canada.*

Eight lactating cows with ruminal and duodenal cannulas were used in a study designed as a double 4×4 Quasi-Latin square with a 2^3 factorial arrangement of treatments to examine effects of dietary factors on digestibility of amino acids (AA) in the intestine. The dietary factors were extent of barley grain processing, coarse (processing index [PI]=75.5%) or flat (PI=60.2%); forage to concentrate (F:C) ratio, low (35:65) or high (55:45); and forage particle length (FPL), long (7.59 mm) or short (6.08 mm). Cows were offered ad libitum access to a TMR. Increased grain processing improved ($P<0.05$) N digestibility both in the intestine (15%) and in the total tract (8%). Reduction in the FPL of the diets reduced ($P<0.05$) intestinal N digestion by 14% without affecting the N digestion in the total tract. Digestibility of essential AA in the intestine (68%) was higher ($P<0.05$) than that of nonessential AA (63%) but digestion of total AA (65%) was similar to that of total N (66%), confirming that intestinal N digestibility is a good predictor of total AA digestibility in the intestine. Digestibilities of individual AA in the intestine ranged from 46 to 77%, and were improved ($P<0.05$) with increasing grain processing. However, effects of F:C or FPL on digestion of AA were limited. Similarly, amount of AA absorbed in the intestine (range of 1.25 to 1.59 kg/d) was increased ($P<0.03$) with increasing grain processing. The magnitude of increase (27%) in the amount of absorbed AA was much higher than the increase (6%) in digestibility, indicating that actual quantity of AA absorbed depends largely on the amounts entering the duodenum. Dietary treatments resulted in no differences in the ranking of limiting AA relative to milk protein synthesis. The results indicate that manipulation of dairy cow diets, especially grain processing, can significantly improve AA availability in the intestine.

Key Words: Grain processing, Forage length, Amino acid digestion

W192 Chemical composition of sugar cane varieties (Saccharum spp l.) with different cycles of production in three cut time. A. Fernandes*[1], A. Queiroz[2], L. Cabral[3], E. Pereira[4], and A. Arruda[4], [1]*Universidade Estadual do Norte Fluminense,* [2]*Universidade Federal de Viçosa,* [3]*Universidade Estadual do Oeste do Paraná,* [4]*Universidade Estadual do Oeste do Paraná.*

The objectives of this work were to determine the chemical composition, the potentialy degradable fraction of NDF (B2) and undegradable fraction (C) and to estimate the ruminal fill of sugar cane with different cycles of production (early and intermediate), in three cut times (426, 487 and 549 days). The laboratorial analysis consisted in dry matter (DM), organic matter, ash, crude protein (CP), ether extract, lignin, neutral detergent fiber (NDF), neutral detergent fiber corrected for ash and protein, acid detergent fiber (ADF), neutral detergent insoluble protein, acid detergent insoluble protein and neutral detergent protein soluble. The TDN was calculated by chemical composition. The degradable and undegradable fractions, and fiber digestion rate, as well as the ruminal fill were estimated by kinetic parameters obtained throught in situ incubation. The advanced cut time increased the DM in 9.5 percentage. The intermediate varieties presented higher TDN than early varieties, which had the highest contents of NDF and ADF, whose respective values were 487.56 and 471.03, and 287.87 and 247.54 g/kg DM for the early and intermediate varieties, respectively. The TDN increased linearly with the cut time, varying from 62.45 to 63.50 percentage however the NDF and ADF contents presented quadratic behavior. The early varieties presented higher content of CP than the intermediate only in the cut time of 549 days; contrarily, the brix of the sugar cane was superior to the intermediate varieties in the last cut. The early varieties presented larger total ruminal fill and lower fiber digestion rate. The degradable fraction of the fiber was reduced and the undegradable fraction was linearly increased with the age of the plants.

Key Words: Carbohydrate, Sugar cane, Ruminal degradation

W193 Statistical properties of nutrients within selected conserved forages. P. R. Tozer*, *Pennsylvania State University.*

Nutrient analysis data from three conserved forages: corn silage; alfalfa silage; and alfalfa hay were used to determine the statistical properties of the nutrients within each forage. The data was collected from a commercial feed analysis laboratory in the northeast of the US. Distributions of 16 nutrients were studied: these nutrients were dry matter (DM), crude protein (CP), soluble protein (SP), acid detergent fiber (ADF), neutral detergent fiber (NDF), lignin, ash, non-structural carbohydrates (NSC), calcium, phosphorous, magnesium, potassium, iron, manganese, zinc, and copper. The nutrient distributions were analyzed for higher order statistical properties, including skewness and kurtosis. These properties indicate whether the nutrients are distributed normally. Of the 48 nutrients examined, all showed statistically significant differences from the normal distribution. Correlation analysis also showed that many nutrients exhibited strong relationships with others within the same feed. In conclusion the results suggest that the assumption of normally distributed nutrients, within the feeds examined, does not hold. This may have important implications for livestock producers, ration formulators and researchers when they attempt to provide rations that are of consistent quality to achieve the goals of the livestock business, or to quantify or qualify the response of animals to a particular nutrient or nutrition program.

Key Words: forages, nutrient composition, normality

W194 Effect of feeding a live yeast product (LYP) to bull calves with failure of passive transfer on performance and patterns of antibiotic resistance. K. N. Galvao*, S. O. Juchem, A. Coscioni, M. Villaséor, W. M. Sischo, J.E.P. Santos, P. G Nunes, and C. J. Pinto, *University of California - Davis.*

Objectives were to determine the effects of a LYP on performance and patterns of antibiotic resistance in fecal Escherichia coli in dairy calves. Forty-eight Holstein calves, 6 d of age with serum total protein (STP) below 5.2 g/dl and IgG below 1.5 g/dl, were blocked by body weight (BW) and STP and randomly assigned to one of four treatments: 1. no added LYP (Control); 2. LYP added to the starter grain (LYG; Saccharomyces cerevisiae; Levucell SC); 3. LYP added to the milk replacer (LYMR; S. cerevisiae, spp boulardii; Levucell SB); and 4. LYP added to the starter grain and to the milk replacer (LYGMR). Calves were offered 440 g of milk replacer DM containing 20% CP and 20% fat for the first 42 d of study and grain (18.1% CP and 3.1 Mcal of ME/kg) for ad libitum intake. Calves were weighed every 2 wk during 84-d study. Blood was sampled weekly for analyses of concentrations of glucose and -hydroxybutyrate. A fecal swab was collected from every calf every 2 wk for isolation of E. coli and determination of antibiotic resistance patterns. Continuous, binomial, and count data were analyzed using the MIXED, LOGISTIC, and GENMOD procedures of SAS (2001), respectively. Grain intakes (g/d) tended to be higher (P=0.07) for calves fed LYP prior to and after weaning and they were, respectively, 438 and 2194 for Controls, 682 and 2576 for LYG, 611 and 2379 for LYMR, and 500 and 2400 for LYGMR. Feeding LYP improved BW gain prior to weaning (298 vs 420 g/d; P=0.04), but not after weaning (907 vs 996 g/d; P=0.27). Feed efficiency (DM intake/BW change) was unaffected by treatment (P=0.40). Plasma glucose was higher for calves fed LYP than controls (74.3 vs 78.9 mg/dl; P=0.02). Number of days with diarrhea prior to weaning tended to be lower for calves fed LYP compared to controls (5.8 vs 4.4; P=0.06). Patterns of antibiotic resistance in E. coli were affected by age of calves, but not by treatment. Addition of a LYP to the diet of calves with failure of passive transfer has the potential to improve animal performance by increasing feed intake and decreasing days with diarrhea.

Key Words: Yeast, Calves, Antibiotic resistance

W195 Effect of age on ruminal fermentation in growing calves fed high concentrate diets with two levels of NDF. A. Rotger, A. Ferret*, S. Calsamiglia, and X. Manteca, *Universitat Autonoma de Barcelona.*

There is limited information on rumen development in calves from weaning to 250 kg BW on ruminal fermentation profile (VFA, ammonia nitrogen concentration, pH and ruminal passage rate). Six female Holstein calves (initial BW 81.1 3.2 kg) fitted with ruminal cannula were used

to describe the changes in the rumen fermentation profile during the growth period. Animals were offered ad libitum one of two TMR diets (15% CP; 2.75 Mcal ME/kg DM). The diets differed in the forage to concentrate ratio (11 to 89 vs. 30 to 70) and the NDF level (19% vs. 28%). A repeated measure trial with three experimental periods at 85, 155 and 258 kg of BW was conducted. Data were analyzed using the PROC MIXED procedure of SAS for a completely randomized design. The model contained effects of diet, period and their interaction. Animal was the random effect and period the repeated factor. Intake of DM increased with age and no differences were observed in the intake of DM, OM, CP and NDF between treatments even when the offered diets were different in the NDF content, suggesting that animals selected feed ingredients. Diet and age had no significant effect on average ruminal pH (6.36 0.16) or on the time pH was below 5.8 (5.1 3.8 h). Ammonia nitrogen concentration was lower in the high fiber diet (5.5 vs.13.1; $P < 0.05$). Diet had no effect on total and individual VFA concentrations. Total VFA concentration ($P < 0.05$) and molar percentage of propionic acid ($P < 0.01$) increased with age. Molar percentage of acetic acid ($P < 0.05$) and the acetic to propionic ratio ($P < 0.01$) decreased with age. Solid passage rate, estimated with chromium, was not affected by diet or age (0.063 0.0033 /h). Liquid passage rate, estimated with Co-EDTA, increased with age ($P < 0.05$) and was higher in the high NDF diet. Overall, ruminal fermentation seemed to increase with age presenting no problems of acidosis. The lack of significant differences between diets could be explained by no differences in nutrient intake.

Key Words: Age, Calves, Ruminal fermentation

W196 Effect of age on in situ degradation kinetics of plant protein supplements in growing calves fed high concentrate diets with two levels of NDF. A. Rotger, A. Ferret*, S. Calsamiglia, and X. Manteca, *Universitat Autonoma de Barcelona.*

Six female Holstein calves (initial body weight 81.1 3.25 kg) fitted with ruminal cannula were used to study the effect of age and NDF intake on degradation kinetics of plant protein supplements. Animals were offered one of two TMR (15% CP; 2.75 Mcal ME/kg DM) ad libitum. The two diets differed in the forage to concentrate ratio (11 to 89 vs. 30 to 70) and the NDF level (19% vs. 28%). Three experimental periods were conduced at 85, 155 and 258 kg of BW in this repeated measure trial. Degradation kinetics of CP of four protein supplements (peas, soybean meal, lupin seeds and sunflower meal) and degradation kinetics of NDF of alfalfa hay were estimated with in situ incubations. A fractional passage rate of 0.06 /h was used to estimate ruminal degradability. Data were analyzed using the PROC MIXED procedure of SAS for a completely randomized design. The model contained fixed effects of diet, period and their interaction. Animal was the random effect and period the repeated factor. Intake of DM increased with age. There were no differences in the intake of DM, OM, CP and NDF between treatments even the differences in the offered rations, suggesting that animals selected feed ingredients. Degradation of CP increased with age ($P < 0.01$) in sunflower meal and tended to increase in peas and lupin seeds ($P < 0.10$). Degradability of CP in lupin seeds ($P < 0.01$) and NDF in alfalfa hay ($P < 0.05$) was higher in the high NDF diet. Age and diet had no significant effect on the soluble or potentially degradable fraction of any protein supplement. The fractional rate of degradation increased with age ($P < 0.10$) in all plant protein supplements except for soybean meal. In general, protein degradability and the fractional rate of degradation increased with age suggesting an increase in the fermentative potential of the rumen. The similar nutrient intake between diets may be responsible for the lack of diet effect on CP degradation in most supplements.

Key Words: Age, Calves, CP degradation

W197 Effect of substitution of a corn-canola meal blend by cull chickpeas on apparent digestibility of diets for sheep. J. F. Obregon*, R. Barajas, and A. Estrada, *FMVZ-Universidad Autnoma de Sinaloa (Mxico).*

To determining the effect of substitution of a corn-canola meal blend by cull chickpeas on apparent digestibility of diets for sheep, a digestibility experiment was conducted. Four Pelibuey sheep, males (BW=25±0.79 kg) were used in a cross over design experiment. The animals were placed individually in metabolic crates (0.6×1.2 m), and were randomly assigned to consume one of two diets in that consists the treatments: Treatment 1) Diet 14.77 % of CP and 3.36 Mcal of DE/kg, containig (DM basis), ground corn 55 %, canola meal 12 %, sudan grass hay 18 %, sugarcane molasses 12 %, urea 0.8 %, limestone 1.2 %, and mineral premix 1 % (control); and Treatment 2)Diet 14.88 % CP and 3.47 Mcal DE/kg, containing ground corn 28 %, cull chickpeas 39 %, sudan grass hay 18 %, sugarcane molasses 12 %, urea 0.8 %, limestone 1.2 %, and mineral premix 1 %. Diets were offered twice a day (800 and 1600 h), after six days of adaptation period, samples of diets (1 kg) and the total of feces produced were collected during four continuous days. Samples were dried, and weighed. DM and CP analyses were performed, and apparent digestibility was calculated. The inclusion of cull chickpeas not affected ($P>0.10$) dry matter digestibility of the diet with values of 77.5 % vs. 77.1 % for control and chickpeas diet, respectively. The digestibility of crude protein was similar between treatments (3.31 vs. 3.30 Mcal/kg), as consequence of that, the DE content of cull chickpeas was estimate to be proximate to 3.66 Mcal/kg, that is the calculate DE value for the 31:69 corn-canola meal blend that was substituted by cull chickpeas in the diet. It is concluded, that cull chickpeas can be include up to 40 % in sheep diets substituting usual ingredients as corn or canola meal, and that its DE content is close to 3.66 Mcal/kg.

Key Words: Cull chickpeas, Canola meal, Digestibility

W198 Silage characteristics,apparent digestibility,and performance of lambs fed apple pomace ensiled with different levels of wheat straw. F. T. Sleiman*, R. A. Sarkis, M. G. Uwayjan, E. K. Barbour, M. T. Farran, and M. N. Nimah, *American University of Beirut, Beirut, Lebanon.*

Fermentation characteristics,consumption and apparent digestibility of apple pomace(AP) ensiled with different levels of wheat straw(WS) were studied using 12 Awassi ram lambs averaging 58kg BW.The study was conducted for a 4wk trial with 1wk collection period.The experimental treatments were: I)100% AP silage(APS), II)100% barley silage(BS)as control, III)70% APS + 30% WS and IV)60% APS + 40% WS.In addition to ad libitum silage feeding, each lamb received 0.8kg concentrate(14% CP on DM basis)per day.Changes in temperature of ensiled AP(treatments I,III and IV)were not significantly different ($P>0.05$) at 7 and 21d after ensiling(18.5, 21.5 and 19.5 C) and (13.0, 15.2 and 14.1 C), respectively. PH of APS treatments were significantly different ($P<0.05$)with treatment I having the lowest value by 7 and 21d after ensiling (3.4 Vs 3.9 and 4.3) and (3.3 Vs 3.9 and 4.1), respectively. Silage DMI of treatments IV and II(control)were similar but not significantly higher ($P>0.05$) than those of I and III (0.5 Vs 0.3 and 0.3kg/h/d), respectively. All lambs gained weight by the end of trial. The highest but not significantly different ($P>0.05$) BWC was recorded for treatment IV as compared to I, II and III (0.39 Vs 0.14, 0.15 and 0.16 kg/h/d),respectively. Similarly, the highest but not significantly different ($P>0.05$) apparent DM digestibility was observed for treatment IV as compared to I, II and III(73.9 Vs 72.3, 72.6 and 71.6%),respectively. In addition, treatment IV had significantly higher($P<0.05$) digestibility of CF (67.9 Vs 48.6, 57.7 and 55.5%), ADF (63 Vs 43.4, 53.5 and 45.0) and NDF (68.5 Vs 67.3, 61.1 and 59.3%)as compared to I,II and III,respectively. Results of this study indicate that ensiling wheat straw with apple pomace improved silage fermentation characteristics,apparent digestibility and animal response.

Key Words: Apple pomace silage, Apparent digestibility, Ram lambs

W199 Effect of substitution of alfalfa hay by hay from long time stored mature Clitoria ternatea on apparent digestibility of diets for growing sheep. A. Estrada*, R. Barajas, and J. F. Obregon, [1]*FMVZ-Universidad Autonoma de Sinaloa (México).*

With the objective of determining the effect of substitution of alfalfa hay by hay from long time stored mature Clitoria ternatea on apparent digestibility of diets for growing sheep, a digestibility experiment by total fecal collection was conducted. Four Pelibuey sheep, males (BW=12.37 kg) were used in a cross over design experiment. the animals were placed individually in metabolic crates (0.6 x 1.2 m), and randomly were assigned to consume one of two diets in that consists the treatments: 1)Diet 18.3% of CP and 3.015 Mcal of DE/kg, containing (DM basis), alfalfa hay 50%, ground corn 27.8%, soybean meal 9.75%, sugar cane molasses 9.58%, urea 0.57%, limestone 1.15%, and mineral premix 1.15% (control); and 2)Diet similar to control, but containing 50% of hay obtained from Clitoria ternatea harvested at 57 days after previous cut and stored by one year, that substitute all alfalfa hay of

the control diet. Diets were offered twice a day (800 and 1600 h), after six day of adaptation period, samples of diets (1 kg) and the total of feces produced were collected during four continuous days. Samples were dried, and weighed. DM and CP analyses were performed, and apparent digestibility was calculated. Clitoria hay diminished (P=0.02) in 14.5% the dry matter digestibility of the diets, with values of 63.4% and 74.1% for clitoria hay and alfalfa hay diets, respectively. Crude protein digestibility, tended (P=0.06) to be 6% lower in the clitoria hay diet than alfalfa hay diet (73.1% vs. 78.0%). The DE content of the diet was decreased (P<0.05) in 14.9% by inclusion of clitoria hay (2.692 vs. 3.164 Mcal/kg). The observed/expected DE of the diet was lower (P<0.05) in clitoria hay diet (0.89)than in alfalfa hay diet (1.05).The digestibility of DM of clitoria was calculate to be 21% lower than alfalfa DM digestibility. The CP of clitoria was 10% less digestible than alfalfa CP, and the DE content of the mature clitoria was calculate to be near of 2.2 Mcal/kg. It is concluded, than Clitoria ternatea harvested after bloom is not a good substitute of alfalfa in diets for growing sheep.

Key Words: Clitoria ternatea, Alfalfa hay, Digestibility

W200 Effect of substitution of alfalfa hay by clitoria hay (Clitoria ternatea L.) on performance of sheep feed growing diets. A. Estrada*, R. Barajas, and J. F. Obregon, *FMVZ-Universidad Autonoma de Sinaloa (Mexico)*.

To determine the effect of substitution of alfalfa hay by cltoria hay (Clitoria ternatea L.) on performance of sheep fed growing diets, a 28 days growth performance experiment was conducted. Twenty-four pelibuey sheep, male (initial BW=15.23 kg) were used in a complete randomized block design experiment. The animals were weighed and grouped by weigh, in groups of three they were allocated in one of eight ground soil pen (2x3 m), fitted with metal feed bunks (1x0.33 m)and drinkers. The pens inside of blocks were randomly assigned one of two diets in that consists the treatments: 1)Diet 18.3% of CP and 3.015 Mcal of DE/kg, containing (DM basis), alfalfa hay 50% (18.01% CP), ground corn 27.8%, soybean meal 9.75%, sugar cane molasses 9.58%, urea 0.57%, limestone 1.15%, and mineral premix 1.15% (control); and 2)Diet as control, but containing 50% of clitoria hay (19.09% CP), that sustitute all alfalfa hay of the control diet. The animals were weighed at day 1 and 28 of experiment, DM intake was recorded daily. The mean final weight of experiment was 20.77 kg and was not altered (P=0.58) by roughage source in diets. Dry Matter intake was not affected (P=0.67) by treatments with values of 0.876 and 0.884 kg/day for alfalfa and clitoria diets, respectively. Average daily gain was similar (P=0.76) for both treatments with means of 0.197 and 0.199 kg/day for alfalfa and clitoria diets, respectively. There are not differences (P=0.98) in the dry matter intake/ADG ratio, with values of 4.45 and 4.24 kg/kg for alfalfa hay and clitoria hay diets respectively. It is concluded that clitoria hay can be included up to 50% in the diets of growing sheep substituting alfalfa hay without detrimental effect on performance.

Key Words: Clitoria ternatea, Alfalfa hay, sheep

W201 Ruminal degradation of dry matter of sudan grass hay grew in a subtropical weather, harvested at two ages in rumen of sheep using nylon bag technique. R. Barajas*[1], J.F. Obregon[1], and A. Estrada[1], [1]*FMVZ-Universidad Autnoma de Sinaloa (Mxico)*.

With the objective of determining the ruminal degradation of dry matter of sudan grass hay grew in a subtropical weather, harvested at two ages in rumen of sheep using nylon bag technique, four sheep (Pelibuey, males BW=34 kg) fitted with ruminal cannula were used. The animals were individually placed in concrete flour pens (1.5×2 m), and fed twice a day (800 and 1600 h) with a 37:63 roughage:concentrate diet. Nylon bags (10×18 cm) containing 5 g of sudan grass hay harvested 60 days after homogenization cut (SGH-60), or sudan grass hay harvested 90 days after homogenization cut (SGH-90), in agreement with a complete randomly experiment design, were randomly designed to be incubated in rumen of sheep during 24, 48, and 72 hours. Once complete the incubation time, the bags were washed with tap water, dried, and DM was determinate. Solubility was measured by five minutes inmersion of bags in a 0.15 N solution of NaCl at 39 Celsius degrees. The solubility of DM of SGH-60 was higher (P<0.05) than SGH-90 (10.6 % vs. 8.5 %). Rumen degradability of DM from SGH-60 at 24 h incubation time was higher (P<0.05) than the correspondent to SGH-90 (40.3 % vs. 30.1 %). At 48 h incubation time, the digestibility of DM from SGH-60 suppers (P<0.05) to DM ruminal degradability of DM of SGH-90 (44.1 % vs. 39.7 %). After 72 h of incubation in rumen, the degradability of DM of SGH-60 continued be higher (P<0.05) than DM of SGH-90 (47.4 % vs. 44.1 %). It is concluded, that sudan grass grew in a subtropical weather, needs be harvested near of 60 days after previous cutting, to prevent loosing of its nutritional value as roughage for ruminants.

Key Words: Sudan grass, Sheep, Rumen degradability

W202 Effect of substitution of sesame meal by cotton seed meal on apparent digestibility of diets for sheep. R. Barajas*, J. F. Obregon, and J. J. Portillo, *FMVZ-Universidad Autónoma de Sinaloa (México)*.

With the objective of determining the effect of substitution of cotton seed meal by sesame meal on apparent digestibility in diets for sheep, a digestibility experiment was conducted. Four Pelibuey sheep, males (BW=21.25±0.95 kg)were used in a cross over design experiment. The animals were placed individually in metabolic crates (0.6×1.2 m), and were randomly assigned to consume one of two diets in that consists the treatments: 1) Diet 19.6 % of CP and 3.106 Mcal of DE/kg, containing (DM basis), cotton seed meal 29.7 %, ground corn 37.3 %, sudan grass hay 19.6 %, sugar cane molasses 10.7 %, urea 0.54 %, limestone 1.1 %, and mineral premix 1.1 % (control); or 2) Diet similar to control, but containing 29.7 % of sesame meal as substitute of cotton seed meal. Diets were offered twice a day (800 and 1600 h), after six days of adaptation period, samples of diets (1 kg) and the total of feces produced were collected during four continuos days. Samples were dried and weighed. DM and CP were performed, and apparent digestibility was calculated. Dry matter digestibility was not affected (P>0.10) by treatments with values of 69.2 % and 69.6 % for cotton seed meal and sesame meal diets, respectively. The apparent CP digestibility of the diets containing sesame meal was higher (P<0.05) than CSM diet (73.1 vs. 68.5 %). The digestible energy content of diets was not affected by treatments (P>0.10), as consequence of that DE of sesame meal was estimate to be near of 3.13 Mcal/kg, that is the value atributted to cotton seed meal, ingredient that was substitute by sesame meal. It is concluded, that sesame meal can be a substitute of cotton seed meal as protein source in the diets for sheep, without affect negatively the nutritional value of the diet.

Key Words: Sesame meal, Cottton seed meal digestibility, Sheep

W203 Effect of *Aspergillus oryzae* fermentation extract on zoospore physiology and carbon source utilization in the rumen fungus *Neocallimastix frontalis*, EB 188. J. Schmidt, S. Albright, K. Tsai, G. Calza, J. Chang, and R. Calza*, *Washington State University, Pullman*.

Direct fed microbials based on the fermentation of *Aspergillus oryzae* (AO) have been used as feed supplements for cattle but with inconsistent results. To improve the consistency of animal response, the mechanism of action needs to be understood. Therefore, we measured the effects of AO extract in powdered or liquid form in both stationary and stirred cultures of a rumen fungus, *Neocallimastix frontalis* EB 188 (ATCC #76100). Cultures were periodically sampled and assayed for extracellular and intracellular protein and enzymes, gas production, zoospore production and maturation, and carbon source utilization. Mobile zoospores matured into germination entities more rapidly (e.g., 3 hours) in treated cultures, and when powdered product was used, 38% ($P \leq 0.05$) more motile zoospores were produced by 50 h of fungal growth. Furthermore, by 110 h of growth 97% ($P \leq 0.01$) more germinated zoospores were found in treated cultures than in controls. Levels of intracellular zoospore malate dehydrogenase and lactate dehydrogenase were increased in treated cultures by 6.4-fold ($P \leq 0.01$) and 2.7-fold ($P \leq 0.05$), respectively. The wheat bran used as carrier for the product and tested as either soluble extract or powder had little effect on fungal cultures. Soluble extract increased fungal physiology and treated cultures produced significantly (at least $P \leq 0.05$) higher levels of secreted enzymes including amylase (213%), CMCase (22%) and β-glucosidase (34%). Culture gas production was higher ($P \leq 0.04$) at 48 and 66 h of growth in extract treated cultures but not thereafter. Culture utilization of glucose was increased by 37% ($P \leq 0.1$) in treated cultures yet high levels of extract (e.g., 5 times recommended) inhibited glucose utilization. AO fermentation extract effects the physiology of

rumen fungi and such information gained in vitro might help determine a mode of action in vivo for these types of direct fed microbials.

Key Words: AO Supplement, Rumen fungus, Cellulase

W204 Effects of *Aspergillus oryzae* fermentation extract on growth, enzyme production, and carbon source utilization of rumen bacteria grown separately and in co-culture with and without rumen fungi. S. Albright, G. Calza, and R. Calza*, *Washington State University, Pullman*.

Soluble components of *Aspergillus oryzae* (AO) were tested *in vitro* using rumen bacteria and a fungus in single and mixed cultures. Bacteria (from ATCC or Rowett Research Institute (RRI) and rumen fungus, *Neocallimastix frontalis* EB188 (ATCC #76100), were grown and periodically assayed for protein and enzymes, culture gas production and carbon source utilization, growth rate, and cellular size. Extract of AO had no effect on the growth rate of monocultures of *Prevotella ruminicola* GA 33 (Pr) (RRI), significantly ($P \leq 0.05$) increased the initial (up to 4 h) growth rate of *Succinimonas amylolytica* B24 (Sa) (RRI), increased ($P \leq 0.01$) the growth rate of *Selenomonas ruminantium* NADL GA-192 (Sr) (RRI) throughout the 10 h experiment, and significantly decreased ($P \leq 0.02$) the growth rates of *Succinivibrio dextrinosolvens* 0554 (Sd) (RRI) and *Eubacterium cellulosolvens* 6 (Ec) (RRI). Measurements of cell size using FACS suggested *Fibrobacter succinogenes* (Fs) (ATCC # 19169), and *Ruminococcus albus* (Ra) (ATCC # 27210) grown in the presence of extract tended ($P \leq 0.1$) to be larger, whereas Ec and Sd tended ($P \leq 0.1$) to be smaller, and Pr, Sa and Sr were unchanged in size. Extract failed (89% in control verses 91% in treated) to increase the extent of cellulose utilization in co-cultures containing all bacteria and the rumen fungus. Supernatant and intracellular amylase and β-glucosidase were higher ($P \leq 0.05$) in co-cultures treated with AO extract whereas total protein and total gas produced were unchanged. Xylanase was significantly ($P \leq 0.01$) decreased in all extract treated co-cultures. Gel electrophoresis methods recorded only slight differences in protein patterns of cellular lysates from bacteria growth either with or without extract. Mixed cultures grown *in vitro* might provide clues to the mode of action *in vivo* for AO based direct fed microbials.

Key Words: AO supplement, Rumen bacteria, Co-cultures

W205 RUSITEC to characterize *Aspergillus oryzae* extracts effects on *in vitro* fermentation and populations of microorganisms. R. Calza*[1], F. McIntosh[2], J. Wallace[2], and J. Newbold[2], [1]*Washington State University, Pullman/U.S.A.*, [2]*Rowett Research Institute, Aberdeen/Scotland*.

Rumen simulation devices possessing 15 vessels, fed daily with hay, with or without Amaferm® extract or an inhibitor isolated from the extract were used to measure *in vitro* fermentation. Vessels were monitored periodically and run for a total of 21 days. There were no significant differences (at $P \leq 0.05$) in the number of total bacteria, fungi, or protozoa in vessels. Cellulolytic bacteria numbers were different ($P \leq 0.01$) at 1.93 x 10^7/ml for control vessels, 4.73 x 10^7/ml for treated vessels, and 2.70 x 10^7/ml in inhibitor containing vessels. Total (Menke) gas and methane production were similar in all vessels as were concentrations of ammonia and major VFA's but lactate tended to be lower ($P \leq 0.1$) in inhibitor treated vessels at 0.60 mmol/d. Measured pH values were similar in all vessels and ranged between 6.65-6.68 on days 11 and 20. Dry matter disappearance was significantly different ($P \leq 0.05$) in control vessels (5.53 g/24 h), treated vessels (6.11 g/24 h), and inhibitor containing vessels (5.07 g/24 h). Serum bottles containing antibiotics to inhibit bacteria and promote fungal growth were set up from RUSITEC vessels at day 20, and assayed over 2-7 days. We failed to record differences in displacement gas or methane produced between treatments at any time of experiment. Fungal produced H_2 was lower ($P \leq 0.06$) in control bottles at 757 μml than in treated bottle at 870 μml ml and lower yet at 505 μml in bottles containing inhibitor. Zoospore numbers tended to be lower ($P \leq 0.1$) at 9.4 x 10^5/ml in controls than in treated bottles at 12.9 x 10^5/ml but both higher than inhibitor containing bottles at 4.9 x 10^5/ml at day 7. Fungal cellulase was lower ($P \leq 0.04$) in the control bottles (2.94 mIU/ml) than in treated bottles (4.29 mIU/ml) but there was no difference between those samples and inhibitor treated bottles (3.13 mIU/ml). Research suggests that Amaferm® influences microbial populations including rumen fungi in RUSITEC.

Key Words: RUSITEC, Amaferm®, Fermentation

W206 Growth antagonist in *Aspergillus oryzae* fermentation extract: Effects on *Bacillus subtilis* and the rumen fungus, *Neocallimastix frontalis* EB188 and component analysis. J. Schmidt, S. Albright, E. Harper, G. Calza, and R. Calza*, *Washington State University, Pullman*.

The presence of growth inhibitor in extracts of *Aspergillus oryzae* (AO) cultures was determined in a common bacteria and a rumen fungus. *Bacillus subtilis* (ATCC #6633) exposed to AO extract (1 h water extraction) dried on discs at concentrations of 0.5, 2, and 4 times the dietary recommended level as supplement, resulted in zones of inhibition surrounding the exposure discs on growth plates measuring 0.2 +/- 0.1, 1.4 +/- 0.2, and 2.1 +/- 0.4 mm, respectively. Twenty-four to 30 h of mixing of AO powder with water was necessary to extract components that completely inhibited the growth of rumen fungus, *Neocallimastix frontalis* EB 188 (ATCC #76100). Fungal and bacterial growth inhibiting compounds were extracted effectively and rapidly using ethyl acetate but not with hexane or methanol. Boiling, freezing, bleach (hypochlorite), and protease pre-treatments of crude extract tended ($P \leq 0.1$) to reduce the inhibition of secreted cellulase in rumen fungus to 67,7%, 49,9%, 96.6%, and 80.1% of control, respectively. Fractions that strongly absorb 340-365 nm light and stimulated or inhibited fungal growth have been partially purified using HPLC and TLC. At least 4 growth inhibitors were detected from the ethyl acetate extract at TLC Rf values of 0.14 to 0.40 when developed with benzene-ethyl acetate (10:1). Anion exchange chromatography separated inhibitor fractions that caused a significant ($P \leq 0.01$) reduction (49% of controls) in the growth of rumen fungus. Such inhibitor fractions reduced (both at $P \leq 0.05$) cellulase and amylase secretions in rumen fungus to 25% and 6% of controls, respectively. Dialysis membranes possessing a nominal exclusion of 3Kd molecular weight resulted in partial removal or inactivation (to 77% of controls) of column separated inhibitor(s). Additional detailed purification studies are needed to identify the inhibitor components of AO.

Key Words: Bacteria, Rumen fungus, AO extract inhibitor

W207 Ruminal degradation of crude protein of raw cull Chop suey beans (Vignia radiata L.,Wilzek) in sheep. J. F. Obregon*, J. C. Robles, R. Barajas, and A. Estrada, *FMVZ-Universidad Autónoma de Sinaloa (México)*.

To determine the ruminal degradation of crude protein of raw cull Chop suey beans (Vignia radiata L., Wilzek) in sheep. Two Pelibuey sheep (31.5 kg) fitted with ruminal cannulas were used. The animals were fed with a diet 25:75 roughage:concentrate, containing 20 % of raw cull chopsuey beans. Nylon bags (10×18 cm) containing 5 g of raw cull chopsuey beans (CCB) or soybean meal (SBM), and were randomly designed to be incubated in rumen of sheep during 3, 6, 9, 12, 18, 24, or 36 hours. Once complete the incubation time, the bags were washed with tap water, dried, and CP was determined. The ruminal degradation of CCP-CP at 18 h incubation time was higher ($P<0.01$) than SBM-CP (96 % vs. 77.4 %). After 36 h of rumen incubation, there are no differences ($P>0.10$) between CCB-CP and SBM-CP (96.9 % vs. 94.3 %). Soluble fraction(a), degradable fraction (b) and rate of degradation by CCB-CP were 28.63 %, 71.7 % and 0.13 % /h, respectively. While by SBM-CO were 11.75%, 95.5% and 0.06%/h for fraction a, b, and c, respectively. The effective crude protein of CCB degraded in rumen was calculated in 90.6 %. It is assumed that undergradable crude protein content of CCB is 9.4 %. It is conclude that crude protein of raw cull Chop suey beans is highly and rapid degraded in rumen of sheep.

Key Words: Chop suey beans, Rumen degradability, Sheep

W208 Effects of slick vs non-slick bunk management on intake, performance, and carcass merit responses by finishing beef steers. P. J. Defoor*, D. A. Walker, and K. J. Malcolm-Callis, *New Mexico State University, Clayton Livestock Research Center, Clayton, NM.*

Slick bunk management (SB) offers feedyards the potential to simplify daily feed allocation decisions. However, the effects of SB on performance and carcass quality are unclear. Therefore, we evaluated SB and non-slick bunk management (NSB) in a 122-d finishing trial using 192 Angus steers (initial BW=392 kg) stratified by BW and assigned randomly within BW strata to one of two treatments (SB or NSB) in a randomized block design with eight pens per treatment and 12 steers per pen. All cattle were fed the same 91% concentrate diet (steam-flaked corn base with 9% alfalfa). The objective of the SB treatment was for bunks to contain at least 0.23 kg of feed per steer at 2230 and 0.0 kg at 0700, before feeding at approximately 0800. The objective of the NSB treatment was for bunks to contain approximately 0.23 kg of feed per steer at 0700 before feeding at approximately 0800. When the quality of accumulated feed in the NSB treatment became compromised, it was removed, weighed, and analyzed for DM. Average DMI for each pen was determined with and without removed accumulated feed. Cattle were weighed individually on d 0, 41, and on d 122 before harvest and subsequent carcass data collection. Daily DMI averaged 0.20 kg/d less (P = 0.16) for the SB treatment (9.52 vs 9.72 kg/d) when discarded accumulated feed was subtracted from feed delivery data. Leaving discarded accumulated feed in the feed log, as would occur in a commercial feedyard, resulted in 0.25 kg/d less (P = 0.09) apparent DMI for the SB treatment. Feed efficiency did not differ (P > 0.33) using DMI derived by either method. No difference (P = 0.65) in ADG (1.84 vs 1.86 kg/d for SB and NSB, respectively) was observed between the treatments, however, marbling score was lower (P = 0.04) for SB than for NSB, and Chi-square analyses indicated a greater (P = 0.09) proportion of carcasses with a modest or higher degree of marbling for the NSB treatment. These data indicate that it is possible to manage bunks to obtain the slick status described herein without adversely affecting performance. However, carcass data indicate the possibility that marbling could be adversely affected by SB; possibly as a result of the slightly reduced DMI and(or) effects on central energy metabolism.

Key Words: Beef cattle, Bunk management, Performance

W209 Effects of winter implant status and monensin feeding on winter and subsequent summer performance by steers grazing tallgrass prairie. T. N. Bodine, H. T. Purvis II, G. W. Horn, and D. A. Cox, *Oklahoma Agricultural Experiment Station.*

We conducted three experiments to evaluate the effects of winter implant status and monensin feeding on winter and subsequent summer grazing performance. Experiment 1 evaluated Synovex-S implants given during the winter and/or summer with season-long grazing. Experiment 2 evaluated winter Synovex-S implants and two summer season-long stocking rates (single and double). Experiment 3 evaluated winter Synovex-S and Revalor-G implants, as well as monensin feeding, followed by summer intensive early stocking. Winter implant usage and monensin feeding increased ($P < 0.05$) winter ADG by 33 and 49%, respectively, across all three studies. During summer grazing in Exp. 1, steers that had been implanted in the winter had 3% lesser ($P < 0.04$) ADG, whereas steers with summer implants had 6% greater ($P < 0.01$) ADG. Additionally, steers without winter implants that recieved summer implants had 10% greater ($P < 0.01$) ADG than steers that received both implants. In Exp. 2, steers with or without winter implants had similar ($P > 0.21$) summer ADG when double-stocked. However, single-stocked steers without winter implants had 6% greater ($P < 0.03$) ADG than steers with winter implants. Across the combined winter and summer grazing period, double-stocked, winter-implanted steers had greater ($P = 0.03$) ADG than steers without winter implants, whereas, single-stocked steers had similar ($P > 0.17$) ADG among winter implant status. Steers with winter implants and steers fed monensin had decreased ($P < 0.02$) summer ADG (-6, -10%) than steers without implants or monensin in Exp. 3. Combined winter and summer grazing period ADG was not different ($P > 0.15$) due to winter implants or monensin. The use of implants or monensin increased animal performance during winter grazing. When potential summer ADG is low, steers implanted in the winter retained their greater BW. However, when summer gain potential is greater, winter implant status and monensin feeding had no effect on combined winter and summer total weight gain.

Key Words: Growth promoters, Ionophores, Stocking rate

W210 Correlation of marbling and yearling weight EPD's with performance and carcass characteristics of early-weaned Simmental steers. N. A. Pyatt*[1], L. L. Berger[1], D. B. Faulkner[1], and P. M. Walker[2], [1]*University of Illinois at Urbana-Champaign,* [2]*Illinois State University, Normal.*

One hundred forty-four early-weaned three-quarter or greater Simmental steers of known genetics were individually fed to determine correlations of marbling EPD (MARB) and yearling weight EPD (YW) with feedlot performance and carcass characteristics. Mean MARB was 0.04 (range -0.12 to 0.25), and YW was 56.4 (range 17.8 to 88). Steers were weaned at 87.0 14.9 days and fed a high concentrate diet for approximately 90 days prior to allotment. Calves were implanted with Synovex C at weaning and successively with Synovex S and Revalor S. Steers were fed a 90% concentrate, whole shelled corn and corn silage diet, supplemented to contain 15% CP using soybean meal for 247.0 9.1 days and harvested at 422.0 19.9 days of age. Final weight was calculated by dividing hot carcass weight (HCW) by a common dressing percent. Samples of *longisimus dorsi* (LD) were collected to verify percent intramuscular fat (%FAT). Steers gained 1.63 0.19 kg/d, consumed 8.99 1.29 kg DM/d, and converted 0.183 0.025 kg gain/kg DM. Steers finished with 649.0 kg final weight, 402.8 kg HCW, 1.12 cm 12th rib fat, and 93.8 cm^2 LD area. USDA yield grades (YG) were 23.2% 1's, 54.9% 2's, 20.4% 3's and 1.4% 4's. USDA quality grades (QG) were 17.7% Select, 44.7% low Choice (C^-) and 36.9% average Choice or better. The American Simmental Association database reported steers of the same breed type graded 55% C^- or better under traditional management, while early weaning resulted in 81.6% C^- or better QG. MARB was correlated (P < 0.01) with gain to feed (G:F) (-0.29), DMI (0.41), QG (0.20), University of Illinois (UI) determined QG (0.26), marbling score (MS) (0.25) and %FAT (0.28). YW was correlated (P < 0.01) with G:F (-0.35), DMI (0.42), HCW (0.25) and YG (-0.31). LD %FAT was correlated (P < 0.01) to ADG (0.27), QG (0.63), UI QG (0.70), MS (0.72), YG (0.31) and UI calculated YG (0.50). R-values for ADG with G:F, ADG with DMI, and G:F with DMI were 0.40, 0.49 and -0.59, respectively (P < 0.01). Selecting for greater MARB can improve carcass quality. Selecting for greater YW may increase HCW and lower YG.

Key Words: Early-weaned, EPD, Correlation

W211 Effects of weaning programs on performance and serum concentrations of non-esterified fatty acids and urea nitrogen in first calf heifers or mature cows. T. R. Whitney*, G. C. Duff, S. P. Cuneo, D. W. Shaefer, and D. A. Henderson, *The University of Arizona, Department of Animal Sciences, Tucson 85721.*

Our objective was to investigate effects of early weaning calves on first calf heifer and mature cow performance and serum concentrations of non-esterified fatty acid (NEFA) and serum urea nitrogen (SUN). Treatments were arranged in a 2 x 2 factorial and included 14 crossbred (Angus x Gelbvieh x Hereford x Barzona x Senepol or Red Angus x Charolais x Tarentaise) first calf heifers and 14 crossbred (Angus x Gelbvieh x Hereford x Barzona x Senepol x Salers) mature cows assigned randomly to one of two treatments: early weaned (EW, calves weaned at 114 d) or normal weaned (NW, calves weaned at 197 d). Blood samples were collected on d 114, 141 197, and 205 post-partum via jugular venipuncture. Overall, BW was greater (P ¡ 0.01) for mature cows vs heifers and for EW vs NW dams (P ¡ 0.01). Heifers with calves EW had 3.06% increase (P ¡ 0.01) in BW than heifers with calves NW, but no change (P ¿ 0.10) in BW was observed for mature cows. Early weaning increased body condition (P ¡ 0.05) and change in body condition compared with NW. No effects of weaning or parity were observed for ADG (P ¿ 0.10). There was no parity x weaning x d or parity x weaning interactions observed (P ¿ 0.10) for NEFA or SUN. There was a parity x d interaction for both NEFA (P ¡ 0.10) and SUN (P ¡ 0.05), but no differences (P ¿ 0.10) were observed between first calf heifers and mature cows within d. Early weaning decreased (P ¡ 0.10) SUN compared with NW status. We hypothesize that early weaning decreased SUN concentrations due to decreased metabolism of muscle protein. Results suggest that EW

can increase BW and body condition in first calf heifers and decrease SUN concentrations in both first calf heifers and mature cows in open rangeland conditions of the desert southwest.

Key Words: Beef cattle, Early weaning, Parity

Production, Management, and the Environment

W212 Serum progesterone in cycling ewes treated with progesterone-impregnated intravaginal inserts on the day of estrus. J. L. Duffey*, D. M. Hallford, C. A. Gifford, and R. L. Rosencrans, *New Mexico State University, Las Cruces, NM/USA*.

Progesterone-impregnated intravaginal inserts (CIDR) can synchronize estrus in ewes but conception may be reduced. This study compared progesterone (P4) profiles in cycling Rambouillet ewes (control, n = 10) with those in cycling ewes (n = 10) receiving a CIDR (0.3 g P4, Pharmacia and Upjohn Ltd. Co., Auckland, NZ) on the day of estrus (d 0) and ovariectomized (OVX, n = 6) ewes treated with a CIDR. The CIDR's were removed after 14 d; intact ewes were then placed with raddled rams during a 21-d breeding season. Ewe BW were similar (P = 0.68) among groups averaging 74 ± 3 kg and serum P4 was less than 1ng/mL on d 0 in all ewes. On d 1, serum P4 differed in controls and in CIDR-treated intact and OVX ewes (0.2 < 2.9 < 4.4 ± 0.3 ng/mL, respectively; P < 0.01). On d 3, control ewes had a P4 concentration of 0.8 ng/mL (P < 0.01) compared with 3.4 ± 0.2 ng/mL in CIDR-treated intact and OVX ewes. This similarity in P4 value in the two CIDR treatments (P > 0.10) continued through d 7 at which time ewes in all three groups averaged approximately 4 ng/mL. Serum P4 in control ewes rose during the luteal phase to peak at 6.4 ± 0.5 ng/mL on d 12 and was greater (P < 0.01) on d 12 through 14 than values in both CIDR-treated groups. However, serum P4 was similar (P > 0.10) in CIDR-treated intact and OVX ewes from d 12 to 14 (2.8 and 1.9 ± 0.5 ng/mL, respectively, on d 14). Serum P4 averaged 6.2 ± 0.7 ng/mL in controls (P < 0.01) compared with 0.3 and 0.2 ng/mL in the two CIDR-treated groups on the day after CIDR removal. Control ewes were marked by rams on an average of d 17.9 compared with d 15.5 (± 0.4) for CIDR-treated intact ewes (P < 0.01). Ten percent of control ewes were marked by rams at a subsequent cycle compared with 60% of CIDR-treated intact ewes (P = 0.02). Results demonstrate that intact cycling ewes produce more P4 during the mid and late luteal phases than that released by the CIDR. The observation that ewes receiving a CIDR on d 0 have the same P4 on d 12 to 14 as CIDR-treated OVX ewes suggests premature demise of the corpus luteum which may have influenced the poor conception rate. (Thanks to Meg Oeller, DVM, CVM, FDA for INAD 10-321)

Key Words: Sheep, CIDR, Synchronize

W213 Progesterone release and clearance patterns of progesterone-impregnated intravaginal inserts in ewes. C. A. Gifford*, J. L. Duffey, R. L. Rosencrans, and D. M. Hallford, *New Mexico State University, Las Cruces, NM/USA*.

Six ovariectomized Rambouillet ewes (BW = 73 ± 4 kg) were utilized to determine progesterone (P4) uptake and clearance patterns after insertion and removal of P4 containing controlled internal drug releasing devices (CIDR, 0.3 g P4, Pharmacia and Upjohn LTD. Co., Auckland, NZ). Animals were maintained in a single pen (12 x 4 m) under ambient conditions with access to shade, water, salt, and alfalfa hay (2 kg/d). In period 1, serum was collected before and hourly for 12 h after CIDR insertion. Serum P4 concentration was 4.7 ± 0.6 ng/mL 1 h after CIDR insertion compared with 0.1 ng/mL (P < 0.01) immediately before CIDR insertion on d 0. Serum P4 peaked at 6.3 ± 0.6 ng/mL (h 4) and remained elevated for the remaining 12 h on d 0. Additional samples were collected daily for 14 d in period 1, and all P4 values were 2 ng/mL or greater. Each CIDR was removed on d 14, and serum was collected intensively for 12 h after CIDR removal. At 15 min after CIDR removal, serum P4 was 1.2 compared with 1.9 (± 0.1) ng/mL before removal. At 1 and 2 h after CIDR removal, serum P4 values averaged 0.8 and 0.7 (± 0.1) ng/mL, respectively; and 12 h after CIDR removal, P4 had declined to 0.2 ng/mL. After 2 wk, the same CIDR was reinserted in the same ewe from period 1 for second and third 14-d periods. Daily P4 concentrations were compared to determine the efficiency of using a CIDR multiple times. Serum P4 averaged 4.4, 2.1, and 0.7 (± 0.4) ng/mL on d 1 of periods 1, 2, and 3, respectively (P < 0.01). On d 7, period 1 P4 value was 3.6 ng/mL compared with 1.5 and 0.3 (± 0.3) ng/mL during periods 2 and 3, respectively (P < 0.01). Serum P4 was < 1 ng/mL after d 9 of period 2 and never averaged greater than 0.7 ng/mL during period 3. On d 14, P4 values were 1.9, 0.7, and 0.3 (± 0.2) ng/mL in the three respective periods. Results show that P4 from the CIDR rapidly enters the circulation (within 1 h) at the time of insertion and is rapidly cleared after CIDR removal (< 1ng/mL by 1 h). Also after 2, 15-d periods in situ, CIDR's were no longer able to increase serum P4 concentrations. (Thanks to Meg Oeller, DVM, CVM, FDA for INAD 10-321)

Key Words: Sheep, CIDR, Synchronize

W214 Effects of seminal traits and mating behavior on number of progeny sired in multi-sire herds. W. A. Whitworth[1], D. W. Forrest*[1], L. R. Sprott[1], B. G. Warrington[2], and J. W. Holloway[2], [1]*Department of Animal Science, Texas A&M University, College Station,* [2]*Texas Agricultural Experiment Station, Uvalde*.

Effects of serving capacity (SC), social dominance rank (SDR) and physical characteristics of bulls on reproductive performance in multi-sire herds were evaluated. Spermatozoal traits and presence of fertility-associated antigen (FAA) were also assessed. In experiment one, Braunvieh (n=6) and Bonsmara (n=6) bulls (18-24 mo of age) were evaluated for body condition score (BCS), SDR, SC, sperm motility and morphology, and FAA status (positive/negative). Bulls were joined with multiparous cows (n=305) for 90 d. Paternity was verified by DNA typing of 251 calves. Regression analyses were used to determine traits associated with variability in number of calves sired per bull. Chi square analyses were used to determine effects of morphology and FAA status on numbers of calves born early (<41 d) or late. All bulls were FAA-positive and more calves were sired by Braunvieh (P<0.05) bulls. Bull breed, motility, morphology, and SDR rank were positively associated with variability in number of calves sired per bull (P<0.05, R-square = 0.75). Bulls with >80% normal sperm sired more calves early in the calving season (P<0.05). In experiment two, Bonsmara (n=6, 13-14 mo of age), Tuli (n=6, 15-18 mo of age), and Waygu (n=6, 18-19 mo of age) bulls were evaluated as in experiment one, along with BW, scrotal size and service efficiency (ratio of mounts to services). Bulls were joined with multiparous cows (n=290) for 90 d. Sire was determined for male calves (n=125). More calves were sired by older (Waygu) bulls (P<0.05). Age of bull, FAA-status, and BW explained variation in number of calves sired per bull (P<0.01, R-square = 0.64). There was a linear relationship (P<0.05) between service efficiency and number of calves sired per bull. Assessment of FAA status of sperm, SDR, and service efficiency in conjunction with a breeding soundness exam will identify bulls that can potentially sire increased numbers of early-born calves.

Key Words: Beef cattle, Bull fertility

W215 Effects of an injectable trace mineral supplement on conception rate of lactating dairy cows. J. A. Vanegas*, J. Reynolds, and R. Atwill, *University of California, Davis. Veterinary Medicine Teaching and Research Center, Tulare CA*.

A total of 830 dairy cows from a commercial dairy farm located in central California were used to evaluate the effects of a single or double dose of a trace mineral supplement(Multimin®)on first service conception rate. Cows were randomly allocated into treatment or control group to either a single (Experiment 1) or a double dose regime (Experiment 2). Allocation was based on days on lactation for the Experiment 1 and the length of their gestation period for Experiment 2. In Experiment 1, cows between 38 to 45 days in lactation (TREATMENT 1 n=191) received a single injection of 5ml of Multimin®. Two hundred and twenty eight similar cows were used as a CONTROL 1. In Experiment 2, cows received an initial injection of 5ml of Multimin® between 2 to 3 wks precalving (TREATMENT 2 n=186). An equal dose was repeated between 38 to 45 days in lactation. Two hundred and twenty eight similar cows

served as a CONTROL 2. Health and reproductive events post calving such as retained placenta and mastitis were recorded. The odds of first service conception for cows and heifers experiencing retained placenta and mastitis prior to first artificial insemination were significantly lower compare with their controls (OR 0.44 to 0.52, P-value 0.01). In Experiment 1, the odds of first service conception were not significantly different for cows and heifers given the one dose regimen of Multimin® compared to their untreated controls (OR 0.94, P-value=0.63). In Experiment 2, the odds of first-service conception were significantly lower for cows and heifers given the two-dose regime of Multimin® compared to their untreated controls. (OR 0.66, P-value=0.002). No significant differences on first-service conception were found between cows and heifers given the two-dose compared to the one-dose regime of Multimin® (OR 1.17, P-value=0.51)

Key Words: Conception rates, Trace minerals, Multimin

W216 Techniques for measuring carcass attributes in live cattle with ultrasound.

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The ubiquitous use of ultrasound in evaluating carcass traits in cattle can be enhanced with convenient and accurate procedures for estimating backfat, longissimus area, and intramuscular fat. It was found that a 5 MHz transrectal transducer (Aloka) provided more accurate measures of backfat over the region of the 12th and 13th rib with a sagittal than a transverse scan with average absolute errors of 1.6 and 2.2 mm, respectively. R^2 values were similar (.70 and .69 - 146 cattle) but the bias was less with the sagittal orientation (1.4 vs 2.1 mm). Longissimus area was estimated from the muscle depth or the distance from the bottom of the backfat to the features representing the transverse processes at the first and second lumbar. In a set of 139 cattle the correlation between this measure and carcass longissimus area was .67. Because this measure is commonly expressed in English measure an equation was developed for technician use (REA = muscle depth in mm/ 4 minus 1). This had an average error of 6.26 cm^2 (.97 in^2 and a bias of 1.9 cm^2. The procedure can be executed using the electronic calipers on most ultrasound instruments although algorithms for these measures on a digitized image were used. Ultrasound technicians should become proficient at estimating percent intramuscular fat from visual interpretation of images. The transverse image between the 12th and 13th ribs was viewed and the amount of ultrasonic speckle plus using the rib bone and spinous processes as densitometers to estimate beam attenuation were considered in making estimates. Results of the accuracy of the visual estimates to predict carcass marbling were compared to computer interpretations of the image using validated programs. Results expressed as R^2 values (n = 42) were .65, .57, .58 and .53 for the visual estimates (using a 12 cm 3.5 MHz transducer) and computer estimates for a 12 cm 3.5 MHz, 17 cm, 3.5 MHz, and a 5 MHz transrectal transducer, respectively. Respective absolute errors were .49, .52, .48 and .44 marbling score units. These results should assist ultrasound technicians to perform rapid evaluations where interpretation software is not available.

Key Words: Ultrasound, Cattle, Carcass

W217 Effect of a birth weight selection index on Hereford calves from inbred and outcross matings.

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The effect on calf performance and proportion assisted births from selecting linebred (LB) or outcross (OC) sires based on a birth weight selection index (SI) was evaluated for five years at the Northern Agricultural Research Center (NARC), Havre, MT. Selection of both LB and OC sires was on an index of adjusted yearling weight minus 3.2 X adjusted birth weight (SI). Linebred sires (Fx=16.3%) were from the LB Hereford herd at NARC with 15 yr selection based on SI and OC sires were selected from different purebred herds in Montana unrelated to NARC sires. Calves (375) were produced by mating two LB and two OC sires per year to LB and OC females with of calves each year from repeat matings. Sires were used two years. The general linear model procedure of SAS included year, age of dam, sex of calf, dam line, sire line, with covariate of calf birth date. Dependent variables were birth weight (BW), weaning weight (WW), weaning hip height (HH), yearling weight (YW), and average daily gain on feed (ADG). CATMOD procedure by SAS was used to evaluate proportion assisted calving (AC). Date of birth, year and age of dam were important (P=.01) for all weight and height traits. Dam breeding only influenced WW (P=.03) with OC calves 8.6 kg heavier. Calves from OC sires were heavier at birth (P<.01) than LB sires (39.5 and 37.2 kg, respectively) and taller (P<.01) at weaning (110.5 and 108.4 cm, respectively). Bull and heifer calf YW from OC sires were heavier (P=.01) than LB sires with bulls 404 and 390 kg, respectively and heifers 363 and 337 kg, respectively. Calves from 2-year-old dams had greater AC (P<.01) than 3+ year old dams. Bull calves from 2-year-old dams and OC sires had greater (P=.04) AC than LB sires (86.0 and 68.6%, respectively) with heifer calves 56.0 and 31.0% AC, respectively. Selecting OC sires on a SI to reduce birth weight and AC was not as effective as in a LB herd selected on a SI for 15 yr with OC sired calves having greater height and weight at weaning and heavier at one year of age.

Key Words: Selection index, Birth weight, Beef cattle

W218 Study of selected physical environmental factors on feed intake of performance-tested beef bulls.

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Feed intake data from 52 individual 140-d feeding trials conducted over a 13-yr period (1978 to 1990) and corresponding selected environmental data from three locations in Arkansas were analyzed to define more precisely the relationship between feed intake and selected environmental factors of performance-tested beef bulls. Feed intake data originated from bulls (n = 2,002) used in University of Arkansas Cooperative Bull Tests at Fayetteville, Hope and Monticello. After a 21-d adjustment period, bulls were full-fed on an individual basis twice daily in the same stall for 140 d. Initial age and weight were recorded at the beginning of each test and weights were taken at 28-d intervals thereafter. Mean initial weight and age were 273 ± 1 kg and 274 ± 0.9 d, respectively. Selected environmental data, which included thermal heat index (THI), relative humidity from 0600 to 1000 (RH6-10) and rainfall, were obtained from the National Climatic Data Center (Asheville, NC). Data were pooled, divided into five 28-d periods beginning with the start of each test, and data from each period were analyzed separately by the GLM procedure of SAS using all animals over all tests. Feed intake was influenced by initial age in all periods ($P < 0.01$) and initial weight in Periods 3 through 5 ($P < 0.01$). Initial weight x breed interactions were present in Periods 1 and 2 ($P < 0.01$). There were THI x breed interactions evident in all periods ($P < 0.01$). A RH6-10 influence was noted in Period 2 ($P < 0.01$). During Periods 3 and 4 there were RH6-10 x breed interactions evident ($P < 0.01$). A rainfall x breed interaction ($P < 0.01$) existed during Period 4. Data suggest that environmental effects on feed intake are strongly influenced by breed, and that initial age and weight of cattle when placed on feed affect intake throughout the feeding period.

Key Words: Beef cattle, Environment, Feed intake

W219 Effect of live weight, preslaughter handling, and gender on blood acid-base status in finishing pigs.

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Live weight has been suggested as an important factor influencing metabolic response of pigs to handling stress and, consequently, the incidence of deaths and downer animals during transport and, ultimately, pork quality. Thus, the objective of this study was to determine effects of preslaughter handling intensity on blood acid-base levels in pigs of varying live weight. Eighty pigs were used in a randomized block design 2 x 2 x 2 factorial arrangement of treatments: 1) live weight (light [104 kg] vs heavy [128 kg]), 2) handling intensity (low vs high), and 3) gender (barrows vs gilts). On the morning of handling test, baseline measurements of blood parameters, rectal temperature, and live weight were collected. Pigs were allowed 2 h rest prior to handling, which consisted of moving pigs through a course (12.2 x 0.91 m) for a total of eight laps. Animals on high intensity treatment were moved rapidly through the course and given 2 shocks/lap with an electric prod while pigs on low intensity were moved at their own pace using a livestock panel and paddle. There were no treatment interactions ($P > 0.05$) and no effect ($P > 0.05$) of treatment on baseline blood measurements taken prior to handling. Post-handling, pigs from light treatment group had higher ($P = 0.04$) blood SO_2 compared to pigs from heavy treatment (65.6 vs 57.2; SE = 2.80) and showed a greater increase ($P = 0.05$) in PO_2 from baseline to post-handling than did heavy pigs (15.6 vs 8.3; SE = 0.05).

Post-handling, pigs on high-intensity handling had greater ($P < 0.001$) lactate (19.1 vs 4.9; SE = 0.56) and PO_2 (51.6 vs 36.5; SE = 2.44) with lower ($P < 0.001$) TCO_2 (18.6 vs 34.7; SE = 0.64), pH (7.02 vs 7.36; SE = 0.015), HCO_3 (16.7 vs 33.0; SE = 0.62), and base excess (-14.2 vs 7.5; SE = 0.75) values than pigs on low-intensity treatment. Results from this study highlight the major impact of pig handling intensity and a limited effect of live weight and gender on blood acid-base status.

Key Words: Acid-base balance, Preslaughter handling, Pork quality

W220 Prediction of wool base, vegetable matter base, fiber diameter, and prickle factor of greasy wool with near-infrared reflectance spectroscopy (NIRS). C. J. Lupton*, J. W. Walker, B. S. Engdahl, and F. A. Pfeiffer, *Texas Agricultural Experiment Station, San Angelo*.

A near-infrared reflectance spectrophotometer (Feed and Forage Analyzer Model 6500M, Foss North America, Eden Prairie, MN) fitted with a transport mechanism and using a customized sample holder (scanning area = 82 cm^2) was used to obtain spectra (at 2 nm intervals in the range 400 to 2498 nm) of 427 core samples (in duplicate) of greasy wool. Twenty-five scans were averaged for each of the duplicate subsamples. The core samples were supplied and had previously been subsampled and analyzed using standard methodology by Yocom-McColl Testing Laboratories, Denver CO. The samples represented a broad cross-section of U.S. wool production. WinISI II software (version 1.04, Infrasoft International, Port Matilda, PA) was used to transform spectral data and calculate prediction equations and expected levels of precision for wool base (WB), vegetable matter base (VMB), average fiber diameter (AFD), SD and CV of fiber diameter, and prickle factor (PF, % of fibers > 30 μm). The SE of calibration (SEC), cross validation (SECV), and prediction (SEP) are presented in the table. The SEP and R^2(P) values for the predictions of the validation set were obtained by using a randomly selected half of the spectra to calculate a calibration equation that was then used to predict constituent values of the other half (actually 207) of the samples. Because SEP > SECV > SEC, possible sampling errors and lack of fit between NIRS-predicted and lab-determined values are indicated. We are attempting to reduce SE and increase R^2 values by repeating the lab analyses on a selected population of the actual subsamples that were scanned.

Constituent	N	Mean	SD	SEC	R^2	SECV	SEP	R^2(P)
WB, %	408	45.8	4.07	1.45	0.87	1.57	1.92	0.77
VMB, %	403	1.84	0.75	0.65	0.25	0.66	0.87	0.22
AFD, μm	412	23.5	3.09	0.66	0.95	0.76	1.31	0.83
SD, μm	410	5.34	1.15	0.31	0.93	0.36	0.50	0.83
CV, %	416	22.4	2.18	1.10	0.74	1.23	1.34	0.66
PF, %	411	14.0	14.5	3.28	0.95	3.70	6.36	0.83

Key Words: Near-infrared reflectance spectroscopy, Wool

W221 Field versus lab measurements for four important wool traits. F. A. Pfeiffer*, C. J. Lupton, and A. A. Simpson, *Texas Agricultural Experiment Station, San Angelo*.

The OFDA2000 instrument (Interactive Wool Group, Fremantle, Australia) was developed to measure average fiber diameter and fiber length properties of raw wool under field conditions. An experiment was designed to compare OFDA2000 field measurements of greasy wool with measurements obtained on the same staples after cleansing and remeasuring on a standardized instrument (OFDA 100, BSC Electronics, Perth, Australia) in a conditioned laboratory. Mid-side samples were removed from 1320 sheep representing 18 groups (differentiated by age and sex) from 8 different flocks in western Texas and measured for (*inter alia*) average fiber diameter (AFD), coefficient of variation of fiber diameter (CV), comfort factor (CF, % fibers $\leq$ 30 μm) and average fiber curvature (AFC). Means (and ranges) for the field-tested samples were 20.1 μm (15.8 to 27.3 μm), 16.8 % (12.7 to 23.5 %), 98.8 % (79.3 to 100 %), and 88.0 deg/mm (47.3 to 134.2 deg/mm), respectively. After cleaning, drying, and conditioning, the samples were re-measured using the OFDA 100. Average differences (OFDA 100 - OFDA2000) and r^2 values for the two sets of data were AFD, -0.22 μm and 0.87; CV, 0.96 % and 0.55; CF, -0.08 % and 0.68; and AFC, 26.04 deg/mm and 0.74. The AFD differences were greatest for groups containing yearling sheep having wool that tapered naturally to a tip (i.e., previously unshorn ewes and rams). For mature sheep, average AFD differences between instruments were close to 0, and r^2 values were high (> 0.9). Average values for CV and CF were similar between instruments but measurements from the two instruments were not as highly correlated as the AFD values. The OFDA2000 consistently underestimated AFC. However, the results were highly correlated with those for the standard instrument ($r^2 = 0.74$). We concluded that AFD measurements obtained in the field using the OFDA2000 are accurate enough to assist with and benefit selection decisions. Field estimates of the other three traits (CV, CF, and AFC) are not as accurate and should be used with caution.

Key Words: Objective measurement, Wool, Sheep

W222 Protocols of reproductive management and their influences on improvement of fertility in Iranian Holstein dairy cattle. G. Koolabadi[1], R. Tahmasbi[1], B. Saremi*[2], and A. Naserian[2], [1]*Dasht Dairy Farm, Neyshabour, Khorasan, Iran*, [2]*Ferdowsi University of Mashhad, Khorasan, Iran*.

The objective of this study was to compare existing methods for synchrony in Holstein dairy cattle and their influence on factors exhibited fertility status. This study carried out in Dasht dairy farm (2000 head), which is located in northeast of Iran (Neyshabour City) and have an acceptable and computerized record keeping system, between years 2002-2003. Cows that didn't show heat until (43±2d) postpartum selected and allocated to each method randomly. Method 1: Injection 2.5 cc prostaglandin, after 24-72h if cows show heat were inseminated, otherwise steps would be repeated. Method 2: Implantation CIDR on d 0, removing on d8, injection of 1cc estradiol on d9 and if heat was detected on d 10-12, insemination was done. Pregnancy test was done 40-45d after insemination by rectal palpation. Parity, Days in milk (DIM), Adjusted milk production (Milk305), Conception rate (CR), Calving ease (CE) and Open days (OD) were collected individually and analyzed by General Linear Models procedures of SAS v6.12 were used for ANOVA to evaluate differences among experimental groups. The design was completely randomized (unequal replicates). Means were compared with Duncan test. Although Parity, Milk 305d and CE have side effects on fertility but in this experiment data didn't show any significant difference between two methods ($P \leq 0.49$, 0.62 and 0.63 respectively) while DIM, CR and OD were highly reduced by using method 1 and were significantly different ($P \leq 0.0001$, 0.031 and 0.0004 respectively). Based on these results, it seems that using method 1 under Iran conditions should be better and reproductive performance will be improved.

Items	Method1	Method2	SEM
Parity	3.19^a	3.44^a	0.16
DIM	265^b	327^a	6.68
Milk (305d)	9037^a	9163^a	116
CR	3.03^b	3.71^a	0.14
CE	1.81^a	1.91^a	0.10
OD	127^b	177^a	6.21

Key Words: CIDR, Prostaglandin, Fertility

W223 Milk citrate as a potential metabolic indicator in dairy cows. L. L. Masson*[1], T. T. Mottram[1], and P. C. Garnsworthy[2], [1]*Silsoe Research Institute, Silsoe, U.K.*, [2]*University of Nottingham, Sutton Bonington, U.K.*

Citrate is a normal constituent of cow's milk, being an important member of the tricarboxylic acid cycle. It is correlated with *de novo* fatty acid synthesis and may be a useful indicator to assess energy balance. On-line monitoring of milk composition with biosensors during milking may be useful to assess metabolic status. Citrate may be a potential metabolite to measure but sources of variation within cows need to be determined and quantified for accurate data interpretation. The aim of this study was to investigate sources of variation in milk citrate. Three groups of 8 Holstein cows from the University of Nottingham's dairy herd were selected according to days in milk. All cows were fed on the same diet and milked 2 times daily. Milk samples were collected from early (days 4-29), mid (days 103-156) and late (days 265-306) lactation cows for 10 consecutive days to investigate diurnal, day-to-day and lactational variation. Citrate was determined by high performance liquid chromatography and data analysed by General ANOVA. Day-to-day variation was estimated at 3.2mM, although there was no significant difference between samples taken at AM and PM milkings ($P=0.129$). There was a significant effect of lactation stage ($P<0.001$) with citrate

being 10.89±0.24mM, 9.76±0.14mM and 10.26±0.15mM in early, mid and late lactation respectively. Variability between cows was greatest in early lactation, ranging from 0.66-3.22mM. These variations would make interpretation of daily measurements difficult with current knowledge. Several other factors also affect milk citrate, including nutrition, health status and season and these must be taken into consideration if citrate is to be measured automatically as an indicator of metabolic status. However, the amount of data required initially to establish variability within cows and normal baseline levels would likely be very large and in practice this nutritional management system may not be feasible.

Key Words: Milk citrate, Variation, On-line monitoring

W224 A survey of mortality and calf management in U.S. Jersey herds. S. Bascon*, R. James, M. McGilliard, and E. Hovingh, *Virginia Tech*.

Our objectives were to assess frequency of mortality of Jersey calves in the United States, and examine relationships between nutrition, management, and mortality. Fifteen percent of 577 herds were selected (n=88) by region, rolling herd average milk , and herd size to obtain a representative sample of the population. Herds were located in PA, OH, or IN (n=25), Southeast (n=16), Northeast (n=17), WI (n=8) and West (n=22). Surveys were conducted by personal interview between December 2000 and June 2001. Herds averaged 7180 ± 757 kg rolling herd average milk , 153 cows, and 199 births annually. Mortality averaged 5.0 ± 6.1% during first 24 h of life including stillbirths, 6.7 ± 8.4% from 24 h to 3 mo of life, and 1.3 ± 1.6% from 3 mo to calving. First colostrum was fed 3.8 3.0 h after birth at 1.9 0.6 L. Calves were weaned at 9.4 3.2 wk. Higher herd milk production and more liquid fed to calves were correlated with reductions in mortality by 24 h. Frequency of mortality by 24 h was highest in herds that calved cows on pasture, and registered less than 100% of calves. Less mortality from 24 h to 3 mo. was associated with herds that used maternity pens, and weaned calves at a younger age. Increased mortality from 24 h to 3 mo was observed in herds that offered calf starter and forage at a later age, used colostrum supplements, and used natural service to breed heifers. Mortality in Jersey calves may be reduced by offering calf starter to younger calves, using maternity pens, and reducing age at weaning to 8 wk of age.

Key Words: Jersey calves, Survey, Mortality

W225 Effects of ozonation of the swine nursery building on air quality and growth performance of weanling piglets. K. W. Kim, J. H. Woo, D. H. Kim, and C. Y. Lee*, [1]*Regional Animal Industry Research Center, Jinju National University*.

Two experiments (Exp.) were performed to study the effect of ozonation on air quality and growth performance of weanling piglets. Ozone was generated using a commercial apparatus outside the nursery building and infused into the house through a duct at a level of 0.03 ppm. In Exp. I, concentrations of harmful gases and temperature of the nursery house were recorded every two hours for 21 days. In Exp. II, 40 cross-bred weanling piglets weighing approximately 7 kg were raised in two ozonated or unozonated control pens alternatively for three weeks and this procedure was repeated three times. In Exp. I, concentrations of ammonia and carbon dioxide of the nursery house were reduced by 22% and 12%, respectively, by the ozonation compared with those of unozonated control house. However, hydrogen sulfide concentration and temperature were not affected by the ozonation. In Exp. II, weight gain, feed intake and feed conversion efficiency were not affected by the ozonation. Collectively, results indicate that ozonation is effective for improving the indoor air quality of the swine nursery unit without affecting the production efficiency.

Key Words: Weanling piglets, Ozone, Harmful gas

W226 Honeybee-keeping sector in Hungary. L. Nyars[2], J. S. Zsarnoczai*[1], and H. F. Salem[1], [1]*Szent Istvan University, Godollo, Hungary,* [2]*Research and Information Institute for Agricultural Economics, Budapest, Hungary*.

In Hungary, 90 % of honey production is for human and based on the estimations the rest 5-10 % of the honey production is used by the industry (baking industry, sweets industry, pharmaceutical industry and cosmetics) and social programmes. As for the sales of honey, there are several marketing channels. The wholesalers purchase 10-13 thousand metric tons of honey from the producers each year depending on the fluctuation of honey production, which is the most significant part of the total production annually. Nominal capacity of the Hungarian honey processing plants is about 40 thousand metric tons, which is double the highest production level of the last ten years. Most of the commercial companies operate their own honey processing plants. This is the reason, why capacities of honey processing exceed level of actual production. The production potentials could make it possible collect 40-46 thousand metric tons of honey, and this quantity could also be processed by actual processing capacity. The cost-income analyses do not justify the exploitation of Acacia forest. Cost-income calculations were made in two different categories. In the category of horizontal hives with frames, the calculations refer to honeybee keeping farms with 50, 100, 150, 200 bee colonies, while in category of hives with supers- boxes honeybee keeping with 200, 400, 600, 800, and 1000 colonies were referred to. Yields were determined by categories. Real incomes were generated at honeybee keeping farms provided with hives with supers. Larger stocks with higher yields resulted in higher profitability indicators. However the high risks, like risk of animal health, of large yields cannot be ignored. Bee keeping farms with less than 100 bee colonies cannot be competitive in the market. In order to remain on markets their co-operation is indispensable.

Key Words: Honeybee-keeping, Real incomes, Competitive on market

W227 Particle size, feed intake, milk yield and chewing activity in Holstein cows. P. Melendez*[1], N. Back[2], S. Lanhart[1], and A. Donovan[1], [1]*College of Veterinary Medicine, University of Florida,* [2]*North Florida Holstein, Inc*.

The objectives were to determine the relationship between fractions of a particle size evaluator at initial feeding and the weigh-back (WB) and to establish the association of fractions with milk yield, feed intake and chewing activity of lactating cows. Models were designed considering fractions as fed and DM basis. The study was conducted in a Florida dairy farm with a RHA of 10,500 kg. One side of a free-stall barn with 160 mid lactation cows was used. Cows were fed a TMR 3X. Nutritional composition was 59.5back was the sum of the 3X. During March 2002 a TMR sample was collected daily from the feed bunk immediately after a.m., noon and p.m. feeding and WB. Particle size was evaluated using the Penn State separator. Initial and WB samples were processed daily after collection. After processing, a sub-sample from each fraction was taken for DM content. Max and min daily temperatures were recorded. Four h after the am feeding, numbers of cows chewing and eating were counted. Milk yield was recorded daily. Linear regression models were developed. Models were for feed intake, coarse, medium and fine fractions from WB, milk yield, and rate of chewing. Table shows that significant models were feed intake, coarse plus medium fraction, medium, milk yield and chewing proportion both as fed and DM. Differences between models were minor. This suggests that when a particle size separator is used to evaluate a TMR, DM content of fractions is not critical.

		As Fed Basis			
Dependent	Independent	Coefficient	SEM	P-value	r2
Feed intake	Min. Temp.	-0.07	0.03	0.03	0.18
Coarse+Med.	Max. Temp.	0.57	0.28	0.05	0.44
	DMI	-3.43	1.06	0.004	
Med.	DMI	-2.96	0.71	0.0003	0.49
	Med.	0.77	0.31	0.01	
Milk Yield	Med.	-0.66	0.21	0.005	0.25
Chew. Rate	Eating	1.05	0.21	0.0002	0.44
		Dry Matter Basis			
Dependent	Independent	Coefficient	SEM	P-value	r2
DMI	Min. Temp.	-0.06	0.03	0.04	0.18
Coarse+Med.	Max. Temp.	0.54	0.29	0.08	0.39
	DMI	-3.32	1.12	0.007	
Med.	DMI	-3.13	0.77	0.0004	0.41
	Med.	0.79	0.35	0.03	
Milk Yield	Med.	-0.64	0.22	0.0079	0.23
Chew. Rate	Eating	1.07	0.22	0.0001	0.43

Key Words: Particle size, Chewing, Dairy cows

W228 Behaviors of transition dairy cows and heifers. K. J. Daniels*, J. R. Townsend, S. S. Donkin, E. A. Pajor, A. G. Fahey, and M. M. Schutz, *Purdue University, West Lafayette, IN*.

Management strategies are critical for a successful transition period and may differ for cows and first calf heifers. The objective of this study was to compare behaviors between transition cows and heifers, emphasizing feeding behaviors and the relationship of these behaviors with DMI and milk yield. Five multiparous Holstein cows (C) and five Holstein heifers approaching first calving (H), were housed in tiestalls from 28d prior to expected calving and provided feed *ad libitum*. The C and H were videotaped 24 h/d, using time-lapse video recording, beginning 15d prior to expected calving until 14d after calving. On d-6, d-2, d2 and d8 relative to actual calving the durations of the following behaviors were measured: standing (S), lying (L), resting (Re), feeding (F), ruminating (R) and ruminating while lying (RL). Daily DMI and postpartum milk yield were recorded. The model selected for analyses included effects of parity group (C and H), day and interactions. There were no significant differences between C and H in L, F or RL. For both parity groups, L (P<.01) differed across d and there were d by parity group interactions for F (P<.05) and RL (P<.01). For all animals, L decreased through d2 and then increased on d8. For C, F decreased through d2 and then increased on d8; while for H, F increased until d-2, decreased at d2 and then increased on d8. Through d2, RL decreased for C and then increased on d8; but for H, RL did not decrease until d2 and then increased on d8. As expected, C had greater milk yield (P<.05) and DMI (P<.01) than H. Milk yield on d8 was significantly affected by Re on d-6 (P<.01). The DMI on d8 was significantly affected by F on d2 (P<.01). Behaviors, DMI and milk yield differed for transition C and H, indicating that managing them differently during the transition period may be beneficial.

Key Words: Dairy cattle, Transition, Behavior

Forages & Pastures: Grazing, cultivars, forage management

W229 Nutritional quality of twenty alfalfa (*Medicago sativa* L) cultivars from Embrapa's Brazil germplasm bank. H. Carneiro*[1], M. de A. Botrel[1], F. de S. Sobrinho[1], and M. Villaquiran[2], [1]*EMBRAPA, CNPGL, Minas Gerais, Brazil,* [2]*E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.*.

Alfalfa is one of the most important forages in the world for dairy cattle production because of its high nutritional value. Although there are many studies on cultivated alfalfa in temperate regions, studies on the nutritional quality of alfalfa under tropical conditions are scarce. Recently, Embrapa, Brazil's national agriculture research service, has initiated alfalfa breeding studies and developed several cultivars. The objective of this research was to evaluate the production and nutritional quality of the Embrapa alfalfa germplasm bank under tropical conditions, specifically in the Zona da Mata region of Minas Gerais state in Brazil. Twenty alfalfa cultivars were evaluated over a 2-yr period in a randomized block experimental design with three replications and five different harvest intervals for nutritional quality and 18 harvest intervals for production determinations. Data were analyzed statistically for the effects of cultivars, harvest interval and the interaction. There were significant differences among cultivars for forage production ($P < 0.04$), CP content ($P < 0.02$), NDF ($P < 0.05$), and in vitro and in situ digestibility ($P < 0.05$), but not differences were found in lignin ($P > 0.05$). These results indicate that Crioula CNPGL1, P 58N58, and F 686, were superior for dry matter production, crude protein and neutral detergent fiber. The Embrapa alfalfa cultivar Crioula CNPGL1 was 14% more productive than P58N58 ($P < 0.05$) and 20% more productive than for F686 ($P < 0.05$). The superior production and quality of the Crioula CNPGL1 alfalfa cultivar reflect good adaptability to soil and environmental conditions of the Zona da Mata area. Therefore, it is evident that potential exists for immediate utilization of these cultivars in this area; however, further studies are needed for different soils types as well as field-testing by producers.

Key Words: Alfalfa, Nutrition Quality, Tropics

W230 Forage production and quality of triticale cultivars in north Alabama. M. Lema*, E. Cebert, and V. Sapra, *Alabama A & M University*.

Because of its cold tolerance and double-cropping potential, triticale can play an important role in bridging the feed shortage gap in late fall and winter in north Alabama when other cool season grasses become dormant. Field trials were conducted in 2001 and 2002 at Winfred Thomas Agricultural Research Station (WTARS) and Sand Mountain Agricultural Substation (SMAS) in north Alabama to evaluate the forage yield and quality of six triticale (X *Triticosecale Wittmack*) cultivars (TCL105, TCL111, TX98D955, TX96VT5019, Tritical 498 and Tritical 2700). The cultivars were planted in four replicated 6-row plots 6.1 m long with rows 1.22 m apart in a randomized complete block design. At both locations, TX98D955, TX96VT5019 and Tritical 2700 produced higher(P<0.05) forage DM than the other cultivars (2-yr average of 4,134; 3,851 and 4,063 kg/ha for TX98D955, TX96VT5019 and Tritical 2700, respectively versus 2,744; 3,070 and 3,077 kg/ha for TCL105, TCL111 and Tritical 498, respectively at WTARS and 6,326; 5,974 and 5,938 kg/ha for TX98D955, TX96VT5019 and Tritical 2700, respectively versus 4,531; 3,784 and 4,060 kg/ha for TCL105, TCL111 and Tritical 498, respectively at SMAS). Crude protein, ether extract and gross energy contents were lower (P<0.05) for TCL111 and TCL105. Acid-detergent fiber content was higher (P<0.05) and IVDMD lower (P<0.05) for TCL 105. The cultivars TX96VT50190 and TX98D955 had higher (P<0.05) P content and the cultivars TCL105, TCL111, TX96VT5019 and TX98D955 higher (P< 0.05) Ca content than the rest.The cultivars TCL105 and TCL111 were higher (P<0.05) in Mg and lower (P<0.05) in K than the other cultivars. Sulfur was higher (P<0.05) for Tritical 498 and Zn higher (P<0.05) for TCL498, TX96VT5019 and TX98D955. Iron content was lower (P<0.05) for TX96VT5019 and TX98D955 than for the other cultivars.

Key Words: Triticale cultivars, Forage production, Forage quality

W231 Grazing and supplementation effects of lablab (*Lablab purpureus*) on weight gains of St. Croix White hair sheep lambs during the dry season. E. Valencia*, R. W. Godfrey, and S. Weiss, *University of the Virgin Islands, Agricultural Experiment Station*.

Scarcity of guineagrass (*Panicum maximum* Jacq.), particularly during the dry season, is a major limitation to growing small ruminants in the eastern Caribbean islands. Lablab (*Lablab purpureus*) is a fast growing and high yielding semi-annual forage legume, but its potential as an animal feed for grazing or supplementation has not been documented. The feeding value effect of lablab on ADG of weaned lambs (15 kg BW) during June-August 2002 (dry season) was investigated. Treatments were unrestricted grazing of guineagrass supplemented with lablab (SL; 0.5% animal liveweight on a dry matter basis), unrestricted grazing of both guineagrass and lablab (GL), and unrestricted grazing of guineagrass (control) in a randomized complete block with two replicates. Lambs (n = 4) grazed pastures (.14 ha) and were supplemented for a 96-d period, after a preliminary adjustment feeding period of 14-d. Lambs were weighed weekly throughout the trial. Herbage mass (HM) was estimated in five .25m^2 areas in each paddock every 21-d. Data were analyzed using GLM procedures of SAS and mean separation when significant was conducted with LSMEANS. There were significant differences ($P < 0.05$) among treatments ADG. There was a four-fold increase in ADG for GL (72.8 $\pm$ 6.2 g/d) compared to the control (18.5 $\pm$ 6.9 g/d). Average daily gain of lambs on GL was also much higher than SL (36.4 $\pm$ 6.4 g/d). There were differences among treatments for HM ($P < 0.05$). At season end, HM on offer for GL (3.64 $\pm$ 0.3 Mg/ha) was two-fold higher than SL (1.9 $\pm$ 0.3 Mg/ha) and control (1.3 $\pm$ 0.3 Mg/ha). These results indicate that weight gains of St. Croix White lambs can be increased with summer grazing or supplementation of lablab. The increased weight gains observed with unrestricted grazing of lablab justify its establishment as a special purpose pasture for use with weaned lambs during the dry season.

Key Words: Grazing, Supplementation, Sheep

W232 Horse preference for alfalfa-grass hay harvested in afternoon or morning. L. C. MacKay*[1], H. F. Mayland[2], and W. P. MacKay[3], [1]*(H.S. Student) Los Altos, El Paso, Texas,* [2]*USDA-ARS, Kimberly, Idaho,* [3]*University of Texas, El Paso, Texas*.

Cattle, sheep, and goats, prefer forage cut in the afternoon to that cut in the morning, presumably because of the greater sugar concentration. However, no quantitative studies have been reported for horses. We tested horses' preference for PM- vs. AM-cut alfalfa-grass hay grown in southeastern Montana. Hay consisted of 70% Grimm alfalfa at 15% bloom and 30% Fairway crested wheatgrass. The hay was cut on July 5, 2002 at 1900 hr and again the next morning at 0700 hr using a swather equipped with a conditioner. Hay was air-dried for 24 h and baled into 300 kg round bales, stored on palettes, tarped, and placed under a metal hay shed. Five kg of each hay were offered ad libitum to each of five American Quarter horses for 10 minutes. Feeding was replicated twice a day for four days and was performed with random sequencing of horses and positioning of the hay buckets placed on the ground. Dry matter intake was determined by weighing before and after feeding. Four samples of each bale were dried in a convection oven at 60^{o}C for two weeks, then ground into a fine powder. Each 1-g sample was combined with 9 ml distilled water, boiled for 5 min., and vacuum filtered through Whatman #1 qualitative paper. Sugars in the filtrate were determined using a Bausch and Lomb 400SD refractometer having range of 0 - 60%. Data were tested with analysis of variance. Horses preferred the PM-cut hay ($P = 0.001$) which had a significantly higher concentration of sucrose ($P = 0.038$). Horses were able to identify the forage having the greater concentration of sugar and ate larger quantities of that hay.

Key Words: Horse, Hay, Preference

W233 Rabbit preference, intake and digestibility of afternoon- or morning-cut alfalfa hay fed ad libitum as pellets. H. F. Mayland*[1], J. C. Burns[2], and B. E. Mackey[3], [1]*USDA-ARS, Kimberly, ID,* [2]*USDA-ARS, Raleigh, NC,* [3]*USDA-ARS, Albany, CA*.

Ruminants show a preference for afternoon- versus morning-cut forage, which is likely a response to accumulated sugars during daylight. We determined rabbit *(Cuniculus oryctolagus)* preference, intake and digestibility of pelleted alfalfa *(Medicago sativa)* hay that was cut either in the afternoon (PM) or in the morning (AM). Preference was determined by *ad libitum* feeding of both hays for 21 days. Dry matter intake of each hay, when fed alone, was determined in a cross over design for two consecutive 2-week periods followed by a one-week period. Apparent dry matter digestibility was determined by daily fecal collections for three consecutive days. Animals had free access to trace mineral salt and fresh water. Feed allocations were replaced daily and subsamples of forage and refusals were composited by group and week for analyses. Rabbits strongly preferred the PM pellets, which formed 95, 97, and 98% of their diet during weeks 1, 2, and 3 respectively. When not given a choice, rabbits ate the same amount of each feed (p=0.54). Rabbits, during the final week, had a dry matter intake of 6.7% of body weight. The apparent dry matter digestibility, as measured by the rabbits, was 640 g kg^{-1}. Like ruminants, rabbits could sense the difference between the afternoon- and morning-cut hays, but contrary to ruminants, rabbits ate the same amount of each hay when not given a choice.

Key Words: Rabbits, Hay pellets, Preference

W234 Effect of previous exposure of sheep to monoterpene odors on intake of alfalfa pellets treated with camphor or α-pinene. R. E. Estell*[1], E. L. Fredrickson[1], D. M. Anderson[1], K. M. Havstad[1], and M. D. Remmenga[2], [1]*USDA, ARS, Jornada Experimental Range, Las Cruces, NM,* [2]*New Mexico State University, Las Cruces, NM*.

Lambs were exposed to aromas of two monoterpenes that had previously been found to decrease intake to determine if exposure during feeding modified effects of these terpenes on subsequent intake. Two experiments were conducted using a split plot design. Thirty-six ewe lambs (mean BW = 23.1 and 42.2 kg in Exp. 1 and 2, respectively) were group-fed alfalfa pellets (4% of BW, DM basis) in enclosed portable buildings (3.0 x 3.7 m) for 2 h each morning for 56 d. Nine lambs were randomly assigned to each of four buildings, and the appropriate chemical (25 g of camphor in Exp. 1 or 50 ml of α-pinene in Exp. 2) was placed in a mesh-covered container in the center of the feeder in two buildings immediately before feeding (two buildings served as controls). After the 8-wk exposure period, lambs were individually fed alfalfa pellets (640 g, DM basis) for 20 min each morning for 10 d (5-d adaptation, 5-d intake measurement) in a metabolism building. Treatments were sprayed on alfalfa pellets at levels representing the concentration of that chemical in *Flourensia cernua* or at 10-fold that concentration. Controls received ethanol carrier only. Lambs were fed in three groups (n = 12), stratified such that one lamb from each building was placed on each treatment in each group. Lambs were housed as one group and fed alfalfa pellets at 5% of BW (DM basis) except during the 20-min tests. No day effect was detected for intake with either chemical ($P > 0.05$); therefore, data for collection periods were pooled across day. Exposure to the volatile aroma for 8 wk had no effect on intake during the 10-d interval for either monoterpene ($P > 0.05$). Moreover, intake during the 10-d interval was not affected by treatment concentration ($P > 0.05$). Neither concentration of the terpene applied to feed nor previous exposure to the volatile aroma from camphor or α-pinene altered feed intake under the conditions of this study.

Key Words: Intake, Sheep, Terpene

W235 Effects of polyethylene glycol and feed blocks on carbohydrate fermentation of woody species. A. Boubaker[1], C. Kayouli[1], and A. Buldgen[2], [1]*Institut National Agronomique Tunis,* [2]*Faculté des Sciences Agronomiques Gembloux Belgique*.

In vitro gas production and organic matter (OM) fermentation were investigated using a closed fermenter containing rumen contents from four goats receiving 70 % of oat hay and 30 % of concentrate. Six shrub species were incubated separately (Erica arborea, Phillyrea angustifolia, Pistacia lentiscus, Myrtus communis, Quercus suber and Vibernum tinus). Vetch oat hay was used as a reference for tannin-free forage. The effects of polyethylene glycol (PEG 4000) and feed block supply were investigated on the mixture of these shrubs. Feed blocks contained (crude weight basis) wheat bran (38%), wheat flour (10 %), molasses (10%), salt (10%), urea (10%), quicklime (15%), dicalcium phosphate (5%), mineral and vitamin supplement (2%). All studied species were

relatively low in crude protein (59-91 g/kg dry matter) and high in fibre (ADF: 266-407 g/kg dry matter). There were differences in volume of gas produced after 72 h with Vibernum tinus producing the highest volume (77.8 ml/g OM) and Quercus suber (27.4 ml/g OM) producing the lowest. However, all shrubs species showed less fermentation activity than hay (96 ml/g OM). Volume of gas production, rate of fermentation, volatile fatty acid production and organic matter fermentation were increased (P<0.05) by the addition of PEG. The rate of such increase was relatively low with feed block addition. However, both PEG and blocks addition had greater effects on VFA and OM fermented than on gas production.

Key Words: Shrubs, Gas production, Feed blocks

W236 Effects of windrowed or baled forage on forage quality and beef cattle production during the winter. V. Nayigihugu*[1], A. D. Schleicher[1], B. W. Hess[1], D. W. Koch[2], and J. W. Flake[2], [1]*Department of Animal Science,* [2]*Department of Plant Science, University of Wyoming.*

The objectives of this study were to determine the effects of previous windrow grazing on forage production, forage quality of hay left in windrows or harvested as bales, and BW change of cows offered each forage type during a winter feeding period. Windrow grazing occurred on two meadows (16.2 and 10.1 ha) during the winter of 2000. Samples were collected every 1.22 m perpendicular to the center of the previously grazed windrow in the spring and the summer of 2000, after which the meadows were harvested. Windrows were combined together to double windrow size. On one half of each meadow, all bales were removed, while on the other half, alternate windrows were baled and removed. Forage samples were then collected once monthly until January 2001. Beginning in November, 54 pregnant cows (BW = 551 ± 16.9 kg) were assigned to windrowed or baled forage for 42 d (16.2-ha meadow = 13 cows/treatment and 10.1-ha meadow = 14 cows/treatment). Forage DM production in the spring was greater ($P < 0.0001$) at 2.44 and 4.88 m compared to where the windrow was grazed the previous year, but this effect was not observed ($P = 0.39$) in the summer. Acid detergent fiber of forage left in windrows was greater ($P = 0.05$) than baled forage from September through January. Estimated DMD was greatest ($P = 0.05$) at harvest and declined more progressively for windrowed forage than baled forage. Forage NDF ($P = 0.09$) and CP ($P = 0.08$) tended to be greater for forage left in windrows compared to forage harvested as bales. Cattle offered windrows lost BW while cattle fed baled hay gained BW, resulting in lower ($P < 0.0001$) ADG for cattle grazing windrows compared to cattle fed baled forage. The reduction in forage nutrient content observed for forage left in windrows appeared to result in reduced production by cows grazing windrowed forage.

Key Words: Cattle, Forage, Grazing

W237 Performance comparison of three hay rake designs. W. A. Greene*, D. A. Munn, and G. L. Sautter, *The Ohio State University, Wooster USA.*

The main objective was to compare the drying efficiency and nutritional value of baled hay resulting from three types of hay rake (bar, rotary, wheel). Dry matter (DM), crude protein (CP), and neutral detergent fiber (NDF), determined by wet chemistry methods, were used for these comparisons. First and second cuttings were harvested from a twenty acre mixed (orchardgrass/alfalfa) and a twenty acre alfalfa field. Hay was mowed with a 12 ft. disc-mower conditioner. The six outside swaths of each field were not included in the trial. Alternate swaths of the hay used in the trial were assigned to each of the three rakes. Representative pre-raking samples were obtained for chemical analyses from the first cuttings. Hay was baled into large round bales with a fixed chamber baler. Within 24 h after baling, representative samples were taken from each bale for chemical analysis (DM, CP, NDF). Although there were no significant differences (P>.05) for pre-raking and post-baling chemical analyses, there tended to be a loss in nutritional value during the raking and baling processes for the alfalfa hay (5.0% lower CP, 6.4% higher NDF). In general, type of rake had little effect on dry matter, crude protein, and NDF of either the mixed or the alfalfa baled hay.

		1st cutting mixed hay				2nd cutting mixed hay		
Rake	n	%DM	%CP	%NDF	n	%DM	%CP	%NDF
Bar	4	83.4	9.0	61.9	1	79.4	16.2	40.3
Rotary	4	82.9	9.6	63.9	1	80.9	16.3	40.3
Wheel	4	82.8	8.9	67.7	2	80.5	16.3	38.8
P		.26	.08	.28				

		1st cutting alfalfa hay				2nd cutting alfalfa hay		
Rake	n	%DM	%CP	%NDF	n	%DM	%CP	%NDF
Bar	2	83.2	16.2	49.2	6	75.2	16.1	36.6
Rotary	5	81.5	15.4	48.3	6	74.8	15.6	38.7
Wheel	3	82.5	14.5	50.6	6	74.4	15.6	38.0
P		.20	.43	.41		.57	.07	.03

W238 Effect of weaning date and pasture rotation frequency on performance by fall calving cows grazing tall fescue pastures - 2-year summary. K. P. Coffey*, W. K. Coblentz, T. F. Smith, D. A. Scarbrough, D. S. Hubbell, III, B. C. McGinley, J. E. Turner, and C. F. Rosenkrans, Jr., *University of Arkansas, Fayetteville, AR.*

Many management-oriented recommendations are available presently to reduce the impacts of grazing *Neotyphodium coenophialum* - infected tall fescue pastures (IF). Our objective was to evaluate the impact of pasture rotation frequency (twice monthly = 2X vs. twice weekly = 8X) and weaning date (early April = EARLY vs. late May = LATE) on performance by fall-calving cow-calf pairs grazing IF mixed with crabgrass. Sixty cows (495 ± 9.6kg initial BW) were allocated randomly by BW and age to one of eleven IF pastures initially. Pasture groups were allocated randomly to either 2X or 8X and half of each rotation frequency were allocated randomly to EARLY or LATE weaning dates in a 2 x 2 factorial treatment arrangement. Open cows were replaced at the start of the breeding season with first-calf heifers with calves. Cow weights, milk production, and quantity of hay offered did not differ ($P > 0.10$) between weaning dates or rotation. Cow BCS at calving did not differ ($P > 0.10$) across treatments, but were higher ($P < 0.05$) from 2X vs. 8X at breeding. On the date EARLY calves were weaned, EARLY managed in a 2X rotation were heavier ($P < 0.05$) than LATE from a 2X rotation or EARLY from an 8X rotation. As expected, however, actual weaning weight was lower ($P < 0.05$) from EARLY vs. LATE, but was not impacted ($P > 0.10$) by rotation frequency. On the late-May weaning date, LATE were still 40 kg heavier ($P < 0.05$) than EARLY, although EARLY had approximately 56 d to recover from weaning. Adjusted 205-d weaning weights did not differ ($P < 0.10$) across treatments. Therefore, at the end of the second calf cycle, rotational grazing management has had no impact on forage species composition and cow or calf performance. Calves weaned in April weighed substantially less, even in late May, when later-weaned calves were weaned, implying a high level of stress in response to the April weaning.

Key Words: Tall fescue, Cattle, Forage management

W239 Effect of weaning date and pasture rotation frequency on post-weaning performance by fall-born calves grazing tall fescue pastures - 2-year summary. K. P. Coffey*, W. K. Coblentz, T. F. Smith, D. A. Scarbrough, D. S. Hubbell, III, B. C. McGinley, J. E. Turner, and C. F. Rosenkrans, Jr., *University of Arkansas, Fayetteville, AR.*

Weaning fall-born calves grazing *Neotyphodium coenophialum* - infected tall fescue pastures (IF) in April (EARLY) rather than late May (LATE) has had serious negative effects on calf weight, even when measured 56 d later. The objective of this study was to evaluate long-term implications of weaning calves from IF pastures managed using a twice monthly (2X) vs. twice weekly (8X) rotation schedule in April vs. waiting until late May or early June. A total of 113 Gelbvieh-sired calves were vaccinated against 7 *Clostridial* strains, IBR, BVD, PI_3, and BRSV 28 d prior to weaning and received a booster vaccination 14 d later. At weaning, calves were gathered at approximately 0800h from their respective pastures, weighed, commingled, and transported directly to a local auction facility. Calves were weighed at the auction facility at approximately 1700, returned to the research station the following morning, and placed in drylots and fed alfalfa hay and 0.9 kg/hd daily of ground corn for 21 d. At the end of the receiving period, calves were grazed as a group on

common bermudagrass pastures. Total BW loss to the auction barn was greater ($P < 0.05$), ADG during the subsequent 21-d receiving period was lower ($P < 0.05$), and time required to recover weight loss was longer ($P < 0.05$) from LATE vs. EARLY, but percentage shrink did not differ ($P > 0.10$) among weaning or rotation treatments. Heifer BW was 58 kg greater ($P < 0.05$) at breeding from LATE calves. Steers previously managed in a 8X rotation schedule and weaned LATE were heavier ($P < 0.05$) at the time they were shipped to a feedlot than EARLY steers. Steers weaned EARLY from a 8X rotation weighed less ($P < 0.05$) than the other treatment groups. Therefore, rotation frequency had little impact on post-weaning calf performance, but weaning fall-born calves in mid-April proved to have serious negative impacts on long-term animal growth performance.

Key Words: Tall fescue, Cattle, Weaning

W240 Performance of cow/calf pairs grazing common crabgrass. D. W. Sanson*[1], E. K. Twidwell[2], and B. C. Venuto[3], [1]*LSU Ag. Center, Rosepine Research Station, Rosepine,* [2]*LSU Ag. Center, Agronomy Department, Baton Rouge,* [3]*LSU Ag. Center, Southeast Research Station, Franklinton.*

Performance of cows and calves grazing crabgrass was evaluated in each of two summers in Southwest Louisiana. Crabgrass was established in mid May each year by planting 3.36 kg of seed plus 52 kg of 8-24-24 fertilizer per ha. When the crabgrass was approximately 7.5 cm high, 67 kg of N was applied per ha. Control pastures also received the same amount of N at this time. Control pastures in Year 1 were bahiagrass and were combinations of common bermudagrass and bahiagrass in Year 2. Cow/calf pairs were stratified by weight and randomly assigned to either crabgrass or control pastures. Cows and calves were weighed on two consecutive days at the start and the end of each experiment. Cows were scored for condition at the time they were weighed. In Year 1, 120 cow/calf pairs were used, with six 10-cow groups on each treatment. In Year 2, 140 cow/calf pairs were used, with seven 10-cow groups on each treatment. In both years, the stocking rate was 2.5 cow/calf pairs per ha. Cow/calf pairs were placed on crabgrass on June 13 during Year 1 and were grazed for 78 days. In Year 2, grazing did not begin until July 2. This delay was due to a lack of moisture needed for germination and growth of the crabgrass and resulted in a 58-day grazing period. Both trials were terminated at the end of August so the ground could be prepared for ryegrass planting. Cows grazing crabgrass gained 10 ± 4 kg during Trial 1, while the cows grazing bahiagrass lost 21 ± 4 kg ($P < .05$). Calves that grazed crabgrass in Trial 1 had higher weight gains than those grazing bahiagrass ($P < .05$). The weight gain of calves grazing crabgrass was 76 ± 2 kg during the 78-d period while the calves grazing bahiagrass gained 52 ± 2 kg. In Trial 2, cows grazing crabgrass had higher ($P < .05$) weight gains and body condition scores than cows grazing bahiagrass pastures. Calves grazing pastures planted to crabgrass also had higher gains ($P < .05$) than calves grazing the control pastures.

Key Words: Beef cattle, Crabgrass, Bermudagrass

W241 Effects of corn or soybean hulls supplementation to bermudagrass hay on ruminal *in situ* disappearance of DM, NDF, ADF and CP of hay, corn and soybean hulls. V. T. Nguyen*, I. A. Orr, B. J Rude, and D. G. St. Louis, *Mississippi State University, MS.*

Six ruminally fistulated crossbred steers (181 ± 23.9kg) were randomly assigned in a 3X3 Latin square design with replication to compare the effects of corn or soybean hulls supplementation on ruminal *in situ* disappearance of bermudagrass hay, corn or soybean hulls. Steers were fed either low quality bermudagrass hay (BG), hay and corn at 0.445 % body weight (BGC) or hay and soybean hulls at 1.16 % bodyweight (BGH). Hay, corn or soybean hull samples were ruminally incubated for 2, 4, 6, 8, 16 and 24 hours. At time 2 and 4, hay DM disappearance for BG was less ($P<.05$; 17.63 and 18.69 %, respectively) than for BGC (18.26 and 19.33 %, respectively) or for BGH (18.43 and 19.81 %, respectively). At time 8, hay DM disappearance for BGH was 24.11 %, greater ($P<.05$) than BG (22.52 %) and BGH (22.63 %). Both DM disappearance values for corn (34.8, 36.10, 40.84, 47.49, 54.42 and 64.01 %) and for soybean hulls (22.79, 26.79, 29.77, 37.42, 46.61 and 56.12 %) for time 2, 4, 6, 8, 16 and 24, respectively, were greater than hay at all times ($P<.05$). Hay NDF disappearance at time 2, 4, 6, 8, 16 and 24 for BG was 3.93, 4.81, 6.55, 10.27, 18.90 and 22.05 %, whereas it was 4.15, 5.47, 7.69, 9.25, 17.10 and 24.81 % for BGC and 4.10, 6.33, 7.88, 11.68, 17.58 and 25.48 %, respectively, for BGH, with differences ($P<.05$) among treatments found only at time 2 and 4. Compared to hay NDF, soybean hull NDF disappeared at a faster rate ($P<0.05$; 8.60, 12.84, 15.81, 18.31, 30.02 and 42.31 % at time 2, 4, 6, 8, 16 and 24, respectively). There were no differences ($P>.05$) in hay ADF disappearance between BG and BGC. However, it was enhanced ($P<.05$) for BGH at time 6, 8 and 16. Hay CP disappearance was the same ($P>.05$) among treatments. When hulls were supplemented, ruminal *in situ* disappearance of DM, NDF and ADF of hay was improved. Based on these results, low quality forage utilization may be enhanced when soybean hulls are supplemented.

Key Words: *In situ* disappearance, Low quality bermudagrass hay, Soybean hulls supplement

W242 Effect of wintering period growth rate on finishing growth rate, final weight and carcass parameters from forage or high concentrate finished cattle. J. P. S. Neel*[1], J. P. Fontenot[2], W. M. Clapham[1], and S. K. Duckett[3], [1]*USDA-ARS, AFSRC, Beaver, WV,* [2]*Virginia Tech, Blacksburg,* [3]*The University of Georgia, Athens.*

Seventy two English-type crossbred steer calves were used to compare growth rate, final weight and carcass parameters from cattle finished on forage (FOR) or high concentrate (CON), after being wintered at low (LOW, ADG = 0.36 kg), medium (MED, ADG = 0.55) or high (HIGH, ADG = 0.82) growth rates. Steers were harvested on the same dates, across treatments, at a commercial meat plant. Data were analyzed as a 3 x 2 factorial design with winter treatment, finishing treatment and two-way interaction in the model. Steer ADG during finishing was greater ($P < .01$) for LOW than HIGH and tended to be greater ($P < 0.10$) for MED than HIGH wintering treatments. Animals had greater ($P < 0.001$) ADG for CON than FOR. Final weight (FW) was greater ($P < 0.05$) for MED and HIGH than LOW wintering treatments and greater ($P < 0.001$) for CON than FOR. Carcass weight (CW) was greater ($P < 0.05$) for MED and HIGH than LOW and tended to be greater ($P < 0.10$) for HIGH than MED. Animals finished on CON had greater ($P < 0.001$) CW than FOR. Wintering treatment did not influence ($P > 0.10$) dressing percentage (DP), yield grade (YG), rib fat (RF), ribeye area (REA) or percent kidney, pelvic and heart fat (% KPH), however quality grade (QG) was greater ($P < 0.01$) for HIGH than LOW and tended to be greater ($P < 0.12$) for HIGH than MED. Animals finished on CON had greater ($P < 0.001$) ADG, FW, CW, DP, YG, QG, RF, REA and % KPH. Wintering steers on the LOW treatment resulted in greater ADG during the finishing period, and lower CW and QG than HIGH but did not influence other carcass characteristics. Finishing cattle on CON resulted in greater ADG, FW, CW, DP, YG, QG, RF, REA and % KPH.

Key Words: finishing, forage, wintering

W243 Comparative performance of yearling crossbred beef heifers grazing three cool-season grass species under irrigation in northern utah using management intensive grazing practices. C. A. Fitzgerald, R. D. Wiedmeier*, P. R. Schmidt, B. A. Kent, and J. L. Walters, *Utah State University, Logan, Utah.*

The carrying capacity of irrigated pastures established with monocultures of three cool-season grass species was determined using yearling crossbred beef heifers. Six adjacent 0.5-ha paddocks were established with three grass species, two paddocks/species: orchard grass (OG) (Dactylis glomerata, "Ambassador"), tall fescue (TF) (Fescue arundinacea, "Fawn") and perennial ryegrass (PRG) (Lolium perrene, "Moyie"). Sixty yearling, crossbred beef heifers (360 kg) were stratified into six groups of 10 heifers each. One group was randomly assigned to each of the six paddocks. Grazing commenced in late May and concluded in late September. Flood irrigation and fertilization of paddocks occurred between five grazing periods during the grazing season. The number of heifers assigned to each paddock was adjusted at the beginning of each grazing period depending on forage availability. Management intensive grazing was used allowing the heifers a fresh pasture allotment each 24 hours. Pasture allotment size was adjusted daily to allow heifer ad-libitum intake with an 8 cm post-grazing stubble height.

Clip plots were taken daily to determine DM availability of each paddock allotment. Heifers were weighed before and after each 24 d (approximately) grazing period. Heifers consuming PRG consumed slightly more DM than those consuming TF (9.7 vs 9.5 kg/h/d, P = 0.005). Intake of OG was intermediate, 9.6 kg/h/d. No difference in ADG resulting from grass species could be detected (P > 0.05). All heifers were gaining BW at an acceptable rate (1.2 kg/d). The carrying capacity of OG and PRG did not differ (194 vs 129 grazing d/ha, respectively, P > 0.05). The TF exhibited increased carrying capacity compared to OG (264 vs 194 grazing d/ha, respectively, P > 0.05) and PRG (264 vs 129 grazing d/ha, respectively, P < 0.05). Based on the results of this study, TF is superior to either OG or PRG for irrigated pasture in northern Utah for development of yearling beef heifers.

Key Words: Grazing, Heifers, Carrying capacity

W244 Influence of turning cows out to pasture on fatty acid profile of milk. R. C. Khanal*, T. R. Dhiman, and R. L. Boman, *Department of Animal, Dairy and Veterinary Sciences, Utah State University.*

Five late lactation Holstein cows milking an average of 25.4±6.4 kg/d were used to study the influence of turning cows out to pasture on fatty acid profile of milk. The 45-d experiment was divided into 3 phases. During first 2 d (Phase 1) of the experiment cows were fed TMR containing 50% forage and 50% grain mix, from 3-31 d (Phase 2) cows were grazed on a predominantly ryegrass pasture with no grain supplementation, and from 32-45 d (Phase 3) cows were fed a diet similar to phase 1. Milk yield was recorded daily. Daily milk fat content and fatty acid profile was determined for samples collected from both a.m. and p.m. milkings. Spline regression was performed to determine the changes in fatty acid profile during different phases. Cows produced an average of 25.2±6.1, 14.0±4.8, and 11.2±5.6 kg/d of milk with 3.4, 4.0, and 3.6% fat in phase 1, 2, and 3, respectively. The CLA content was 4.54 mg/g of fat in phase 1 and reached a maximum of 25.3 mg/g of fat on d 25 of the experiment. No significant change (P>0.05) occurred thereafter in phase 2. The $C_{18:1t-11}$ content was 28.9 mg/g of fat in phase 1 and reached a maximum of 79.5 mg/g of fat on d 24 of the experiment with no significant change thereafter (P>0.05) in phase 2. The $C_{18:2}$ fatty acid declined gradually with no further decrease observed after d 24 (P>0.05) of the experiment while $C_{18:3}$ increased significantly (P<0.05) with no further increase after d 9 (P>0.05) of the experiment in phase 2. The CLA content in milk fat reached the value similar to phase 1 within d 5 once cows were taken off the pasture with no change thereafter (P>0.05). There was no significant change (P>0.05) in other fatty acids after d 7 once the cows were moved to phase 3. In the present study it took 23 days to establish the highest level of CLA in milk fat after cows were turned out to pasture for grazing with no grain supplementation. Other fatty acids were also stabilized near d 23 after turn out of cows to pasture.

Key Words: CLA, Pasture, Cows

W245 Consumer acceptability characteristics of conjugated linoleic acid (C LA) enriched milk and cheese. R. C. Khanal*[1], T. R. Dhiman[1], C. Brennand[1], R. L. Boman[1], and D. J. McMahon[1], [1]*Utah State University.*

Consumer acceptability characteristics of CLA enriched milk and cheese was studied in two experiments. Experiment 1: 15 cows were randomly assigned either to a diet containing 51:49 forage to concentrate ratio (TMR), grazed on pasture (PS) or PS with 3.2 kg/d of a grain mix containing 75, 10, 10, and 5% of full-fat extruded soybeans, beet pulp, ground corn, and molasses on DM basis, respectively (ES). Experimental duration was 6 wk with final 3 wk for measurement. Average CLA contents in milk fat were 5.2^b, 16.2^a, and 16.9^a mg/g of fat for TMR, PS, and ES diets, respectively. Milk from wk 4 to 6 was used for consumer acceptability characteristics. Experiment 2: 18 cows were randomly assigned either to a TMR, PS, or PS with 3.2 kg/d of full-fat extruded soybeans (ES) diet. Cheese was manufactured from the milk collected during wk 4 to 6 of the experiment. Cheese had 4.7^b, 15.7^a, and 14.6^a mg of CLA/g of fat for TMR, PS or ES diet, respectively. An open panel of consumers (n=75) evaluated CLA enriched milk (mouth-fill, color, flavor, and overall quality) and cheese (color, flavor, texture, and overall quality) from experiment 1 and 2, respectively on a hedonic scale of 1-9. A trained panel evaluated the milk (n=8) and cheese (n=7) for evenness of color, flavor, and overall quality in a scale of 1-10. There were no significant differences (P>0.05) among treatments for any of the parameters studied for milk and cheese by both open and trained panels except for oxidized flavor in cheese. Trained panel scored significantly lower (P=0.04) for oxidized flavor in cheese from ES treatment (2.6) compared to either of the cheese from TMR (2.9) or PS (3.0) treatments. In conclusion, CLA enriched milk and cheese were similar in color, flavor, and consumer acceptability characteristics except for oxidized flavor in cheese made from the milk of cows fed full-fat extruded soybeans while on pasture.

Key Words: CLA, Milk and cheese, Consumer acceptability

W246 Influence of genotype, heading date and cutting date on fatty acid composition of ryegrass. V. R. Loyola*[1,3], J. J. Murphy[2], M. O'Donovan[2], N. Gowen[2], M. D. S. Oliveira[3], and C. Stanton[1], [1]*Teagasc, Dairy Products Research Centre, Moorepark, Fermoy, Ireland,* [2]*Teagasc, Dairy Production Research Centre, Moorepark, Fermoy, Ireland,* [3]*Universidade Estadual Paulista, UNESP, Jaboticabal, Brasil, supported by FAPESP.*

Ruminant products are the only significant source of conjugated linoleic acid (CLA) and they are an alternative as a source of omega-3 fatty acids, which may be beneficial components in the human diet. Linoleic and α-linolenic acids in feed are the precursors of these fatty acids in milk and meat. Animals grazing fresh grass have higher levels of omega-3 and CLA in their meat and milk, when compared with those consuming conserved forages. Therefore, it is important to quantify the variation in the precursors of these fatty acids in grasses. Our objective was to evaluate the effects of genotype, heading date and cutting date on the concentration of fatty acids (FA) in perennial ryegrass (*Lolium perenne* L.) cultivars. Ryegrass samples were taken at four cutting dates (22/05, 12/06, 03/07 and 28/08/2000) from a 2x2 factorial experiment in a split-plot design with three replications. The four ryegrass cultivars used were: Millenium, Portstewart, Napoleon and Spelga. Forage samples were freeze-dried and grounded. Fatty acids were methylated using a one-step methylation, and analyzed by gas chromatography. The genotype effect was significant (P<0.05), with tetraploid cultivars resulting in higher total FA concentrations (19.03 g/kg DM), in comparision to diploid cultivars (16.73 g/kg DM). Intermediate heading cultivars presented higher (P<0.05) total FA levels (19.38 g/kg DM), compared to late heading (16.38 g/kg DM). There was also a significant effect of cutting date (P<0.01) on total FA concentrations, with the highest levels 18.52 and 19.97 g/kg DM, found in May and August, respectively. The June and July total FA concentrations, 16.59 and 16.45 g/kg DM, respectively, differed only from August (P<0.05). This work demonstrates the viability of manipulation of ruminant products through management and breeding of grasses, aiming alter its FA levels.

Key Words: Ryegrass, Growth stage, Fatty acids

Extension Education

W247 Consumer response to beef quality assurance certification of producers. J. W. Comerford*[1], J. P. Slayton[2], and L. Zerby[2], [1]*Penn State University, University Park, PA USA,* [2]*Pennsylvania Beef Council, Middletown, PA USA.*

A study was conducted to evaluate the response of consumers to information about beef quality assurance certification training of producers. Two methods were used. First, six focus groups were interviewed after observing three separate informational posters about beef quality assurance training at a mock retail meat case. Secondly, 168 consumers were interviewed while shopping at the meat case at one of nine retail food stores in central and eastern Pennsylvania. Group interviews revealed that consumers were receptive to information about beef products; implications of "advertisement" and the use of the terms "animal welfare" and "training of producers" were highly negative, while "safety" and "quality" were neutral; some form of validation of the program was positive and desirable; and information should be located on the meat package or within the meat case. Store interviews revealed 74% of consumers thought quality assurance labeling had "some importance" to

them, 87% felt producers were "concerned about the quality and safety of beef", and 63% indicated quality assurance information positively influenced their "confidence in buying beef". The results indicated consumer confidence in the quality and safety of beef can be enhanced by providing beef quality assurance certification labeling.

Key Words: beef quality assurance, consumers, food safety

W248 Dairy beef: Maximizing quality & profits—an educational program for dairy producers. D.A. Moore[1], J. Kirk[1], F. Garry[2], W. Wailes[2], J. Dalton*[3], J. Busboom[4], D.J. Klingborg[1], M. Payne[1], J. Marchello[5], and M. Poe[1], [1]*University of California, Davis,* [2]*Colorado State Univeristy,* [3]*University of Idaho,* [4]*Washington State University,* [5]*University of Arizona*.

Dairy producers not only ship milk, they are in the beef business too! Dairy market cattle are a major source of beef and can represent up to 15%of a dairy's income. In western states alone, over 800,000 dairy cows worth about $500 million are marketed to slaughter every year. Demands on meat packers as a result of Hazard Analysis Critical Control Point plan implementation have focused their attention on the quality of incoming cattle. In response to this, a 7-western state collaborative project was developed to create a distance learning program for dairy producers, cooperative extension advisors, and dairy veterinarians to provide a consistent message about dairy beef food safety. Project coordinators at the University of California-Davis designed this program with input from dairy and meats scientists, veterinarians and media specialists from six other western states: Arizona, Colorado, Idaho, New Mexico, Oregon and Washington. The curriculum was developed in a modular format and individuals from different states took lead on specific segments. Educational segments include videos, narrated slide sets, written materials, and interactive evaluation tools (quizzes, discussion questions, and evaluations) as well as links to more detailed informational websites. The course was also designed to be packaged as a trainer's and participant's CD-ROM for individuals requesting in-residence training or without access to the Internet. As part of the development process, the project team solicited formative evaluations from extension specialists, dairy producers, veterinarians, and milk processor representatives that allowed these individuals to be part of the project and make important suggestions to improve program quality. Twenty individuals reviewed all course segments, completed an evaluation tool, and provided written comments. They highlighted correctable navigation problems and image quality on different computers and internet access but all were positive about the content and messages. "Dairy Beef: Maximizing Quality and Profits" http://dairybeef.ucdavis.edu is a distance learning program that focuses on improving the quality of the dairy cattle going to slaughter to increase income from cull dairy cattle and assure future access to beef markets.

Key Words: Dairy beef, Food safety, Training

W249 Bacteria counts on the surface and subsurface of *Klebsiella pneumoniae* inoculated sand and wood shavings. L. Clow, R. Bey, J. Reneau*, and R. Farnsworth, *University of Minnesota, St. Paul, MN 55108*.

PVC pipe was used to simulate a cow's stall. Sterile sand and wood shavings were placed in 4 inch diameter PVC pipe which had been cut to 1-4 inch lengths. The pipe was filled with bedding material and K. pneumoniae spray inoculated at a rate of 25 ml per 1 inch of bedding material. Experiments on sand and wood shavings were performed in duplicate at the same time. All bacteria concentration determinations were made in duplicate as well.
At 0.5, 1.0, 1.5, 2.0 hours following inoculation bacteria concentrations were determined on the surface and bottom of the cylinders for both sand and wood shavings.
Results of these studies indicates that regardless of depth the surface of sand had lower bacteria counts per sq. cm. than wood shavings. This observation was independent of time following inoculation. When the depth was increased from 1 to 2 or more inches the same trend held that bacteria counts on the surface were lower for sand. In general, bacteria counts were higher on the bottom than on the top of the inoculated sand or wood shavings.
These observations help explain why cows housed on clean groomed sand have lower incidence of udder infections than cows housed on wood shavings or dirty (ungroomed sand). Inaddition, it provides further evidence that care must be taken not to till to deeply when grooming stalls.

Key Words: Bedding, Cows, Klebsiella

W250 Oregon dairy environmental stewardship program. M. E. French*, T. W. Downing, and P. D. French, *Oregon State University, Corvallis, OR/USA*.

The Oregon Dairy Environmental Stewardship Program was designed to recognize dairies for producing high quality milk and providing safe dairy products to Oregonians as well as educating the public. Today many of the dairy's neighbors have been removed from agriculture. There is a wealth of misinformation that has generated consumer concerns, from antibiotic residues to odor issues. The Oregon Dairy Environmental Stewardship Program focuses on the need for environmental soundness, but assumes the producer's care and concern for the environment and considers how to work with the producer to achieve this goal. As animal agriculture becomes more consumer driven, dairy producers will be challenged to enhance product value, while simultaneously controlling cost, animal well being, integrity of the environment, and food safety. This is a voluntary program that will put the dairy industry in the forefront of any future regulations. In order to become an Oregon Dairy Environmental Steward, a ten-step process must be completed. These include: a nutrient management plan, milk sanitation permit to produce and sell Grade A milk, completion of a water quality evaluation, wildlife protection assessment/ wetlands determination, odor management plan, elimination of mercury, emergency action plan/ farm plan, confined animal feeding operation (CAFO) compliance, six hours of continued education - completed within 18 months, and some form of public outreach. The dairy must remain in compliance with changing state regulations, take at least three hours of continued education within a twenty-four month period after certified and update plans as needed. Many dairies have already achieved several of the stewardship criteria and should be recognized for their continued achievements. The Stewardship program was patterned after several programs already in existence and was revised to meet the needs of both Oregon dairy producers and Oregon citizens. Overall, the Oregon Dairy Environmental Stewardship Program was designed to protect the long-term growth of the entire dairy industry.

Key Words: Environment, Stewardahip, Voluntary

W251 Effect of artificial insemination versus natural service breeding on production and reproduction parameters. J. W. Smith, L. O. Ely, W. D. Gilson, and W. M. Graves, *University of Georgia*.

U.S. dairy cows are bred by artificial insemination (AI), natural service (NS), or by a combination. This study examines the effect of four breeding systems on production and reproduction performance parameters and the interaction of region and herd size on breeding system. DHI Holstein herd summary records for the year ending 2001 obtained from DRMS, Raleigh, NC were sorted and classified by region (North, Midsouth, South) and herd size (small [< 100 cows], medium [100-249], and large [> 250]). Herds were assigned to breeding systems by % NS usage as follows: (1) 0, (2) 1-20, (3) 21-89, and (4) 90-100. The average % AI and % NS usage by breeding system was: (1) 100, 0; (2) 93, 7; (3) 54, 46; and (4) 1, 99. The main effects of breeding system on milk production and reproductive performance parameters are in the table.
Milk production and actual calving interval (CI) were lower ($P < 0.05$) with breeding system 4 within each region. Milk production was not different between breeding systems 1 and 2 within each region. Actual CI was not different for breeding systems 1, 2, and 3 in the Midsouth and South regions and breeding systems 1 and 2 in the North region. Days dry tended to be higher for breeding systems 3 and 4 than breeding systems 1 and 2. Breeding system 4 had the lowest average % in milk within each region. The % dry 40-70 days was lowest for breeding system 4 within each region and within each herd size group ($P < 0.05$).

Breeding System	1	2	3	4	SEM
Herd Milk Production (kg/yr)	9572^a	9225^b	8752^c	8108^d	53
Actual Calving Interval (mo)	14.09^b	14.20^b	14.35^a	13.62^c	0.04
Days Dry	64.2^c	66.9^b	69.4^a	69.6^a	0.4
% Dry 40-70 d	72.9^a	68.7^b	60.1^c	49.8^d	0.6
% Dry > 70 d	20.4^d	24.3^c	29.8^b	35.2^a	0.5
% Dry < 40 d	8.2^c	7.9^c	10.7^b	15.5^a	0.4
% in Milk	87.5^a	86.9^b	86.2^c	84.8^d	0.1
% Left Reproduction	21.8^a	19.7^a	17.7^b	15.4^c	0.6

^{abcd} Least squares means within a row with the same superscript do not differ ($P < 0.05$).

Key Words: Reproduction, Breeding, DHI

W252 Ranking of dairy farms based on economic measures per cwt milk sold and per cwt milk equivalent.

A. E. M. de Araujo* and A. de Vries, *University of Florida*.

Our objective was to compare the ranking of dairy farms based on economic performance measures per cwt milk sold and per cwt milk equivalent. A common method is to calculate cost, revenue, and profit per cwt sold. A disadvantage of this straightforward method is that the production cost per cwt cannot be directly compared to the price received for milk when other revenue is obtained, such as from the sale of livestock. Therefore, an alternative method is to calculate economic performance measures based on cwt equivalent. Cwt equivalent is calculated as the total revenue divided by the price of milk per cwt. It is the amount of milk produced to obtain the same total revenue if no revenue was obtained from other sources but milk on the farm. The total production cost per cwt equivalent can be directly compared to the price of milk. The same price of milk should be used to compare the economic performance of dairies. Data were collected through the Dairy Business Analysis Project (DBAP) from dairy farms in Florida, Georgia, and Alabama between 1995 and 2001 (n = 15, 20, 33, 44, 20, 15, 39, respectively). Average milk price used was $17.50. The ratio of cwt sold to cwt equivalent was on average 0.93, ranging from 0.65 to 1.26. Total production cost / cwt sold ranged from $12.71 to $25.28 (average $17.58) while total production cost / cwt equivalent ranged from to $11.59 to $23.54 (average $16.19). Average net farm income from operations (NFIFO) / cwt sold was $1.52 and average NFIFO / cwt equivalent was $1.31. The top 6 dairies based on NFIFO / cwt sold and NFIFO / cwt equivalent were identical for 1995, 1996, 1999, and 2000. One of the top 6 dairies was replaced in 1997, 1998, and 2001. The lowest Pearson correlation coefficient between NFIFO / cwt sold and per cwt equivalent of the seven years was 0.984 (1996). The Pearson correlation coefficient between total production cost / cwt sold and per cwt equivalent ranged from 0.419 (2001) to 0.878 (1995). We concluded that the ranking of dairies based on the cost of production may be significantly affected by the method of choice, whereas the ranking based on NFIFO is hardly affected.

Key Words: Dairy, Economics, Production equivalent

W253 Lamb carcass education program for Oregon sheep producers indentifies characteristics that determine carcass value.

R. R. Mills*, J. M. Thompson, and K. Walburger, *Oregon State University, Corvallis, OR*.

A lamb carcass education program in conjunction with the Umatilla County Fair was established in 1990 as a carcass value information feedback system for purebred and commercial sheep producers in northeast Oregon. The program provides the opportunity for participants and other producers to evaluate value-determining factors of market lambs and correlate live animal characteristics with the carcasses from the same lambs. Detailed lamb carcass data, including ribeye area were collected and analyzed on market lambs (n=241) entered by producers from the years 1990 to 2002. Sire breed types represented were SF (Suffolk, n=200), TX (Texel and Texel x Suffolk, n=28), and OT (other sire breeds, n=13). Lambs from TX sires had lighter live weights, lighter carcass weights, and lower dressing percentages than SF and OT sired lambs (live weight = 48.8, 54.1, and 52.4 kg; carcass weight = 24.9, 29.3, and 28.3 kg; and dressing percent = 50.9, 54.1, and 53.9%, respectively; P<.05). There were no sire type effects (P>.05) for fat thickness, leg conformation score, ribeye area, USDA Quality Grade, or USDA Yield Grade. However, TX sired lambs produced larger ribeye areas / unit of carcass weight than SF and OT sired lambs (0.64, 0.59, and 0.57 cm^2/kg carcass weight, respectively; P<.05). Over the 13 year history of the program there was no change (P>.05) in fat thickness, dressing percentage, ribeye area, or USDA Yield Grade. During the same time, live weight and carcass weight declined (3.4 and 0.5 kg, respectively; P<.05), but leg conformation score and ribeye area per unit of carcass weight increased (0.57 conformation score and 0.08 cm^2/kg carcass weight, respectively; P<.05). The data from this study (2.1% Yield Grade 4 and 5) confirms that genetics and management / production systems currently exist in the US lamb industry to produce high quality, lean, heavily muscled lamb that can be competitive with other sources of human dietary protein.

Key Words: Lamb, Lamb carcass, Cutability traits

W254 Financial performance of dairies in Florida and Georgia in 2001.

L. O. Ely*[1], A. deVries[2], and R. G. Giesy[2], [1] *University of Georgia,* [2] *University of Florida*.

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.

Forty-one dairies submitted financial data for 2001. Thirty-nine dairies were included in the summary with complete data. Of these, 27 were located in Florida, 11 in Georgia and 1 in Alabama. The average herd size was 977 cows and 477 heifers with 17,170 lbs. of milk sold per cow. The average culling rate was 36 percent. There was an average of 19 FTE workers per farm with 51.5 cows per FTE worker and 880,000 lbs. milk sold per FTE worker. Total revenue per cwt. was $20.00/cwt. with $18.24/cwt. milk income. The average total expense was $17.75/cwt. The largest expense items were purchased feed ($7.32/cwt.), labor ($2.69/cwt), and livestock ($1.64/cwt). Net farm income from operations was on average $2.25/cwt. and net farm income was $2.39/cwt. The debt to equity ratio was 0.72, the rate of return on assets was 0.09, the rate of return on equity was 0.11, the operating profit margin ratio was 0.09 and asset turnover rate was 0.90. Individual expense items did not have a clear association with either herd size or level of production.

Milk price/cwt. was positively associated with herd size while total expenses/cwt. has a negative association, resulting in an average net farm income of $1.88/cwt for ≤400 cows, $2.31/cwt. for 400-900 cows and $2.76/cwt for ≥900 cows. Total expenses/cwt were negatively associated with level of production, resulting in an average net farm income for level of production of $1.98/cwt. for ≤16,000 lbs./cow, $2.25/cwt. for 16,000-18,000 lbs./cow and $2.94/cwt. for ≥18,000 lbs./cow.

Rate of return on assets had a positive association with both herd size and level of production.

Herd size and production level were positively associated with higher profitability.

Key Words: Dairy, Financial, Management

W255 Biological and economical efficiency of an accelerated, value-added cow-calf production system.

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The major objective of the study was to determine the biological and economical efficiency of an accelerated, value-added cow-calf production system. The system contains three major components, which are grazing, feedlot and wintering periods. Thirty-two mature crossbred beef cows (700 kg) with superior milking ability (10 kg/d) were selected and mated to bulls known for exceptionally rapid growth EPDs. From May through October, cow-calf pairs grazed improved, irrigated pastures using management intensive grazing practices. On September 1, calves were stratified into early weaned (EW) and normal weaned (NW) groups. The EW were weaned from their dams and placed back on pasture September 1, while the NW remained with their dams on pasture until weaning on November 1. On November 1, all calves were placed in a feedlot and stepped up to an 80% concentrate finishing diet in

21 d. Cows were wintered December through April, on either ammoniated wheat straw supplemented with alfalfa hay or the cows grazed standing corn plants. Feed inputs were monitored daily during each period. Calves and cows were weighed on a monthly basis and cows were body condition scored at the same time. All economic inputs and outputs were analyzed using actual market data. Profitability was assessed at September and November weaning and at feedlot finish. Marketing calves (262 kg) at September 1 indicated a $94 loss per cow. By November 1, NW calves weighed 26 kg more than EW calves (341 vs 315 kg, P < 0.05). Marketing calves at November 1 indicated a $61 and $86 loss per cow for the NW and EW calves, respectively. By retaining ownership to feedlot finish, a $72 and $70 profit per cow was indicated for NW and EW calves, respectively. Carcass quality was not affected and there were no differences in finish weight (506 vs 498 kg, P = 0.25). Wintering cows on grazed corn plants instead of ammoniated straw-alfalfa hay increased profitability by $30.61 per cow.

Key Words: Beef, Pasture, Nutrition

W256 Dairy herd expansion and modernization options available in UW-FARM. S. M. Combs, S. M. Lindsey, and D. K. Combs, *University of Wisconsin-Madison*.

UW-FARM (Field Nutrient Application and Recommendation Manager) is designed to identify acceptable strategies for managing on-farm and purchased nitrogen and phosphorus in a profitable and environmentally responsible manner. The program relies on soil test results consistent with Wisconsin Soil Test Recommendations for Field, Vegetable and Fruit Crops (UWEX A2809) to maximize optimum use of nutrients and restricts nutrient/manure applications in environmentally sensitive areas consistent with best management practices and NRCS- 590 (USDA-Natural Resources Conservation Services-Wisconsin, 1993). UW-FARM can also be used to ask "what if" when producers are considering expansion or other modernization practices. Assessing the impact on meeting current best management practices and NRCS-590 prior to actual expansion will allow producers to meet environmental constraints in a proactive manner. UW-Farm runs on all versions of Microsoft Windows beyond version 3.x. The program can be downloaded from www.uwlab.soils.wisc.edu or requested on CD. Entering herd cow numbers on the "expansion/modernization options" screen will show the manure quantity, available N and corn acres needed to use manure available N produced from these animals. The impact of raising heifers on or off-farm is available. Increasing cow numbers increases the need for feed and dairy producers traditionally have met forage requirements by growing and feeding alfalfa. UW-FARM calculates forage needs for cows and replacements. Producers may opt to grow less alfalfa and more corn for silage when acreage is limited because greater tonnage can be realized from corn silage. Users can estimate the percentage of the forage requirement to be supplied as alfalfa and corn silage. Total acres of each forage and total N need for corn silage is estimated. The impact of raising replacement heifers on or off-farm on forage needs manure N production can be evaluated. The total tons of P2O5 required at optimum soil test P levels are totaled for the alfalfa/corn silage options. The potential decrease in available manure phosphorus by limiting dietary phosphorus or cow numbers can be evaluated.

Key Words: Dairy, Manure, Nutrient cycling

W257 Net present value economic analysis model for adoption of photoperiod manipulation in lactating cow barns. R. L. Crill*, J. J. Hanchar, C. A. Gooch, and S. T. Richards, *Cornell University, Ithaca, NY*.

New technologies requiring capital investment in assets that have useful lives greater than one year should be analyzed using Net Present Value methods to assess whether the technology should be adopted. Photoperiod manipulation, also known as long-day lighting, is an emerging technology in the dairy industry. A Net Present Value Analysis Model to determine discounted cash flows over a ten-year expected useful life associated with the adoption of long-day lighting technology was developed by the authors. The model, in electronic spreadsheet form, allows farm business managers to evaluate the economic worth associated with the investment, and perform quick assessment of "best" and "worst" case scenarios using farm-specific values. In addition, the farm manager can easily develop more extensive sensitivity analyses on key variables. Using farm level data from two operating dairy farm businesses and the model, the authors estimated net present values over the ten-year expected useful life of $56,990 and $28,915. All investments with positive net present values are attractive investments, since they assure a rate of return that is greater than the minimum acceptable rate specified for the individual farm business. Sensitivity analyses results suggest that factors having a negative impact on overall economic worth include low milk production response, high electricity costs, and high ration costs. Farm business managers that utilize this analysis tool in decision-making should find this tool valuable for estimating the economic worth associated with long-day lighting technology.

Key Words: Net present value, Photoperiod manipulation, Economic anlysis model

W258 Regionalization of dairy Extension in-service training in the Mid-Atlantic and Northeast states. R. R. Peters*[1], M. L. O'Connor[2], L. J. Hutchinson[2], M. L. Westendorf[3], E. A. Claypoole[4], G. W. Anderson[5], D. P. Marcinkowski[5], W. E. Graves[6], S. M. Andrew[7], W. L. Shockey[8], P. S. Erickson[9], and J. W. Barlow[10], [1]*University of Maryland,* [2]*Pennsylvania State University,* [3]*Rutgers University,* [4]*Cornell Cooperative Extension,* [5]*University of Maine,* [6]*University of Massachusetts,* [7]*University of Connecticut,* [8]*West Virginia University,* [9]*University of New Hampshire, and* [10]*University of Vermont*.

The Middle Atlantic Consortium was awarded a grant from the Kellogg Foundation to develop a project titled, Regionalization of Programs in the Mid-Atlantic and Northeast to Enhance the Quality and Accessibility of Education in Animal Science. The objective for Extension training was to develop a high quality, regional program by increasing the cooperation among institutions and reducing redundancy in development and delivery of training materials. The organizational structure to plan the annual two-day dairy Extension in-service training program has been through a regional steering committee. The themes and location for the training programs during the last four years are as follows: 1999,Cattle Health Assurance Training, New Paltz, NY; 2000, Environmental Management of Dairy Farms, Hagerstown, MD; 2001,Tools for Dairy Production and Finance, Wilkes-Barre, PA; 2002, Clearing the Way to Profitability: Nutrition and Herd Health, Labor Management, and Profitability, Wilkes-Barre, PA. Nationally recognized keynote speakers with expertise on the theme subject have participated each year. Attendance has ranged from 55 to 65 educators. A valued feature of this training program is that speakers prepare presentations in PowerPoint. These presentations and other resources in electronic format are copied to a CD and presented in a notebook at registration. The training program has provided the opportunity to capitalize on cooperative efforts that provides excellent in-depth, regular training. Participants have rated the program as excellent or very good (84/%), and 94/% plan to use some part of their learning experience in their next year's Extension programs.

Key Words: Regional, Extension, Training

W259 Relationship of cow hygiene scores and SCC. J. K. Reneau*, A. J. Seykora, B. J. Heins, R. F. Bey, M. I. Endres, and R. J. Farnsworth, *University of Minnesota*.

The objective of this study was to investigate if there was any correlation between cow hygiene score and individual cow SCC. A scoring system scale from 1 to5 was selected to score cows for hygiene. Score 1 indicates a cow that is clean while a score 5 indicates a very dirty cow. The cow hygiene scorecard was broken down into five general areas: Tail head, Flank, Belly, Udder, and Rear legs and feet. Nine herds were selected for the trial (8 free stall, 1 tie stall). All herds were deemed to have predominantly environmental mastitis problems as indicated by bulk tank cultures. Individual cow SCC and culture data were used to edit known contagious mastitis pathogen infected cows from the data. A total of 1093 cows in the 9 herds were hygiene scored within 2 days of DHI test day. Each cow was scored in each of the five body areas. An udder-leg composition score was created, by averaging the udder and rear legs scores. A regression model was used to determine the effect that hygiene score had on SCS: SCS = Herd + Parity + DIM + DIM + "Hygiene score"; where SCS is the linear somatic cell count on DHIA test day, there were four parity groups (1,2,3, and 4 or greater), and DIM is the days in milk on DHIA test day. The model was run separately for each hygiene score trait. The mean SCC, SCS, FCM, DIM, and 305ME for the 1093 cows in the study were 405,242 (SD 1,017,000),

3.35 (SD 1.98), 80.91 lbs (SD29.2), 207 days (SD 139.59), and 24,321 lbs (SD 5022) respectively. Herd, Parity, DIM and DIM were all significant effects in the model (P < .01). Of the hygiene score traits Tail head, Flank and Belly were not significant. However, as Udder, Rear legs, and Udder - Rear legs composition scores increased SCS also increased. For each 1 standard deviation increase in Udder, Rear legs or Udder - Rear legs composition score, SCS increased by 0.13, 0.17 and 0.17, respectively. Similar herds with predominance of environmental mastitis infections and similar somatic cell count levels may expect to see a 40-50,000 change in herd SCC for each 1-unit change in cow hygiene scores.

Key Words: SCC, Cow hygiene score

W260 Implementation of a pilot Dairy Quality Management Program in Maryland. R. R. Peters*[1], R. A. Kohn[1], J. W. Simms[1], D. M. Schwartz[1], S. W. Fultz[1], M. R. Bell[1], J. E. Hall[1], J. Fearer[2], D. Booth[2], M. Clarke[2], K. Hendricks[2], and D. Shinham[2], [1]*University of Maryland, College Park, MD,* [2]*Maryland Department of Agriculture, Annapolis, MD.*

A one-year pilot Dairy Quality Management Program (DQMP) was launched starting with a one-day training program for five Maryland dairy producers and their advisors on July 3, 2001. The training program focused on three programmatic areas: biosecurity, animal health, and animal nutrient management. As a pilot program, it was emphasized that a major objective for everyone was experiential learning. The team approach to problem solving was implemented to enhance learning. Dairy advisory teams usually included six professionals. The initial team meeting with the producer started with a survey of farm and herd health information, herd goals and concerns, employee management, a farmstead map, detailed maternity and heifer-calf management practices, and ranking of current herd health concerns. Subsequently, a walk-through progressing from youngest to oldest animals was conducted with the advisory team using risk assessment forms. At the completion of risk assessment, the team convened with the farm family. Areas in need of improvement were discussed from two perspectives: most important for animal health risk and most practical for producer to improve. As assessments were completed, the advisory team outlined a herd plan with three to five goals supporting the overall herd goals initially discussed with the producer. The herd plan included the person responsible for task implementation, deadline for implementing the practice and the frequency to conduct task. Rations were examined and milk urea nitrogen was measured monthly to evaluate herd nutrition. The producer and team met at least quarterly to monitor progress. A personal interview was completed for each herd using producer attitude and herd plan as criteria for evaluation. All producers expressed a positive experience with DQMP. Farms changed 1 to 7 (median = 3) management or facility changes per farm. It is concluded that producers will adopt and implement DQMP on their farms.

Key Words: Dairy, Quality, Management

Dairy Foods: Microbiology and Cheese

W261 EPS and lactic acid production by *S. thermophilus* 1275: influence of pH, temperature, nutrients and co-culturing with non-EPS starter. B. Zisu*[1], G. Harvey[2], and N. P. Shah[1], [1]*Victoria University, Melbourne, Australia,* [2]*Dairy Farmers, Tingalpa, Queensland, Australa.*

Lactic acid bacteria that synthesise exopolysaccharides (EPS) are used increasingly in the dairy industry to improve rheological behaviour, mouthfeel and texture of fermented milks. We have identified a strain of *Streptococcus thermophilus* 1275 which produces both capsular and extracellular EPS.

The objective of this study was to examine EPS and lactic acid production by *S. thermophilus* 1275 in skim milk under various pH and temperatures, supplementation with whey protein concentrate (WPC) and co-culturing with non-EPS *S. thermophilus*.

S. thermophilus 1275 was grown in skim milk in a Biostat B fermenter and samples were taken at 0, 6, 12, 18 and 24 h to determine the amount of EPS, and levels of lactic acid, lactose, glucose and galactose. The bacterial count was also enumerated. EPS was isolated by protein removal and precipitation with ethanol and quantified using the phenol-sulphuric method. Lactic acid, lactose, glucose and galactose were determined using HPLC.

S. thermophilus 1275 produced 406 mg/L of EPS and 3.09 g/L of lactic acid at 37^{o}C. High temperatures and low pH reduced the EPS production, which ultimately ceased at pH 4.5. Maximal growth of the organism and lactic acid production occurred at conditions different to those for EPS production. The pH, temperature, WPC and co-culturing played an important role in the rate and the amount of EPS and lactic acid produced. EPS production peaked at pH 5.5 and at 37-40^{o}C reaching at 458mg/L. The EPS production was further stimulated by co-culturing with non-EPS *S. thermophilus* reaching at 832mg/L and the highest lactic acid concentration of 31.41 g/L. EPS production was highest at 1029 mg/L with WPC supplementation at pH 5.5, however, lactic acid concentrations were lower with WPC supplementation. Significantly less lactic acid was produced when the pH was not controlled during fermentation with or without WPC supplementation.

EPS production can be increased by supplementation with WPC. WPC also reduced the concentration of lactic acid. Co-culturing with non-EPS *S. thermophilus* significantly increased EPS production and may provide a more attractive means of increasing EPS production, thereby improving textural and functional characteristics of dairy foods without the use of additives.

Key Words: Exopolysaccharides, Co-culturing, Nutrient supplementation

W262 selection of prebiotics utilization from *Lactobacillus acidophilus* ATCC 43121 for synbiotics. E. Y. An*[1], S. Oh[2], and S. H. Kim[1], [1]*Korea University,* [2]*Hnkuk Yakult Institute.*

The number of food and other dietary products containing live Bifidobacterium and Lactobacillus bacteria has increased in recent years. In the large intestine, prebiotics, in addition to their selective effects on bifidobacteria and lactobacilli, have influenced many aspects of bowel function through fermentation. The selected synbiotic pairs of stimulated lactobacillus strains and oligosaccharide enhancing their growth were studied to determine the effect of probiotics, prebiotics and synbiotics. This research was investigated effective ability of *L. acidophilus* ATCC 43121 bacteria on minimal media by ratio of adding prebiotics which was used as substrates. Viable cell count of *L. acidophilus* ATCC 43121 and pH of media were measured during twelve, twenty four hours incubation at 37 with seven prebiotics which were of different concentrations to increase the growth of *L. acidophilus* ATCC 43121 selectively. From this experiment results, the effect of prebiotics was signicantly($P<0.05$) higher in control media compared to media adding ratio of fructooligosaccharide, lactulose, raffinose of incubation for twenty four hours. The addition ratio expansion of this three prebiotics was increased consequently by strains growth but pH was decreased. For this experiment response surface methodology to create the right mix ratio which will maximize the bacteria's vital energy by using mix of selected three prebiotics and from this, the right mixture ratio was 36.5%, 0.00% and 63.5%.

Key Words: *Lactobacillus acidophilus*, Prebiotics, Synbiotics

W263 Factors affecting autoaggregation behavior of bifidobacteria. S. A. Ibrahim*, O. A. Hassan, C. W. Seo, Y. Murad, M. Worku, and G. Shahbazi, *North Carolina A&T State University.*

Recent evidence suggests that the addition of bifidobacteria as a dietary adjunct or probiotic may have important health benefits. However, in order for these bacteria to manifest beneficial effects, they need to achieve an essential mass through aggregation. Consequently, the ability of bifidobacteria to aggregate is a desirable property sought for use in commercial food preparations. The objective of this research was to determine the effect of media composition and incubation temperatures on autoaggregation behavior of bifidobacteria. Another objective of this work was to determine the cell surface characteristics of bifidobacteria as related to autoaggregation. Autoaggregation behavior of bifidobacteria was determined using different media (TPY, Wilkins-Chalgren and

mMRS) and incubation temperatures (34, 37, and 42 C). Autoaggregation ability was measured as autoaggregation percentage. In this procedure, overnight culture was shaken at different times (30, 60, 90, 120, and 150 min). After shaking, 2 ml of the upper suspension of the culture was transferred to anther tube and the optical density (O.D.610nm) was measured. Three types of autoaggregation behavior characterized the strains: (1) autoaggregation sensitive (S) for strains that formed a precipitate resulting in a clear solution, (2) autoaggregation resistant (R) for strains that produced consistent turbidity, and (3) autoaggregation moderate (M) for strains that showed slight turbidity. Results on the media composition showed that TPY broth increased the autoaggregation behavior of the tested strains, whereas Wilkins-Chalgren and MRS reduced autoaggregation behavior. Calcium ions induced the autoaggregation. Tween 20 and Tween 80 reduced autoaggregation behavior. Higher incubation temperature (42 C compared to 34 C) increased the ability of strains to autoaggregate. Hydrophilic and electrostatic surface properties influence the autoaggregation behavior of bifidobacteria. Our data indicated that media selection; incubation temperature, and calcium ions are important factors affecting autoaggregation behavior of bifidobacteria. Autoaggregation should be considered when selection of bifidobacteria for their specific use in commercial preparations.

Key Words: Bifidobacteria, Autoaggregation

W264 Screening and selection of acid and bile resistant *Lactobacillus reuteri*. S. A. Ibrahim*, S. Ahmad, C. W. Seo, G. Shahbazi, M. M. Salameh, and M. Worku, *North Carolina A&T State University*.

Probiotic supplements are becoming increasingly popular in the United States and Europe. Although there are many different types of probiotics, the most common live cultures found in yogurt products are *L. bulgaricus*, *S. thermophilus*, *L. acidophilus*, and bifidobacteria. In addition to these beneficial cultures, some dairy industries are beginning to add *Lactobacillus reuteri* to their products as a beneficial culture. *L. reuteri* helps prevent and treat both viral and bacterial diarrhea enhancing the body's resistance to gastrointestinal disease. However, in order to survive and colonize in the gastrointestinal tract, *L. reuteri*needs to show high tolerance to acid and bile salt. The purpose of this work was to investigate the effect of acid and bile salt on the survival and growth of *L. reuteri*. Five strains (CF 2F, DSM 20016, MM 7, MM 2-3, and SD 2112) of *L. reuteri* were used in this study. Cultures were inoculated into fresh MRS broth with various concentrations of bile salt (0.0, 0.1, 0.2, 0.3, and 0.4%) and pH values (pH 2.0, 3.0 and 6.5). Samples were then mixed well and incubated at 37 C for 48 hrs. Bacterial growth was monitored by measuring turbidity at 610 nm in a spectrophotometer at different time intervals during the incubation period. Results showed that a 0.3% bile salt concentration caused a significant reduction in the growth of all tested strains ($P < 0.05$). The survival of *L. reuteri* differed significantly among tested strains; MM 2-3 showed significantly higher growth rates than the other tested strains over the 48 hr incubation period. At a 0.2% bile salt concentration, a significant growth reduction ($P < 0.01$) was observed for strains CF2 F and MM7. None of the tested strains survived low pH (2.00 and 3.00). The results suggest that acid and bile tolerance is an important selection characteristic for the use of *L. reuteri* cultures as a dietary additive.

Key Words: *Lactobacillus reuteri*, Acid and bile resistant

W265 Fourier transform infrared (FTIR) spectroscopy for rapid detection, identification, and enumeration of bacteria in foods. H. Yang, C. W. Seo, and S. A. Ibrahim*, *North Carolina A&T State University*.

The presence of microorganisms in food products has important ramifications for safety, quality, regulations, and public health. Rapid and reliable methods are required for the detection of microorganism, especially foodborne pathogens. The use of Fourier transform infrared (FTIR) spectroscopy and chemometrics (partial least square (PLS) regression and hierarchical cluster analysis (HCA)) for the rapid detection, identification, and enumeration of bacterial in cultures was investigated. In this study, gram-negative (*Escherichia coli* O157:H7 (H1730, F4546, Cider, E0019) and *Salmonella typhimurium* (ATCC 14208)) and gram-positive (*Lactobacillus reuteri*(SD2112, MM2-3, MM7, CF2-7F, MF14-C) were used. Pathogens were grown in brain heart infusion agar (BHI) whereas lactobacillus strains were grown in MRS broth. All strains were incubated at 37 C for 24hr. FTIR spectrometer with attenuated total reflectance (ATR) was used to measure aqueous microbial samples. Fresh broth without microorganism was used as background. The spectral data collection was just taken about 3 minutes. Different spectral regions (3700 - 2800 cm^{-1} and 1800 - 1000 cm^{-1}) were used to identify and classify. Bacteria were clustered into negative ((*E. coli* O157:H7, *S. typhimurium*) and positive (*L. reuteri*) groups while the rate of correct classifications is 100%. HCA even demonstrated the differences among H1730, F4546, Cider, E0019 strains of *E. coli* and SD2112, MM2-3, MM7, CF2-7F, MF14-C strains of *L. reuteri*, separately. A dendrogam indicated that CF2-7F was different from the rest of *L. reuteri* because it was found in the infant sample while the other were from adults. PLS regression was used for enumeration of bacteria. A R-square value was 0.999 from PLS model based on spectral data and cell numbers. Our results indicated that FTIR spectroscopy could be used as a rapid method for the identification and enumeration of bacteria in foods.

Key Words: Fourier transform infrared (FTIR), Dairy foods, Pathogens

W266 Encapsulation of *Lactobacillus reuteri* with sodium alginate for continuous production of lactic acid. S. A. Ibrahim*, C. W. Seo, S. Phetsomphou, and G. Shahbazi, *North Carolina A&T State University*.

Lactic acid fermentation is a well-known process used to preserve food products. The most common approach in lactic acid fermentation is the use of batch system. However with this process several factors limit efficiency of the production of lactic acid. For example, the end products may cause an inhibitory effect on the lactic acid bacteria (LAB). Consequently an alternative method, one that does not have inhibitory effects on LAB is needed. A possible method that meets these challenges involves immobilization of LAB with sodium alginate. The objective of this research was to determine the ability of encapsulated *Lactobacillus reuteri* (*L. reuteri*) in sodium alginate to produce lactic acid. In this study, the production of lactic acid was compared using two types of fermentation methods: Batch and batch bead fermentation. Six strains of *L. reuteri*, CF 2-F, DSM 20016, SD2112, MM 7, MF 14-C and MM 2-3 were used. These strains were grown in lactobacillus MRS at 37C for 24 hrs. The cells were then washed and suspended in 10-ml peptone water. Sodium alginate beads were prepared by resuspending the 10-ml culture in 7% sodium alginate solution. Beads were manufactured by dropping sodium alginate culture into ice-cold (2 C) 0.4M calcium chloride using a separatory funnel. Under comparable conditions the sodium alginate encapsulated cells were allowed to ferment in 500-ml lactobacillus MRS and whey based medium at 37C for 24 hrs. Samples were withdrawn at two -hour intervals during storage period and analyzed for pH value, lactose, glucose, and lactic acid. Results showed that the pH reached 4.00 within 15 hrs with beads fermentation and reached 5.40 using conventional batch. This indicates that higher acid yields can be produced using bead fermentation. Strain MM 2-3 produced the highest lactic acid yield as measured by pH value (pH 3.70) and lactic acid (8.0%) while strain SD2112 produced the lowest acid yield as measured by pH value (pH 4.18) and lactic acid (2.0%) levels. Our results suggest that using immobilized cells of *L. reuteri* could have potential use to produce lactic acid for commercial applications in food and pharmaceutical industries.

Key Words: *Lactobacillus reuteri*, immobilization

W267 Antimicrobial activity of *Lactobacillus reuteri* against *Escherichia coli* O157:H7. S. A. Ibrahim*, M. M. Salameh, W. M. Brown, G. Shahbazi, and C. W. Seo, *North Carolina A&T State University*.

Lactobacillus reuteri (*L. reuteri*) is known to produce a broad-spectrum of antimicrobial compound, reuterin. The antimicrobial spectrum of reuterin includes Gram-positive and Gram-negative bacteria. The purpose of this study was to determine the antimicrobial activity of *L. reuteri* against the foodborne pathogen, *Escherichia coli* O157:H7 (*E. coli O157:H7*). Six different strains of *L. reuteri* (CF2-F, DSM 20016, MF14-6, MM2-3, MM-7) were incubated at 37C for 24 hrs in two different growth media (MRS without glycerol, and MRS with 0.2 M glycerol solution). Samples were centrifuged (5,000g/15 min) to obtain supernatants (200μl) which were then tested against five strains of *E. coli*

O157:H7 (944, 1730, Cider, E0019, F4546). *E. coli* O157:H7 growth was monitored by measuring turbidity at 610 nm in a spectrophotometer at different time intervals during incubation at 37 C for 8 hrs. Results show that *L. reuteri* has the ability to produce antimicrobial compound against *E.coli* O157:H7 only in the presence of glycerol. Such inhibition could not be observed when *L. reuteri* was grown in MRS without glycerol. Two strains of *L. reuteri* showed total growth inhibition against the foodborne pathogen. The growth inhibition could be observed within 4 hrs in LB broth. The growth inhibition was observed before the end of the exponential phase. The activity of *L. reuteri* against *E. coli* O157:H7 was confirmed using agar diffusion assay. These results suggest potential application of *L. reuteri* as a natural biopreservative to control growth of *E.coli* O157:H7 and ensure the safety of our foods.

Key Words: *Lactobacillus reuteri*, *Escherichia coli* O157:H7

W268 Development of endospore-specific primers for the analysis of microbial populations in milk powder. M. Arendts*[1], C. Kitts[2], and R. Jimenez-Flores[1], [1]*Cal Poly DPTC,* [2]*Cal Poly Biological Sciences*.

A comprehensive risk assessment of the microbial quality of milk powder should include information about endospores as well as viable bacteria. *Bacillus* endospores are present in raw milk, used in milk powder production, in numbers ranging from less than 10 to greater than 100 per g of solid. However, in the finished product they range from less than 1000 to over $5x10^5$ per gram, meaning that endospore-forming bacteria will have the most significant effect on the microbial quality of the powder. Molecular methods offer a unique and sensitive tool for rapid microbial detection. Our focus is to apply polymerase chain reaction (PCR) methods to detect early germination of endospores in milk products. We have studied the germination gene, GerC3, from endospore-forming members of the family *Bacillus*. This led to the development of specific primers for PCR detection. In the Dairy Products Technology Center (DPTC) endospore library, we have been able to detect five specific strains that contribute to the lipolysis, casein hydrolysis, starch hydrolysis, and acid production of milk products using our primers. The primers designed in this work identified either a 100bp or a 500bp in a conserved region of the GerC3 gene found in the five DPTC target strains. These bands have been detected during germination activity in all five of these *Bacillus* strains. Spore germination has been difficult to study because it involves extremely rapid physiological responses in a spore whose structure is biochemically intractable. We have evaluated the developed primers in Reverse Transcriptase- PCR (RT-PCR) in the early detection of specific endospores present in skim milk powder resulting in the ability to document the presence or absence of endospore forming bacteria. Results indicate that the rapid growth of endospore forming bacteria can be monitored using RT-PCR.

Key Words: Endospore detection, PCR, Milk powder

W269 The effect of the incorporation of lactobacilli and whey protein isolate on the level of cell glutathion and immunoglobulin M(ig M). Y. H. Yoon*[1] and J. R. Byun, [1]*Department of Animal Science and Technology, Chung-Ang University*.

The effect of the incorporation of whey protein isolates and Lactobacillus spp.in the mouse diet on the level of cell glutathion and Immuniglobulin M(Ig M) in the germ free ICR mouse feeding system.The study was conducted to find out the effect of incorporation of Lactobacillus spp. on the cell gluthatione level and Ig M level in the spleen ,liver and erythrocyte cells. The highest and statistically significant level of glutathione in spleen cell has been shown in L.casei YIT 9018 cell fed group by feeding the diet containing 20% whey protein isolates among the 6 lactobacilli($p>0.05$). which was determined by the method utilyzing glutathione assay kit and the level of cell glutathione revealed to be strain dependent. Providing with the L. casei YIT 9018 or L. acidophilus NCFM increased the level of liver glutathione level significantly. And the level of glutathione in erythrocite increased significantly by feeding the diet containing 20% whey protein isolate and with L. casei YIT 9018 or L. casei CU 001($p>0.05$). Feeding L. casei YIT 9018 with whey protein isolate or L. acidophilus NCFM increased the Ig M level in the splenocyte significantly which was determined by the method of plaque forming unit counting.

Key Words: Glutathione, Imminoglobulin M, Lactobacillus spp.

W270 Evaluation of modified Elliker agar as an enumeration medium for selected Lactic acid bacteria. D. Patel*, L. Goddik, K. Kido, and P. Elliker, *Food Science and Technology, Oregon State University*.

The objective of the project was to evaluate efficacy of Elliker agar medium as a general purpose enumeration medium for lactic acid bacteria. International Dairy Federation (IDF) recommends M17 agar for starter lactococci and streptococci and MRS agar (DeMan Rogosa Sharpe) for starter lactobacilli enumeration. Current IDF protocol requires specific pH, incubation temperature and incubation conditions (e.g. anaerobic incubation) typical for specific starter bacteria. In light of this the Elliker agar medium with specific modifications was utilized to enumerate selected lactic acid bacteria as a convenient medium that can be used easily by the industry in a routine fashion.
Lactic acid bacteria, namely *S*treptococcus thermophilus (ST), *L*actobacillus delbrueckii subsp. bulgaricus Y (LB), *L*actococcus lactis sub sp. lactis ATCC 11454 (LL) and *L*actobacillus acidophilus NCK 1070 (LA) were utilized. All lactic acid bacteria were subcultured in sterile skim milk. Experiments were repeated 3 times. Appropriate dilutions of skim milk cultures were pour plated as per IDF scheme. Additionally, Elliker medium was used in pour plating at comparable pH and a general pH 6.8 for all the comparisons. Elliker agar modifications utilized alternative nitrogen sources such as casein hydrolysate and 3 per cent sterile skim milk. Based on the statistical analysis of data we found that modified Elliker medium gave similar recovery with regards to LA, LL, LB and ST when compared to M17 and MRS agar. It was also found that LB can be enumerated without anaerobic incubation when the purpose is general enumeration. pH had no significant influence in Elliker medium in regard to enumeration. Modified Elliker medium appears to be a good candidate for general purpose enumeration media for lactic acid bacteria.

Key Words: Lactic acid bacteria, International Dairy Federation, Fermented dairy foods

W271 Effects of co-culturing EPS and non-EPS starter cultures and supplementation with WPC on syneresis, textural and rheological properties of set yoghurt. T. Amatayakul*[1], B. Zisu[1], F. Sherkat[2], and N. P. Shah[1], [1]*Victoria University, Melbourne, Australia,* [2]*RMIT University, Melbourne, Australia*.

Exopolysaccharide (EPS) producing starter cultures are becoming increasingly popular for use in the dairy industry. In our earlier study, EPS producing *Streptococcus thermophilus* 1275 when co-cultured with non-EPS *S. thermophilus* produced higher levels of EPS. Supplementation with WPC increased EPS production and reduced the rate of lactic acid production.
The objective was to assess if these approaches could improve syneresis, textural and rheological properties of yoghurt.
Six batches of yoghurts were made in triplicate using 12% reconstituted skim milk (RSM) with or without replacement of RSM with 0.5% WPC and co-culturing with EPS and non-EPS starter culture (75:25). Syneresis was determined as a percentage of whey expelled after centrifugation. A TA-XT2 texture analyser was used to measure textural properties and gel firmness, and rheological properties were determined by using a Haake Rheostress 50 rheometer. HPLC was used to measure the amount of lactic acid produced. EPS was quantified using the phenol-sulphuric method.
Yoghurts made using EPS starters cultures showed reduced syneresis. Control yoghurts made with non-EPS starter and without WPC showed 65.20% syneresis, and those made using co-cultures 60.26%. Co-culturing and partial replacement with 0.5% WPC showed the highest reduction in syneresis at 52.37%. Control yoghurts had the hardest viscosity and hardness. Hardness and viscosity reduced in yoghurts containing EPS starter cultures, whereas WPC increased hardness and the viscosity was unaffected. In addition, yoghurts supplemented with WPC did not show shear thinning behaviour. Yoghurts made with non-EPS *S. thermophilus* had the lowest shear stress regardless of supplementation with WPC. Yield stress was lowest in control yoghurts at 248.70 Pa. Co-culturing and WPC showed the highest yield stress at 363.367 Pa.

Supplementation with WPC and co-culturing with EPS starters has a significant effect ($p<0.05$) on reduction of syneresis, textural and rheological properties of set yoghurt, and may provide an alternative means of improving functional characteristics of yoghurts without incorporating the use of stabilizers.

Key Words: Exopolysaccharides, Rheological properties, Yoghurt

W272 Thermophilin 110: a broad spectrum bacteriocin of *Streptococcus thermophilus*. G. A. Somkuti* and D. H. Steinberg, *Eastern Regional Research Center, ARS-USDA*.

A survey of thermophilic lactic starter cultures for bacteriocin production identified the broad spectrum antimicrobial peptide thermophilin 110 of *Streptococcus thermophilus*ST110, a strain used in yogurt and cheese fermentations. The range of bacteria inhibited by the bacteriocin included lactococci, lactobacilli and pediococci, in addition to related thermophilic streptococci. Production of thermophilin 110 at 37°C paralleled growth of *S. thermophilus* ST110 in a tryptone-yeast extract-lactose medium. After 16 h of growth, bacteriocin titers reached 320 units/ml by an agar well diffusion assay with *Pediococcus acidilactici* as the indicator strain. Thermophilin 110 was sensitive to digestion by proteolytic enzymes and lost its activity after a 60 min exposure to pepsin, pronase and papain. It was also inactivated by amylase treatment indicating glycosylation as a prerequisite for activity. Antimicrobial activity was fully retained after heating crude thermophilin 110 preparations at 80°C for 60 min. Thermophilin 110 was acid resistant and remained stable between pH 3 and 7 but lost its activity after exposure to pH 10. Plasmid analysis of *S. thermophilus* ST110 indicated the absence of plasmids, suggesting that the genetic determinant for thermophilin 110 production is probably located on the chromosome. Inhibition of several species of pediococci is a unique feature of thermophilin 110, implying a potential for applications in controlling the growth of spoilage bacteria in wine and beer fermentations.

Key Words: Bacteriocin, Thermophilin 110, *Streptococcus thermophilus*

W273 The influence of cold adaptation on cryotolerance of *Bifidobacterium infantis*. A. Gevorgyan* and R. F. Roberts, [1] *The Pennsylvania State University*.

The purpose of this study was to determine the influence of cold adaptation on cryotolerance in *Bifidobacterium infantis* strain ATCC 15697 and commercial strain BI-4. Growth of ATCC 15697 and BI-4 in Reinforced Clostridial Broth (RCB) was determined at 20°C, 25°C, and 37°C by measuring OD_{600}. Overall BI-4 grew faster than ATCC 15697 in RCB incubated at 37°C. Neither strain grew in RCB when incubated at 20°C or 25°C for up to 7 days. For cold shock experiments and freeze-thaw challenge, cells were grown in 100 ml RCB at 37°C until mid-log phase (OD_{600}= 0.5) then 25 ml of culture was harvested and resuspended in the same volume of tempered medium (20°C, 25°C, 37°C). Ten ml of resuspended inoculum was transferred into two sterile tubes and incubated at the designated temperatures for 240 min. One ml samples were taken at 0, 30, 60, 120 and 240 min and frozen at -20°C for 24 hours, thawed for 10 min at 30°C, sampled for viable count and then re-frozen. The population of survivors was determined before freezing and after 1, 3, 6 and 9 freeze-thaw cycles by spread plating decimal dilutions on RCA plates and incubating anaerobically at 37°C for 72h. Survivor data were normalized to the initial population (before freezing). Experiments were replicated three times. When BI-4 was incubated at 20°C or 25°C prior to freezing there was no change in population after 9 freeze-thaw cycles. However when BI-4 was incubated at 37°C for 60, 120, and 240 min the strain exhibited 0.5 log decrease in population after 9 freeze-thaw cycles. Overall, ATCC 15697 was more sensitive to freeze-thaw challenge than BI-4. However, the loss of viability was reduced by incubating at 20°C or 25°C when compared to 37°C, especially at incubation time of 120 and 240 min. Viable cells of ATCC 15697 could not be recovered after 6 freeze thaw cycles following incubation at 37°C for 240 min. Viability of both strains after 9 freeze-thaw cycles decreased when incubated at 37°C for longer time (120 and 240 min) suggesting cells in stationary phase are less cryotolerant. Incubation at suboptimal temperatures did not increase cryotolerance of *B. infantis* and the effect of freeze-thaw challenge was strain dependent.

Key Words: Probiotics, Bifidobacterium, Cryotolerance

W274 Effect of c2 phage peptide on acid development in milk inoculated with *Lactococcus lactis* spp *lactis* C2 with and without c2 phage infection. I. Surjawan and C. L. Hicks*, *University of Kentucky, Lexington, KY 40546*.

Peptides from c2 phage were prepare by hydrolyzing c2 bacteriophage(Φ) with ficin (0.2% at 26°C for 6 h). Inhibition of phage proliferation tests were conducted in milk following a rennet cheese schedule (1 h ripening at 31°C, rennet, cutting, cooking to 37°C, and holding at 37°C) by measuring change in pH during 4.5h of fermentation. Six sterilized pint jars were filled with 96 ml of pasteurized milk. Milks were inoculated (4%) with C2 culture that was grown in medium with (2 jars) and without (3 jars) phage peptides (2%) added. One jar was inoculated with culture grown in medium containing 1% c2 peptide. The milk in this jar also contained 1 % added c2 peptide. One of the milks that was inoculated with culture grown in medium without c2 peptide contained 2% added c2 peptide. Four of the milks were infected with c2 phage (10^3 pfu/ml). The pH decreased fastest in milk inoculated with C2 culture grown in medium without added c2 peptide then in milk inoculated with culture grown in medium containing c2 peptide. These 2 milks had significantly better acid production (pH 5.63 and 5.71, respectively after 4.5 h of fermentation) than the other 4 milks. However, milks that were inoculated with culture grown in c2 peptide (both the 2% peptide medium and 1 % peptide medium with 1% peptide added to the milk) and infected with (Φ)c2 did continue to produce acid (pH 6.01) throughout the fermentation period. When 2% c2 peptide was added to the milk and inoculated with culture grown in medium without peptide, acid development stopped (pH 6.23) after 200 min. Acid production in milk inoculated with culture grown in medium without peptide and infected with (Φ)c2 stopped (pH 6.25) after 120 min of fermentation. These results suggest the culture grown in media containing c2 peptide were protected from c2 phage proliferation and lysis during the fermentation period better than when the peptide was added to the milk, or when no peptide was present.

Key Words: *Lactococcus lactis*, c2 Bacteriophage inhibition, pH Milk

W275 Inhibition of *Salmonella* and *Escherichia coli* phage with c2 phage peptide. C. L. Hicks, J. Tang, and I. Surjawan, *University of Kentucky, Lexington, KY 40546*.

Peptides from *Lactococcus lactis* Φc2 (phage) were prepared by hydrolyzing Φc2 (10^9 pfu/ml) with ficin (0.2% at 26°C for 6 h). Hydrolyzed peptide were partially purified by ultrafiltration (3000 mwco). Ultrafiltration permeate was dialyzed (500 mwco) and freeze dried, then used to formulate growth media. *Salmonella choleraesuis* ssp. *choleraesuis* (Smith) Weldin serotype Typhimurium deposited as *Salmonella typhimurium* (Loeffler) Castellani and Chalmers ATCC 14028 and *Escherichia coli* (Migula) Castellani and Chalmers ATCC 47076 were grown in 1558 medium and 1065LB medium, respectively, with and without Φc2 peptide present (various concentrations) and, with and without their respective phage (*S. choleraesuis* ssp. *choleraesuis* serotype Typhimurium phage ATCC 40282 and *E. coli* lamda 97538). *S. choleraesuis* ssp. *choleraesuis* grew faster when c2 peptide (1.5 and 2.5% concentrations) was added to the 1588 growth medium (incubated at 37°C for 6 h). However, when ATCC 40282 phage was added to the growth medium (infected after 130 min incubation) with and without peptides the media that contained 1.5 and 2.5% peptide had an extended growth period of 21 and 28 min, respectively, before lysis occurred suggesting that c2 peptide had a minor inhibition effect on ATCC 40282 phage proliferation. *E. coli* also grew faster when the c2 peptide (2 and 4% concentration) was added to the 1065LB growth medium. However the most rapid growth was present in the medium containing 2% peptide suggesting that peptide in the 4% medium was starting to block metabolic transport. When the lambda 97538 phage was added to the growth medium (infected after 90 min of incubation) only a slight inhibition of phage proliferation occurred in the 2% c2 peptide medium (20 min) whereas in the 4% peptide medium phage proliferation was suppressed by 120 min suggesting that c2 peptide was an effective inhibitor of lambda 97538 phage proliferation.

Key Words: *Salmonella*, Bacteriophage inhibition, c2 phage-peptide

W276 Correlation between the USU stretch test and the pizza fork test. B. L. Moyes*[1], D. J. McMahon[1], and C. J. Oberg[2], [1]*Utah State University, Department of Nutrition and Food Sciences,* [2]*Weber State University, Department of Microbiology.*

A correlation between the USU stretch test and the pizza fork test would allow the stretch properties of Mozzarella cheese to be measured in an objective manner. The USU Stretch Test uses a modified texture-profile analyzer to pull strands of cheese from a melted reservoir, measuring the load exerted on the probe during stretching. Fifty grams of shredded cheese was melted for 45 min at 65, 70, 75, 80, and 85°C and a three-pronged hook was used to lift the strands of cheese for 30 cm at a rate of 100 cm per min. The load exerted on the probe was recorded and the following parameters were used to search for a correlation with values obtained from the pizza fork test. Pizza fork test values were provided by an industrial partner. Melt Strength was defined as the maximum load obtained during stretching, and the probe extension at Melt Strength was termed the Stretch Extension (SE). Stretch Load (SL) was defined as the load exerted on the probe at any point following Melt Strength. These SL values were also used to calculate the slope of the curve formed as the load decreased after Melt Strength was obtained. In general, greater correlation was found at higher temperatures. At 85°C, the correlation coefficient (r) between the fork test distance and Melt Strength, slope from 10 to 15 cm, SL from 5 to 10 cm, SL from 15 to 20 cm, and SE obtained from the USU Stretch Test were 0.71, -0.80, 0.84, 0.69, and -0.36 respectively. The correlation coefficient for the same parameters were 0.61, -0.68, 0.71, 0.83, and -0.84 at 80°C; 0.61, -0.41, 0.43, 0.60, and -0.54 and 75°C; 0.73, -0.46, 0.61, 0.69, and -0.85 at 70°C; and 0.73, -0.66, 0.72, 0.67, and -0.29 and 65°C.

Key Words: Mozzarella, Stretch testing, Functionality

W277 Impact of cheese defects on U.S. graded cheeses. M Smukowski*[1], W. L. Wendorff[2], Y. Ping[1], and R. D. Rao[2], [1]*WI Center for Dairy Research, Madison, WI, USA,* [2]*University of Wisconsin-Madison, Madison, WI, USA.*

Grading records for over 40,000 metric tonne of Cheddar, Colby, Monterey Jack, and Swiss cheese were obtained from ten national cheese manufacturers or processors. Licensed graders recorded defects and established grades for each lot of cheese. Major defects identified in Cheddar cheese were acid flavor, curdy, short and weak body and open texture. Major defects for Colby and Monterey Jack cheeses were weak body and acid and whey flavors. Over 16% of the Swiss cheese was downgraded due to defective eye formation or utensil flavor. Potential economic impacts of the major cheese defects are reported. Trained panelists evaluated Cheddar cheese obtained from the retail market and found less than 10% of the cheese would have been graded as Grade A. Major defects noted were acid, flat, whey, and bitter flavors. Other defects included short, pasty, and weak body and open texture. It is suggested that cheesemakers must continuously evaluate cheeses throughout the aging process, distribution and marketing of cheeses to effectively assess their cheesemaking procedures and practices.

Key Words: Cheese, Defects

W278 Microencapsulated Iron fortification and flavor development in Cheddar cheese. H. S. Kwak, H. J. Ahn, J. Ahn, and J. S. Seok, *Sejong University, Seoul, Korea.*

This study was designed to examine the effect of microencapsulated iron-fortified Cheddar cheese and vit C as a bioavailable helper of iron on chemical and sensory aspects. Coating material was PGMS, and ferric ammonium sulfate and vit C were selected as core materials. The highest efficiency of microencapsulation of iron and vit C were 72 and 94%, respectively, with 5:1:50 ratio (w/w/v) as coating to core material to distilled water. TBA absorbance was significantly lower in microencapsulated treatments than those in uncapsulated treatments during ripening. The productions of short-chain free fatty acid and neutral volatile compound were not significantly different between microencapsulated and uncapsulated Cheddar cheese during ripening periods. In sensory aspects, bitterness, astrigency and sourness were higher in Cheddar cheese fortified with microencapsulated iron and uncapsulated vit C than others. The present study indicated that fortification of iron as well as vit C did not show any defect problem to Cheddar cheese, and suggested the possibility of iron fortification of Cheddar cheese.

Key Words: Iron fortification, Microencapsulation, Cheddar cheese

W279 Comparison of microbial populations of unfrozen and frozen control goat cheeses with those of 3 month frozen-stored ones. J. H. Lee*, S. J. Lee, A. Kalantari, and Y. W. Park, *Fort Valley State University, Fort Valley, GA.*

Few scientific studies have been reported on microbial profiles of commercial caprine cheeses in relation to food safety and shelf life of the products. A commercial soft goat cheese was purchased and Monterey Jack (MJ) cheese was manufactured at the pilot plant of Fort Valley State University. Both varieties were prepared in 3 batches, and divided into three equal portions. One portion was stored as unfrozen control (UFC) at 4^oC for 4 weeks (0, 14, 28 days), and the other two subsamples were frozen at -20^{o}C and stored for 0 and 3 months (FZC and 3FZ), then immediately thawed at 4^oC, followed by aging at 4^oC as was done for UFC. Changes in microbial populations were enumerated for total aerobic plate count (TPC), *E. coli* and coliform, yeast and mold, and *Staphylococcus aureus* using 3M Petrifilm techniques. pH and acid degree values (ADV) for all cheeses were determined. The pooled data of the respective TPC (log cfu/g) for UFC, FZC, and 3FZ groups of soft and MJ cheeses were: 6.93, 6.67 and 5.51; 8.44, 8.34 and 8.09, indicating that there were significant ($P<0.05$) reduction in TPC with storage treatments in soft cheeses, whereas no difference in MJ cheeses. The TPCs of 0, 14 and 28 days aging at 4^oC for corresponding cheeses were: 8.01, 5.67 and 5.52; 8.57, 8.17 and 8.15, revealing that there were significant ($P<0.05$) decrease in TPC with aging times in both cheeses. Low levels of coliforms and *E. coli* were found in MJ, but not in soft cheeses, and these cells were significantly declined by freezing and aging. The 2 main effects (storage and aging) were not significant for the pooled data of yeast counts of MJ, whereas those were significant ($P<0.05$) for the soft cheeses. Yeast counts tended to increase with aging in UFC and FZC groups of both cheeses, but significantly decreased in 3FZ group. Mold counts in both soft and MJ cheeses were similar at 3.0 (log cfu/g) for all storage groups. *E. coli*, coliform, and *Staphylococcus aureus* in soft cheeses were non-detectable <1.0 (log cfu/g), suggesting that no food safety hazard was in the cheese.

Key Words: Microbial population, Goat cheese, Frozen-storage

W280 Quantitative analysis of water-soluble volatile free fatty acids in commercial Swiss-type cheeses. T. Ji, W. Harper, and V. Alvarez, *The Ohio State University, Columbus, Ohio.*

Short chain ($\leq C_{12}$) water-soluble volatile free fatty acids (FFAs) contribute to the final flavor characteristics of cheese. Quantification of FFAs in varying Swiss-type cheeses can provide information concerning the ripening processes. The objective of this study was to compare the concentrations of FFAs in varying aged Swiss-type cheeses as an indirect parameter of flavor development. Twelve commercial domestic, imported Gruyere, Emmenthal and Jarlsberg Swiss-type cheeses of varying ages were analyzed in duplicate. A capillary gas chromatograph equipped with a flame ionization detector was used for the analysis of FFAs. Each standard curve of fatty acids was made using authentic fatty acids by diluting in double purified distilled water except higher volatile non-branched fatty acids with even carbon numbers such as octanoic, decanoic and dodecanoic due to low water solubility. Predominant FFAs in all cheeses were ethanoic (99-196 mg/kg cheese), propanoic (81-281 mg) and butanoic (40-131mg) acids. Ethanoic acid (C_2) exceeded the propanoic acid (C_3) in 6 cheeses in which C_3 was less than 100 mg. Butanoic acid (C_4) was greater than C_2 and C_3 in only two cheeses. In four cheeses, C_4 was higher than C_3 and all of these cheeses had more C_2 than C_3. 3-methylbutanoic acid was presented in only 5 of 12 cheeses. Gruyere only showed all of even carbon numbered ($\leq C_{12}$), C_3 and branched fatty acids such as 2-methylpropanoic, 3-methylbutanoic and 4-methylpentanoic acids. Some domestics and Gruyere cheeses containing low C_2 (99 -129 mg) and C_3 (81-98 mg) had high concentrations of decanoic acid. Domestic cheese (3 mo age) and Gruyere (> 6 mo) showed higher volatile non-branched fatty acids with even carbon numbers (C_8, C_{10} and C_{12}). Emmenthal and Jarlsburg had high level of ethanoic (184 and 152 mg) and propanoic (243 and 245 mg) acids. The commercial cheeses generally showed two patterns of lower molecular weight fatty acids: (a) those cheeses where C_2 is greater than 100 mg

and C_3 is greater than 175 mg (6 cheeses) and (b) those that showed less than 100 mg of C_3 (6 cheeses). High concentrations of C_8, C_{10} and C_{12} correlated to low C_3 in most cases.

Key Words: Swiss cheese, Volatile free fatty acid

W281 Compositional differences between whey, salty whey, and press whey from commercial manufacture of cheddar cheese. R. D Rao* and W. L. Wendorff, *University of Wisconsin-Madison, Madison, WI, USA*.

Salty and press whey streams are currently underutilized in the dairy industry because of difficult, costly processing and high salt content. In addition, relatively little information is available on the composition of these whey streams. In Wisconsin alone, over two million gallons of salty whey are produced in a year, most of which is landspread or disposed of into waste treatment systems. This study investigated gross compsitional differences between whey, salty whey, and press whey streams derived from Cheddar cheese. Differences between individual whey protein compsition were also studied. Individual proteins were quantified using SDS-PAGE and digital imaging. Solids, ash, fat, and chloride content were significantly greater in the salty and press whey as compared to standard Cheddar cheese whey. Individual whey proteins analyzed include lactoferrin (LF), bovine serum albumin (BSA), immunoglobulin G (IgG), β-lactoglobulin (β-LG), and α-lactalbumin (α-LA). Salty and press whey showed slightly decreased proportions of IgG compared to that of the standard Cheddar whey. Amounts of BSA (wt. %) were comparable in all samples. The percentage of α-LA in the salty and press whey streams were roughly half of that found in the standard Cheddar whey. β-LG concentrations decreased by about 20% from the standard Cheddar whey to the salty and press whey streams. The percentage of LF increased from less than 1% to greater than 30% in both the salty and press whey. Differences in gross composition between standard Cheddar whey and salty and press whey can be used to determine modifications needed in whey processing. Salty and press whey may be good sources of lactoferrin, making processing of these whey sources a more profitable and viable option for whey processors.

Key Words: Salty whey, Press whey, Lactoferrin

W282 Physico-chemical and microbiological characteristics of Cheddar cheese manufactured with a cholesterol lowering spread and oil high in omega-3 fatty acids. K. J. Aryana* and R. Gough, *Louisiana State University Agricultural Center*.

Milk fat is high in saturated fatty acids. Replacing milk fat in Cheddar cheese with health beneficial lipids could improve consumer appeal and demand for the product. The objective was to study the impact of a gradual replacement of milk fat by a cholesterol lowering spread, Benecol® and oil high in omega-3 fatty acids, Omega Pure™ on the physico-chemical and microbiological characteristics of full and low fat Cheddar cheeses. Cheddar cheese was manufactured by replacing milk fat with Omega Pure™ and Benecol® in the following ratios; milk fat : Omega Pure™ / Benecol® 100:0; 75:25; 50:50; 25:75; 0:100. The attributes studied were color, pH, proteolysis and microbiological profile. Color was measured in L^* a^* and b^* values using a hand held colorimeter; proteolysis was studied by gel electrophoresis; and the microbiological profile was determined by standard plate counts, coliform counts, yeasts and mold counts. The pH was significantly ($P<0.05$) lower when Omega Pure™ / Benecol® was used at 100% fat level in full fat Cheddar cheese compared to the full fat control. Lower usage levels of Omega Pure™ / Benecol® in full and low fat Cheddar cheeses did not result in significant ($P<0.05$) differences when compared to full and low fat Cheddar cheese controls, respectively. The full fat control was lower ($P<0.05$) in b^* (yellowness) values compared to the full fat cheeses with Benecol®. There was a significant ($P<0.05$) and steady decline in b^* values of full fat cheeses made with decreasing amounts of Benecol®. There were slight changes in the gel electrophoretic patterns of the treated cheeses. Coliforms in the controls and the treated samples were estimated at $<$ 10 cfu/ml. The low fat samples appeared to have a higher standard plate count than the full fat samples. Use of the health beneficial lipids altered some characteristics of low fat and full fat Cheddar cheeses.

Key Words: Fermented, Health, Lipids

W283 RAPID method of cheese sample preparation for microstructural studies by electron microscopy. K. J. Aryana*[1] and M. C. Henk[2], [1]*Louisiana State University Agricultural Center*, [2]*Louisiana State University*.

Cheese sample processing for electron microscopy involves several days. A quicker method that processes cheese samples without altering its microstructure would be desirable. The objective was to identify such a suitable, rapid method. The rapid method involved an initial fixation of cheese in a solution of 2% glutaraldehyde and 1% OsO_4 in 0.05M cacodylate buffer for 10 min. This was followed by a second fixation in 2% glutaraldehyde and 2% OsO_4 in 0.05M buffer for an additional 20 min. Both of these solutions were mixed from stock solutions immediately before use, as components would react with each other in the absence of any sample. Sample fixation by the rapid method was attained in a total of 30 minutes compared to 17 hours in the control, i.e., 15 hours (overnight) fixation in 1% glutaraldehyde and 2 hours fixation in 1% OsO_4. After fixation, en block staining with aqueous uranyl acetate was conducted for 30 minutes. This was followed by ethanol dehydration and infiltration in resin. En bloc staining provided uniform staining, ultimately saving time and reducing grid handling and contamination encountered when staining sections with alcoholic uranyl acetate. Additionally, the rapid method was conducted with LR White resin compared to Spurr's epoxy resin in the control. The former is used directly while the latter has to be freshly prepared and involves precise weighing and orderly mixing of four toxic chemicals. The microstructure of cheese processed by the rapid method appeared unaltered when compared to the control. The protein matrices in both the control and the rapid method processed samples picked up the heavy metal stain and were easily seen. The dispersed fat globules were also clearly visible in both the control and treated samples. This rapid method of cheese sample preparation did not alter cheese microstructure and can be recommended for accelerated sample processing for electron microscopy.

Key Words: Structure, Fermented, Fixation

W284 Effect of setting pH on the properties of mozzarella cheese made from whole milk and dry milk protein concentrate by direct acidification. S. Rehman, N. Farkye, and Y. Boorus, *California Poly technic State University, San Luis Obispo, CA*.

The pH of milk at setting affects the properties of mozzarella cheese. Milk protein concentrate (MPC) containing 64.0% protein, 20% lactose and 2% calcium was used to standardize whole milk to a protein to fat ratio of 1.4 for Mozzarella cheese manufacture. Our objective was to compare the effect of pre-acidification of whole milk standardized with MPC to different pH values in Mozzarella cheese made by direct acidification. Standardized, pasteurized (72°C 16 s) was divided into three lots, A, B and C and respectively adjusted to pH 5.6, 5.8 and 6.0 with 2% citric acid prior to setting (5 mL chymosin / 100 kg milk). The coagulum was cut and the curds were cooked (36°C) and stretched (82°C). Cheesemaking was repeated thrice. All cheeses were stored at 4°C for 5 weeks. Composition, yield, meltability, baking properties and hardness in the cheeses were determined by standard methods, while primary proteolysis was assessed by urea-polyacrylamide gel electrophoresis and determination of water-soluble N contents of the cheeses. Significant differences ($P<0.05$) in the % moisture (51.54 ± 2.09, 50.87 ± 2.32, 47.94 ± 1.85) and calcium contents (mg/kg cheese, 36.75 ± 1.183, 45.76 ± 4.24, 53.75 ± 2.05) were observed for vats, A, B, C respectively showing that decreasing milk pH caused increase in moisture and decrease in calcium. No significant ($P>0.05$) differences were observed in lactose, protein, fat and yield of the cheeses, % fat or protein recoveries. The % total solids recoveries increased significantly with increase in setting pH of milk. The milks pre-acidified to pH 5.6 gave the cheeses with best meltability, least hardness, minimum browning while baking on pizza and highest levels of proteolysis. The results of this study suggest that if Mozzarella cheese with better functional properties is to be manufactured by using MPC, then the milk should be pre-acidified to pH of 5.6.

Key Words: Milk protein concentrate, Mozarella cheese, Direct acidification

W285 Effect of calcium on functionality of fat free Mozzarella cheese. N. S. Joshi, R. I. Dave, and K. Muthukumarappan, *South Dakota State University, Brookings, SD.*.

Mozzarella cheese consumption has increased steadily for many years. Calcium plays significant role in functional properties of Mozzarella cheese. Fat free Mozzarella cheese has not become popular because it has poor melt properties. Our recent research on part skim Mozzarella cheese indicated that cheeses with reduced calcium possess better melting properties, particularly softening, melting and flow. Therefore a study was planned with an objective to examine effects of altering calcium levels on functionality of fat free Mozzarella cheeses.

Skim milk was preacidified to four pH levels (control = no treatment, T_1 = pH 6.2, T_2 = pH 5.9 and T_3 = pH 5.6) using citric and acetic acids to alter calcium content in cheeses. The cheeses were made by direct acidification method using glucono-delta-lactone and were analyzed for composition (moisture, protein, fat, salt, ash, and calcium), melt area (modified Schreiber test), melt profile (softening and melting time-temperatures, extent and rate of flow), color (L^*), and proteolysis (soluble nitrogen). The data were analyzed using PROC GLM and PROC MIXED procedures of SAS®.

Preacidification of skim milk significantly ($P < 0.05$) reduced the ash and calcium contents, whereas, rest of the components remained at par in all the cheeses. As the calcium in the cheeses reduced from 0.79 % in control to 0.66 % in T_1, 0.59 % in T_2 and 0.50 % in T_3 cheeses flowed faster ($P < 0.001$) with higher flow rate and required significantly ($P < 0.001$) less time to melt. The control cheese had higher ($P < 0.05$) post melt whiteness (L^*) as compared to experimental cheeses (90 vs. 88.9, 88.5 and 88.7 in T_1, T_2 and T_3 respectively). Soluble nitrogen was the highest in T_3 (1.80 %) followed by T_2 (1.13 %), T_1 (0.82 %) and control (0.60 %) on d30. Refrigerated storage of all the cheeses resulted in increase in melt area ($P < 0.01$), flow rate ($P < 0.001$), extent of flow ($P < 0.01$), and soluble nitrogen ($P < 0.001$) along with decrease in melting time ($P < 0.05$) and melting temperature ($P < 0.001$). The post melt whiteness of the cheeses was not affected by refrigerated storage.

Key Words: Fat free Mozzarella, Calcium, Functioanlity

W286 Changes in microstructure of part skim Mozzarella cheese as a function of calcium. N. S. Joshi, K. Muthukumarappan, and R. I. Dave, *South Dakota State University, Brookings, SD.*.

Mozzarella cheese has unique functional characteristics that are not available in other cheese varieties. Casein of the reduced calcium curd better emulsifies the fat and its subsequent distribution within the continuous protein matrix decides rheological and functional properties of Mozzarella cheese. Thus calcium is a key factor in determining the basic structure of Mozzarella cheese. Our objective was to understand the role of calcium in microstructure of part skim Mozzarella cheese.

Calcium content of part skim Mozzarella cheeses was altered by manufacturing cheese from milk preacidified to four pH levels (control =no treatment, T_1 = pH 6.2, T_2 = pH 5.9 and T_3 = pH 5.6) using citric and acetic acid. Direct acidification method using glucono-delta-lactone was followed for cheese making. Cooking and draining time were adjusted to obtain uniform moisture content in all the cheeses. Structure of the cheeses was evaluated by scanning electron microscopy (SEM) as well as confocal laser scanning microscopy (CLSM) techniques. Information obtained from both the microscopic analyses was quantified in terms of numbers, area and size of the fat globules using software HL Image ++. Calcium content of the cheeses was significantly different (control = 0.65, T_1 = 0.48, T_2 = 0.42 and T_3 = 0.35 %), whereas rests of the compositional parameters were similar ($P > 0.05$). The microstructure study using both SEM and CLSM revealed that reduced calcium cheeses had greater number of round fat particles (control = 125, T_1 = 193, T_2 = 184, and T_3 = 215 in SEM and control = 86, T_1 = 87, T_2 = 125, and T_3 = 140 in CLSM), and their distribution in reduced calcium cheeses was also more uniform. The above findings support our hypothesis that casein in the reduced calcium cheese better emulsifies the fat globules and significantly improve the melting of Mozzarella cheese.

Key Words: Mozzarella, Microstructure, Calcium

W287 Effects of stage of lactation and aging on functional properties of Colby and Cheddar cheeses manufactured from goats' milk. D. W. Olson*[1], D. L. Van Hekken[1], M. H. Tunick[1], K. A. Soryal[2], and S. S. Zeng[2], [1]*USDA, ARS, Eastern Regional Research Center, Wyndmoor, PA,* [2]*Garza Institute for Goat Research, Langston University, Langston, OK.*

In the United States, goats in many herds begin their lactation at the same time. In this study, the effects of cheese milk obtained at various stages of lactation (early, peak, and late) and cheese storage (0, 8, and 16 wk for Colby and 0, 8, 16, and 24 wk for Cheddar at 4°C) on sliceability, meltability, and color changes upon heating (232°C for 5 min or 130°C for 75 min) of Colby and Cheddar cheeses manufactured from Alpine goats′ milk were evaluated. The cheeses were manufactured at Langston University, OK. Sliceability (force required to cut through a sample) was measured using a TA.XT2 Texture Analyzer with a wire cutter attachment. Meltability was measured using the Schreiber Melt Test. Color including whiteness was measured using a HunterLab ColorQuest XE colorimetric spectrophotometer. A greater cutting force to slice the cheese was required when measurements were made at 0 wk of storage using peak lactation milk instead of early or late lactation milk to make Cheddar cheese. No consistent effects of stage of lactation were observed on the whiteness and meltability of Colby and Cheddar cheeses. With aging, the whiteness before and after heating of both types of cheese and the force required to cut through the cheeses decreased but their meltability increased. The changes in the color, meltability, and sliceability were greater between 0 and 8 wk than the corresponding changes occurring between 8 and 16 wk of storage. The changes in the functional properties closely follow the proteolysis of the cheese as it ages. The stage of lactation has less impact on the functional properties of the cheeses than aging and indicates that storage and proteolysis are key factors in the functional quality of goats′ milk cheeses.

Key Words: Goats' milk cheese, Functional properties, Stage of lactation

W288 Effects of milk pasteurization and aging on functional properties of Mexican Mennonite cheese. D. W. Olson*[1], D. L. Van Hekken[1], M. H. Tunick[1], P. M. Tomasula[1], F. J. Molina-Corral[2], and A. A. Gardea[2], [1]*USDA, ARS, Eastern Regional Research Center, Wyndmoor, PA,* [2]*Centro de Investigacion en Alimentacion y Desarrollo, Cuauhtemoc, Chihuahua, Mexico.*

Currently, little is known about the functional properties of commercially available semi-hard cheeses manufactured by the Mennonite community in Chihuahua, Mexico. In this study, sliceability, meltability, and color changes upon heating of Mexican Mennonite cheeses made from raw or pasteurized milk were compared. Two brands of raw milk cheese and two brands of pasteurized milk cheese, obtained from four different manufacturers in Chihuahua, Mexico, were analyzed in triplicate after 0, 4, 8, 12, and 16 wk of storage at 4°C. Sliceability (force required to cut through a sample) was measured using a TA.XT2 Texture Analyzer with a wire cutter attachment. Meltability was measured using the Schreiber Melt Test on samples heated to 232°C for 5 min. Color was measured using a HunterLab ColorQuest XE colorimetric spectrophotometer on samples before and after heating at 232°C for 5 min or 130°C for 75 min. Compared to pasteurized milk cheeses, raw milk cheeses had less browning and total color change after heating at 130°C, melted more at 232°C, and required less cutting force. With aging, all cheeses increased in meltability, decreased in whiteness when measured before heating, and required less cutting force to slice. In addition to proteolytic breakdown occurring in both cheeses as they age, the differences in the functional properties are a result of, in part, the mixed microflora present in the raw milk cheeses compared to the more homogeneous microflora provided by presence of dairy cultures in pasteurized milk cheeses.

Key Words: Mexican Mennonite cheese, Functional properties, Shelf-life

W289 Proteolysis and rheology of soft goat milk cheese after frozen storage. D. L. Van Hekken*[1], M. H. Tunick[1], D. W. Olson[1], and Y. W. Park[2], [1]*USDA, ARS, Eastern Regional Research Center, Wyndmoor, PA,* [2]*Fort Valley State University, Fort Valley, GA.*

Seasonal milking practices for dairy goats in the US limit the availability of domestic fresh soft goat cheese. With the demand for soft goat cheese

increasing, freezing of the fresh curd could allow US goat producers to supply soft cheeses throughout the year. In this study, the effects of freezing and long term frozen storage on the proteolysis and texture of soft goat cheese was evaluated. Plain soft cheeses were obtained from a grade A goat dairy in Georgia and received three storage treatments: fresh control (FC) at 4°C for up to 4 wks, frozen (-20°C) and thawed after 2 d (FTC) or 3 mo (3MF), then stored as FC group. Although all frozen samples showed minute ice crystal formation throughout the body of the cheese, no free liquid was noted when samples were thawed. Proteolysis was monitored using SDS-PAGE and rheological properties were measured using a universal testing machine and a dynamic analyzer. At the start of refrigerated storage, all samples that had been frozen (regardless of length of frozen storage) had 1 to 2% less beta-casein than the fresh cheeses. After 4 wk of refrigerated storage, all cheeses showed 2 to 3% proteolytic breakdown of beta-casein. FC cheese had a fragile texture with values of 10.6 N for hardness, 10.1 mm for springiness, 0.10 for cohesiveness, 9.3 mJ for chewiness, 15.9 kPa for elastic modulus, 5.28 kPa for viscous modulus, and 1.75 kPa.s for complex viscosity. The FTC cheese had slightly lower values for hardness (7.36 N), cohesiveness (0.08), and chewiness (5.2 mJ) and elastic and viscous moduli decreased from d1 to d28 (11.3 kPa and 3.60 kPa, respectively). However, the 3MF cheeses were slightly harder and chewier than the FC cheese and the viscoelastic properties were similar to those of the FC cheese. Frozen storage of soft goat cheese affects its textural quality through the creation and removal of ice crystals in addition to the proteolytic breakdown of caseins in the cheese matrix.

Key Words: Goat milk cheese, Proteolysis, Rheology

W290 Effect of sodium chloride and acid on rennet coagulation and curd firmness of high heat-treated milk. M. R. Acharya* and V. V. Mistry, *MN-SD Dairy Foods Research Center, South Dakota State University.*

Raw whole milk was pasteurized at 62.8, 68.3, 73.9 or 79.4°C for 30 min and divided into ten portions. Five levels of sodium chloride, 0 (S0), 0.5 (S1), 1.0 (S2), 1.5 (S3) or 2.0% (S4) or five levels of 2% lactic acid, 0 (A0), 1.5 (A1), 3.0 (A2), 4.5 (A3) or 6.0 ml/100 ml of milk (A4) were added to formulate a total of 10 treatments. There were three replications. From each treatment, 100 ml sample was inoculated with 1.0 ml of 2:100 diluted rennet solution and incubated in a water bath at 32°C. Curd firmness was judged at intervals using a knife to determine cutting time. A Formagraph was used to measure the curd formation characteristics. Ten ml milk from each treatment was inoculated with 200μL of 1:100 diluted rennet solution at 32°C and the unit was operated for 180 min. Formagraph plots were used to determine rennet coagulation time (r, min), time to reach firmness of 20 mm (k_{20}, min) and firmness (mm) at 30, 60, 90 and 120 min as a_{30}, a_{60}, a_{90} and a_{120}, respectively. Only treatments A2, A3 and A4 could reach cutting strength at 79.4 and 73.9°C. At 68.3°C all treatments except controls reached cutting strength. Rennet coagulation time by both subjective (knife) test and Formagraph reduced from control (S0) to S1 and then increased with increase in sodium chloride content and reduced with increase in level of acidification. Values of k_{20}, a_{30}, a_{60}, a_{90} and a_{120} indicated similar trends as rennet coagulation time. It is concluded that desired cutting time and curd firmness, suitable for cheese making can be obtained from high heat treated milk with added sodium chloride or acid.

Key Words: Sodium chloride, Lactic acid, Rennet

W291 An accelerated cheese ripening in cholesterol-reduced Cheddar cheese by β-cyclodextrin. H. S. Kwak, C. S. Jung, H. J. Ahn, and J. Ahn, *Sejong University, Seoul, Korea.*

This study was carried out to find whether cheese ripening process was accelerated in cholesterol-reduced Cheddar cheese or not, which made by cream separation following by 10% β-CD treatment. The cholesterol removal rate of the cholesterol-reduced cheese was 91.9%. The production of short-chain free fatty acids (FFA) increased with ripening time in both control and experimental cheeses. The short-chain FFA data showed that cholesterol-reduced cheese ripened for 2 and 4 wk released a similar amount of FFA in control cheese ripened for 16 wk (4 mo) and 24 wk (6 mo). With ripening period, the increase of neutral volatile compounds, especially, acetaldehyde, acetone, ethanol and 2-heptanone was more profound in control than in β-CD treated group. In addition, cholesterol-reduced Cheddar cheese produced much higher total free amino acid and bitter amino acids than control during all ripening periods. In sensory analysis, texture score of control Cheddar cheese showed an increasing trend with 32 wk ripening, however, that in β-CD treatment group decreased during a ripening period (8 wk). Above results indicated that the cholesterol-reduced cheese made by β-CD treated cream resulted additionally in an accelerated ripening means.

Key Words: Acceleration of ripening and cholesterol removal, β-cyclodextrin, Cheddar cheese

W292 Influence of feeding strategy (pasture vs TMR) on proteolysis in Ragusano cheese during ripening. V. Fallico*[1], L. Chianese[2], J. Horne[1], S. Carpino[1], and G. Licitra[1], [1]*CoRFiLaC, Regione Siciliana, 97100 Ragusa, Italy,* [2]*Food Science Department, Naples University, Portici, Italy.*

Pasture contributes to aromatic profiles of milk and derived-cheese providing odor compounds that the animal can transfer to milk via the rumen. Aromatic substances were found in the milk and cheese of grazing ewes, but not in those of sheep fed TMR (Total Mix Ration). Proteolysis also contributes to cheese flavour, producing low molecular weight aromatic compounds and amino acids that may act as flavour precursors. The aim of this study was to evaluate the effect of feeding strategy (pasture vs TMR) on proteolysis of Ragusano, a brine-salted pasta filata cheese made from raw cow's milk without starter, during ripening (1, 120 and 210 d). Primary proteolysis was monitored by urea-PAGE, isoelectric focusing (IEF) and immunostaining with polyclonal antibodies against α_{s1} and β-caseins. Reversed phase-HPLC was used to assess secondary proteolysis by fractioning 12% TCA-soluble peptides. Both urea-PAGE and IEF profiles of pasture and TMR cheeses showed similar proteolytic patterns at each level of ripening, indicating that diet had no effect on primary proteolysis. Densitometry of urea-PAGE profiles of cheeses aged 120 and 210 days revealed slightly higher proteolysis levels in TMR cheeses. Similar but not significant ($P>0.05$) trends were found in chemical analyses (15.72 vs 14.23 at 120 d, 15.22 vs 14.16 at 210 d, SN/TN %). Immunoelectrophoretic patterns were useful in identifying the origin of main primary peptides. In vitro hydrolysis reactions with chymosin and plasmin helped to elucidate the potential role of these enzymes in primary proteolysis. Different feeds had a qualitative impact on secondary proteolysis. Peptide patterns resolved better in pasture HPLC profiles suggesting a more defined and balanced action of microbial peptidases involved in oligopeptide and amino acid production. Chemical analyses revealed a nonsignificant ($P>0.05$) trend showing larger 12% TCA-soluble peptide fractions in TMR profiles at each level of ripening.

Key Words: Ragusano cheese, Feed, Proteolysis

W293 Effect of sodium citrate on structure-function relationships of Cheddar cheese. A. J. Pastorino*, C. L. Hansen, and D. J. McMahon, *Western Dairy Center. Nutrition and Food Sciences Dept. Utah State University.*

The objective of this study was to determine the effect of sodium citrate on the structure and functionality of Cheddar cheese. The hypothesis was that citrate (sodium citrate) injection would affect cheese properties mainly through its effect on insoluble calcium (measured as the difference between total calcium and water-soluble calcium of a cheese extract). A 9-kg block of Cheddar was made, vacuum-packaged, and then stored for 2 wk at 4°C. After storage, the cheese was cut into 0.5- to 0.6-kg blocks that were vacuum-packaged and stored for 1 wk at 4°C. Cheese blocks were then high-pressure injected with a buffer solution (pH 5.27) containing 40% (wt/wt) citric acid trisodium dihydrate and 6.25% (wt/wt) anhydrous citric acid, from zero (control) to five times (successive injections performed 24 h apart). Increased citric acid content of cheese from 0.22 (uninjected) to 1.39% (after five injections) caused phosphate solubilization. Thus, the insoluble phosphate content of cheese decreased from 0.54 to 0.45 mmol/g protein. However, unexpectedly, the soluble calcium content decreased from 0.34 (control) to 0.28 mmol/g protein (after five injections), whereas the insoluble calcium content remained unchanged (0.42 mmol/g protein). The decrease in soluble calcium probably resulted from the formation and concentration of crystals in the cheese surface, which was not included in samples for analysis, and from serum expulsion. Higher concentration of solutes in the water phase would increase the volume of serum, but the cheese had limited holding capacity and serum was expelled. Citrate injection increased the sodium content of cheese from 0.63 to 0.93%, but

it had no effect on cheese pH (5.2). After five injections, the protein matrix occupied increased area of cheese matrix (83 versus 78%). Even though citrate injection had no effect on insoluble calcium, and thus the rate and extent of cheese flow were unaffected, increased phosphate solubilization, and possibly decreased ionic calcium content, resulted in expansion of the protein matrix and increased cheese hardness.

Key Words: Calcium, Phosphate, Protein matrix

W294 Continuous manufacture of mozzarella cheese using concentrated microfiltration retentate and recovery of virgin whey proteins. A. V. Ardisson* and S.S.H. Rizvi, *North East Dairy Foods Research Center. Cornell University.*

The objective was to develop a continuous cheese-making process, which utilizes concentration factor (CF) 8-9, pH 6.0 skim milk microfiltration (MF) retentate to produce low-moisture part-skim (LMPS) Mozzarella cheese.
Pasteurized skim milk was microfiltered to a concentration factor of 8-9 at 50C using a 0.1μm nominal pore diameter microfiltration membrane unit with a total area of 0.72 m^2. The system was equipped to maintain a uniform transmembrane pressure (UTMP) in the range of 68.9 KPa to 172.4 KPa. The milk was gradually acidified during microfiltration to pH 6.0 using glucono-d-lactone (GDL) at a concentration of 1.6g/l skim milk to adjust the calcium to protein ratio in the final retentate. Experiments were conducted to test the effect of four different cross flow velocities (CFV): 2.5, 3.5, 4.5 and 5.5 m.s-1on permeate flux, which allowed the determination of fouling of the membrane. Furthermore, flux decay was evaluated at four different transmembrane pressure levels (68.9 KPa, 103.4 KPa, 137.2 KPa and 172.4 KPa). The process was scaled-up to a membrane unit with a total area of 9.1 m^2 for the continuous production of cheese. The obtained retentate was subsequently standardized with heavy cream to a casein to fat ratio of 0.85 and converted into LMPS Mozzarella cheese curd in an Alcurd continuous cheese coagulator using single strength rennet (80μl/Kg retentate). The resulting curd was then cooked and stretched. The analyses performed on skim milk, retentate, permeate and cheeses included total solids, protein (Total N, non-protein N and non-casein N), fat and ash. The fat, moisture and protein contents of the cheese produced by the process as well as its textural characteristics were within the normal ranges for LMPS.

Key Words: Microfiltration mozzarella, Microfiltration retentate cheese, Whey protein depletion of milk

W295 Lexicon development of appearance and texture descriptors for melted cheddar cheese. K. M. Asato*, I. M. Tsai, and M. R. McDaniel, *Oregon State University, Corvallis, OR.*

A lexicon to define the sensory properties of melted cheddar cheese was created using a trained descriptive panel. The lexicon characterizes appearance (surface rupture, meltedness, oiliness, and edge browning) and texture (stringiness, stretchiness, springiness, firmness, toothpull, smoothness, cohesiveness, denseness, and chewiness). The newly developed lexicon was used to evaluate seven samples consisting of three commercial brands of shredded cheddar cheese at different ages (sharp, medium and mild) in order to determine how heat treatment (oven and microwave) affected the sensory perception of melted cheese. Microwave treated cheese was higher than oven treated cheese in all descriptors except edge browning, smoothness and cohesiveness. Under the same heat treatment, melted sharp cheddar was rated higher in oiliness and lower in all texture descriptors than melted medium and mild cheddar.

Key Words: Melted cheese, Cheddar, Sensory

W296 Monitoring spores and spore-forming bacteria populations in commercial skim milk powder production plants using conventional and molecular methods. C. Murillo*[1], C. Kitts[2], and R. Jimenez-Flores[1], [1]*Cal Poly Dairy Products Technology Center,* [2]*Cal Poly Biological Sciences Department.*

The microflora of milk powder consists of a wide array of microorganisms of which special attention is given to *Bacillus spp.* spores and spore formers. *Bacillus spp.* spores survive well in all processing stages and inhabit the milk powder in the dormant state indefinitely. Upon reconstitution, spores may germinate, and through their enzymatic activity become detrimental to quality. The objectives of this study are to 1) enumerate total aerobes, mesophilic, and thermophilic spore populations in commercial, low-heat skim milk powder production plants; 2) characterize the microbial ecology of this process using Terminal Restriction Fragment Patterns (TRFPs); and 3) compare the changes in the ecology during this process. Fluid and powder skim milk was collected from 3 commercial facilities during spring, summer, and fall '01-'02. Sampling points included the raw milk silo, separator, evaporator, and spray dryer. Samples were normalized based on total solids. Every sample was evaluated for total aerobes, mesophilic, and thermophilic spores. For TRFPs community DNA was extracted, amplified by 16S PCR, and digested with *HaeIII* and *DpnII*. Spore formers are predominant in condensed and powdered milk, and tend to increase in the powder with increasing processing time. In raw milk mesophilic and thermophilic spores ranged from ¡25CFU/g to 70CFU/g and ¡25CFU/g to 10^2 CFU/g, respectively. In powder they ranged from ¡25CFU/g to 10^3 CFU/g and ¡25CFU/g to 10^6 CFU/g, respectively. Both spore counts from skim milk showed an increasing trend with run time and rendered the powder out of the 10^3 CFU/g limit. In the ecology TRF patterns successfully described microbial populations, and an overall decrease in microbial diversity between raw and powdered milk was observed. Overall, *Bacillus spp.* were found in 92important organisms included *Clostridium spp.* (57*Staphylococcus spp.* (29*Streptococcus spp.* (9*Bacillus spp.* were present in 100from all 3 plants.

Key Words: Milk powder, Terminal restriction fragment patterns, Quality

W297 Enterotoxigenic *Bacillus* spp. DNA fingerprints revealed in powdered milk products using rep-PCR. R. M. Cooper* and J. L. McKillip, *Ball State University, Muncie, IN.*

As a staple food, milk powders and other dry functional dairy ingredients must reflect strict quality control and a long shelf life. As a means of assessing the microbiological quality of a battery of dry dairy products, the technique of repetitive element palindromic polymerase chain reaction (rep-PCR) was used as a screening tool to detect DNA fingerprinting profiles from potentially enterotoxigenic *Bacillus* spp. in five industrial formulations of lecithin, soy fiber, whey protein concentrate, and nonfat dry milk powder. Following a nonselective enrichment protocol (11-13 h) in tryptone phosphate glucose yeast extract (TPGY) broth to induce spore germination and vegetative cell growth to densities of 10^6 CFU/ml, each dry product was subjected to a commercial DNA extraction procedure and rep-PCR to generate distinct amplicon banding patterns that were analyzed using agarose gel electrophoresis. A distinct 1,230bp diagnostic band consistent with that of previously characterized enterotoxigenic *Bacillus cereus* was demonstrated in rep-PCR from nonfat dry milk, lecithin, and soy powders. The identity of the diagnostic band was confirmed by restriction enzyme analysis, and in each case generated the same digest pattern as the rep-PCR amplicon from the positive control *B. cereus*. These data validate the method of rep-PCR as a viable means of screening powdered dairy ingredients (and perhaps many other foods) for enterotoxigenic *Bacillus* spp. without the need for plating and enumeration using selective and differential media.

Key Words: Enterotoxigenic *Bacillus* spp., rep-PCR, Detection

Food Safety: Food safety; Methods, prevalence and control

W298 Detection of viable Enterobacteriaceae in milk by using real-time broad-range RT-PCR. S. H. Choi* and S. B. Lee, *Sangji University, Wonju, Korea.*

This study was carried out to develop real-time broad-range RT-PCR which could detect viable Enterobacteriaceae in milk. The threshold cycle(Ct) of the RT-PCR was determined by using Multiscribe reverse transcriptase and SYBR Green PCR Master mix(Applied Biosystem) and iCycler iQ(Bio-Rad). Following the RT-PCR , the synthesized DNA was confirmed in agarose gel electrophoresis. The nucleotide sequences of primers were designed based on the ribosomal protein genes, S11

and S13, in alpha ribosomal protein operon. The RT-PCR syntesized a DNA fragment of 520 bp from the template RNA isolated from 10^7 of ten Enterobacteriaceae strains, but not from *Pseudomonas fluorescens*, *Acinetobacter calcoaceticus*, *Enterococcus faecalis*, *Listeria monocytogenes*, and *Bacillus coagulans*. The Cts to detect the Enterobacteriaceae strains ranged from 21 to 23 but the Cts to detect the other bacteria were more than 40. The limit of bacterial number to detect *E. coli* was 1000. The Ct to detect *E. coli* in milk heated at 65°C for 30 min, at 100°C for 10 min, and at 121°C for 15 min were 32.7, 37.2 and >40.0, respectively. RNase treatment of the heated *E. coli* increased Ct but not unheated *E. coli*.

Key Words: RT-PCR, Enterobacteriaceae, Milk

W299 Use of real-time polymerase chain reactions (PCR) for the detection of pathogenic microbes in bulk-tank milk. J. S. Karns*, J. S. Van Kessel, and M. L. Perdue, *USDA-ARS, Beltsville, MD*.

Recent reports suggest an increase in consumption of raw milk and products made from raw milk in the United States. Several outbreaks of food-borne disease have been associated with the consumption of these products. Traditional culture methods for detection of pathogens in foods are generally time-consuming and labor intensive, often requiring more than 96 hours for positive identification. Methods for the rapid detection of pathogenic microbes in raw milk could help to minimize risks associated with consumption of raw milk. The objective of this study was to examine the usefulness of real-time PCR for the detection of *Salmonella enterica* and *Listeria monocytogenes* in bulk-tank milk. Twenty-four milk samples identified as *Salmonella* positive by traditional culture techniques and 176 that were *Salmonella* negative based on culture techniques were chosen for PCR analysis. DNA was isolated from the same tetrathionate enrichments used for culture identification and subjected to real-time PCR analysis using a commercially available reagent kit. Fifty-three samples were identified as *Salmonella*-positive by real-time PCR analysis. Two samples that were identified as being positive for *Salmonella* via culture were identified as being *Salmonella*-negative based on real-time PCR while 23 samples originally determined to be *Salmonella*-negative were *Salmonella*-positive based on real-time PCR. Serotyping confirmed that isolates from the 2 cultures that were PCR negative were not *Salmonella* while more rigorous culture of one of the PCR-positive, culture-negative enrichments did result in isolation of *Salmonella*. Eighty-one samples of bulk-tank milk shown to be positive for *Listeria* sp. by traditional culture were chosen for analysis with a published TaqMan primer/probe set specific for *Listeria monocytogenes*. DNA was isolated from the same Modified Listeria Enrichment broth cultures used for culture identification. Of these 81 samples 42 were clearly positive by real-time PCR, 8 were tentatively positive, and 31 were shown not to contain *L. monocytogenes*, indicating that the *Listeria* isolated from them were non-pathogenic species. This study suggests that real-time PCR techniques can be used to detect pathogenic microorganisms in bulk-tank milk with a sensitivity as good or better than traditional culture methods. In addition, these methods yield results within 24 h for *Salmonella* and 48 h for *Listeria*, greatly reducing the time required for positive identification of these pathogens in raw milk.

Key Words: *Salmonella*, *Listeria*, TaqMan

W300 Survey of bulk tank milk in the United States for food-borne bacterial pathogens. J. S. Van Kessel*[1], J. S. Karns[1], B. J. McCluskey[2], and M. L. Perdue[1], [1]*USDA-ARS, Beltsville, MD*, [2]*USDA-APHIS, Fort Collins, CO*.

The consumption of raw milk and raw milk products has led to periodic disease outbreaks in the United States and more information is needed to assess the incidence of food-borne pathogens in bulk tank milk. The objective of this study was to determine the prevalence of *Salmonella* spp., *Listeria monocytogenes*, and *Escherichia coli* in bulk tank milk in the United States. As part of the NAHMS Dairy 2002 survey, 861 bulk tank milk samples were collected from farms in 21 states and, when possible, shipped overnight on ice to the USDA-ARS laboratories in Beltsville, MD. Milk was directly plated on selective agars (MacConkey, Sorbitol MacConkey, XLT4, and Modified Oxford media) for direct bacterial enumeration and was enriched in selective broths (EC, tetrathionate, and modified Listeria enrichment broth) to increase detection sensitivity. After enrichment, cultures were streaked on selective media as above. Coliforms are often used as a general indicator of fecal contamination and coliforms were detected in 798 (92.7%) of the milk samples. Twenty two samples (2.6%) were culture-positive for *Salmonella*. When the *Salmonella enterica* isolates were serotyped, nine different serotypes were represented. The most common serotype was Montevideo which was found in seven milk samples. *Salmonella enterica* Newport was isolated from four samples, *S. enterica* Muenster, *S. enterica* Meleagridis, *S. enterica* Cerro, and *Salmonella* 44:Z36, (Z38) were identified in each of two milk samples, and *S. enterica* Dublin, *S. enterica* Anatum and *Salmonella* Sal9,12:nonmotile were identified in one milk sample each. *Listeria* was detected in 90 milk samples (10.4%) and, based on hemolysis, approximately 50% of these were *Listeria monocytogenes*, the only species of *Listeria* pathogenic to humans. The results of this survey demonstrate that *Listeria* and *Salmonella* contamination of bulk milk is relatively low and infrequent. Although their presence presents a risk to consumers of raw milk and raw milk products, pasteurization kills each of these species.

Key Words: *Listeria*, *Salmonella*, Milk

W301 Efficacy of lactic acid to prevent rapid *Salmonella* infection in market weight swine. M. D. Howard*[1], H. S. Hurd[2], and J. K. Gailey[2], [1]*National Swine Research and Information Center*, [2]*National Animal Disease Center, Ames, IA*.

Swine can become rapidly infected with *Salmonella* during lairage at the abattoir and during transport; suggesting a need for intervention. The goal of this research was to determine the efficacy of lactic acid to reduce rapid *Salmonella* infection. Thirty six market weight swine were randomly assigned to one of four treatments: 1) 0% lactic acid and 0 g Tylan®; 2) 0% lactic acid and 20 g Tylan®/907 kg of feed; 3) 0.44% lactic acid and 0 g Tylan®; 4) 0.44% lactic acid and 20 g Tylan®/907 kg of feed. Lactic acid was administered through drinking water. Lactic acid and Tylan® were available to pigs for 7 d prior to euthansia. Animals were placed in a pen contaminated with nalidixic-acid resistant strain of *Salmonella typhimurium* χ4232 and remained in the pen a minimum of 2 h and a maximum of 4 h prior to euthanasia. Samples of stomach fluid, ileal tissue, ileocecal lymph nodes, cecal contents, and distal colonic contents were analyzed for the presence of *S. typhimurium* χ4232. Among the four treatments no differences ($P \geq 0.05$) were detected in *Salmonella* prevalence from stomach fluid, ileal tissue, ileocecal lymph nodes, cecal contents, and distal colonic contents. Although not statistically significant some indications of treatment effects were noted. Cecal contents of pigs drinking water free of lactic acid tended ($P=0.27$) to have lower *Salmonella* prevalence than pigs consuming lactic acid. Distal colonic contents of Tylan®-free pigs tended ($P=0.21$) to have lower *Salmonella* prevalence than pigs consuming Tylan®. Ileal tissue of pigs drinking lactic acid water tended ($P=0.28$) to have lower *Salmonella* prevalence than pigs drinking untreated water. No treatments differences were detected in stomach-fluid concentrations of total lactic acid, dissociated, and undissociated lactic acid ions. This research suggests lactic acid was ineffective in reducing *Salmonella* prevalence; lack of lactic acid concentration differences in stomach-fluid suggests orally consumed lactic acid was either rapidly absorbed or administered at a level that was inadequate to raise it above physiological values.

Key Words: Lactic acid, *Salmonella typhimurium*, Market swine

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