pattern of calls differed greatly. On the day of hatch, calling rate gradually increased over the 16 h period. In contrast, during the post-hatch period, hen calls increased quickly during the first nine h, and then declined dramatically. The amount of time spent calling changed over the duration of the 16 h period. Hens spent more time calling at hatch than pre-hatch ($p < 0.001$), and more time calling in post-hatch than hatch ($p < 0.05$). In summary, the hens called more and spent more time calling as incubation progressed through hatch. A better understanding of parent - offspring communication during hatching may lead to beneficial applications to the commercial poultry industry.

Key Words: Poultry, Vocalization, Incubation

1154 The relationship between physiological parameters and behavioral response to social stress among three genetic lines of laying hens. R. Freire*[2], P. Singleton[1], Y. Chen[1], M.W. Muir[2], Ed. Pajor[2], and H.W. Cheng[1], [1]*USDA-ARS, Livestock Behavior Research Unit,* [2]*Dept of Animal Science, Purdue University.*

Two genetic lines of White Leghorn hens have been selected for high (HGPS) and low (LGPS) group productivity and survivability resulting from cannibalism and flightiness. Different behavioral patterns induced by heat and cold stress have been reported between the selected HGPS line and a commercial Dekalb XL (DXL) line. The aim of this study was to examine differences in the behavioral response to social stress among the three genetic lines and relate these differences to physiological variables that were reported previously. Twenty hens from each of the three genetic lines were paired to form 3 mixed line combinations and kept in cages from 17-wk to 24-wk of age. Activities were recorded from video using instantaneous sampling at 1-min intervals for 30 min and continuous recording of aggressive pecking in a 10 min period started at 0800 daily. No evidence was found that the three genetic lines differed in dominance status ($P > 0.1$ for 3 combinations) or attack latencies ($P > 0.7$). The HGPS hens spent less time pecking at the feathers or body of another hen (damaging pecking) than LGPS hens ($P < 0.05$). In addition, pecking at the cage (cage pecking) was lower in HGPS and LGPS hens than in DXL hens ($P < 0.01$). The differences in damaging pecking could not be explained by variation in physiological variables ($P > 0.2$), but a large proportion of the variation in cage pecking (r^2=59%) among the lines ($P < 0.001$) was explained by physiological variables, such as its unique alterations of heterophil/lymphocyte (H/L) ratio and corticosterone levels reported previously. In conclusion, the lower damaging pecking and cage pecking in HGPS hens may be related to their lower social stress in 2-hen cages when compared to the other two lines. The data suggests that the genetic lines could be used as animal models for stress physiological observations.

Key Words: Social stress, behavior, Genetic selection, chickens.

1155 Stress induced alterations of IgG concentrations and hematological parameters in genetically selected chicken lines. Y. Chen*[1], P. Singleton[1], M.W. Muir[2], and H.W. Cheng[1], [1]*USDA-ARS, Livestock Behavior Research Unit,* [2]*Dept of Animal Science, Purdue University.*

Two genetic lines of White Leghorn hens were selected for high (HGPS) and low (LGPS) group productivity and survivability resulting from cannibalism and flightiness. The aim of this study was to examine whether the selection alters the hens' immunity and hematology differently in response to social stress. At 17-wk of age, hens were randomly assigned into single- and 2-hen cages. The 2-hen cages contained one hen from HGPS or LGPS and one from a commercial Dekalb XL line that was used as standardized genetic competitor. At 24-wk of age, blood samples were collected from 70 hens (10 hens from 3 line, 2 replicates, plus 10 extra testers). Blood smears were prepared and stained with Wright's stains. A differential leucocyte count was collected from 200 leukocytes per hen. Concentrations of plasma IgG were quantified using ELISA. In single-hen cages, compared to HGPS hens, LGPS hens had a greater heterophil/lymphocyte (H/L) ratio ($P < 0.01$). In addition, LGPS hens had a greater number of eosinophils ($P < 0.01$). However, there was no difference in the concentrations of IgG between HGPS and LGPS hens. In 2-hen cages, when compared with these same lines in the single-hen status, LGPS hens exhibited a heterophilia, and a greater ratio of H/L ($P < 0.01$). In addition, although both HGPS and LGPS hens had an eosinophilia in 2-hen cages, a more intense increase was found in LGPS hens ($P < 0.001$). In contrast, HGPS hens had a greater increase in the concentrations of IgG in 2-hen cages vs. single-hen cages ($P < 0.01$). The data indicates that the immunity and hematology were differently regulated by the selection in the HGPS and LGPS lines. The changes of these physiological parameters in HGPS hens could be associated with their better adaptation to social stress that has been reported previously. Some of the parameters, such as ratio of H/L, eosinophilia, and IgG concentrations, could be used as an indicator of chicken well-being.

Key Words: Social stress, Plasma IgG and hmatological parameters, Genetic selection, chickens.

ASAS/ADSA Ruminant Nutrition: Feed Additives, Rumen Fermentation, Minerals, and Transition Cows

1156 Use of exogenous enzymes from amylases from *Bacillus licheniformis* and *Aspergillus niger* in high-grain diets. R Rojo, G Mendoza*, S Gonzalez, R Barcena, M Crosby, and L Landois, *Colegio de Postgraduados.*

Two industrial amylases, alpha-amylase from *Bacillus licheniformis* and glucoamylase from *Aspergillus niger* were evaluated as exogenous enzymes in sheep fed high-grain diets. Amylolytic activity was compared with ruminal amylases at conditions of pH and temperature similar to the rumen. In situ DM digestibility of sorghum diets (79%) was measured at 12 h of ruminal incubation. Amylases were added to the sorghum (2.9 g enzyme/kg grain) before mixing the diet. Fifteen sheep were used in a completely randomized design (control, amylase or glucoamylase) and individually fed for 40 d. The highest activity (units/mg protein) was found ($P<0.01$) in the amylase from *B. licheniformis* (4.1893) followed by the *A. niger* (1.9522) and ruminal fluid (0.0621). Addition of alpha-amylases increased in situ DM digestibility (%) at 12 h (control, 60.78), being greater with *B. licheniformis* (65.6) than *A. niger* (64.3). Intake was not affected by enzyme addition and no statistical differences were found in ADG (Control 238, *A. niger* 258, *B. licheniformis* 270 g/d), even when feed conversion numerically tended to be improved with the amylases (Control 4.59, *A. niger* 4.01, *B. licheniformis* 3.93 g/d). Despite the high amylolytic activity of the amylases and the improvements on in situ DM digestibility, no differences were detected in sheep performance.

Key Words: Enzymes, Grains, Starch

1157 Effect of direct-fed microbials supplementation on dairy cows fed nitrogen deficient diets and on *in vitro* bacterial growth. D. R. Ouellet* and J. Chiquette, *Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada, Lennoxville, Canada.*

Eight rumen fistulated Holstein dairy cows (679 kg BW; SEM = 5) were used in a duplicated 4 x 4 Latin square design with a 2 x 2 factorial arrangement of treatments. Dairy cows were fed diets formulated to be adequate (CTL) or deficient (DEF) in metabolizable protein (MP; 12% less than requirements). The two diets were fed with or without direct-fed microbials (DFM) supplement (10 g /head/d of a mixture of *Aspergillus oryzae* and *Saccharomyces cerevisiae*). Total mixed ration (60:40 grass silage:barley based concentrate) was fed 12 times daily. Dry matter intake, milk production and composition were determined. The DFM mixture was also supplied, *in vitro*, to pure bacterial cultures in order to study the effect on bacterial growth rate. Given the high milk yield, both diets were estimated (NRC, 2001) to be deficient (10 and 14% less MP than requirements for CTL and DEF, respectively). Milk production averaged 40.3 kg/d and was not affected by the level of MP in the diets or by DFM. Dry matter intake tended to be lower for cows fed DEF (21.2 vs 22.9 kg/d, $P < 0.07$) resulting in a tendency ($P < 0.09$) to improve milk efficiency by 9%. Milk constituents (protein, fat and lactose) were unaffected by treatments. When supplied *in vitro*, the DFM mixture stimulated the growth of *Selenomonas ruminantium* ($P < 0.001$), *Streptococcus bovis* ($P < 0.02$) as well as some cellulolytic species such as *Butyrivibrio fibrisolvens* ($P < 0.02$) and *Fibrobacter succinogenes* ($P < 0.01$). On the other hand, DFM did not

affect the growth of *Ruminococcus albus* or *Ruminococcus flavefaciens*. In conclusion, except for bacterial growth *in vitro*, addition of direct-fed microbials to diets deficient in metabolizable protein had no effect on the *in vivo* parameters reported.

Key Words: Direct-fed microbials, Dairy Cattle, Protein Deficiency

1158 Exogenous amylases from Bacillus licheniformis and Aspergillus niger improve starch digestion but not performance of sheep. G Mora, R Barcena, G Mendoza, S Gonzalez, and J Herrera, *Colegio de Postgraduados*.

Two industrial amylases, alpha-amylase from Bacillus licheniformis and glucoamylase from Aspergillus niger, were evaluated as exogenous enzymes in sheep fed 50% sorghum grain (30% corn stover; 9% soybean meal; 9% molasses; 1% urea; 1% minerals). Enzymes were added at 2.1 g/kg sorghum, with three treatments: Control, amylase from Bacillus licheniformis and glucoamylase from Aspergillus niger. A metabolic trail was conducted using a 3 x 3 Latin Square design with 3 sheep (68 3.0 kg BW) fitted with ruminal and duodenal cannula. The same treatments were randomly allotted to 21 lambs (26 23.9 kg initial BW) individually fed during 60 days; a Completely Randomized Design with initial BW as a covariate was used. Ruminal starch digestion was lower (P<.05) in the control group (75.1%), as compared to exogenous enzymes (82.95% amylase; 87.2% glucoamylase); ruminal pH, ammonia-N or VFA did not change. No differences (P>.05) were found in total tract starch digestion. In the growing assay, enzymes did not change (P>.05) (kg/d; 1.16 control; 1.29 amylase; 1.19 glucoamylase), daily gain (g/d; 211 control; 231 amylase; 209 glucoamylase) or feed conversion. Although ruminal starch digestion was improved with exogenous enzymes, no differences were detected in sheep performance.

Key Words: Starch, Digestion, Enzymes

1159 Influence of monomer or dimer forms of isopropyl ester of HMB, on the supply of metabolisable methionine to the blood of ruminants. J.C. Robert*, C. Richard, and B. Bouza, *Aventis Animal Nutrition, Antony, France*.

In this experiment, three products were tested : HMBi(M) (2 hydroxy 4(mthyl thio) butanoic acid isopropyl ester), containing 99% of monomers ; HMBi(MD) composed of 57% of monomers and 40% of dimers and Smartamine^{TM} M(Sm M) a methionine coated with a pH sensitive polymer based coating. Two non lactating rumen cannulated Holstein cows were used. Four treatments were given (4x one week periods) randomized between the two cows in a single dose : T1 : 65 g (M) ; T2 : 65 g (MD) ; T3 : 111 g (MD) ; T4 : 63 g Sm M.T4 was supplied at 1600h the first day (D1) for each experimental period and T1, T2 and T3 on D2 at 0800h. The animals were offered 10 kg/animal/day of a ration comprising 75% hay and 25% concentrate delivered in equal quantities twice a day. Blood samples were obtained on D2 of each experimental period at 0800, 0900, 1000, 1100, 1300 and 1500h and on D3 at 0800h. For T4, some additional blood collections were realized on D2 at 1800 and 2000h and on D3 at 0800, 1100 and 1500h to describe more completely the appearance of methionine in the blood. Blood plasma methionine concentrations (BPMC mg/100g) were measured on D1 at 1100h to establish base line values. Based on comparison of AUC and taking into account a reference value of 80% for bioavailability of methionine from Smartamine^{TM} M , the bioavailability of methionine into the blood from an oral single dose was 44% for HMBi(M). Dimers did not show any methionine bioavailability.

Treatment	T1 (M)	T2 (MD)	T3 (MD)	T4 (Sm M)	SED	Source p<
HMBi monomer (g/animal)	64	37	64	0		
HMBi dimer (g/animal)	0	26	44	0		
Sm M	0	0	0	63		
Methionine Equivalent g*	49	49	83	49		
Base line BPMC (mg/100g)	0.35	0.37	0.34	0.32	0.02	NS
Net BPMC (mg/100g)**	1.55a	0.82b	1.26ab	1.31a	0.62	0.001
Net Area Under Curve**	26.6b	9.9c	26.1b	47.8a	4.5	0.05

*based on methionine equivalent concentration in M and MD : 0.77 ; in Sm M : 0.74. **discounting base line

Key Words: Methionine, Bioavailability, Chemical derivative

1160 A blood kinetics methodology to measure bioavailability of rumen protected methionine sources for ruminants. J.C. Robert*, G. Etave, T. D'Alfonso, and B. Bouza, *Aventis Animal Nutrition, Antony, France*.

This experiment was designed to describe the relationship between spot digestible methionine supply and plasma methionine response in terms of Area Under the Curve (AUC). Four non lactating rumen cannulated Holstein cows were randomly assigned to four treatments in a latin square design (4x1week periods) . The four treatments comprised four levels of Smartamine^{TM}M - a methionine coated with a pH sensitive polymer based coating : T1 : 7.1, T2 : 17.8, T3 : 28.6 and T4 : 39.3 ; all values relate to estimated intestinal available methionine(g/day). Smartamine^{TM} M was supplied through the rumen cannula into the rumen liquid phase at 1600h on the first day (D1) of each experimental period. The animals were offered 10 kg/animal/day of a ration comprising 75% hay and 25% concentrate delivered in equal quantities twice a day. Blood samples were obtained on the second day (D2) of each experimental period, every two hours, starting at 0600h for the first eight samples and thereafter every four hours from 0600 until 1800h for D3 and D4. Blood plasma free methionine concentrations (BPMC mg/100g) to determine base line values were measured on D1 at 0900, 1100 and 1500h. The best relation between AUC(Y) and quantity of digestible methionine (X :g) was described by the exponential equation: Y = - 15.937454 (1-exp.(0.038261 X)) (SED=0.57). The objective, in the future, is to use this equation as a calibration to calculate the bioavailability of different sources of rumen protected methionine.

Treatment	T1	T2	T3	T4	SED	Dose p<
Smartamine^{TM} M supply (g/animal)	12	30	48.2	66.4		
Digestible Methionine* (g/animal)	7.1	17.8	28.6	39.3		
Base line BPMC (mg/100g)	0.38	0.38	0.36	0.35	0.02	
Net** Max. BPMC	0.23a	0.69ab	1.18b	2.25c	0.25	0.0009
Net**Area Under Curve	4.71a	16.3ab	31.0b	55.8c	6.2	0.0008

*based on methionine concentration in Smartamine^{TM} M : 0.74 and bioavailability 0.80 **discounting base line

Key Words: Methionine, Bioavailability, Methodology

1161 Effect of live yeast versus yeast culture on milk yield and related parameters in early lactation cows. G. Higginbotham*[1], J. Merriam[2], E. DePeters[3], and J. Sullivan[4], [1]*University of California Cooperative Extension, Fresno/Madera Counties,* [2]*University of California Cooperative Extension, Stanislaus/Merced Counties,* [3]*University of California, Davis,* [4]*Nutrius/Bioproducts, Kingsburg, CA*.

Live yeast and a yeast culture were compared in the diets of lactating cows. Two pens of early lactation Holstein cows on a commercial dairy farm, each totaling approximately 200 cows, were used to investigate effects of supplementing their diets with a feed additive containing

live *Saccharomyces cerevisiae* yeast (BIOY) or an additive containing fermentation products produced from a yeast culture (YC). Pens were similar in cow composition for parity and averaged 100 days in milk at the start of the study. Experimental design was a crossover with two 4-week periods. Both treatment pens were fed a mixed ration 2x daily composed of alfalfa silage, alfalfa hay, flaked corn, whole cottonseed, corn distillers, almond hulls, wheat millrun, soybean meal, mineral mix, molasses, animal fat and EnerGII®. Both feed additives were fed once daily in the TMR. The BIOY group received 114g/cow/day of BIOyeast® which provided 4g of Procreatin-7® (SAF Products, Minneapolis, MN), or 60 billion live CFU. The YC group received 114g/cow/day of Diamond V yeast culture® (Cedar Rapids, IA). Cows were milked three times daily and housed in freestalls with access to an open dry-lot. Milk yield and composition were recorded by measuring milk weights from two milkings for three consecutive days during the last week of each period. Daily feed intake as well as feed refusal were measured on a pen basis using the EZfeed™ feed management program Adjusted mean production per cow for the complete trial, based on milk measurements at the end of each period, was not different and averaged 44.2 and 44.5 kg/d (milk) and 43.6 and 43.5 kg/d (3.5% FCM) for BIOY and YC groups respectively. No difference in percentages of milk fat, protein, lactose and SNF occurred. Rumen fluid pH, total VFA concentration and blood urea N as measured from 8 cows per treatment were unaffected by treatment. Dry matter intake, which was measured on a pen basis, was similar. Results suggest that similar milk production responses can be achieved by feeding either live yeast or the metabolites produced from a yeast fermentation process.

Key Words: Yeast, Yeast culture, Milk production

1162 Milk production effects of a mycotoxin binder in diets with normal levels of contamination. A. Garcia*[1], M. L. Cuevas[1], G. A. Loarca[2], C. Landetta[3], and R. A. Patton[4], [1]*Instituto Tecnologico y de Estudios Superiores de Monterrey, Queretaro, Qro/Mexico,* [2]*Universidad Autonoma de Queretaro, Queretaro/Qro/Mexico,* [3]*Grupo Karluis, Queretaro,Qro/Mexico,* [4]*Nittany Dairy Nutrition, Mifflinburg, PA/USA.*

We investigated the effect of inclusion of a specific mycotoxin binder (Mexsil^{MR}, Grupo Karluis) on the milk producing ability of dairy cows fed low levels of dietary mycotoxins. Cows were divided equally into 2 treatment groups based on milk yield and parity. They were fed TMR and were milked 2X per day for 12 periods of 2 weeks each. Dietary treatments consisted of the normal diet and normal diet plus 125 g of mycotoxin binder. Feed samples were submitted to a laboratory for nutrient and mycotoxin analysis. Corn silage and TMR were screened for aflatoxin, zearalenone, deoxynivalenol (DON), fumonisin and T-2 toxin using commercial kits. Milk production and milk components were determined biweekly. Health and reproduction data were recorded. Statistical analysis was performed using Proc Mixed of SAS with pretreatment production variables used as covariates. Factors in the model were diet, parity, period and BST. TMR samples had greater mean concentration of mycotoxins than did corn silage samples except for zearalenone. Mean mycotoxin levels in the TMR across the study were below accepted tolerances. However, mycotoxin concentration was not constant due to SE of about 100 percent. Mean biweekly T-2 levels were elevated in periods 6 and 8. Total mycotoxin levels were elevated in periods 6, 8 and 10. Milk production of control cows declined in periods of higher mycotoxins. SCC and BCS were improved overall for binder treated group. Mean production response to feeding mycotoxin binder for 12 weeks is presented below. We conclude that when feed levels of T-2 are in excess of recommended even for a short time, inclusion of this mycotoxin binder will lessen production decreases.

Variable	Units	-Binder	SE	+Binder	SE	Significance
Milk Yield	kg	34.8	.83	35.2	.85	Treatment*Period<.05
Protein	%	3.08	.01	3.08	.01	ns
Fat	%	3.58	.05	3.56	.05	ns
Log SCC		1.67	.06	1.50	.07	.05
BCS		2.80	.02	2.88	.02	.01

Key Words: Mycotoxins, DON, T-2

1163 Milk production in Holstein cows supplemented with different levels of ruminally protected methionine. A Lara*[1], G.D. Mendoza[2], R Barcena[2], C.M. Garcia[2], and L Landois[2], [1]*Universidad Autonoma Chapingo,* [2]*Colegio de Postgraduados.*

The effect of different levels of ruminally protected methionine (RPMet) were studied in lactating cows. Forty multiparous Holstein cows were fed a basal diet (18.8% CP, 35% ruminal degradable protein, and 1.7 Mcal kg-1 Enl) with alfalfa, corn silage and concentrate (48% forage: 52% concentrate). After calving, cows were randomly assigned to the treatments, which consisted in four levels of RPMet: 0, 8, 16 and 24 g d-1 of MepronM85 (Degusa Co.). Milk production and composition were measured over 120 d postpartum. Body weight and condition score, DM intake and milk production were measured each 15 d (3 consecutive days) starting on day 5 post-partum. Milk samples were also collected (07:00 and 18:00 h). Data were analyzed with the repeated measures (four treatments in 8 periods through lactation). No treatment effects (P>.05) were detected on DM intake (25.48 2.51 kg d-1), body weight (599.78 19.78 kg), body condition score (2.51 0.19 units) and milk fat. However, milk production and protein were increased with addition of RPMet (P<.01). Cows supplemented with 8, 16 and 24 g of RPMet produced 2.2, 4.4 and 2.3 kg d-1 of more milk above the control, whereas milk protein output was increased by 93, 158 and 72 g d-1, respectively. Milk production responded quadratically (P<.05) to methionine level (Y = 31.11 + 0.5354 X + 0.0175 X), with the maximum milk production estimated with 16.2 g d-1 RPMet. Results indicated that Holstein cows with a mean of 35 kg d-1 milk, will require addition of ruminally protected methionine (16 g d-1) to improve milk production.

Key Words: Methionine, Milk production, Milk composition

1164 Enzymic release of reducing sugars from oat hulls by cellulase, as influenced by a synergistic interaction between *Aspergillus* ferulic acid esterase and *Trichoderma* xylanase. P. Yu*[1], J.J. McKinnon[1], D.D. Maenz[1], V.J. Racz[1,2], and D.A. Christensen[1], [1]*Department of Animal and Poultry Science, University of Saskatchewan, Canada,* [2]*Prairie Feed Resource Centre Inc., Canada.*

High amounts of hydroxycinnamic acids, mainly *p*-coumaric (PCA) and ferulic (FA) acids, are believed to be inhibitory to oat hull biodegradability by rumen microorganisms. Previous studies have shown that a novel enzyme - *Aspergillus* ferulic acid esterase (A-FAE) and *Trichoderma* xylanase (T-XYL) act synergistically to break the ester linkage between FA and the attached sugar of feruloyl-polysaccharides, releasing FA from oat hulls. We examined maximum enzymic release of reducing sugars from oat hulls with particle size of 250 μm by the action of individual enzyme alone (A-FAE at 4678.4 U/assay; cellulase at 22 levels, ranging from 0 to 2772.7 U/assay; T-XYL at twenty-two level, ranging from 0 to 4096 U/assay) and by the action of cellulase at six levels (6.3 mU, 2 U, 16 U, 128 U, 1024 U and 2772.7 U/assay), as influenced by a synergistic interaction between A-FAE (13 mU/assay) and T-XYL (1 U or 256 U/assay). Total acid-extractable reducing sugars in the oat hulls used in this study were 793.8 μg/mg. The results show that after a 24 h incubation with A-FAE alone, no reducing sugars were observed to be released from oat hulls. With cellulase alone, as the concentration increased from 0 to 2772.7 U/assay, the release of reducing sugars increased (P<0.01) from 0 to 39% with the highest release of reducing sugars at 512 U/assay. With T-XYL alone, as the concentration increased from 0 to 4096 U/assay, the release of reducing sugars increased (P<0.01) from 0 to 33% with the highest release at 2048 U/assay. When incubated together with T-XYL (1 U or 256 U/assay) and A-FAE (13 mU/assay), cellulase (6.3 mU-2772.7 U/assay) significantly increased (P<0.01) release of reducing sugars from 8 to 68%. These results indicate that the synergistic interaction between A-FAE and T-XYL on release FA from feruloyl-polysaccharides could make the remainder of the polysaccharides open for further hydrolytic attack and facilitate the accessibility of the main chain of polysaccharide to cellulase. This action extends the cell wall hydrolysis, thus releasing a higher yield of reducing sugars. Such enzymic pre-treatment of oat hulls may provide a unique advantage to rumen microorganisms for the biodegradation of the complex cell wall of oat hulls.

Key Words: Reducing sugars, Synergistic interaction, Oat hulls

1165 Effects of exogenous enzymes on fiber degradation of corn stalks. G. Tirado-Estrada[1], I. Mejia-Haro[1], C.R. Cruz-Vazquez[1], G.D. Mendoza-Martinez[2], I. Tovar-Luna[3], and J. Fajardo-Pea[1], [1]*CIGA ITA de Aguascalientes, Mexico,* [2]*Colegio de Posgraduados, Texcoco, Mexico,* [3]*URUZA- UACH.*

To evaluate effects of corn stalks treated with exogenous fibrolytic enzymes on digestibility and ruminal fermentation, a study was carried out in three experimental phases: I, IVDMD; II, in situ DM digestibility (ISDMD); and III, ruminal fermentation patterns. In phase I the effect of the enzyme concentration (E) was evaluated: 0 (control), 1.5 and 3 g kg^{-1} with three application methods of the enzyme: 1) dry (DE); 2) dry + 250 ml of water (DE+W); and 3) in a solution of 500 ml of water (SE). Treatments were: 0 enzyme (T0; control), 1.5 g of DE (T1), 3 g of DE (T2), 1.5 g of DE+W (T3), 3 g of DE+W (T4), 1.5 g of SE (T5), 3 g of SE (T6). In Phase II, four enzyme levels were used: 0, 1, 2 and 3 g kg^{-1}, two treatment times of corn stalks (0 h = T0 h and 24 h = T24 h), and two forage:concentrate rates, 82:18 (DI), and 73:27 (DII). In Phase III, the effect of the four enzyme levels on digestibility was evaluated on six sampling times 0, 3, 6, 9, 12 and 24 h after the application of the enzyme. Data were analyzed by ANOVA using the GLM of SAS (1985). IVDMD was affected (P<0.06) by enzyme application. T1 was higher (P<0.05) than T0, T4, T5, and T6. ISDMD and residual NDF disappearance (NDFR) of corn stalks were affected (P<0.01) by the E level due to type of diet and E x T and T x D interactions. Treatments with exogenous enzymes had greater values (P<0.05) of ISDMD than the control, and using 1g of E to 24 h presented the highest value (P<0.05). No differences (P>.05) were produced by enzyme level on the degradation of ADF. DI was higher (P<.01) than DII in both IVDMD and NDFR. In the reduced model (data of DI; 4 x 2) treatment of 1 g of E to T24 h was greater than the rest of the treatments (P<0.05) for ISDMD and NDFR. Quadratic and cubic trends in the complete experiment (Factorial 4 x 2 x 2) were shown for ISDMD and NDFR by enzyme effects and also in the E x T to 24 h interaction (P<0.01). The greatest concentration of total VFA was obtained with 1 and 2 g of E at 3 and 9 h of sampling (P<0.05), and propionate was increased at 1 g of E (P<0.05). The highest concentration of N-NH4 was reached with 1 and 2 g of E at 3 h (P<0.05). Results indicated exogenous fibrolytic enzymes affect digestibility and fermentation of corn stalks.

Key Words: Fibrolytic, enzymes, Fiber

1166 Effects of an acetyl esterase containing preparation produced by a ruminal fungal isolate on *in vitro* ruminal fermentations. J. M. Tricarico*[1] and K. A. Dawson[2], [1]*University of Kentucky, Lexington, KY,* [2]*Alltech Biotechnology Inc., Nicholasville, KY.*

An anaerobic fungus was isolated from the rumen of a steer fed a fescue hay-based diet and was grown anaerobically to produce a crude acetyl esterase containing enzyme preparation. This preparation did not contain measurable amounts of cellulase or xylanase activity. A series of studies were then performed to examine the effects of this enzyme preparation on in vitro digestion of a fescue hay-based diet by ruminal microorganisms. Batch cultures, established with rumen fluid from a steer fed the same diet, were used to examine the effects of supplemental acetyl esterase on in vitro VFA production. The effects of supplemental acetyl esterase on NDF digestion were examined using the Daisy^{II} in vitro incubation system and Ankom^{200} fiber analyzer (Ankom Technology Corp., Fairport, NY). After incubation at 39°C for 12 h, total VFA production and estimated hexose utilization rates were greater ($P < 0.05$) in cultures receiving the fungal preparation at 0.855, 2.85, 5.70, 8.55 and 11.4 units acetyl esterase/L than in control cultures. Acetyl esterase supplementation increased total VFA production mainly by enhancing ($P < 0.05$) acetate production without affecting the productions of propionate and butyrate except at acetyl esterase concentrations of 11.4 units/L. Total VFA production was greater ($P < 0.05$) in cultures receiving l.14 units acetyl esterase/L than in control cultures as early as 2.5 h into the incubation. However, NDF digestibility after incubation for 3, 6, 9 or 12 h and the rates of total VFA production calculated for the period of time between 3 and 12 h of incubation were not different between cultures receiving 1.14 units acetyl esterase/L and control cultures. These results indicate that acetyl esterase containing preparations enhance ruminal in vitro fermentation of feed and may have an impact on ruminant performance.

Key Words: Ruminants, Digestion, Esterases

1167 Contribution of an acetyl esterase containing enzyme preparation to the action of exogenous enzyme supplements for ruminants. J. M. Tricarico*[1] and K. A. Dawson[2], [1]*University of Kentucky, Lexington, KY,* [2]*Alltech Biotechnology Inc., Nicholasville, KY.*

Two studies were performed to examine the effects of combining a fungal enzyme preparation containing acetyl esterase activity and a commercial enzyme supplement for ruminants (Fibrozyme, Alltech, Inc., Nicholasville, KY) on *in vitro* fermentation of feed by ruminal microorganisms. The addition of both enzyme supplements to 1-L ruminal-simulating continuous cultures fed a fescue hay-based diet increased DM digestibility (47.4 vs. 60.2 g, $P < 0.10$), total VFA concentrations (112.7 vs. 122.8 mmoles/L, $P < 0.05$), estimated hexose utilization (62.5 vs. 68.3 mmoles/L, $P < 0.05$) and ammonia concentrations (30.8 vs. 31.4 mmoles/L, $P < 0.05$). Concentrations of acetate, propionate and butyrate were 7.8, 10.8 and 11.7 % greater ($P < 0.05$) in cultures receiving the enzyme supplements than in control cultures, respectively. In addition, enzyme supplementation reduced the acetate to propionate ratio (3.47 vs. 3.37, $P < 0.05$) and the pH (6.92 vs. 6.86, $P < 0.05$). The concentrations of total anaerobic, lactic acid-utilizing and cellulolytic bacteria did not differ in enzyme supplemented and unsupplemented cultures. In the second study, gas production was used to examine the kinetics of digestion in batch cultures fed a fescue hay-based diet, or its water-insoluble fraction, in the presence and absence of supplemental enzymes. Cumulative gas production over a 24-h period was 14 % greater (44.4 vs. 50.7 mL, $P < 0.05$) in cultures receiving the enzyme supplements than in control cultures when the fescue hay-based diet was used as the substrate. The maximum rate of gas production was reached 2 h earlier in enzyme supplemented cultures than in unsupplemented cultures when the water-insoluble fraction from the fescue hay-based diet was used as the substrate. These studies indicate that exogenous enzyme supplements containing acetyl esterase activities enhance ruminal fiber digestion by reducing the time required to reach the maximum rate of fermentation of insoluble substrates in feed.

Key Words: Ruminants, Digestion, Esterases

1168 Intake and milk production of dairy cows fed lactic acid bacteria and mannanoligosaccharide. J. Gomez-Basauri*[1], M.B. de Ondarza[2], and J. Siciliano-Jones[2], [1]*Alltech, Inc., Nicholasville, Kentucky,* [2]*F.A.R.M.E. Institute, Homer, New York.*

The objective of this 28-day study was to determine the effect of a supplement (27.27 g/d) containing strains of lactobacilli *Lactobacillus acidophilus, Lactobacillus casei, Enterococcus (Streptococcus) faecium* (Total lactic acid bacteria 1 billion CFU's/g) and mannanoligosaccharide (Bio-Mos®, Alltech, Inc, Nicholasville, KY) on daily dry matter intake (DMI), milk yield, and milk component concentration. Study animals consisted of two groups of 100 cows on a commercial dairy farm. Each group had similar initial milk yield (39.2 Kg/day) and days in milk (DIM, 154 days). Prior to the start of the study, it was determined that no pen effect existed. Cows entering any group during the course of the study were paired on production and days in milk. The basal ration consisted of corn silage, alfalfa/grass hay crop silage, whey, and commercial feed blend. Total ration composition was 17.7% CP, 38% UIP, 37.5% NFC, 4.5% fat, 28% forage NDF, and 1.67 Mcal/Kg NE_l. Thirteen days of milk yield data were used for statistical analysis. Milk was sampled from each cow during one milking on one day during week 3 and week 4 and analyzed for milk components. Cows fed lactic acid bacteria and mannanoligosaccharide consumed 0.42 Kg less DM (P<0.03) and produced 0.73 Kg/d more milk (P<0.06). There was a significant treatment by date interaction (P<0.03). Cows fed lactic acid bacteria and mannanoligosaccharide increased milk yields over time while control cows maintained constant milk yields.

	Treatment	Control	SE	P<
DMI (Kg/d)	24.56	24.98	0.13	0.03
Milk (Kg/d)	39.57	38.84	0.27	0.06
Milk Fat (%)	4.44	4.24	0.07	0.07
Milk Protein	3.04	3.02	0.02	NS

Key Words: Mannanoligosaccharide, Lactating Cows, Lactobacilli

1169 Effects of a commercial bacterial culture feed supplement on ruminal microorganisms. S. A. Martin*, *University of Georgia*.

The objective of this study was to examine the effects of a commercial bacterial culture feed supplement on growth and lactate production by mixed ruminal bacteria grown in batch culture. In addition, the effect of the feed supplement on the in vitro fermentation of ground corn or soluble starch by mixed ruminal microorganisms was investigated. When mixed ruminal bacteria were grown in medium that contained 2 g/L maltose, bacterial growth and lactate production peaked at 8 h and lactate was utilized over the next 22 h. Similar incubations were conducted using only the bacterial feed supplement and bacterial growth and lactate production peaked at 24 h and some lactate was utilized over the next 24 h. When mixed ruminal bacteria were incubated in the presence of the bacterial feed supplement, bacterial growth peaked after 8 h and lactate production peaked at 8 h and most of the lactate was utilized over the next 40 h. In 24 h ground corn fermentations by mixed ruminal microorganisms, 3.5 and 7 g/L of bacterial feed supplement decreased ($P < 0.05$) final pH and the acetate:propionate ratio, while 7 g/L decreased methane ($P < 0.05$) and butyrate concentrations and increased ($P < 0.05$) propionate and lactate concentrations. Similar treatment effects were observed in 48 h ground corn incubations except that the 7 g/L treatment increased ($P < 0.05$) butyrate concentration and no lactate accumulated. Fermentation of soluble starch in the presence of both concentrations of bacterial feed supplement for 48 h decreased ($P < 0.05$) final pH, hydrogen, methane, propionate, and butyrate and increased ($P < 0.05$) lactate. Collectively, these results suggest that the bacterial feed supplement alters the mixed ruminal microorganism fermentation.

Key Words: rumen, microorganisms, bacterial feed supplement

1170 Effect of forage level and fibrolytic enzymes on nitrogen digestion in beef cattle diets. M. Murillo, M.S. Vazquez, H.L. Castro, J.F. Sanchez, and M.A. Cerrillo*, *Universidad Juarez del Estado de Durango, Durango, Dgo. Mexico*.

Four Simmental bulls (550 ±45 kg BW) fitted with cannulae in rumen and duodenum were used in a 4x4 Latin Square design with a 2x2 factorial arrangement to evaluate the interaction of forage level (66 vs 33%) and fibrolytic enzymes (0 vs 15 g/d, Fibrozyme®) on ruminal digestion and postruminal nitrogen flow. There were no interactions between forage level and fibrolytic enzymes on ruminal digestion and postruminal flow of nitrogen (P>.05). However, low forage level in the diet increased intake and ruminal digestion of nitrogen, 12.5 and 10% respectively, (P<.01). The addition of fibrolytic enzymes to the diet affected neither ruminal digestion of nitrogen nor microbial efficiency (P>.05). However, low forage level increased microbial efficiency 9.7% (P<.05). Flow of feed and microbial nitrogen to the small intestine as well as post ruminal and total tract digestion of nitrogen were not affected by the addition of enzymes to the diet (P<.05). High level of forage increased flow of feed nitrogen to the duodenum (28.3%, P<.05, whereas low forage level increased the flow of microbial nitrogen (14%, P<.01). These results indicate that the addition of fibrolytic enzymes to the diets evaluated in this study did not affect nitrogen digestion.

Key Words: Fibrolytic enzymes, Cattle, Nitrogen digestion

1171 The effect of monensin and bovine somatotropin on lactation performance and body condition score of dairy cows. L J Erasmus*[1], L C Coetzee[1], C H Hesse[2], and T E Spike[3], [1]*Agricultural Research Council, Irene, South Africa,* [2]*Elanco Animal Health, Bryanston, South Africa,* [3] *Elanco Animal Health, Indianapolis, IN*.

Monensin supplementation has been associated with an improved energy status in dairy cows resulting from an increased supply of glucogenic precursors in the form of propionate. Bovine somatotropin (bST) administration is known to prolong the period of negative energy balance experienced by cows during early lactation. This study investigated the effect of bST (sometribove/500mg/14 d) administration (commencing d 60 or d 100), with or without monensin supplementation on the productivity of dairy cows. Sixty four Holstein cows (32 multiparous and 32 primiparous) were used in a completely randomized block design. All cows received an alfalfa-corn based total mixed ration (18.5% CP, 11.3 MJ ME/kg DM) supplemented with 16 ppm monensin from 3 wk prepartum until 3 wk postpartum whereafter cows were blocked and assigned to treatments based on parity, milk production from d 15 to d 21, body weight, and body condition score (BCS). The four experimental treatments which were fed until d 240 postpartum were: 1) no monensin, bST d 60 (B60); 2) no monensin, bST d 100 (B100); 3) monensin plus, bST d 60 (MB60); 4) monensin plus, bST d 100 (MB100). Milk production varied from 31.3 kg/d (MB100) to 33.4 kg/d (B60) and did not differ among treatments (P>0.05). Dry matter intake was higher for cows that received bST on d 100 compared to d 60, the effect being most pertinent amongst primiparous cows (P<0.05). Monensin supplementation per se did not affect intake but tended to depress butterfat percentage (P=0.08). Body condition score was significantly increased (P<0.05) by monensin supplementation (2.60 vs 2.82); earlier administration of bST had no effect on BCS. Gross efficiency of milk production was increased (P<0.01) by earlier bST administration; 1.43 vs 1.30 for cows administered with bST on d 60 and d 100 respectively. These data suggest that monensin can play a positive role in recouping BCS before the next lactation and earlier bST administration (d 60) can improve gross efficiency of milk production.

Key Words: Dairy cows, Somatotropin, Monensin

1172 Differential response of D- and L-Met free plasma in cows fed different sources of rumen protected Met. Mercedes Vazquez-Anon, David Parker*, and Julia Dibner, [1]*Novus International, Inc. St. Louis, MO*.

L-Met is the biologically active form of Met. D-Met can also be used as a Met source by the cell after its conversion to L-Met. In this study, the contribution of different Met sources to plasma D- and L-Met is evaluated. Five dairy Holstein cows were used in a 5 x 5 Latin Square design. Oral doses of 49 g of DL-Met (E), 56 g of Alimet® (A), 32 g of Smartamine (S), and 28 g of Mepron (M) were mixed with 454 g of corn meal and offered to cows for 4 days. On day 4, the dose remaining after 30 minutes was placed within the rumen under the mat layer. All doses were calculated to supply equivalent amount of Met to the animal. Blood samples were taken on day 4 at 0, 1.5, 3, 6, 9, 12 and 24 h intervals for analysis of total free Met. In addition, analysis of D- and L-Met was undertaken using a chiral column from samples of two of the cows fed A, S and M. The averaged total free Met concentration over time was 2.27a, 2.40a, 3.03b, 3.68c and 5.12d ug/ml (± 0.38) for control, E, A, M and S, respectively (numbers with different letter differed P ≤ 0.01). A significant time by treatment interaction was observed (P≤ 0.01). Plasma Met concentrations peaked at 6, 12 and 12 h after feedings from cows fed A, S and M, respectively. The rapid appearance of Met in cows fed A is due to its faster ruminal clearance with the rumen liquid phase and partial absorption across the omasum prior to its arrival in the duodenum. Met from S and M is not absorbed until they reach the transporter systems in the small intestine. Distribution of D- and L-Met isomers differed among sources. Of the total plasma Met over the 24-h sampling period, 100 % was in the form of L-Met in cows fed A. In animals fed S, D- and L-Met contributed 52 and 48 % to the total plasma Met. In animals fed M, D- and L-Met contributed 50 % and 50 %, respectively. Differences in the peak response in plasma free Met concentration to rumen protected methionine sources can be partially explained by the contribution of D-Met to the plasma free Met pool in animals given M and S.

Key Words: Plasma , Methionine

1173 Effect of ruminally protected methionine and inert fat on milk production in primiparous Holstein cows. J Ayala*[1], G Mendoza[2], L Landois[2], A Ramirez[3], and S Vega[31], [1]*Universidad Autonoma Chapingo,* [2]*Colegio de Postgraduados,* [3]*Universidad Autonoma Metropolitana*.

The effects of two levels of ruminally protected methionine (RPMet) and inert fat were studied in lactating cows. Thirty two primiparous Holstein cows were fed with a basal diet with alfalfa, corn silage and concentrate (60% forage: 40% concentrate). After calving, cows were randomly assigned to the treatments in a completely randomized desing with factorial arrangement (2 x 2), which consisted in combinations of two levels of RPMet: (0 and 20 g d^{-1} of MepronM85 ; Degusa Co.) with inert fat (0 and 3.5% of DM). Intake was estimated with markers. Milk production was measured during the first 45 days post-partum. Milk samples were collected during lactation peak (07:00 and 18:00 h). Daily intake was (kg) improved with fat (control 18.9^b; Met 18.3^b; fat

19.3^{ab}; Met+fat 20.3^{a}). Milk production (kg/d) at lactation peak was lower (P<.05) in control group (17.0^{a} vs. Met 23.5^{b}; fat 24.7^{b}; Met+fat 23.9^{b}), with lower persistency . There were no interactions fat x Met; main effects on milk production (45 d post-partum) were: met 21.6^{b}; fat 19.32^{ab}; 16.0^{a} control. Milk fat (%) was increased (P<.05) with inert fat (control 2.89^{a}; Met 2.71^{a}: fat 3.22^{b}; Met+fat 2.78^{a}) whereas milk protein (%) was augmented with RPMet (control 2.61^{a} ; Met 2.95^{b}; fat 2.58^{a} ; Met+fat 2.84^{b}). There was a positive response in primiparous Holstein cows receiving ruminally protected methionine and inert fat.

Key Words: Methionine, Inert fat, Milk production

1174 Ruminal degradability of different feeds in the presence of *Saccharmoyces cervisiae*. G. Scaglia*[1], J.J. Williams[1], L.W. Greene[1], and N.A. Cole[2], [1]*Texas A&M University Agricultural Research and Extension Center, Amarillo,* [2]*USDA-ARS at Bushland.*

Research from our laboratory has shown that feeding *Saccharmoyces cervisiae* (SC) to growing steers increased ruminal fluid pH and digestibility of certain nutrients. Therefore, the objective of this study was to determine the *in situ* dry matter disappearance (DMD) of grain and hay sources, and ruminal fluid pH in the presence of different yeast strains. Three ruminally-cannulated cows were individually fed either no yeast, 10 g of SC47 (BIOSAF; $8x10^{9}$CFU/g), or 5.3 g of P7 (PROCREATIN-7; $1.5x10^{10}$CFU/g) daily in a 3 X 3 Latin Square (LS) design. Each period of the LS consisted of a 12-day adaptation and 3-day data collection. Cows were fed 7.7 kg of a concentrate diet (80% corn grain, 10% cottonseed hulls, and 10% of a protein/vitamin/mineral supplement) using electronic Calan gate feeders. On day 13, 5 g of steam-flaked corn grain, wheat grain, milo, alfalfa hay, and low and high quality sorghum hay was introduced into the rumen contents using *in situ* digestion bags at 0, 24, 36, 40, 44 and 48 hours (3 replicates/feed/time). At 48 h, bags were removed and washed with hot water until rinse water was clear. Bags were dried at 60 C and weighed to determine DMD at the different times of incubation. On day 15, ruminal fluid pH was measured at 0, 2, 4, 6 and 8 h after feeding. Wheat grain was the most rapidly digested followed by corn grain and then milo. Alfalfa hay was the most rapidly digested among the forages, with both sorghum hays having similar (P > 0.10) DMD. Yeast had no effect (P > 0.10) on the rate or extent of the *in situ* DMD of grains or hays. The regression of indigestibility (1-DMD) did not indicate that yeast strains used in this study affected the DMD of grains or hays. Ruminal fluid pH (6.45, 6.47, and 6.30) was similar (P = 0.16) when cows were fed the control, P7, and SC47 diets, respectively. These data suggest that there was no effect of the yeast strains tested on the DMD of the grains or hays and on ruminal fluid pH.

Key Words: grains, hays, yeast

1175 The effects of ethoxyquin on performance and antioxidant status of feedlot steers. K. W. McBride*[1], L. W. Greene[1], N. K. Chirase[1], E. B. Kegley[2], and N. A. Cole[3], [1]*Texas A&M University System, Amarillo, TX,* [2]*University of Arkansas, Fayetteville, AR,* [3]*USDA-ARS, Bushland, TX.*

The effect of dietary ethoxyquin (EQ) on antioxidant status, VFA status, feed conversion, ADG, and volatile N losses from manure were determined. Eighty feeder steers (219 kg) were purchased and transported to Fayetteville, AR. Steers were housed in 16 pens during a 42-d backgrounding period, and fed either a control diet or 150 ppm EQ, (Agrado; Solutia Inc., St. Louis, MO). Pre-transit blood and ruminal fluid samples were obtained at 0700 on d 42 and steers were transported by truck to Bushland, TX that evening. On arrival (0600), steers were processed and allotted to 6 pens equipped with pin-pointer feeders or 2 bunk pens (10 hd/pen). Steers were fed either a control or 150 ppm EQ diet in a 2 x 2 factorial arrangement with pre-transit diet. Jugular blood was drawn on d 0, 28, and 87 post-transit. Weights were obtained at 28-d intervals, and rumenocentesis was performed on d 5 and 28 to determine ruminal fluid VFA. Samples of excreta were collected from pen surfaces on d 28 to determine NH_3 volatilization using an in vitro gas emission chamber. Steers fed EQ in Arkansas had lower (P < 0.05) serum vitamin E concentrations pre-transit than controls steers (1.93 vs 2.23 μg/mL). Post-transit, steers that received EQ in Arkansas had higher (P < 0.04) vitamin E concentrations than control steers. Steers receiving EQ post-transit had greater vitamin A concentrations (P < 0.03) than control steers on d 28 and 87. Steers fed EQ consumed more (P < 0.001) feed (8.58 vs 7.25 kg/d) for d 1 to 182, and subsequently had greater (P < 0.05) ADG (1.61 vs 1.45 kg/d). Butyrate and iso-valerate were the only VFA affected by treatment, post-transit. The excreta harvested from pens housing steers fed EQ had 37% greater (P < 0.03) NH_3 volatilization than control pens. These results suggest that adding ethoxyquin to a typical feedlot diet may increase ADG of feedlot steers, and may effect certain antioxidant concentrations during the receiving period.

Key Words: Steers, Antioxidant, Feedlot Performance

1176 Effect of exogenous fibrolytic enzymes on the digestion of alfalfa hay and barley straw by cellulolytic ruminal bacteria. Y. Wang*[1], T. A. McAllister[1], L. J. Yanke[1], K. A. Beauchemin[1], D. P. Morgavi[1], L. M. Rode[2], and W. Yang[1], [1]*Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB,* [2]*Rosebud Technology Development Ltd., Lethbridge, AB.*

The effects of exogenous fibrolytic enzymes on colonization and digestion of ground barley straw and alfalfa hay by *Fibrobacter succinogenes* S85 and *Ruminococcus flavefaciens* FD1 were studied in vitro. Particles 1.5-2.0 mm diameter were used in the study. The enzyme was a mixture of two preparations from *Trichoderma* spp., with predominant xylanase and β-glucanase activities. Substrates (100 mg) were incubated in 5 ml of medium containing 0, 28 or 280 μg/ml enzyme for 24 h at 39°C, then were inoculated with medium or 24-h bacterial culture (0.1 ml) and incubated for a further 48 h ($n = 4$). Substrate colonization (via scanning electron microscopy) and NDF disappearance were determined. Glucose was included in an additional set of controls to assess possible effects of reducing sugars (RS) in the enzyme, but RS were found not to affect colonization or NDF digestion. Both levels of enzyme and both bacteria were effective at digesting NDF from hay and straw. With both substrates, more NDF hydrolysis ($P < 0.01$) was achieved with enzyme at high rate than at low. Strain FD1 had a greater capacity ($P < 0.01$) to digest hay than did S85, but digestion of straw was similar ($P > 0.05$) between the species. Presence or amount of enzyme did not affect ($P > 0.05$) extent of hay digestion by S85. A synergistic effect ($P < 0.01$) of S85 and enzyme on straw digestion was observed with 28 μg enzyme/ml but not 280 μg/ml. Strain FD1 digested more ($P < 0.01$) hay and straw with high enzyme than with low or no enzyme, but the effect was additive rather than synergistic. Bacterial colonization of both substrates was enhanced by preincubation with enzyme. Included in the incubation medium, exogenous enzymes showed potential to improve fiber digestion by cellulolytic ruminal bacteria. Their efficacy was dependent on bacterial species and rate of application.

Key Words: Exogenous enzymes, Cellulolytic bacteria, Fiber digestion

1177 Sources of non-protein nitrogen and the addition of Sacharomyces cerevisiae to sugar cane based diets for young bulls: Intake, digestibility, nitrogen balances and ruminal parameters. E. S. Pereira*[1], A. C. Queiroz[2], S. C. Valadares Filho[2], L. F. Miranda[3], and A. M. V. Arruda[1], [1]*Universidade Estadual Oeste Parana ,* [2]*Universidade Federal Viosa,* [3]*Universidade Federal Minas Gerais, Brazil.*

The objective of the present study was to evaluate the effects of the non-nitrogenous sources and the addition of Sacharomyces cerevisiae to sugar-cane based diets on the intakes and the total and partial apparent digestibility of dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), total carbohydrates (TC), neutral detergent fiber (NDF) and non- structural carbohydrates (NSC). The nitrogen balance and ruminal parameters were also evaluated. Four Holstein-Zebu young bulls rumen and abomasal fistulated were allotted to a 4x4 Latin Square design in a 2 x 2 factorial arrangement. The animals were fed with sugar cane based diets, supplemented with two nitrogenous sources (urea or poultry litter) and two daily Sacharomyces cerevisiae addition (0 and 10 g/animal). The indigestible neutral detergent fiber (NDFi) was used as a marker, to determine the total and partial apparent digestibility of the nutrients. The intakes of DM, OM, EE, TC, NSC was not influenced by the nitrogenous sources and by the Sacharomyces cerevisiae addiction. The intakes of CP and NDF were higher for the diets supplemented by poultry litter. The coefficients of total digestibility of CP and EE were higher for diets with urea. The apparent total digestibility of DM, OM,TC, and NDF were not influenced by the nitrogenous sources and by the Sacharomyces cerevisiae addiction. The ruminal pH linearly decreased for the diets supplemented with urea, and presented a quadratic behavior when to these diets were

additioned Sacharomyces cerevisiae. The ruminal ammonia concentrations presented a quadratic behavior, and the maximum estimated values of 16 .90; 26.12; 18.48 and 14.40 mg/dL for the diets with sugar-cane and urea, sugar cane, urea and Sacharomyces cerevisiae; sugar-cane and poultry litter; sugar-cane, poultry litter and Sacharomyces cerevisiae, respectively.

Key Words: Bovine digestibility, Intake, Supplements

1178 Effects of Live Yeast Concentrates on the In Vitro Semi-Continuous Culture Fermentation of a High Concentrate Diet. J. J. Williams*, G. Scaglia, and L. W. Greene, *Texas A&M University Research and Extension Center.*

A semi-continuous culture fermentation system was utilized to examine the effects of live yeast concentrate on ruminal pH in vitro. The experiment was designed as a 6 X 6 latin square utilizing 5 different strains of live yeast concentrate including: L13 (1 x 10^{10} cfu), L30 (1 x 10^{10} cfu), L11 (1 x 10^{10} cfu), SC47 (8 x 10^{9} cfu) and proceatin 7 (1.5 x 10^{10} cfu) yeast strains. Six fermentation vessels containing inoculum from a ruminally fistulated cow were fed a high concentrate diet for 6 periods of 14 d. Each vessel was fed 7.5 g of diet containing a specific live yeast concentrate 3 times daily at 8 h intervals. Each canister was flushed with carbon dioxide (CO_2) to maintain anaerobic conditions. All fermentors were maintained in a circulating heated water bath kept at a temperature of 39C. Standard McDougall's artificial saliva was utilized as a buffer at a flow rate of .56 ml per min. Yeast treatments were included in each of the diets based on equal quantities of colony-forming units (cfu). After a 2 d adjustment period all fermentors were fed their respective diets for 12 d. On d 10 and 11 pH of the inoculum was measured every 2 h for 8 h. On d 12 samples were taken every 2 h for 8 h. All samples were immediately placed in a -20C freezer. During periods 1 - 5 of the experiment, the SC47 treatment displayed pH values less than ($p < .05$) control. There were however no differences among any treatments when all periods were combined. The pH data for the L11 treatment also displayed values that were consistently less than ($p < .05$) control, however, again no difference overall was determined among any treatment. Although none of the yeast treatments displayed a significant ($p < .05$) increase in pH above control, the L13 and L30 yeast treatments did show a consistent numerical increase over the pH values of all other treatments.

Key Words: Continuous Culture, pH, yeast

1179 Use of gas production technique to estimate the rate and extent of starch degradation from starchy feedstuffs in rumen fluid. Weizhong Chai[1], A. H. van Gelder[1], and J. W. Cone[1], [1]*ID TNO Animal Nutrition, Institute for Animal Science and Health, The Netherlands.*

Abstract Gas production (GP) and starch degradation (STAD) from starchy feedstuffs were measured simultaneously by in-vitro incubation in buffered rumen fluid after 0, 4, 6, 8, 12, 16 and 24 h incubation to explore the possibility to estimate STAD via GP technique for starchy feedstuffs. The results showed the ranking in the initial degree of starch degradation and gas production. Potato starch and maize had the slowest initial rate, and tapioca, corncob mix and barley had the fastest ones in STAD. Starch degradation of Over 75% took place after 6-h incubation and nearly finished completely in 24-h incubation. Potato starch and maize, likewise, had the slowest initial rate of gas production, and however the fastest initial rate was found in the samples with smallest total starch content (TSC) such as pea and barley. Gas production was in line with the starch degradation, but the linking degree between GP and STAD varied with the samples with different TSC, especially in the initial incubation. Overall regression indicated a strong correlationship between GP and STAD with R2 0.88 and for individual sample, R2 ranged from 0.93 1.00. The regression relationship was affected by TSC of the sample. A larger TSC displayed a higher coefficient and constant as well. R2 for the constant and coefficient regression with TSC was 0.88 and 0.91 respectively. The multiple linear regression was made via TSC and GP as two main predictors: STAD=-318.14+0.427*TSC+1.876*GP(R2=0.95, RSD=48.71, P=0.0000). The estimation equation was further modified by using GP as main predictor and its constant and coefficient was, however, indirectly estimated by incorporating the regressions of constant and coefficient with TSC instead of direct estimation: STAD=(0.2088*TSC+168.55)+GP*(0.00136*TSC+0.9654)(R2=0.97, RSD=41.2, P=0.0000). R2 and RSD in both equations were well improved if compared with the values of 0.88 and 76.15 of the regression using GP as unique predictor. The much higher in R2 and RSD of the second equation indicated the modified equation was more accurate and robust. Gas production technique can be used to estimate the rate and extent of starch degradation in rumen fluid, as long as the starch content is taking into account.

Key Words: Gas production, Starch degradation, Rumen fermentation

1180 The effects of substrate, ammonia and pH on gas production and starch degradation from starchy feedstuffs in buffered rumen fluid. W. Z. Chai[1], J. W. Cone*[1], A. H. van Gelder[1], and A. A. Kamman[1], [1]*ID TNO Animal Nutrition, The Institute for Animal Science and Health, The Netherlands.*

Abstract Three experiments were conducted to evaluate effects of pH, substrate and ammonia levels on starch degradation (STAD) and on gas production to look into the optimal conditions for GP technique in starchy feedstuff evaluation. The pH effect on STAD of six starchy samples was studied by using phosphate buffer mixed with rumen liquor in 24-h in-vitro incubation. The results indicated pH 5 adversely affected STAD and no significant differences were found among pH 7, 6 and 5.5, even though STAD appeared larger at pH 6. The ranking in STAD degree of the starchy feedstuffs was found in vitro degradation with rumen fluid at all pH levels. Barley, wheat and tapioca showed the highest STAD and potato starch and maize the lowest in STAD at each pH level. Minimum STAD took place in first 4-h incubation. Substrate level did not affected total GP (g-1OM), but influenced total GP per incubated bottle. On the other hand, substrate concentration significantly affected the shape of gas curve. Increased substrate reduced the time to reach the half-maximal gas production and curve sharpness. Thus substrate concentration affected the fermentation rate, and higher increased substrate concentration increased GP rate in the OM range of 100 500mg substrate. Ammonia carbonate concentration (ACC) did not affected total GP (g-1OM) in such starchy feedstuffs, but it affected the shape of GP profile. GP rate was improved with the increase of ammonia carbonate in the buffer. GP rate of 0.0 ACC was significantly slow from those of other ACC. Though GP rate of 1.0 ACC was the fastest, but no significant differences were found among ACC levels of 1.0, 1.5 and 2.0 in GP rate. The finding from this study proved pH 6.9, 1.0g ACC and 400mg substrate in buffered rumen fluid, the condition of media was currently used in ID-Lelystad, were appropriate in GP technique for the STAD evaluation of starchy sample. These experiments emphasize the need for standardization of GP technique to facilitate the comparison of results among the samples and laboratories. This need will be extreme when GP is used for feed evaluation. The sensitiveness in GP rate and extent among starchy samples imply the great potential and accuracy of GP technique in evaluating the characteristics of different starchy feedstuffs.

Key Words: Gas production; Starch degradation;, Substrate; Ammonia; pH;, Rumen fermentation; In vitro

1181 Splanchnic first pass sequestration of acetate absorbed from the washed reticulo-rumen of dairy cows. N. B. Kristensen*, *Danish Institute of Agricultural Sciences, Tjele, Denmark.*

The present study was undertaken to investigate the sequestration of acetate in the reticulo-ruminal epithelium and liver of dairy cows. Four ruminally fistulated Holstein cows yielding 15 to 25 kg milk/d were infused with 2-13C-acetate (6.2 ± 0.1 mmol/h) in a jugular vein and blood was sampled from the other jugular vein or V. epigastrica. The reticulorumen was emptied and washed in warm tap water and isotonic NaCl. The buffers incubated in the ru-men was bicarbonate buffered, adjusted to pH 6.8 and heated to 39C before administration. The experimental protocol was divided into 3 periods of intraruminal incubations: C1) 45 min with 20 l of control buffer without VFA, Exp) 180 min with 20 l VFA buffer and con-tinuous intraruminal infusion of VFA, and C2) 45 min with 20 l of control buffer without VFA. The isotopic composition of acetate was measured by gas/liquid chromatography - isotope ratio mass spectrometry. During the Exp period 4.55 ± 0.02 mole of acetate, 2.06 ± 0.01 mole of propionate and 0.42 ± 0.00 mole of butyrate were added to the rumen. During the Exp period the cows absorbed 2.87 ± 0.05, 1.36 ± 0.01, and 0.28 ± 0.00 mole of the ace-tate, propionate and butyrate, respectively. The irreversible loss rate (ILR) of acetate

(357 ± 32 mmol/h) was not different (P = 0.3) in period C1 compared with period C2 and this value was used as an estimate of acetate supply of non-ruminal origin. The ILR of acetate re-sponded promptly to the introduction of VFA buffer into the rumen. After 10 min of VFA buffer incubation the ILR had increased (P < 0.001) to the level maintained throughout the 180 min period (1115 ± 47 mmol/h). Of the acetate absorbed by the cows 20 ± 2 % did not enter the peripheral circulation. During VFA buffer incubations the splanchnic first pass se-questration of acetate was 193 ± 25 mmol acetate/h. These results show that the maximum possible acetate metabolism in the reticulo-ruminal epithelium under these experimental conditions is insignificant in relation to the ILR of acetate in a non-nutrient deprived cow.

Key Words: VFA, Metabolism, Dairy cows

1182 The effect of dietary roughage on rates of glucose, acetate and beta-hydroxybutyrate clearance from plasma in dairy calves. D.L.J. Benschop*[1], J.P Cant[1], and R. Spratt[2], [1]*University of Guelph, Guelph, Canada,* [2]*Agribrands Purina Canada Inc., Woodstock, Canada.*

It has been suggested that the ability to utilize VFA post-absorptively occurs subsequent to the structural development and ability to produce VFA in the rumen. To test the effect of dietary roughage on post-absorptive utilization of glucose, acetate and beta-hydroxybutyrate (BHB), 24 male Holstein calves were stratified by liveweight at one week of age and randomly assigned to one of four dietary treatments (n=12) for a period of eight weeks. Treatments were a processed-grain control diet (CON), and three diets in which the grain was partially replaced by 10% roughage (10R), 20% roughage, or cracked corn (CC). Analyzed NDF levels in the CON, 10R and 20R diets were 18%, 20% and 23% of DM, respectively. Glucose, acetate and BHB clearance tests were carried out on weeks two, six and eight of age. Calves were weaned from milk replacer at week 5. BHB was injected through a jugular vein catheter as a bolus of 0.036 mmol/kg bodyweight (BW) at week 2 and 0.09 mmol/kg BW at weeks 6 and 8. Due to the fast rate at which BHB levels returned to baseline, blood samples were collected at -10, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 25 and 40 minutes post-injection. Glucose (2.78 mmol/kg BW) was infused over a 1-min period and samples were taken -10, 0, 5, 10, 15, 20, 25, 30, 45, 60, 90, 120 and 150 min after infusion. Sodium acetate (0.8 mmol/kg BW) was infused over a 3-min period and samples were obtained at -10, 0, 2, 4, 6, 8, 10, 15, 20, 25 and 30 min post-infusion. Baseline glucose concentration in plasma was not affected by treatment but increased from 4.5 to 6.2 mM between 2 and 8 weeks of age. Glucose clearance also was not affected by dietary treatment but increased from 3.42 to 4.39 ml/(min kg) between weeks 2 and 6. Plasma acetate concentrations increased as the calves developed and at week 8, acetate concentration in plasma was significantly increased to 0.15 mM on 20R compared to 0.09 mM on CON. Acetate clearance, however, was significantly lower at 21.4 ml/(min kg) on 20R compared to 48.4 on the CC diet. Acetate clearance was greatest at week 2. The increase in acetate concentrations in blood as the calves developed was due to an increased production of acetate in the rumen with no improvement in the capacity to utilize acetate post-absorptively.

Key Words: Roughage, Rumen, clearance

1183 Altering ruminal microbial colonization and synthesis by manipulation of dietary factors. W. Z. Yang*[1], K. A. Beauchemin[1], and L. M. Rode[2], [1]*Agriculture and Agri-Food Canada,* [2]*Biovance Technologies Inc..*

Effects of dietary factors including kernel thickness of processed barley grain, ratio of forage to concentrate (F:C), and forage particle size on bacterial colonization of feed particles and distribution in the rumen, and duodenal flow of bacteria in dairy cows were evaluated. The experiment was designed as a double 4 x 4 Quasi-Latin square with a 2 x 3 factorial arrangement of treatments using eight lactating cows with ruminal and duodenal cannulas. Barley grain was steam-rolled to a coarse (1.60 mm) or flat (1.36 mm) thickness; ratio of F:C was low (35:65) or high (55:45); and forage particle size was long (7.59 mm) or short (6.08 mm). Cows were offered ad libitum access to a total mixed diet. Bacterial colonization was linearly increased (P<0.01) from about 5 to 70% with decreasing size of rumen particles. The degree of colonization on each fraction of the rumen particulate matter as determined by sieving was only affected (P<0.10) by ratio of F:C with consistently higher (P<0.10) bacterial colonization for high than for low F:C ratio diets. Concentration of solid associated bacteria (SAB) in duodenal digesta was greater (P<0.05) than that of ruminal digesta. Of the total bacterial mass within the rumen, less than 20% was associated with the liquid (LAB) and with over 70% was associated with the small particles that passed through the 0.6-mm sieve. In general, bacterial distribution in the rumen was not influenced by dietary factors. While the bacterial pool in the rumen was lower (P<0.04) when flatly rolled barley, rather than coarsely rolled barley, was fed, bacterial flow to the duodenum was greater (P<0.10) with increasing F:C ratio. These results indicate that manipulation of dietary factors such as F:C ratio has the potential to alter bacterial colonization of rumen particles and the relative proportion of LAB to SAB, which were positively correlated to bacterial flow to the duodenum.

Key Words: Dietary Factors, Bacterial Colonization and Distribution, Microbial Protein Synthesis

1184 Metabolism of 2-13C-propionate in the rumen epithelium of sheep. N. B. Kristensen*[1], T. H. Steensen[1], S. G. Pierzynowski[2], and A. Danfr[1], [1]*Danish Institute of Agricultural Sciences, Tjele, Denmark,* [2]*Lund University, Lund, Sweden.*

The aim of the present study was to estimate the contribution of ruminal 2-13C-propionate to the net portal flux of lactate in sheep fed barley based concentrate. Three rams (46 ± 2 kg BW) were fitted with silicone catheters in A. mesenterica, V. ruminalis and V. porta. During blood sampling the sheep were fed every hour and continuously intraruminally infused with water + 0.30 mmol/h of 2-13C-propionate (Trt0) or 20 mmol/h of propionate + 0.42 mmol/h of 2-13C-propionate (Trt20). Blood flow was measured using p-aminohippuric acid dilution. Concentration and isotopic composition of propionate, lactate and glucose were measured by gas/liquid chromatography - isotope ratio mass spectrometry. The contribution of ruminal 2-13C-propionate to the net portal flux of lactate was calculated from a balance equation with the assumption that no arterial lactate was metabolized in the portal drained viscera (PDV) and that lactate produced in the PDV was derived only from arterial glucose or ruminal propionate. The irreversible loss rate of propionate in the rumen tended to increase (P = 0.06) with Trt20 (81 ± 20 mmol/h) compared with Trt0 (71 ± 19 mmol/h). The relative enrichment of 13C in arterial lactate, portal lactate and arterial glucose compared with ruminal propionate was not affected by treatment (P > 0.10) and estimated as 21 ± 4, 22 ± 4 and 37 ± 4 %, respectively. The portal net flux of lactate (6 ± 1 mmol/h) was not affected by treatment (P > 0.10). In one sheep the 13C enrichment of lactate produced in the PDV was numerically lower than the 13C enrichment of arterial glucose. The contribution of propionate to the lactate flux in this animal was set to 0. The calculated conversion of ruminal propionate into portal lactate was 0.8 ± 0.4 % of the ILR of ruminal propionate and was not affected by treatment (P > 0.10). These results show that the amounts of ruminal propionate recovered as lactate in the portal vein is insignificant compared with the ILR of propionate in the rumen.

Key Words: VFA, Metabolism, Ruminant

1185 Validation of the Sulphur hexafluoride(SF_6) tracer gas technique in measuring methane and carbon dioxide production of cattle. D. A. Boadi*, K. M. Wittenberg, and A. Kennedy, *University of Manitoba, Winnipeg, Manitoba Canada.*

Methane (CH_4) and carbon dioxide (CO_2) production from six crossbred yearling beef heifers (399.8 12.8 kg) were measured for six days, using a SF_6 tracer gas technique (TRACER) and the open-circuit calorimetry hood method (CAL), to validate the former in estimating CH_4 and CO_2 production in the field. Animals were individually fed, 50% barley concentrate and 50% alfalfa cubes at 1.3x maintenance requirements daily. After feeding, 24 hr gas measurements were taken on three heifers by each method. The three heifers as a group, were switched on subsequent days between CAL and TRACER methods in an incomplete block design. Methane production ranged from 107.5 to 144.6 Ld^{-1}(mean 129.6 4.0 Ld^{-1}) on CAL, and 90.2 to 165.6 Ld^{-1}(mean 136.7 4.0 Ld^{-1}) on TRACER. The mean CH_4 production (Ld^{-1}) was not different (P = 0.24) between methods. In contrast, TRACER CO_2 production was 20% higher than CAL CO_2 production (P < 0.01). The range in CO_2 production was 1573.7 to 2048.7 Ld^{-1}(mean 1892.4 74.0 Ld^{-1}) by CAL and 1540.7 to 3330.2 Ld^{-1}(mean 2353.5 74.0 Ld^{-1}) by the TRACER method. Day to day variation in CH_4 production, was not different between methods (P > 0.05), however animal to animal variation (11.7%) was significant by TRACER method (P = 0.04) but not CAL method

(P = 0.53). Comparison of the equality of variance between the two methods showed that there were no differences in variations (P > 0.05) between CAL and TRACER for CH_4 production. On the other hand, variations in CO_2 production was not equal (P > 0.05) between methods. It is concluded that the SF_6 tracer technique can accurately estimate CH_4 production, but not CO_2 production. The study implies that for field CH_4 measurements using the TRACER method, more animals are needed than CAL in order to reduce animal to animal variations.

Key Words: Methane and CO_2 measurements, SF_6 tracer gas technique, Validation

1186 Effect of pH and solid dilution rate on microbial fermentation and nutrient flow in a dual flow continuous culture system. M. Rodriguez, S. Calsamiglia*, and A. Ferret, *Universidad Autonoma de Barcelona, Spain*.

Eight dual-flow continuous culture fermenters (1320 mL) were used in two consecutive periods to study the effects of pH and solid dilution rates on microbial fermentation and nutrient flows using liquid (LAB) or solid (SAB) associated bacteria. Fermenters were fed continuously a 60 to 40 forage to concentrate ratio (17% CP, 29.3% NDF). Each period consisted in 7 days for adaptation and 3 for sampling. The last day of the experiment, LAB and SAB pellets were isolated from each fermenter. Fermenters were maintained at a contant temperature (38C) and liquid dilution rate (10% per h). Treatments were arranged in a factorial design, being pH (H = 6.4; L = 5.5) and solid dilution rate (S = 5, and F = 10 % per h) the main factors. No significant interactions were detected. Treatments L and F resulted in lower apparent DM, OM, NDF and ADF digestibilities. True digestibility of DM and OM were only significant in L and F when SAB were used for calculations. Total volatile fatty acids were lower in F vs S (61.4 vs 73.2 mM, respectively). At low pH, the concentration of propionate increased (25.4 vs 16.9 % for L and H, respectively) and that of acetate decreased (58.2 vs 64.9 %, for L and H, respectively). Solid dilution rate did not affect ammonia N concentration, but S increased dietary N flow, and reduced bacterial N flow, protein degradation and the efficiency of microbial protein synthesis when SAB were used. Similar results were obtained with LAB, but differences in dietary N flow and protein degradation were not significant (P > 0.05). Low pH reduced ammonia N concentration (10.8 vs 17.6 mg/100mL), but did not affect the efficiency of bacterial N synthesis or bacterial N flow. Dilution rate and pH affected microbial fermentation profile. However, results were different depending on the bacterial population selected for calculations. Acknowledments: Financial support provided by Project CICYT AGF097/0444.

Key Words: Microbial fermentation, dilution rate, pH

1187 A dynamic mechanistic model of small intestinal starch digestion and glucose absorption in the dairy cow. J A N Mills*[1], L A Crompton[1], J Dijkstra[2], J A Maas[3], C K Reynolds[1], and J France[1], [1]*The University of Reading, Reading, UK,* [2]*Wageningen University, Wageningen, NL,* [3]*University of Delaware, Delaware, USA*.

The high contribution of postruminal starch digestion to total tract starch digestion on certain energy dense diets demands that limitations to small intestinal starch digestion are identified. A dynamic mechanistic model of the small intestine was constructed and evaluated with regard to its ability to simulate published experimental data for abomasal carbohydrate infusions in the dairy cow. The seven state variables represent starch, oligosaccharide, glucose and pancreatic amylase in the intestinal lumen, oligosaccharide and glucose at the unstirred water layer (UWL), and the intracellular glucose of the enterocyte. Enzymic degradation of starch is a two stage process involving luminal pancreatic amylase and oligosaccharidase on the brush border of the enterocyte confined within the UWL. Na+ dependent glucose transport (SGLT1) into the enterocyte is represented along with a kinetically asymmetrical facilitative GLUT2 transport system on the basolateral membrane. The small intestine is subdivided into three main sections representing the duodenum, jejunum and ileum for parameterisation. Further sub-sections are defined between which there is a continual flow of digesta represented as a fractional rate. The model predicted non-structural carbohydrate disappearance for cattle unadapted to duodenal infusion with an $r^2 = 0.92$ and a root mean square prediction error (rootMSPE) of 25.4%. Simulation of glucose disappearance for mature Holstein heifers adapted to various levels of duodenal glucose infusion yielded an $r^2 = 0.81$ and a rootMSPE of 38.6%. Behavioural analysis identified the limitations for small intestinal starch digestion efficiency at high levels of duodenal starch appearance. Limitations to individual metabolic processes, particularly to starch digestion in the proximal section of the intestine, can create asynchrony between starch degradation and glucose uptake capacity. The model indicated that there were a series of rate limiting steps in small intestinal starch metabolism including pancreatic amylase secretion, oligosaccharidase activity, and glucose uptake via SGLT1.

Key Words: Small Intestine, Dynamic Model, Dairy Cow

1188 Effect of rumen degradable protein and fiber quality on ruminal bacterial populations in continuous culture. D. L. Hastings*[1], K. E. Griswold[1], G. A. Apgar[1], S. A. Kocherginskaya[2], R. I. Mackie[2], and B. A. White[2], [1]*Southern Illinois University, Carbondale, IL,* [2]*University of Illinois, Urbana, IL*.

The effect of rumen degradable protein and fiber quality on bacterial biodiversity was examined using dual-flow continuous culture. The experimental design was a 4 x 4 Latin square with a 2 x 2 factorial arrangement of treatments. Factors were level of rumen degradable protein and quality of fiber, and the treatments were: 1) high degradable protein (12% of dietary DM) with high quality alfalfa (HPHF), 2) high degradable protein (12% of dietary DM) with low quality alfalfa (HPLF), 3) low degradable protein (9% of dietary DM) with low quality alfalfa (LPLF), and 4) low degradable protein (9% of dietary DM) with high quality alfalfa (LPHF). Periods were 10 d with 7 d for equilibration and 3 d for sampling. Bacterial samples were collected from inoculum, and the fermentor vessels during each 3 d sampling period. Samples were separated into particle associated bacteria (PAB) and planktonic bacteria (PLB), and whole DNA was extracted. DNA was subjected to PCR amplification of the V3 hypervariable region of the 16s rRNA gene. The resulting oligonucleotides were separated using denaturing gradient gel electrophoresis (DGGE) to assess bacterial diversity in each sample. Data were analyzed using the GLM procedures of SAS. Results indicated that the bacterial diversity of samples from the 3 sampling days were 16.88 - 20.85% similar for PAB and 19.23 - 23.03% similar for PLB compared to the inoculum used in the system. There were no treatment effects on similarity of sample diversity to inoculum diversity (P>.05). Indices of similarity were calculated to determine if RDP or fiber quality would alter bacterial populations. There was a trend for treatments containing low quality fiber to select for more highly similar bacterial populations compared to high quality fiber treatments (50.4 vs. 31.7 for PAB and 32.1 vs. 15.0 for PLB, respectively) (P=.085). Level of RDP had no effect on similarity of bacterial populations. Altering dietary elements can cause changes in ruminal bacterial diversity in continuous culture.

Key Words: RDP, Fiber Quality, Bacterial Diversity

1189 Effects of an Inhibitor of Obligate Amino Acid Fermenting Bacteria upon Ruminal and Nutrient Utilization by Calves. E.L. Moody*[1], C.E. Cole[1], F.O. Carrette-Carron[1], W.C. Ellis[1], G. Wu[1], M.M. Kothmann[1], and R.J. Wallace[2], [1]*Texas A&M University,* [2]*Rowett Research Institute*.

Deamination of amino acids in excess of that required by rumen microbes is nutritionally wasteful for the ruminant's tissues. Obligate amino acid fermenting bacteria account for most amino acid deamination and an inhibitor of these bacteria has been identified (Floret, et al., 1999 Appl. Environ. Microbiol. 65:3258-3260). The objective of this experiment was to investigate effects of LY29 upon ruminal and animal utilization. Effects of LY29 were determined during successive periods involving lagged ruminal additions of 0, 0.8, 1.6, 0 and 0 g/d of LY29/d to 12 cattle having rumen and duodenum cannula. The two levels of LY29 were evaluated in a mixed diet of 30% cottonseed hull and 70% concentrate diet (160g CP/kg DM). Each period consisted of a 9 d adaptation period and a 5 d period for collection of digestion data. Flux of nutrients to the duodenum was computed with reference to nutrient and indigestible NDF, IF, ratios at the duodenum and diet. Intake of diet DM was determined during d 7-14. Responses to 1.6 g LY29 are reported because most responses were not maximal for 0.8 g/d dose. For the mixed diet, responses to 1.6 g/d of LY29 vs. the control resulted in significant (P < 0.05) responses in feed intake (0.82), feed efficiency (1.15), rumen ammonia (0.45), M% of ruminal acetate (1.18), propionate (0.53), butyrate (1.24), isobutyrate (0.72) and valerate (0.73), duodenal flow of OM and IF (0.81) and duodenal flow of N (0.67). Rate of gain was not significantly affected by LY29. These results suggest that LY29

was effective in improving efficiency of ruminal utilization of feed CP by reducing excessive ruminal deamination of amino acids by obligate amino acid fermenting bacteria.

Key Words: rumen, bacteria, amino acid deamination

1190 Colonization Patterns of Forage Fragments by Rumen Microbes. C.A. Marsh*, W.C. Ellis, J.H. Matis, E. Moody, C. Lowe, and J. Johnson, *Texas A&M University, College Station, TX, Brazos*.

Level and rate of colonization of forage tissues by rumen microbes is postulated as causal of enhanced digestion rate of potentially digestible NDF, and its rates of turnover and voluntary intake. The time course of association of diaminopimelic acid (DAPA) with residues of plant tissues *in situ* was studied to reflect patterns of immigration/growth rate and migration/lysis rate by the microbial ecosystem. It is recognized that DAPA concentrations vary among individual species of microbes, however, for present purposes it is assumed that the dynamics of DAPA is representative of dynamics of the microbial population. Leaf and stem parts of bahia grass *(Paspalum notatum Fuegge)* hay were separated and ground to pass a 2 mm sieve and then placed in the rumen in 40 micro porosity bags until removed after 0,3, 6, 12, 18, 24, 36, 48, 60, 72, 96, 144 and 168 h residence time. Dried material from within the bag was hydrolyzed in sealed tubes in 6M hydrochloric acid and DAPA and amino acids determined via HPLC. Observed time courses of DAPA/g of initial DM appeared to involve three phases: 1) an initial rapid influx and efflux of DAPA, suggesting a rapid immigration/growth rate and subsequent rapid migration/lysis rate within the first 24 h, 2) a more gradual immigration/growth rate in excess of migration/lysis rate which reached an asymptotic level around d 5 and 3) a migration/lysis rate in excess of immigration/growth rate after d 5. The more gradual accumulation over d 2 through 5 conforms to a logistic model in which availability of substrate was not limiting the level of DAPA accumulation until after d 5. It is proposed that the patterns of DAPA observed reflect the dynamics of colonization of feed fragments by successive species of microbes having specific attachment preferences for different ecological niches associated with residues of the feed fragment. The rate and level of colonization must then be modeled as the sum of two phases: 1) the initial influx-efflux phase and 2) the subsequent logistic accumulation phase.

Key Words: Rumen, Microbes, Diaminopimelic acid

1191 Effect of pH and solid dilution rate on the amino acid profile of liquid and solid associated bacteria, and its impact on the estimation of the contribution of microbial amino acids to the total amino acid flow in a continuous culture system. M. Rodriguez, S. Calsamiglia, and A. Ferret, *Universidad Autonoma de Barcelona, Spain*.

Eight dual-flow continuous culture fermenters (1320 mL) were used in two consecutive periods to study the effects of pH and solid dilution rates on the estimation of the contribution of microbial amino acids (AA) to the total amino acid flow. Fermenters were fed continuously a 60 to 40 forage to concentrate ratio (17% CP, 29.3% NDF, 20.4% ADF). Fermenters were maintained at a constant temeprature (38°C) and liquid dilution rate (10% per h). Treatments were arranged in a factorial design, being pH (H = 6.4; L = 5.5) and solid dilution rate (S = 5, and F = 10 % per h) the main factors. Each period consisted in 7 days for adaptation and 3 days for sampling. The last day of the experiment, LAB and SAB pellets were isolated from each fermenter and their AA content (mg AA/g DM) analyzed. To estimate the contribution of microbial AA to the total AA flow using LAB or SAB, the AA content of each bacterial isolate was multiplied by the bacterial DM flow estimated within each isolate. Solid dilution rate and pH affected ($P < 0.05$) the AA profile of LAB and SAB. When the AA content was multiplied by the estimated bacterial DM flow within type of bacterial isolate, pH and dilution rate did not affect the estimated flow of AA. When the average across all treatments of the AA content (g/g DM) or flow (g/d) of SAB vs LAB were compared, no significant differences were detected, except for de content (g/g MS) of Tyr, His and Phe. Results demonstrate that the AA content of SAB and LAB may be different and affected by ruminal fermentation conditions. However, its implications on the estimation of the contribution of microbial AA to the total supply may be quantitatively less important. Acknowledgment: Financial support provided by CICYT AGF97/0444.

Key Words: Bacteria amino acid profile, pH, Dilution rate

1192 Methane emissions from lactating dairy cows fed diets based on conserved forage and grain or pasture. T. R. Dhiman*, K. C. Olson, M. S. Zaman, I. S. MacQueen, and R. L. Boman, *Department of Animal, Dairy and Veterinary Sciences, Utah State University, Logan, UT 84322-4815*.

Methane (CH4) emissions from cows are energetic losses and contribute to atmospheric greenhouse gases. Six lactating dairy cows (692 ± 58.9 kg BW, 3 intact and 3 rumen-cannulated) were used in a replicated 3 x 3 Latin Square experiment to study the influence of diet on methane emissions. Each period was 28 d. The first 21 d was for adaptation to diets and data were collected during the last 7 d in each period. Treatments were (1) a TMR containing grain and alfalfa hay in a 60:40 ratio, (2) 40% of daily requirements from grazing predominately perennial ryegrass and 60% from a grain mix, and (3) all nutrient intake from pasture grazing. Milk production and feed intake were recorded. Methane emissions from each cow were measured using sulfur hexafluoride as an external marker. Ruminal pH, NH_3-N, and VFA concentrations were measured in the rumen-cannulated cows. Daily DM intakes were 18.3, 13.3 and 15.9 kg d^{-1} ($P = 0.07$) and 3.5% fat-corrected milk yields were 21.8, 20.4, and 18.3 kg d^{-1} ($P = 0.76$) in treatments 1 through 3, respectively. Milk fat, protein, lactose, solids not fat, and urea contents did not respond to treatments. Methane emissions did not differ among treatments when expressed as g $cow^{-1}d^{-1}$ ($P = 0.96$), g kg^{-1} of DM intake ($P = 0.46$), or g kg^{-1} of fat-corrected milk ($P = 0.42$), with overall mean across treatments of 445.0 g cow^{-1} d^{-1}, 29.2 g kg^{-1} of DM intake ($P = 0.46$), and 29.1 g kg^{-1} of fat-corrected milk. Acetic acid decreased and propionic acid increased ($P = 0.02$) under the pasture plus grain treatment relative to the other treatments. Ruminal pH, NH_3-N and other VFA concentrations did not differ among treatments. Dietary differences in this experiment had minimal influence on ruminal fermentation variables, or methane emissions in lactating dairy cows. The results from this study suggest that energetic loss in the form of methane from cows fed conserved forage and grain based diets was similar to those fed high quality pasture only.

Key Words: Cow, Milk, Methane

1193 A Role for Rumen Microbial Protein Synthesis in Regulating Ruminal Turnover. W.C. Ellis*[1] and J. H. Matis[1], [1] *Texas A & M University*.

Ruminal turnover is commonly considered a physical process determined by passive, mixing and dilution of intake rate of undigested NDF, UF, by rumen load of UF. Ruminal flux of degraded dietary entities was investigated as possible regulating nutrients. Literature sources were used that reported varied expressions of turnover that were converted to a common expression of mean turnover rate through two rumen compartments, UFke. The UFke was computed from rare earth-compartmental model data. Where the turnover rate, k, was determined as the exponential dilution rate of intake rate of an indigestible marker/rumen load of indigestible marker, UFke was computed as 1/k. Mean rate of digestion of potentially digestible NDF, PDF (PDFkd), was computed as the natural logarithm of NDF digested in the rumen/mean ruminal residence time of UF (1/UFke). Rumen degraded protein, RDP, ruminal degraded NDF, RDF, and rumen microbial protein efflux, MPE, were as reported. Ruminal flux of non-structural carbohydrates, RDNSC, was computed as OM - [(NDF+lipids+CP)0.8]. Ruminal flux of degraded carbohydrates, RDCHO, was computed as RDF+ RDNSC. Energetic efficiency of MPE was computed as MPE/RDCHO. The database consisted of 85 treatment means from 28 experiments. All variables were expressed as daily flux per kg BW and relationships were examined with MPE as the dependent variable and daily flux of ruminally degraded nutrients as the independent variables. A non-linear, convex relationship existed between rumen load of UF and UFke. This relationship possessed greater curvature than conformed to exponential expectations for a passive, mass action, turnover of UF. In experiments with cattle fed mixed diets, significant ($P < 0.05$) regression existed between rumen load of UF and intake rate or dietary concentrations of UF. Efficiency of rumen microbial protein efflux, MPE/RDCHO, was correlated ($P < 0.05$) with rates of ruminal degradation of RDP, PDF, and RDP/RDCHO. The same relationships lacked significance ($P>0.05$) in the data for forage fed animals. These results imply that in cattle

fed mixed diets, ruminal turnover of UF was regulated metabolically in response to flux proportions of RDP/RDCHO that enhances efficiency of rumen microbial synthesis, MPE/RDCHO.

Key Words: Rumen, Microbial , Protein

1194 Effect of replacing dietary starch with sucrose on nutrient utilization by ruminal microorganisms during continuous culture fermentation. G. A. Varga[1], T. W. Cassidy[1], V. A. Ishler[1], X. Markantonatos*[1], N. D. Luchini[2], and G. A. Broderick[3], [1]*Pennsylvania State University,* [2]*Bioproducts, Inc,* [3]*U.S. Dairy Forage Research Center.*

A dual flow continuous culture system was used to investigate the effects of replacing dietary starch with sucrose at various concentrations on nutrient digestibility and ruminal fermentation. Four diets were evaluated using a completely randomized design during four replicates. Diets were formulated to contain on a DM basis 40% alfalfa silage, 20% corn silage, 20.5% rolled high moisture shelled corn, 9% soybean meal, 2% fat, 1% vitamin-mineral supplement, 7.5% supplemental non-structural carbohydrate (NC) with a nutrient composition of 16.7% CP, 1.7 Mcal/kg NEl and 29% NDF. The NC fed in the four diets was: A) 7.5% starch, 0% sucrose: B) 5% starch, 2.5% sucrose; C) 2.5% starch, 5% sucrose; and D) 0% starch and 7.5% sucrose. Four continuous culture fermenters were used with solid mean retention time and liquid dilution rate of 24 h and 11%/h, respectively. On day 7-9 effluents were collected daily and composited for nutrient digestibility determination and for analysis of ammonia-N, and VFA. No differences were observed in pH throughout the day ranging from 5.67 to 6.21 with an overall mean of 5.97 $\pm$ 0.08. Ammonia-N concentration averaged 9.23 mg/100ml $\pm$ 0.66 with a trend (P<0.11) for a positive linear effect with increasing sucrose in the diet. Apparent DM digestibility was not different among treatments and averaged 46.8% $\pm$1.5. NDF digestibility increased linearly when sucrose was added to the diet and at the highest inclusion was 66.1% vs. 60.9% when compared to the all starch diet. Total VFA was not different among treatments and averaged 103.9 $\pm$ 0.66 mM. Branched chain VFA concentration decreased linearly with increasing sucrose in the diet. Bacterial N content was not affected by treatment. Replacing starch with sucrose in the diet resulted in an alteration in microbial fermentation such that NDF digestibility was enhanced.

Key Words: Sugar, Starch, Ruminal fermentation

1195 In vitro effects of lactate-utilizing rumen bacteria on ruminal fermentation. S.-W. Kim*, S. R. Rust, H. Roman-Rosario, and M. T. Yokoyama, *Michigan State University, East Lansing, MI.*

A facultative lactate-utilizing bacterium (Isolate 1) was isolated from the rumen of beef cattle fed a diet consisting of 95% corn silage and 5% of a protein-mineral supplement. The isolate was a gram positive rod with a Chinese character arrangement. It produced 36 mM of acetate, 58 mM of propionate and 37 mM of butyrate from 159 mM of lactate. When glucose was the carbon source, the bacterium produced only lactate. The bacterium was placed into a mixed rumen culture to evaluate its potential to alter VFA production. One mL of Isolate 1 was added to a round bottom flask that contained rumen fluid (50 mL) from hay-fed heifers, buffer (50 mL) and 3 g of readily fermentable substrates (starch, glucose, cellobiose, xylose, and casein). Triplicate flasks were incubated anaerobically at 39^{o}C. Three mL of culture were removed at 0, 3, 6, 12, and 24 h of incubation while gassing flasks with O_2-free CO_2. The concentrations of lactate in cultures were 0.5, 4.1, 51.5, 117.7, and 128.0 mM for control and 10.8 (P < 0.05), 10.1, 45.4, 124.3, and 150.4 mM (P < 0.01) for Isolate 1 at 0, 3, 6, 12, and 24 h of incubation, respectively. VFA concentrations were not different among treatments through 24 h of incubation. Acidity was higher in Isolate 1 at 24 h (P < 0.01). The fermentation products after 24 h of incubation are shown in the Table below. The Isolate 1 did not affect VFA composition but increased the lactate concentration in mixed culture.

Item	Control	Isolate 1	SEM	P
Lactate (mM)	128.0	150.4	2.26	< 0.01
Total VFA (mM)	126.8	125.0	1.21	0.17
Acetate (mM)	66.6	65.6	0.42	0.49
Propionate (mM)	35.9	36.5	0.54	0.35
Butyrate (mM)	19.0	18.0	0.66	0.30
pH	4.33	4.19	0.02	< 0.01

Key Words: Lactate, Bacteria, Ruminal fermentation

1197 Ethanol absorption from the rumen. T. Veresegyhazy*[1], H. Febel[2], G. Nagy[1], and A. Rimanoczy[1], [1]*Faculty of Veterinary Science, Szent Istvan University, Budapest,* [2]*Researche Institute of Animal Breeding and Nutrition, Herceghalom.*

Ethanol absorption through the rumen was investigated in *in situ* experiments. Three British Milk ewes fitted with rumen cannula (Bar Diamond 8C) were used. The ruminal content was removed and the forestomachs were washed out with water. Subsequently the apparatus developed by Engelhardt and Sallmann (1972) for the isolation of rumen was put in place. After closing the cannula, 2.8 L of physiological saline solution, either 20 or 60 mL ethanol, 2 mL Cr-EDTA were infused respectively and the fluid volume was completed to 3 L with physiological saline solution. This was followed by removal of the 0-min sample intended for the determination of the initial ethanol and Cr-EDTA concentrations. Further samples were taken at 5, 15, 30, 45, 60 and 75 min. This process was repeated with each animal. Every data point represents the mean of 6 measurements. The Cr content was determined by atomic absorption. The concentration of ethanol was determined by gas chromatography. The fluid volume and ethanol content in the rumen were calculated according to the dilution rate of Cr-EDTA and the ethanol concentration in the samples. Absorbed ethanol was considered to be the difference of the ethanol content of the sample taken at 0 min and the other sampling time. During 75 min absorbed 81% of 20 mL and 64.2% of 60 mL ethanol. The amounts of absorbed ethanol were 16.2 and 38.5 mL respectively. The equations of absorption are y= $-0.0474x^2+5.6544x+10.869$ and y = $-0.1377\ x^2+19.541x+24.606$ using 20 and 60 mL ethanol respectively. Ethanol absorption is quicker when the ethanol concentration is higher. The speed of ethanol absorption decreased during experiments because of saliva production and ethanol elimination through the rumen wall. Drawing a graph the curves are characteristic to passive transport. Ethanol can penetrate through the rumen wall probably by passive transport mechanism.

Key Words: ethanol, absorption, rumen

1198 Influence of drinking saline water and feeding level on feed and water intake, digestibility, thermo-respiratory response and blood constituents in sheep. Mostafa Kobeisy*[1], Fisal Elhommosi[1], Galal Abdel-Hafiz[1], and Hassanain Badawy[2], [1]*Animal Prod. Dept., Fac. of Agric., Assiut University, Assiut-Egypt.,* [2]*Desert Research Center, Cairo-Egypt.*

The trial aimed to study the influence of drinking saline water along with different nutritional conditions on digestive function, thermo-respiratory response and blood constituents in Saidi sheep. Six clinically healthy Saidi rams over one year old with an average body weight of 40 kg were used in this study. Saline water was fresh tap water containing 1.5% of commercial sodium chloride. Feed and water intake were recorded daily and blood samples were taken for Hb and PCV %,and serum total protein, albumin, globulin, triglycerides, cholesterol, AST and ALT determination. Drinking saline water decreased feed intake by about 15% and increased (P<0.01)water intake by about 42%. Digestibility coefficients of ether extract and acid detergent fiber were lower (P<0.05) in animals drinking saline water than those drinking tap water. Drinking saline water decreased (P<0.05) respiration rate, whereas rectal temperature was not significantly affected. Animals drinking saline water had higher (P<0.01) PCV %, and serum albumin and triglycerides concentrations than those drinking tap water. Under drinking saline water conditions, animals fed ad libitum level had significantly higher concentrations of Hb, PCV and serum albumin than those fed restricted level.

Key Words: Sheep, saline water, digestibility, blood, thermo-respiratory response

1199 Influence of supplemental chromium on performance, concentrations of liver triglycerides, and blood metabolites during the transition period of dairy cows. J. A. Jackson*, V. Akay, R. Scaletti, S. T. Franklin, D. M. Amaral-Phillips, C. H. Hamilton, and R. J. Harmon, *University of Kentucky, Lexington, Kentucky*.

This study evaluated the effects of dietary Cr supplementation on DMI, milk yield, liver triglycerides and blood metabolites in lactating dairy cows from wk 4 prepartum until 8 wk postpartum. Twenty-four Holstein cows (10 primiparous) were blocked by expected calving date and parity and randomly assigned to either the basal diet (control) or control diet supplemented with 11.5 or 8.0 mg / head / d of Cr, as chromium picolinate, for multiparous and primiparous cows, respectively. Cows were housed in tie stalls for approximately 40 days before the expected calving date and fed a close-up dry cow TMR until calving. At calving, they were fed a lactation TMR with DM containing 30 % corn silage, 30 % alfalfa silage and a 20 % crude protein concentrate mix. Blood samples were collected on d 30 and 15 before expected calving date and on d 3, 30 and 60 after calving and analyzed for plasma NEFA and BHBA, and serum triglyceride, insulin and cortisol. Liver samples were obtained on d 30 and 15 before calving and on d 3 and 30 after calving and analyzed for triglycerides. No differences were detected in DMI between treatments. Least squares means for wk 5 to 8 were 22.0 versus 21.8 kg/d for the control and Cr supplemented groups. No differences ($P > 0.05$) were detected in milk yield between treatments and averaged 36.8 and 34.6 kg/d for control and Cr supplemented groups, respectively. The percentage of fat was higher ($P < 0.05$) and protein trended higher ($P = 0.13$) in the milk of cows fed the Cr supplemented diet. Liver triglycerides averaged 3.9 and 3.3 % wet weight (NS) on d 3 after calving for the control and Cr supplemented groups, respectively. Chromium supplementation did not significantly alter plasma NEFA and BHBA, or serum triglyceride, insulin or cortisol concentrations at any sampling date or when averaged over the sampling dates. However, BHBA trended lower ($P = 0.10$) for the Cr supplemented versus the control cows on d 3 after calving. Results suggest that Cr supplementation during the transition period had no effect on DMI or milk yield. Blood metabolites and liver lipids were largely unaffected by Cr supplementation.

Key Words: Transition dairy cow, Dietary chromium supplementation, Fatty liver disease

1200 Effect of dietary phosphorus concentration on estrous behavior of lactating dairy cows. H. Lopez*[1], Z. Wu[1], R. Cherel[2], L. D. Satter[1,2], and M. C. Wiltbank[1], [1]*Dairy Science Department, University of Wisconsin, Madison,* [2]*US Dairy Forage Research Center, USDA-ARS, Madison*.

It is common for dairy producers to increase dietary phosphorus (P) above NRC requirements in an attempt to increase expression of estrus. The objective of this study was to determine the effect of dietary P concentrations of .38 or .48% of the TMR (DM basis) on estrous behavior of lactating cows as measured by a radiotelemetric system (HeatWatch ® DDX, Denver, CO). At calving 48 Holstein cows were randomly assigned to one of the dietary treatments. Cows were housed in a free-stall barn and received a radiotelemetric transmitter on d 45 postpartum to record estrous standing activity. Observations on estrous behavior presented here are from the first year of a two-year study published elsewhere (J. Dairy Sci. 83:1052). The radiotelemetric system was employed only during the first year of that study. The total number of estrous periods recorded for the 48 cows was 83. The mean duration of estrous cycles was 22±0.8 d with a range of 17 to 26 d and 21±0.6 d with a range of 16 to 29 d for cows fed the .38 and .48% P diets, respectively ($P = 0.82$). The mean duration of estrus was 9.1±1.0 and 8.8±1.1 h for cows fed the .38 and .48% P diets, respectively ($P = 0.82$). The average number of mounts during estrus was 7.5±1.2 and 8.0±1.5 ($P = 0.81$) and the total mounting time was 29.6±1.0 and 31.9±5.8 s ($P = 0.75$) for cows fed the .38 and .48% P diets, respectively. Phosphorus treatment had no detectable effect ($P = 0.87$) on intensity and duration of estrous behavior.

Intensity and duration of estrus[1]	.38% P (n=42) n	%	.48% P (n=41) n	%
Low intensity, short duration	10	24	13	32
Low intensity, long duration	19	45	17	41
High intensity, short duration	11	26	9	22
High intensity, long duration	2	5	2	5

[1]Estrus was characterized by standing events as low (<1.5/h) or high (≥1.5/h) intensity and by estrus duration as short (<7 h) or long (≥7h).

Key Words: Dairy Cows, Estrous Behavior, Phosphorus Requirement

1201 Mineral content of Acacia mangium Willd under defoliation conditions. T. Clavero*, E. Miquelena, and A. Rodrguez-Petit, [1]*La Universidad del Zulia*.

A field experiment under tropical dry forest condition was carried out in Zulia, Venezuela with the objective of determining the effect of cutting frequency and height of clipping on mineral content of leaves on Acacia mangium Willd. The factors studied were three frequencies (6, 9 and 12 weeks) and three defoliation heights (50, 75 and 100 cm) A split-plot in a random block design with three replications was used. The results showed highly significant differences ($P<0.05$) for frequency and height interaction on the concentration of K, Mn and Zn. Calcium, Mg, Na and P were only affected by maturity. The principal effect on mineral content of leaves in Acacia mangium was age. Mineral concentration decreases due to translocation from leaves to branches and stems with increasing maturity.

Key Words: Acacia mangium, mineral composition, defoliation

1202 Pasture applied biosolids as related to copper status of grazing beef steers. M. E. Tiffany, L. R. McDowell*, G. A. O'Connor, F. G. Martin, N. S. Wilkinson, and H. Q. Nguyen, *University of Florida*.

Angus yearling steers (N=96) were randomly assigned to bahiagrass pastures (N=32) treated with 3 high Mo-containing biosolids varying in mineral content for 151 d and evaluated for mineral status, with special attention to Cu. The biosolids are classified as high quality and originated from Tampa (T) and Largo (L), FL and Baltimore (B), MD. Copper concentrations of biosolids varied from 431-989 ppm and Mo from 12-60 ppm. Biosolids and NH_4NO_3 (control) fertilizer was applied to 0.81-ha pastures at a rate of either 179 kg N/ha (X) or 2, 3 and 6X: 1) control C, 1X; 2) L1X; 3) L2X; 4) B3X; 5) B6X; 6) T3X; and 7) T6X. The soils were acid (pH 5.0-5.8) and well drained (soil series of Millhopper sand). There were 3 animals per pasture with 4-6 replicates of treatments. One of 3 steers of each plot received a 3-ml subcutaneous injection of Cu glycinate (60 mg Cu/ml). Forage concentrations were low in Cu (<6 ppm) and Mo (<2 ppm) and high in S (>0.4%). At experiment termination, 1/3 of steers had slight-to-moderate hair discoloration. Cupric glycinate injections dramatically increased liver Cu, with an overall average of 185.9 ppm (dry basis) for injected steers compared to 96.6 ppm for noninjected cattle. Cu-injected animals had higher ($P<0.001$) liver Cu than the two corresponding pen mates. At the end of the experiment, the means of all biosolids treatment animals that did not receive supplemental Cu had liver Cu considerably less than the control. Five of 6 biosolids treated steer groups had lower ($P<0.001$) liver Cu (ppm) than the control C 1X (127) as follows: B3X (97), L1X (82), B6X (72), T6X (56) and T3X (49). In agreement with declining Cu status in livers, all plasma Cu treatment means resulting from biosolids applications were less than the critical concentration of 0.65 μg/ml. In agreement with low forage Mo concentrations, all liver samples were low in Mo. Liver Mo concentrations were well below the 5 mg/kg level considered toxic. Biosolids treated steers all had lower ($P<0.05$) liver Zn than the controls, and steers on pastures B6X, T3X and T6X had lower liver Fe than controls. Implications: Pastures treated with high Mo-containing biosolids resulted in a decline of Cu status of steers. The decline in Cu status was not due to Mo, but most likely from low forage Cu (<6 ppm) and high forage S (>0.4%).

Key Words: Biosolids, Cattle, Fertilizer

1203 Effect of shade and organic zinc supplementation on performance of Brahman bull calves fed growing diets in dry tropic weather. R. Barajas* and A. Felix, *Universidad Autonoma de Sinaloa (Mexico)*.

To determine the effect of shade and organic zinc supplementation on performance of Brahman bull calves feeding growing diets in dry tropic weather, 64 Brahman bull calves (BW = 294 kg) were used in a 28 day complete randomized block design experiment (September/2000). Shade (WS) or no shade (NS) in pens and diet supplemented or not with additional 30 ppm of zinc from Availa-Zn 100^{TM} (Zinpro Corp.

MN). No shade pens were ground floors pens (6 x 16 m), provided with metallic feed bunker (2.8 m); in each of four NS pens, six bull calves were placed (16 m of of vital space and 0.46 m of feed bunk by head). Shaded pens were 6 x 26 m, ground floor and central shade (4.8 x 6.7 m; belted type; 3.5 m high; north-south oriented) supplied with metallic layer; ten bull calves were placed in each (15.6 m of vital space and 3.14 m of shade, and 0.6 m of feed bunk by head). Shade increased (P<0.03) the final weight 2.3% (334 vs 342 kg) and ADG by 19% (1.42 vs 1.7 kg/d). The use of shade diminished (P<0.05) DM intake 5% (10.08 vs 9.54 kg/d) and feed/gain by 20% (7.15 vs 5.71). The dietary intakes of net energy was 17% and 24% higher (P<0.02) in the calves in WS treatment than in NS treatment. Extra zinc supplementation had no effect (P>0.10) on performance of bull calves. An additive effect of shade plus zinc supplementation was observed (P<0.05), improving final weight, ADG, feed/gain and NEm content of the diet. WS + Zn tended (P<0.06) to increase NEg content of the diet, and had no effect (P>0.10) on DM intake. It is concluded that the use of shade in pens improved the performance of Brahman bull calves in feedlots during the ending summer under dry tropic weather condition, and that organic zinc supplementation support and benefits for feedlot cattle only if environmental conditions are adequate.

Key Words: Beef cattle, Shade, Zinc

1204 Supplementation of ascorbic acid and plasma concentration in the neonatal dairy calf. T.R. Johnson*[1], S.D. Eicher[2], C.A. McKee[1], K.L. Cutshall[3], M.L. Henry[3], and S.P. Coburn[3], [1]*Purdue University, West Lafayette, IN,* [2]*USDA-ARS, West Lafayette, IN,* [3]*Indiana University Purdue University Fort Wayne, IN.*

Forty-six female neonatal Holstein calves were fed colostrum and treated for 3 d as described in Purdue Dairy SOP C-1.0 Management of newborn calves. Calves were then switched to milk replacer (20% CP, 20%fat, all milk) fed in 2 equal feedings at 10% BW/d and adjusted weekly for the 6 wk study. Treatments were: 1. Control; 2. BG (a β-glucan product fed at 2.5% of dry milk replacer, NaturalChem. Industries, Ltd.); 3. Ascorbic acid (AA; Vitamin C 500 mg STAY-C 35, Roche Vitamin, Inc.); and 4. BG+AA, at the same concentrations as each supplement when fed alone. Milk replacer, water and supplements were mixed with a bakery wisk and fed in individual pails. Calves were fed replacer and supplements at 0600h and 1300h, and plasma was taken by jugular venipuncture into in heparinized vacutainers at 0830 h. Plasma was frozen at -80°C. Analysis of plasma AA concentration was conducted using a microspectrophotometer method (Bio. Chem. Med. 1973. 11:41-48). Data were analyzed by SAS PROC MIXED REML, with combined symmetry (CS) as covariate. Mean plasma AA were: Control, 2.15 ± .34; BG, 2.24 ± .34; AA, 2.46 ± .36; BG+AA, 2.67 ± .37 μg/ml. Week effects approached significance (P<.06); and treatment and treatment x week effects were not different (P>.65). Although AA+BG effects were reflected in physiological, production and immunological variables (McKee et al. 2000. JDS 83: Suppl. 1. 134), the present plasma AA data supports other reports that suggest that plasma is not a good indicator of AA status.

Overall treatment means by week, (CS) covariate

	Wk 0	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6
Mean	2.52	2.30*	2.23*	2.16*	2.44	2.35	2.53
SE	0.22	0.22	0.22	0.22	0.22	0.22	0.22

*P<.05

Key Words: Ascorbic acid, β-glucan, Neonatal

1205 Effect of organic (Availa-Cu) versus inorganic ($CuSO_4$) Cu on the rate and extent of copper repletion in post-partum Brangus heifers. G. P. Yost[1], L. R. McDowell[1], C. K. Swenson[3], and J. D. Arthington*[2], [1]*University of Florida - IFAS, Dept. of Animal Sciences, Gainesville,* [2]*Range Cattle Research and Education Center, Ona,* [3]*Zinpro Corporation, Eden Prairie, MN.*

It has been proposed that organic copper (Cu) is more bioavailable than inorganic sources of the element. In beef cattle research these benefits have been variable. We hypothesized that the bioavailability of organic Cu should be of specific importance to stressed cattle. The post-partum stress associated with first calf heifers is a result of increased calving difficulty, lactation, and continued growth of the heifer. Therefore, the objective of this study was to compare the effect of organic (Availa-Cu, Zinpro Corporation, Eden Prairie, MN) vs. inorganic (copper sulfate) Cu supplementation in post-partum, lactating, first-calf heifers. Thirty-seven Cu-deficient, Brangus heifers were selected from a south-central Florida ranch. Two 14 d enrollment periods were utilized to account for calving dates over a 4-wk period. Within each period, and after calving, heifers were allocated to one of two treatments (n= 12 and 15 for organic and inorganic treatments, respectively). Copper treatments were formulated into a corn/cottonseed meal carrier at a targeted level of 15 ppm. Treatments were delivered for 83 d to individual pens housing 2 or 3 heifers. All heifers were provided ad-lib access to long stem limpograss hay containing 8.7 ppm Cu. Heifers assigned to both treatments were initially Cu deficient (56 and 51 ppm liver Cu for organic and inorganic treatments, respectively). Liver Cu increased in all heifers regardless of treatment, however, heifers supplemented with organic Cu tended (P=0.17) to have higher mean liver Cu values compared to those receiving inorganic Cu (139 vs. 109 ppm). Over 83 d of supplementation the rate of liver copper repletion was 2.21 vs. 1.73 mg/kg/d for organic and inorganic Cu, respectively. No treatment differences were detected in plasma ceruloplasmin concentrations. By d 83 post-partum, only 4 of 27 heifers had returned to estrus (n= 2/treatment) as determined by P4 levels > 1 ng/mL for two consecutive 7 d samples. These data suggest that organic copper may provide post-partum, first calf heifers with a more bioavailable form of supplemental copper.

Key Words: Organic mineral, Copper, Heifer

1206 Supplementation effects of calcium salts of unsaturated fatty acids on ruminal environment and forage digestion in grazing dairy cows. S. Wagner[1], G.F. Schroeder*[1−2], G.A. Gagliostro[3], I. Vidaurreta[1], and J. Couderc[1], [1]*Fac.Cs. Agrarias UNMdP,* [2]*CONICET,* [3]*INTA EEA Balcarce, Argentina.*

The objective was to determine if the supply of calcium salts of unsaturated fatty acids (UFA-Ca, 65% unsaturated FA) would affect ruminal environment and pasture NDF and CP digestion in dairy cows grazing an alfalfa pasture (DM=22.7%; NDF=25.7%; CP=25.0% and IVDMD=71.3%). Three Holstein cows fitted with ruminal cannulas were allotted to a 3 x 3 Latin Square. Treatments were as follows. In T0, cows received pasture plus 5 kg/d of ground corn and 0.4 kg/d of fish meal. In T1, 0.8 kg/d of UFA-Ca were added to the T0 diet and in T2 corn grain was isoenergetically replaced by 0.8 kg/d of UFA-Ca. Nylon bags containing fresh forage (5 g DM/bag) were incubated in the rumen and removed at 0, 3, 6, 9, 12, 16, 20, 24, 36, 48, and 72 h to estimate the in situ disappearance of NDF and CP. Ruminal pH values, concentrations of NH3-N and total volatile fatty acid and parameters of in situ pasture NDF and CP disappearance were not affected by UFA-Ca supply. Results suggested that UFA-Ca behaved as inert fats when they were added to the diet of dairy cows grazing alfalfa pastures.

	Treatment				
Item	T0	T1	T2	SEM	P<
pH	5.8	5.9	5.8	0.05	0.20
NH3 (mg/dl)	17.9	18.3	16.8	4.95	0.81
VFA (mmol/L)	109.9	109.8	100.3	18.3	0.22
Acetate:Propionate	3.00	2.95	3.01	0.08	0.86
NDF degradation					
Soluble (%)	10.6	14.5	14.9	3.88	0.73
Degradable (%)	63.8	60.2	57.6	5.64	0.77
Rate of digestion (%/h)	6.63	6.60	7.70	0.72	0.57
Effective degradability 1	41.6	42.4	43.0	2.97	0.95
CP degradation					
Soluble (%)	52.4	56.8	60.2	2.56	0.30
Degradable (%)	44.6	40.2	36.1	2.45	0.25
Rate of digestion (%/h)	11.7	11.2	11.0	0.35	0.50
Effective degradability 1	80.4	80.9	81.6	1.29	0.81

1 Assuming a rate of passage of 7 %/h.

Key Words: Unsaturated fats, Ruminal digestion, Grazing condition

1207 Effects of Zinc and(or) monensin on the utilization of a barley-alfalfa diet in beef cattle. H. M. Arelovich*[1], H. E. Laborde[1], C. J. Ackerman[2], M. I. Amela[1], and M. B. Torrea[1], [1]*Universidad Nacional Del Sur, Bahia Blanca, Argentina,* [2]*Oregon State University, Corvallis, OR.*

Previous research has indicated that the addition of 250 to 400 ppm Zn to low-quality forage diets altered rumen fermentation by retarding ammonia accumulation and increasing molar proportions of propionate. This experiment was designed to investigate the impacts of dietary inclusion of Zn and(or) monensin on the productive performance and blood metabolite changes in sixteen recently weaned Angus steer calves (198 kg initial liveweight). Steers were individually housed and fed a mixed diet of 50% cracked barley grain, 40% ground alfalfa hay and 10% sunflower meal at 0800 and 1700 daily in equal proportions. The composition of the diet was 14.3% CP, 46.1% NDF, 20.5% ADF and 6.7% ash. Four treatments were randomly allotted to four individually fed steers/treatment. Treatments were: 1) Control (C); 85% wheat middlings + 15% NaCl, 2) Zinc (Z); C + 450 ppm ZnCl2; 3) monensin (M); C + 300 mg monensin and 4) zinc + monensin (ZM); C + 450 ppm Zn + 300 mg monensin. All treatments were added to the basal ration at a rate of 200 g/steer at 0800 and were fed for 77 d. Blood samples were collected via jugular venipuncture. Data was analyzed using nonorthogonal contrasts; 1) C vs all other treatments, 2) C vs Z, and 3) Z vs ZM. No differences ($P > .10$) were detected in any of the parameters measured. Therefore, we conclude that inclusion of zinc at the level of 450 ppm did not alter performance or blood parameters of steers fed a basal diet consisting of 50% cracked barley grain, 40% ground alfalfa hay and 10% sunflower meal. Dry matter intake, ADG, feed conversions (FC), total tract apparent OM digestibility (DIG), and results of blood analysis for hematocrite (HTC), glucose (GLU), urea (U), total protein (TP), alkaline phosphatase (ALKP) and creatinine (CRT), are reported in the following table.

					Blood Serum					
	ADG (g/d)	DMI (kg/d)	FC (g/g)	DIG (%)	HTC (%)	GLU (g/l)	U (g/l)	TP (g/dl)	ALKP (Ul/l)	CRT (mg/dl)
C	1013	7.7	.13	62	38	.91	.38	7.39	320	1.30
Z	1008	8.0	.13	63	39	.96	.40	7.24	292	1.27
M	1026	7.1	.15	67	37	.87	.39	7.24	358	1.35
ZM	982	7.4	.13	66	37	.89	.39	7.27	346	1.36
SE	52.5	.27	.01	.03	.9	.04	.02	.127	37.3	.045

[a]Standard error of the means n = 16

Key Words: Zinc, Monensin, Beef

1208 Performance and conservation of phosphorus in growing cattle. L. W. Greene*[1,2], F. T. McCollum III[1], N. K. Chirase[1,2], and T. M. Montgomery[2], [1]*Texas A&M University Agricultural Research and Extension Center,* [2]*West Texas A&M University.*

One hundred forty four crossbred heifers (average initial weight, 178 kg) were used in a 43 d receiving and 103 d growing trial. Cattle were randomly assigned to 12 pens and fed ad libitum a diet consisting of 50% steam flaked corn (SFC), 40% cottonseed hulls (CSH) and 10% protein/mineral/vitamin (PMV) supplement. Each pen was randomly assigned to either 1.4 kg brewers' grain yeast (BGY) top-dressed on the feed daily or no BGY. On d 44, growing diets were formulated using either SFC (39.7%), CSH (5.0%), soybean hulls (38.8%), fat (3.6%) and PVM-1 (13.0%) to contain 0.22% P or SFC (69.7%) CSH (18.0%), fat (1.8%) and PVM-2 (10.5%) to contain 0.33% P. The P diets were assigned to the 12 pens in a 2 X 2 factorial arrangement with BGY. During the growing period, diet intake was adjusted at 2 wk intervals to produce a projected ADG of 0.9 kg/d. On d 146, cattle were weighed and total pen manure weighed and sampled. Heifers fed BGY during the receiving period consumed 6.5% more feed (P=.0001; 6.7 vs 6.2 kg/d) and gained 23.4% more (P=0.02; 0.94 vs 0.76 kg/d) than those fed the control diet. Heifers fed BGY were 15% more (P = 0.01) efficient than those fed the control diet (0.137 vs 0.119 gain/feed). No interaction occurred between BGY and dietary P during the growing period. Heifers fed BGY consumed more feed (P = 0.03; 5.58 vs 5.47 kg), had greater ADG (P = 0.01; 1.0 vs 0.93 kg/d) and improved feed conversion (P = 0.04; 0.178 vs 0.169 gain/feed) compared to those fed no BGY. BGY did not affect (P = .50) N and P retention on the pen surface. Feeding 0.22% P did not affect feed intake (P = 0.98), ADG (P = 0.15) or feed efficiency (P = 0.12) compared to heifers fed 0.33% P. However, feeding 0.22% P reduced the amount of P retained on the pen surface by 29% (P = 0.03). Feeding BGY during the receiving and growing period increased heifer performance. Reducing dietary P in growing diets reduced the quantity of pen surface P without reducing performance.

Key Words: phosphorus, environment, yeast

1209 The effect of copper source and level on the rate and extent of copper repletion in Holstein heifers. G. P. Yost*[1], L. R. McDowell[1], C. K. Swenson[3], and J. D. Arthington[2], [1]*University of Florida – IFAS, Gainesville ,* [2]*University of Florida – IFAS, Ona,* [3]*Zinpro Corporation, Eden Prairie, MN.*

The objective of this study was to evaluate the rate and extent of Cu repletion in Holstein heifers using two Cu sources (organic and inorganic) at two levels (15 and 30 ppm). An additional repletion treatment included a Cu oxide bolus. Heifers (n=50) were individually fed a depletion diet fortified with Fe, S, and Mo at 50 ppm, 0.40%, and 15 ppm DM of the total diet, respectively. Following 70 d of depletion, heifers were stratified by liver Cu and randomly allotted to one of five repletion treatments. Four treatments consisted of feed sources of Cu (Feed-Cu), 1) $CuSO_4$ at 15 ppm, 2) $CuSO_4$ at 30 ppm, 3) Availa-Cu at 15 ppm, and 4) Availa-Cu at 30 ppm. A fifth treatment, consisting of an intraruminal bolus (Bolus), contained 12.5 g of Cu oxide needles. Repletion treatments were delivered in the same total mixed ration without supplemental Fe, S, and Mo. Copper status was assessed in blood and liver samples collected on 14 d intervals for 70 d. Irrespective of treatment, all heifers increased in body weight during the repletion period. Liver Cu increased in each Feed-Cu treatment over time. Bolus heifers reached a peak in liver Cu concentration (165.5 ppm) on d 28. Heifers receiving $CuSO_4$ at 30 ppm achieved higher liver Cu compared to heifers receiving $CuSO_4$ at 15 ppm, but not those receiving Availa-Cu at 15 or 30 ppm (88.2 and 137.3, and 98.1 and 118.5 ppm for $CuSO_4$ at 15 and 30 ppm and Availa-Cu at 15 and 30 ppm, respectively). Mean liver Cu for Bolus heifers (131.1 ppm) was greater ($P<0.05$) than $CuSO_4$ at 15 ppm, but not other Feed-Cu treatments. Plasma ceruloplasmin was higher ($P<0.001$) in Bolus heifers versus other treatments. No differences in plasma ceruloplasmin were detected for Feed-Cu source or level. Red blood cell superoxide dismutase activity was higher ($P<0.05$) in Bolus heifers compared to heifers receiving Availa-Cu at 15 ppm, but not other Feed-Cu sources (1.03 and 0.79 units of activity for Bolus and Availa-Cu at 15 ppm, respectively). These results indicate that all Cu sources evaluated in this study elevated Cu status of depleted heifers, particularly when provided at higher dietary levels.

Key Words: Holstein, Repletion, Copper

1210 Effects of biotin on liver metabolism in lactating dairy cows. C. K. Reynolds*[1], A. J. Packington[2], and G. M. Weber[3], [1]*The University or Reading, UK,* [2]*Roche Vitamins (UK),* [3]*F. Hoffmann-La Roche Ltd., Switzerland.*

The objective was to measure effects of supplemental biotin on portal-drained viscera (PDV) and liver (LIV) metabolism in 3 multiparous, catheterized, mid-lactation Holstein x Friesian cows (664 kg BW). A TMR of 30 % dried lucerne, 20 % grass silage, 50 % concentrates and 17.8 % CP (DM basis) was fed hourly at 97 % of ad libitum DMI . Added carrier (.5 kg ground wheat/d) without or with biotin (20 mg/d) was fed in a switch-back design with three 2-wk periods. Hourly measurements (8) of PDV and LIV blood flow and net nutrient flux (mmol/h) were obtained on d-14 of each period. Biotin had no effect (P > .57) on DMI (22.2 kg/d), milk yield (29.5 kg/d) or blood flow (L/h) for PDV (2020) or LIV (2570), but increased (P < .02) arterial hemoglobin (94.5 vs 98.7 g/L) and oxygen (5.35 vs 5.57 mM) concentration and decreased (P < .07) arterial CO2 concentration (27.22 vs 26.94 mM). There was no effect (P > .45) of biotin on net flux of glucose, lactate, oxygen or b-OH-butyrate across PDV (19, 174, -3672 and 281, respectively) or LIV (686, -95, -3892 and 394, respectively). Similarly, biotin had no effect (P > .28) on net flux of acetate, propionate or n-butyrate across PDV (3390, 932 and 212, respectively) or LIV (1814, -858 and -152, respectively). Biotin did increase net PDV release of ammonia (703 vs 945; P < .01) and removal of urea (49 vs -218; P < .07). This was associated with a numerical increase in net PDV acetate release (3087 vs 3694) and suggests an effect on rumen fermentation and(or) urease activity. Net LIV flux of ammonia (-882) and urea (824) were not affected (P > .24), but removal of i-valerate was increased (-39 vs -47; P

< .07), indicating an enhancement of LIV methylcrotonyl-CoA carboxylase activity. The decrease in blood CO2 also suggests an enhancement of biotin dependent carboxylase activity. Biotin effects on carboxylase activity and hemoglobin may be of benefit to the dairy cow, especially in early lactation.

Key Words: Biotin, Liver, Lactation

1211 Organic chromium and selenium effects on performance, digestibility and carcass characteristics of lambs.

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Organic selenium (0.0, and 0.3 ppm as Sel-Plex-50) and chromium (0.0, 0.250 and 0.350 ppm as Biochromium; Alltech, Inc.) were fed for 95 d to 54 Rambouillet cross lambs (27.04.83 kg BW) in a complete random design experiment with a 2x3 factorial arrangement of treatments. An in vivo digestibility and nitrogen balance trial was done with 24 lambs (four/treatment). Lambs were slaughtered at the beginning (four) and at the end (30; 45.383.13 kg) to evaluated carcass variables by comparative slaughter and specific gravity. Means were analyzed by orthogonal contrasts (C): C1) 0 Se vs 0.3 ppm Se; C2) 0 Cr, 0 Se vs 0.250+0.350 ppm Cr, 0 Se; C3) 0 Cr, 0.3 ppm Se vs 0.250+0.350 ppm Cr, 0.3 ppm Se; C4) 0.250 ppm Cr, 0 Se vs 0.350 ppm Cr, 0 Se; 5) 0.250 ppm Cr, 0.3 ppm Se vs 0.350 ppm Cr, 0.3 ppm Se. Biochromium (0.0, 2.5 and 3.5 g/lamb/d) and Sel-Plex-50 (0.0 and 3.0 g/lamb/d) were fed individually every morning with the basal diet (% DM): sorghum grain 65.2, corn stover 12.8, DPW 12.0, alfalfa hay 2.0, vitamin and mineral premix 2.0, SBM 2.0, wheat bran 1.5, fish meal 1.5, urea 1.0. DMI was higher (P<0.08) for unsupplemented lambs (C2; 1265 vs 1186 g/d). Lambs receiving Cr and Se (C3) had better (P<0.05) feed conversion (6.4 vs 10.1), higher (P<0.01) ADG (229 vs 184 g/d), and heavier BW (48.7 vs 44.3 kg; P<0.001) and carcass (22.4 vs 20.9 kg; P<0.01). Cr (0.350 ppm) without Se (C4) improved feed conversion (5.92 vs 9.73; P<0.07), carcass weight (23.1 vs 20.7 kg; P<0.02); and yield (56.9 vs 53.4%; P<0.06). Lambs fed Cr with (C3) or without (C4) Se had higher digestibility of DM (70.3 vs 61.9%, P<0.0002, C3; 73.3 vs 62.6%, P<0.0001, C4) and CP (60.7 vs 48.9%, P<0.0002, C3; 65.1 vs 51.2%, P<0.0002, C4). Lambs receiving Cr and Se (C3) retained more (P<.0343) N (28.18 vs 11.74 g). Addition of organic Cr improved BW gain, carcass variables, feed conversion and digestibility, and N retention in lambs fed a 65% sorghum grain diet.

Key Words: Organic chromium, Organic selenium, digestibility

1212 Effects of source of supplemental zinc on heifer performance during receiving and finishing phases.

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Ninety-seven beef heifers (British x Continental; average initial BW = 223.7 kg) were used to study the effects of Zn source on health and performance. On arrival at the Texas Tech University Burnett Center, heifers were weighed, tagged, vaccinated, treated with Micotil, dewormed, and assigned randomly to dirt-floor pens (three pens per treatment; eight heifers per pen). All heifers were fed a 65% concentrate diet that contained NRC (1996) recommended levels of vitamins and minerals, except Zn. Treatments were: control (no supplemental Zn) and 75 mg/kg of supplemental Zn from either zinc sulfate, zinc methionine, or zinc propionate (KemZin 2700^{TM}; Kemin Ind., Des Moines, IA). During the 35-d receiving phase, heifers were monitored daily for signs of bovine respiratory disease, and suspect calves with rectal temperatures $\geq 39.7^{\circ}$ C were treated and returned to their pens. At the end of the receiving phase, all heifers were group-fed the control diet for 42 d, during which, the concentrate level of the diet was increased to the final 88% concentrate finishing diet. Heifers were then stratified by BW (within original treatments), assigned to feedlot pens (four heifers per pen; six pens per treatment), and implanted with Revalor H. Heifers were weighed at 28-d intervals throughout the finishing period. During the receiving phase, control heifers had a higher (P < .05) d-35 BW and were more efficient (P < .05) than heifers in the other three treatments. Dry matter intake and ADG did not differ (P > .05) among treatments for the 168-d finishing period; however, feed:gain was poorer (P < .05) for heifers in the control group than for the average of the other treatments. With the exception of KPH, which was less (P < .04) for $ZnS0_4$ than for the two organic Zn sources, carcass characteristics did not differ (P < .05). In newly received cattle, neither level nor source of supplemental Zn affected heifer performance. Moreover, Zn source had minimal effects on performance and carcass characteristics of finishing heifers, but lack of supplemental Zn might negatively affect feed efficiency during the finishing phase.

Key Words: Zinc, Cattle, Feedlot

1213 Adaptations in amino acid concentrations, body fat and body protein in dairy cattle fed varying amounts of protein in the transition period.

J. P. McNamara*, J.J. Sage, T.L. Citron, and G.J. Phillips, *Washington State University.*

The objectives were: to determine effects of prepartum protein intake and dietary amino acid balance on production, amino acid concentrations, adaptations in body fat and protein and, indirectly, body protein breakdown in early lactation and to determine the effects of rates of milk production and feed intake on adaptations in body fat, protein and rate of protein breakdown. Holstein cows (42) were fed two concentrations of protein for 21 days prepartum (11 and 14 percent) with or without 20 g per d methionine hydroxy analog and then fed a common diet of 16 percent CP for 120 days postpartum. Subcutaneous fat biopsies were taken from 31 cows at 14 d before, 60, and 120 days after calving and the diameters of fat cells (FCD) were determined and body fat (BF) and protein (BP) were calculated using validated equations. Dry matter intake averaged 25.4 kg (SD 3.1 kg) and milk production 41.6 kg (SD 1.4 kg). Protein intake prepartum was positively related to DMI and milk production postpartum (P < 0.05); cows fed the 14 % CP ration ate 0.9 kg more DMI and gave 1.7 kg more milk than those fed the 11 % ration. Cows fed AT88 prepartum lost less (P < 0.05) body protein by d 60. From d 60 to d 120 BF increased 8.5 kg and 11.5 kg for low and high protein groups and BP increased 0.5 kg and 1.0 kg. Serum concentrations of branched chain amino acids fell (P < 0.05) 17 percent in the first 4 weeks postpartum, lysine fell 12 to 15 percent, histidine fell 16 percent, and methionine and cysteine increased 20 to 30 percent (all P < 0.05). The ratio of serum 3-methylhistidine to creatinine (3-MH:C) was determined to indicate muscle protein degradation. An increase in the 3-MH:C ratio in late gestation and very early lactation (P < 0.05) indicated increased BP breakdown, there was no effect of prepartum ration. This data set provides adequate information to challenge a mechanistic model of nutrient use in dairy cows during the early lactation period.

Key Words: lactation, metabolic model, body composition

1214 Challenging performance of a mechanistic model of metabolism to describe nutrient flux and body pools in early lactation.

J. P. McNamara*, J.J. Sage, T.L. Citron, and G.J. Phillips, *Washington State University.*

Data were collected to challenge the behavior and sensitivity of existing metabolic models (Molly, AAMolly, University of California, Davis) to describe changes in body fat, protein and amino acid concentrations in early lactation dairy cows. Holstein cows (42) were fed 11 or 14% CP diets with or without methionine analog (AT88) for 21 days prepartum and a common 16% CP diet from 1 to 120 DIM to determine effects on production, nutrient metabolism, and body composition. Rates of intake, milk composition and yield, serum metabolites, body fat and protein content were determined at intervals for the first 120 d of lactation. Postpartum dry matter intake averaged 25.4 kg/d (SEM = 0.7 kg/d) and the cows produced a mean of 40.7 kg/d milk (SEM = 1.2 kg/d). From 14 days precalving to 60 d postcalving, BP decreased (P < 0.05) 8.2 kg and 8.5 kg for the 11% and 14% CP treatments. From d 60 to 120, BP increased 0.6 kg. The ratio in serum of 3-MH:C was elevated at 7 d postpartum (P < 0.05) and the 3-MH:C ratio at d 7 was greater (P < 0.05) in cows fed 11% CP prepartum then in cows fed 14% CP. Higher-producing (> 45 kg milk/d) cows in this study mobilized (P < 0.05) up to 18 kg body protein in early lactation. Feed composition, DMI, initial body weight and composition observations were explicit model inputs. The model described milk production from feed intake only with as: simulated milk (kg/d) = 0.26 * observed + 28.9 kg /d with a regression coefficient of 0.61. When milk production potential was entered on an individual cow basis, the relation between observed and simulated milk production was: simulated = 0.903 * observed + 2.9 kg/d with a regression coefficient of 0.96. The model simulated BP change to 120 d similarly (within 1 SD) to observed (observed = 7.5, simulated = 10.5 kg) but a greater increase in body fat (124.8 kg

simulated vs - 41.7 kg observed). The model AAmolly describes use of sulfur amino acids, histidine and lysine and predicted utilization of these amino acids from body stores in early lactation, as was observed. These mechanistic models describe milk outputs from quite well, within 1 SD of observed. The description of changes in body fat and protein over a period of 1 to 3 weeks postpartum is still inadequate and will require better experimental data for improvement.

Key Words: lactation, metabolic model, body composition

1215 Effects of prepartum intake, postpartum induction of primary ketosis, and periparturient disorders on performance and blood metabolites in dairy cows. H. M. Dann*, J. K. Drackley, and D. E. Morin, *University of Illinois, Urbana*.

Multiparous Holstein cows were used to determine the effects of different prepartum intakes and postpartum health statuses on dry matter intake (DMI), milk yield, and blood metabolites. Cows were fed a diet (1.54 Mcal NE_L/kg, 14.1% CP) from dry-off to parturition at either ad libitum (A; n=17) or restricted (R; 80% of calculated NE_L requirements; n=18) intake. After parturition, all cows were fed a lactation diet (1.58 Mcal NE_L/kg, 16.8% CP). At 4 d in milk (DIM), cows were assigned to 3 groups: healthy-control (HC; n=6), healthy-ketosis induction (HK; n=9), and periparturient disorder (PD; n=17), based on a physical examination. HC and PD were fed for ad libitum intake. HK were fed at 50% of d 4 DMI from 5 DIM to signs of clinical ketosis or 14 DIM, and then returned to ad libitum intake. Prepartum DMI was higher and serum nonesterified fatty acids (NEFA) were lower for A than R ($P<0.05$). Serum glucose, Ca, and albumin did not differ between A and R at -14 DIM. Prepartum intake (A vs. R) did not affect DMI, milk yield, or blood metabolites postpartum. From 1-4 DIM, DMI was higher ($P<0.05$) for HC and HK than for PD. Milk yield was higher ($P<0.05$) for HC than PD; HK was intermediate. At 4 DIM, HC and HK had higher ($P<0.05$) Ca than PD. Albumin was higher ($P<0.05$) for HK than PD; HC was intermediate. Glucose and NEFA did not differ. From 5-14 DIM, DMI was higher ($P<0.05$) for HC than PD. HC produced more milk ($P<0.05$) than HK and PD. At 14 DIM or onset of clinical ketosis, glucose was higher ($P<0.05$) while NEFA and β-hydroxybutyrate (urine and plasma) were lower ($P<0.05$) for HC and PD than HK. Albumin was higher ($P<0.05$) for HC and HK than PD. Calcium was lower ($P<0.05$) for HK and PD than HC. From 15-42 DIM, DMI and milk yield did not differ. At 21 DIM, glucose, NEFA, Ca, and albumin did not differ. Prepartum intake did not affect postpartum performance or blood metabolites. Periparturient disorders and induction of ketosis negatively affected performance and blood metabolites.

Key Words: Ketosis, Transition Cow, Metabolism

1216 Rumen volume and liquid dilution rate in transition dairy cows. C. K. Reynolds*, D. J. Humphries, and J. D. Sutton, *The University of Reading, UK*.

The objective was to measure effects of transition and supplemental barley on rumen digesta fill and liquid dilution rate in 10 rumen cannulated Holstein x Friesian cows in late gestation and early lactation. Cows were fed a grass-silage based gestation TMR for BW (671 kg) stasis without (n = 5) or with (n = 5) 1 kg (as fed) barley/d for 6 wk before expected calving date (CD) and a maize-silage based lactation TMR beginning 7 d before expected CD (2 kg DM/d). After calving lactation TMR was fed for ad libitum DMI. Cows were fed equal meals at 8-h intervals. Rumen liquid volume, DM content and liquid dilution rate were estimated by marker dilution at an average of 17 and 8 d before and 10, 20 and 31 d after calving. Markers (CrEDTA or CoEDTA) were introduced into the rumen at separate times, either 1 h before or 1 h after feeding at 0830 h. Subsequent representative rumen samples were analyzed to determine marker dilution and DM concentration and results for each marker were averaged. Feeding barley had no effect (P > .10). Milk yield at d 10, 20 and 30 after calving was 36.5, 41.9 and 43.3 (SEM 1.5) kg/d, respectively. The data show that increases in DMI after calving are associated with increased rumen DM fill and liquid turnover, but total liquid content was not affected.

Day from CD...	-17	-8	10	20	31	SEM	P-Day
DMI, kg/d	10.8	9.8	16.5	20.2	18.8	.7	.01
Rumen DM, kg	7.1	7.0	8.3	9.5	10.3	.8	.01
Rumen liquid, kg	51.8	50.0	48.9	54.2	57.7	4.3	.26
Total digesta, kg	58.9	57.0	57.1	63.7	67.9	5.1	.15
Liquid dilution, %/h	14.8	15.1	17.7	17.5	16.2	.8	.02

Key Words: Rumen fill, Dairy cows, Transition

1217 Effects of dietary energy density on performance of transition dairy cows. E. Rabelo*, R. L. Rezende, S. J. Bertics, and R. R. Grummer, *University of Wisconsin, Madison*.

Forty cows and twenty heifers were used in a randomized block design to evaluate different dietary energy densities during the periparturient period. Prepartum (d -28 to calving) diets were dry-low (DL, 1.57 Mcal NEl/kg, 14% CP, 42% NDF, 34% NFC) and dry-high (DH, 1.66 Mcal NEl/kg, 14% CP, 34% NDF, 41% NFC). After calving, half of the cows from each prepartum treatment group were assigned to a low (L, 1.67 Mcal NEl/kg, 18% CP, 33% NDF, 37% NFC) or high (H, 1.74 Mcal NEl/kg, 18% CP, 27% NDF, 44% NFC) diet until d 20 postpartum. After d +20 postpartum, all cows were fed H until d +70. Prepartum DMI was higher for animals fed DH than DL (13.1 vs. 11.3 kg/d, P < .0001). Treatment differences for DMI during the prepartum tended to be more pronounced for cows compared to heifers (P < .13). There was a treatment by time interaction on DMI after calving; animals that were fed DH had higher DMI at the second wk of lactation compared to animals fed DL (P < .05). Animals fed H had a higher DMI for the first 20 d of lactation compared to animals fed L (16.3 vs. 15.0 kg/d, P < .06). Diets did not affect DMI after the third wk of lactation. Prepartum diets did not affect milk, fat or protein yield. Milk production increased faster for animals fed H compared to animals fed L (P < .001). There was a prepartum treatment x time interaction on milk fat content (P < .02). Animals fed DH had higher milk fat content during the second wk of lactation than animals fed DL (4.43 vs. 3.91%, P < .01); no differences were observed during subsequent weeks. Increasing dietary energy postpartum tended to decrease milk protein percentage (3.14 vs. 3.06%, P < .11) and did not affect milk fat percentage. Feeding diets with higher energy density prepartum positively affects DMI during the prepartum period and possibly during early lactation. Increasing energy density of the diet during the first 3 wk postpartum positively affects DMI and milk production during the first 3 wk of lactation.

Key Words: Transition cow, Dietary energy, Lactation

1218 Effects of dietary energy density on blood parameters and liver triglyceride of transition dairy cows. E. Rabelo*, R. L. Rezende, S. J. Bertics, and R. R. Grummer, *University of Wisconsin, Madison*.

Forty cows and twenty heifers were used in a randomized block design to evaluate dietary energy densities during the periparturient period. Prepartum (d -28 to calving) diets were dry-low (DL, 1.57 Mcal NEl/kg, 14% CP, 42% NDF, 34% NFC) and dry-high (DH, 1.66 Mcal NEl/kg, 14% CP, 34% NDF, 41% NFC). After calving, half of the cows from each prepartum treatment group were assigned to a low (L, 1.67 Mcal NEl/kg, 18% CP, 33% NDF, 37% NFC) or high (H, 1.74 Mcal NEl/kg, 18% CP, 27% NDF, 44% NFC) diet until d 20 postpartum. After d +20 postpartum, all cows were fed H until d +70. Blood samples were taken at d -7, +1, +4, +7, +21 and +35 relative to calving and analyzed for plasma BHBA, glucose, and NEFA, and serum insulin. Liver biopsies were taken on d +1, +21 and +35 relative to calving. Data through d +1 were statistically analyzed separately from data after d +1. Treatment differences for blood and liver parameters on specific days are indicated only when a treatment x day interaction was significant. There was a prepartum treatment effect on NEFA through d +1 (247 vs. 331 uEq/L, P < .01, DH vs. DL), with treatment differences being greatest at d +1 (500 vs.733 uEq/L, P < .0001, DH vs. DL). Animals fed DH had lower NEFA at d +4 (483 vs. 511 uEq/L, P < .01) and BHBA at d +21 (5.8 vs. 8.2 mg/dl, P < 0.05), and higher glucose at d -7 and +7 (54.6 vs. 52.6 mg/dl, P < .10; 47.9 vs.45.6 mg/dl, P < .10) and insulin at d -7 (17.8 vs. 13.7 uIU/ml, P < .01) than animals fed DL. At d +7 and +21, animals fed H had higher glucose (48.5 vs. 44.9, 49.6 vs. 44.6 mg/dl, P < .001) and insulin (12.3 vs. 9.9, 15.5 vs. 11.7 uIU/ml, P< .01), and

lower BHBA (4.8 vs.8.2, 4.5 vs. 9.6 mg/dl, P < .001) than animals fed L. Liver triglyceride at d +21 was lower for animals fed H compared to animals fed L (11.0 vs. 15.6 ug TG/ug DNA, P < .06). A more favorable metabolic profile occurs when increasing the energy density of the diet prepartum or immediately postpartum compared with delaying the increase until d +20 postpartum.

Key Words: Transition cow, Dietary energy, Blood and liver

1219 Changes in hepatic methylmalonylcoenzyme A mutase (MCM, E.C. 5.4.99.2) activity during the transition period in the dairy cows. B. Graulet*[1], A. Desrochers[2], and C.L. Girard[1], [1]*Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada, Lennoxville,* [2]*Facult de Mdecine Vtrinaire, St-Hyacinthe, Canada.*

The objective was to look at the activity of the hepatic cobalamin-dependent enzyme MCM in dairy cow during the transition period. This enzyme controls the utilisation of methylmalonyl-CoA for neoglucogenesis and thus might be strongly stimulated in dairy cow by the intake of transition and early lactation diets and the increased needs in glucose for milk production. Liver biopsies were taken up repeatedly from 6 multiparous cows 3 wk before calving (-3 wk) and at 2, 4 and 8 wk of lactation. MCM activity was assayed spectrophotometrically from purified mitochondrial matrix. MCM activity decreased from 14.04 ± 1.29 to 7.58 ± .75 nmol/min/mg of intramitochondrial proteins (P < .037) between -3 wk and 2 wk of lactation then returned (P < .004) and stayed at its initial level at wk 4 and 8. Apparent Km and Vmax values towards methylmalonyl-CoA (mean initial values : 175.2 ± 34.0 μM and 19.96 ± 3.16 nmol/min/mg of protein, respectively) followed the same quadratic pattern (P < .052). The dose-response curves of MCM activity towards its cofactor adenosylcobalamin (AdoCbl) indicated the same variations around calving for the apomutase but not for the holomutase part of the activity which remained stable until wk 2 then increased from 4.95 ± .45 to 8.00 ± .80 nmol/min/mg of protein at wk 8 (P < .023). Holomutase activity represented 41.2, 65.3, 61.5 and 59.6 % of total MCM activity at -3, 2, 4 and 8 wk, respectively. This increase was associated to a reduction in plasma vitamin B12 concentrations (-33 %, P < .003). Apparent Vmax values towards AdoCbl (initial level 8.59 ± .71 nmol/min/mg of protein) varied also quadratically. Apparent Km values towards AdoCbl were constant until wk 2 (.58 ± .20 to .69 ± .14 μM), decreased by 36 % at wk 4 (P < .056) and then returned to the inital values at wk 8 (P < .001). Our results show that MCM activity is decreased during the first weeks of lactation and consequently might reduce neoglucogenesis.

Key Words: MethylmalonylCoA mutase, Cow, Lactation

1220 Effects of a modified stair-step compensatory growth model for gestating beef heifers. A. M. Encinias*, H. B. Encinias, T. D. Klein, G. P. Lardy, M. L . Bauer, and C. S. Park, [1]*North Dakota State University, Fargo, ND USA.*

Thirty-six gestating Angus and Angus-cross heifers were used to evaluate the effects of energy restriction imposed at 90 d of gestation. Heifers were grouped by verified AI date into six pens (6 heifers/pen) and fed a grass hay/corn silage diet for 10 d. At 90 d of gestation, pens of heifers were assigned randomly to one of two dietary energy treatments: control (CON) or stair-step (SS). Control heifers were fed 20.4 Mcal ME/d from d 90 to 210 of gestation and 23.0 Mcal ME/d through d 270, to achieve 0.54 kg ADG (minus fetus). Stair-step heifers were fed 13.3 Mcal ME/d (65% of CON) from d 90 to 210 (restriction) of gestation and 29.9 Mcal ME/d (130% CON) through d 270 (refeeding). During restriction, diet was formulated to elicit no gain (minus fetus) in SS heifers. Three-day consecutive weights were used to measure initial and final period BW. Initial and final body condition was estimated for each period. Initial BW ($P = 0.72$; 463 (CON) vs 474 (SS) ± 21) and BCS ($P = 0.81$; 6.1 vs 6.1 ± 0.1) were not different between treatments. Imposed restriction, did not influence BW ($P = 0.20$; 540 vs 490 ± 26 kg) between CON and SS, respectively. However, by design, CON heifers had a greater BW change ($P = 0.004$; 77 vs 16 ± 8 kg) and ADG ($P = 0.004$; 0.64 vs 0.13 ± 0.06 kg) during the restriction period. As a result SS heifers decreased ($P = 0.001$) in BCS. During refeeding phase, compensatory response (2.77 kg ADG) was observed in SS through d 28. Energetic efficiency (kg ADG:Mcal ME) was also greater for SS during refeeding ($P = 0.002$; 0.054 vs 0.031). In addition, SS heifers achieved a higher ADG ($P = 0.001$; 1.61 vs 0.73 ± 0.05 kg) than CON during refeeding. At the conclusion of feeding phase, heifer BW ($P = 0.95$; 584 vs 587 ± 13 kg) and BCS ($P = 0.70$; 6.2 vs 6.1 ± 0.2) were similar among CON and SS, respectively. Compensatory response elicited by SS during refeeding, allowed heifers to reach a similar final BW and BCS compared to conventionally reared gestating beef heifers.

Key Words: Beef heifer, Stair-step compensatory growth, Gestation

PSA Processing and Products

1221 Influence of CO_2 cryogenic cooling on low populations of *Salmonella* Enteritidis in inoculated table eggs. J.B. Gurtler* and D.E. Conner, *Department of Poultry Science, Poultry Product Safety and Quality Program, Auburn University, AL .*

Because Salmonella Enteritidis (SE) is the primary cause of foodborne illnesses arising from table eggs, there is interest in developing processes to limit SE risk. Cryogenic cooling with CO_2 improves microbial counts of naturally contaminated eggs and can reduce high SE populations in inoculated eggs. Furthermore, elevated CO_2 levels decrease SE growth in yolk-containing media. The present study was undertaken to determine the effects of CO_2 cryogenic cooling on SE propagation in eggs at low inoculum levels. Fresh eggs (with a mean temperature of 27C) were gathered and inoculated, via injection into albumen, to *ca.* 160 cfu/egg with SE. One half of the eggs were cooled at *ca.* -60C for 6 min with CO_2 in a prototype cryogenic cooling unit, producing a post-cooling egg temperature of 12.9C, and then stored at 7C. The remaining eggs were traditionally cooled, requiring 5 days to achieve 7C and held at that temperature thereafter. Egg pH and SE populations were determined every three days up to day 15 and then weekly up to day 49 of storage. Populations of SE remained static over the 49 days following cryogenic cooling, whereas SE populations increased significantly in traditionally cooled eggs. After day 6, cryogenically cooled eggs' SE populations were consistently 2.5-4.5 $\log_{10}$ cfu/ml lower than those traditionally cooled. No marked difference was noticed in pH values. Rapid cooling with CO_2 effectively inhibited SE growth in stored table eggs, and therefore may provide an efficient controlled cooling process for maintaining and increasing safety of table eggs.

Key Words: *Salmonella* Enteritidis, eggs, CO_2

1222 Effect of soybean soapstock on laying hen performance and egg quality parameters. V. Pardio*[1], L. Landin[1], K. Waliszewski[2], M. Avalos[1], A. Flores[1], and L. Guzman[1], [1]*Universidad Veracruzana, Veracruz, Veracruz/Mexico,* [2]*Instituto Tecnolgico de Veracruz, Veracruz, Veracruz/Mexico.*

The aim of the study was to determine the effects of soybean soapstock in laying hen diets on performance and egg quality parameters since variations in feed can adversely affect egg parameters resulting in economic losses to poultry producers. A total of 192 White Leghorn laying hens, 20 wk of age, was housed in two double-deck cage batteries with 4 birds in each cage at 25C. The birds were allotted to six dietary treatments, with each treatment replicated four times randomly among the batteries with 8 birds for replicate. The diets were sorghum-meal ground based with soybean oil at 3.5% and were isocaloric and isonitrogenous. Feed and water were provided for *ad libitum* consumption. Diet T1 had 25%, diet T2 50%, diet T3 75% and diet T4 100% of soybean soapstock, which was added in the amount to reach the requirement of 1.5% linoleic acid and complemented with soybean oil, control diet with pigment (T5) and control diet without pigment (T6) had 100% soybean oil. Four eggs from each replicate were randomly selected daily during eight weeks, kept at 4C and analyzed within two days after collection for determination of egg quality parameters: egg weight, shell thickness, Haugh unit score, albumen and shape index. Production performance -number and weight of eggs produced, feed conversion and percentage of production per treatment were recorded. Data were analyzed by ANOVA (P<0.05) and significant differences among treatment means were analyzed by Tukey and Dunnett tests using Minitab 10.5 statistical program. Results indicated that the egg quality parameters among treatments were not statistically different during the eight weeks. No statistical differences were observed in production performance during the first two