1417 Protocols for detection of EPSP synthase gene in sheep fed diets containing Roundup Ready® canola. R. Sharma*[1], T.W. Alexander[1,2], D. Damgaard[1], R.J. Forster[1], and T.A. McAllister[1], [1]*Agriculture and Agri-Food Canada, Lethbridge, AB,* [2]*University of Alberta, Edmonton.*

Standardized protocols were developed for detecting the gene encoding 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) in samples collected from sheep fed barley-based diets containing 6.5% (DM basis) Roundup Ready® canola (RRC). Glyphosate tolerance in RRC is conferred by the coding region of EPSPS derived from *Agrobacterium tumefaciens* CP4. Genomic DNA was extracted from diets and rumen digesta using a modified CTAB extraction procedure, but was found unsuitable for reproducible PCR amplification of EPSPS gene fragments from complete diets. Passing the genomic DNA from the CTAB extraction through a DNeasy™ plant mini-kit column (Qiagen), however, did produce a good yield of PCR-quality DNA. A Wizard™ genomic DNA purification kit (Promega) was used for extraction of DNA from blood samples. Primer sets were designed and PCR reaction conditions standardized that allowed amplification for of eight different regions (144- to 527-bp fragments) of the 1.3-kb EPSPS coding region. Positive PCR controls for both plant and bacterial DNA were included in screening diet and digesta samples, PCR controls for animal DNA with ovine tissues, and all three controls with fecal samples. Screening samples for the presence of the transgene entailed PCR assays for the eight fragments at two genomic DNA concentrations (ng and pg range). Using positive controls (spiked samples), the assay was confirmed sensitive enough to detect pg quantities of transgene in diet and blood, and ng quantities in digesta samples. Results of PCR assays were confirmed with Southern blot hybridizations. This protocol has been optimized for DNA extraction and sensitivity of detection, and has proven highly reliable. Transgene fragments were not detected in blood samples collected from sheep 2 to 3 h after feeding the RRC diet. Rubisco small subunit-specific (∼500 bp) and chloroplast DNA-specific fragments (653 bp) could be detected in digesta and fecal samples, whereas no fragments of the EPSPS coding region were found.

Key Words: EPSP Synthase, Roundup Ready®, PCR

1418 Influence of nutrition and body condition score on plasma concentrations of IGF-I and thyroxine (T4) in gestating beef cows. C. A. Lents*[1], R. P. Wettemann[1], J. M. Bolanos[2], F. J. White[1], I. Rubio[1], N. H. Ciccioli[1], and L. J. Spicer[1], [1]*Department of Animal Science, Oklahoma Agricultural Experiment Station, Stillwater, 74078,* [2]*Ministry of Agriculture, San Jose, Costa Rica.*

Pregnant Angus x Hereford cows (n = 73) were used to determine the effects of nutrient intake and body condition score (BCS; 1 = emaciated and 9 = obese) on concentrations of IGF-I and T4 in plasma. At 2 to 4 mo of gestation, cows were blocked by BCS and assigned to one of four nutritional treatments: high (ad libitum access to a 50% concentrate diet in the drylot), or adequate native grass pastures and one of three amounts of a 40% CP supplement each day (moderate, 1.6 kg; low, 1.1 kg; or very low, 0.5 kg). After 115 d of treatment, all cows grazed dormant native grass pasture and received 1.6 kg/d of a 40% CP supplement. At 70 and 125 d of treatment, cows were gathered and plasma samples were collected by tail venipuncture (fed sample). After 18 h without feed and water, a second plasma sample was collected (fasted sample). Concentrations of IGF-I and T4 were determined by RIA. BCS was similar for all groups (4.6 ± 0.1) at the initiation of treatment. After 70 d, BCS was greatest ($P < 0.01$) for high cows and similar for moderate, low, and very low cows. High cows had greater ($P < 0.05$) concentrations of IGF-I in fasted samples than all other groups, but IGF-I was similar in fed samples for all treatments. Treatment and access to feed did not influence plasma concentrations of T4. BCS at 70 d was correlated with plasma IGF-I in fasted samples (r = 0.43; $P < 0.001$) but not in fed samples. After 125 d of treatment, BCS was greatest ($P < 0.01$) for very high cows (6.4 ± 0.1), similar for moderate and low cows (4.8 ± 0.1), and least ($P < 0.01$) for very low cows (4.5 ± 0.1). Plasma concentrations of IGF-I at 125 d in fasted and fed samples were not influenced by previous treatments and were greater ($P < 0.001$) in fasted than fed cows. Body condition at 125 d was correlated with IGF-I in plasma in fasted samples (r = 0.33; $P < 0.01$) and in fed samples (r = 0.41; $P < 0.01$). We conclude that concentrations of IGF-I in plasma of cows are correlated with BCS in late gestation.

Key Words: BCS, IGF-I, Thyroxine

Ruminant Nutrition
Feed Additives, Fiber, and Minerals

1419 Preliminary report on chemical composition and ruminal degradation of *Aloe vera*. J. A. Vergara, M. A. Cuauro, and O. E. Araujo Febres*, *The University of Zulia, Maracaibo, Venezuela.*

Ruminal degradability of dry matter (DMS) and organic matter (DMO) of *Aloe vera*(AV) and *Brachiaria humidicola*(BH) as a reference were evaluated. Ten grams samples of AV and BH milled to 3 mm were incubated in nylon bags at 0, 6, 12, 24, 48 and 72 h in two crossbred steers with permanent rumen canulae (350 kg LW). Non-linear regression was used to calculate the parameters: a, b and c, while a + b was the potential degradability (PD); c, ruminal degradation rate (DR); a, instant degradability (ID). A completely randomized design with 4 replicates was used; means of degradation at 48 and 72 h and equation parameters were compared by LS Means. Chemical composition of AV was: DM: 90%; OM: 86.9%; crude protein: 7.5%; ADF: 39.6%; and NDF: 38.5%. DMS of AV was stabilized among 48 and 72 h (89.90%) higher than (P<0.05) values for BH at 48 h. Same performance had DMO. PD of MS and MO of AV (99.87% and 99.84%) were higher (P<0.05) than BH values (71.44% and 68.67%). DR of MS in the rumen was similar among byproducts (0.022 vs. 0.029, respectively); while DR of MO was 0.031 and 0.022 for AV and BH, respectively. The higher value (P<0.05) of DI of AV (40.9%) increased PD. AV degradability and Venezuelan production potential of this specie determine a high importance for animal feeding in arid zones.

Key Words: Aloe vera, Ruminal Degradability, Arid Zone

1420 Influence of addition of fibrolytic enzymes on enzyme activities and fermentation patterns of pure substrates *in vitro*. D. Colombatto*, D. P. Morgavi, and K. A. Beauchemin, *Research Center, Lethbridge, Alberta, Canada.*

A completely randomized study was carried out to investigate possible modes of action of an enzyme mixture (Liquicell 2500, Specialty Enzymes and Biochemicals, CA) with potential to be used in ruminant diets. The enzyme contained mainly xylanase and cellulase activities, with residual amylase and pectinase. Microcrystalline cellulose (CE), oat spelt xylan (XYL) and a mixture (1:1 v/v, CEXYL) were incubated in Hungate tubes (100 mg/tube, eight replicates), untreated or treated with Liquicell 2500 applied at 0.51 and 2.55 l g DM $^{-1}$ (L1 and L2, respectively). Interaction time was 20 h at 24C. Rumen fluid was collected 5 h post-feeding from a steer fed alfalfa hay *ad libitum*, and incubated at 39C with anaerobic buffer (1:4 v/v). At 1, 6, 18 and 48 h post incubation, samples from the liquid fraction were analyzed for xylanase, endoglucanase (CMCase), β-glucosidase and β-xylosidase activities (39C and pH 6.0). Volatile fatty acids (VFA) were quantified at 6, 18 and 48 h. Samples from 6 and 18 h of incubation were processed to obtain a feed-particle associated bacterial fraction (FPA), which was analyzed for enzymic activities as previously described. Addition of Liquicell 2500 at L2 increased (P<0.05) the initial (up to 6 h) xylanase, CMCase and β-glucosidase activities in the liquid fraction by an average of 85%, indicating that the exogenous mixture supplied extra enzymes and that these enzymes were resistant to the proteolytic action of rumen fluid. Across substrates, xylanase, and CMCase activities in the FPA fraction after 18 h were increased (P<0.05) with L2 by an average of 32%, suggesting an increase in the fibrolytic activity of rumen microbes. Total VFA were numerically (P>0.05) increased by L2 com-

pared to the controls (146 vs. 142, 141 vs. 127, and 153 vs. 148 mmol for CE, XYL and CEXYL, respectively), largely due to a numerical increase (P>0.05) in acetate production. Selected exogenous enzymes can increase the fibrolytic capacity of rumen fluid *in vitro*.

Key Words: Fibrolytic enzymes, Rumen, *in vitro*

1421 Screening of fibrolytic enzymes as feed additives for ruminants: can the effect of enzyme additives on *in vitro* fermentations be predicted by enzyme activities and feed hydrolysis? D. Colombatto*, D. P. Morgavi, A. F. Furtado, and K. A. Beauchemin, *Research Center, Lethbridge, Canada*.

A completely randomized study examined 23 commercial enzyme preparations (EP) for their biochemical properties and their ability to influence the hydrolysis (in absence of rumen fluid) and the *in vitro* rumen degradation of alfalfa hay (AH) and corn silage (CS). The EP's were analyzed for protein contents and for main and side fibrolytic activities (16 in total), at 39C and pH 6.0. The release of reducing sugars (RS) from AH and CS was determined by triplicate incubations of 25 mg substrate with EP for 15 min at 39C and pH 6.0. In the degradation study, triplicate amounts (1 g) of AH and CS were weighed into fermentation flasks, to which individual EP's (1.5 mg/g DM forage) were added 20 h before inoculation with rumen fluid. Anaerobic buffer (pH 6.0) was added 3 h later, and flasks were stored at 25C until inoculated with rumen fluid collected from 3 lactating dairy cows fed a TMR. Dry matter degradation (DMD) was determined after 18 h incubation at 39C. The protein contents and enzymic activities were correlated to the RS released and the DMD of each substrate using the Stepwise Regression procedure of SAS. Protein content explained 60 and 59% of the variation in RS released from AH (RS= 0.0115x - 0.2175, P<0.0001), and CS (RS= 0.0038x + 0.2550, P<0.0001). Activity against β-glucan explained a further 24% (P<0.10) of the model for AH, whereas activities against xylan, cellulose, starch and cellobiose explained a further 37% of the model (P<0.10) for CS. There was a significant relationship (P<0.05) between activity against oat spelt xylan and substrate DMD. However, the relationship was positive with AH (DMD= 0.042x + 453.6, P<0.01, R^2= 0.29) but negative with CS (DMD= -0.033x + 446.6, P<0.04, R^2=0.19). Protein content and enzymic activities explained the release of reducing sugars, but they accounted for little of the variation on *in vitro* rumen DMD of AH and CS.

Key Words: Enzyme activity, Degradation, Relationship

1422 Fibrolytic exogenous enzymes improve performance in steers fed sugar cane and stargrass. A. Gomez[1], J. Perez[1], G.D. Mendoza*[1], E. Aranda[1], A. Hernandez[1], J.A. Ramos[1], and R. Rojo[2], [1]*Colegio de Postgraduados, Montecillo, Texococo, Mexico,* [2]*Universidad Autonoma de Guerrero, FMVZ-URCCH, Cuajinicuilapa, Gro. Mexico*.

This experiment was conducted to study the effects of fibrolytic enzymes (Fibrozyme) on gain and digestibility of steers grazing stargrass and sugar cane plus urea as a complementary forage in tropical conditions. Twenty crossed (*Bos taurus* x *Bos indicus*) steers (270 30 kg BW) were used in a grazing trial (80 days), feeding individually concentrate (1 kg/d, 14% CP) and urea treated sugar cane (USC), in a completely randomized design according to the following treatments: 1) Grazing control (GC); 2) USC-0; 3) USC + 15 g/d Fibrozyme(USC-15); 4) USC + 30 g/d Fibrozyme (USC-30). The stocking density was 6 steers/ha. Forage intake was estimated with two makers (chromic oxide and acid insoluble ash). Gain was improved with fibrozyme showing a linear (P < 0.01) response to Fibrozyme level (g/d: C 484; USC-0 548; USC-15 634; USC-30 776) associated to a linear (P < 0.05) increment of sugar cane intake (kg/d: C 0.0; USC-0 3.04; USC-15 3.15; USC-30 3.24) and a higher DM digestibility (P < 0.05) than control group (%: C 65.0; USC-0 73.4; USC-15 71.4; USC-30 72). No effect was detected in stargrass or total DM intake. Results indicated that Fibrozyme improved nutrient intake from sugar cane improving daily gain.

Key Words: Fibrolytic enzymes, Sugar cane, Steers performance

1423 Exogenous fibrolytic enzymes and sugar cane improve performance in steers fed stargrass. A. Gomez[1], J. Perez[1], G.D. Mendoza*[1], E. Aranda[1], A. Hernandez[1], J.A. Ramos[1], and R. Rojo[2], [1]*Colegio de Postgraduados, Montecillo, Texococo, Mexico,* [2]*Universidad Autonoma de Guerrero, FMVZ-URCCH, Cuajinicuilapa, Gro. Mexico*.

One of the principal factors limiting animal production when ruminants are grazing tropical pastures, is forage availability through the year. In this way, several strategies with complementary forages like as sugar cane have been used to improve ruminant production. The use of fibrolytic exogenous enzymes may enhance digestion of forages by cattle. This experiment was carried out to study the effect of exogenous fibrolytic enzymes (Fibrozyme) and chopped sugar cane treated with urea (1%) and minerals (0.5%), on gain and digestibility of steers grazing stargrass in humid tropic. Twenty crossed (*Bos taurus* x *Bos indicus*) steers (275 25 BW) were used in a grazing trial (80 days), feeding individually concentrate (1 kg/d, 14% CP) and sugar cane treated with urea and minerals (SCT), in a completely randomized design according to the following treatments, 1) Grazing control (GC); 2) SCT-0; 3) SCT + 15 g/d fibrozyme (SCT-15); 4) SCT + 30 g/d Fibrozyme (SCT-30). The stocking density was 6 steers/ha. Forage intake was estimated with markers (Chromic oxide and acid insoluble ash). Gain was improved with fibrozyme showing a linear (P < 0.01) response to exogenous fibrolytic enzymes level (g/d: GC 482^a; SCT-0 682^b; SCT-15 789^c; SCT-30 992^d) associated to a linear (P < 0.01) increment of sugar cane intake (kg/d: GC 0.0^a; SCT-0 3.03^b; SCT-15 3.10^c; SCT-30 3.24^d). Intake of stargrass was reduced (P < 0.05) by enzymes (kg/d: GC 11.54^a; SCT-0 9.11^a; SCT-15 8.38^b SCT-30 8.32^c), but no effect (P > 0.05) were detected in total DM intake (kg/d: GC 12.47^a; SCT-0 13.07^a; SCT-15 12.41^a; SCT-30 12.68^a) and digestibility (%: GC 65.00^a; SCT-0 70.21^a; SCT-15 68.24^a; SCT-30 67.79^a). Results indicated that Fibrozyme and chopped sugar cane treated with urea and minerals improved daily gain and could be used in grazing steers in humid tropics.

Key Words: Fibrolytic enzymes, Sugar cane, Steers performance

1424 Effects of fibrolytic enzyme supplementation for dairy goats in mid lactation. E. González[1], G. Caja*[1], E. Albanell[1], C. Flores[1], A. Castro[1], R. Casals[1], X. Such[1], A. Bach[2], and C. Torre[2], [1]*Universitat Autonoma de Barcelona, Spain,* [2]*Agribrands Europe-España S.A., Spain*.

Twenty-four multiparous Murciano-Granadina dairy goats in mid lactation (wk 13 to 26) were used in a single cross-over design to evaluate the effects of supplementation with an exogenous fibrolytic enzyme complex (*Promote*^{TM}) on feed intake and lactation performances. At the end of lactation trial, eight goats (four per treatment) were selected to measure the total tract digestibility from wk 27 to 30 of lactation. Degradability of DM and NDF, as well as gas production, were also studied under in vitro conditions. Goats received an ad libitum total mixed ration composed of 65% forage (dehydrated mixture of 50% alfalfa and 50% maize-whole plant) and 35% concentrate to which the enzyme was added. Treatments were according to concentrate: Control (**C**; without enzyme) and Enzyme (**E**; *Promote*^{TM}, included at 0.47 g/kg). Feed intake (2.02 kgDM/d), milk yield (1.51 l/d), 4% ECM (1.80 l/d), and milk composition (TS, 13.9%; fat, 5.25%; CP, 3.75%; true protein, 3.54%) were not affected by enzyme supplementation, although CN tended to decrease in the E treatment (C, 2.87%; E, 2.81%; P< 0.09). Body weight change (C, -0.1 kg; E, +1.90 kg; P< 0.10) and body condition score change (C, +0.09; E, +0.19; P<0.14) tended to be higher with enzyme treatment. Digestibilities of DM (C, 68.9%; E, 72.0%) and OM (C, 70.4%; E, 73.4%) were higher (P<0.05) with enzyme supplementation, digestibility of CF tended to decrease (C, 41.9%; E, 37.6%; P<0.14), while digestibilities of CP (61.9%), NDF (54.3%) and ADF (48.8%) were not affected with the enzyme addition. Total tract digestibility results could not be supported by the in vitro trial on which similar effects were observed both for degradability (DM, 51.8%; NDF, 37.7%) and gas production (335 ml/gDM) at 48h. Supplementing dairy goat diets with *Promote*^{TM}, under the conditions of this trial, did not affect significantly lactation performances but enhanced DM and OM digestibility.

Key Words: Fibrolytic Enzymes, Dairy Goats, Digestibility

1425 Effects of direct-fed microbials on ruminal fermentation, digestibility, and bacterial protein synthesis during continuous culture. W. Z. Yang*, K. A. Beauchemin, and D. D. Vedres, *Agriculture and Agri-Food Canada, Lethbridge, Canada*.

A dual effluent continuous culture system (CC) was used to investigate the effects of adding bacterial direct-fed microbials (DFM) to a feedlot finishing cattle diet on ruminal fermentation, ruminal digestibility, and microbial protein synthesis in a 4 × 4 Latin square design. The treatments were control, *Propionibacterium* P15 (PB), *Enterococcus faecium* EF212 (EF), and *Enterococcus faecium* EF212 combined with a yeast culture (EFY) (Chr. Hansen BioSystems Co. Milwaukee, WI). Fermenters were fed twice daily a feedlot finishing cattle diet that consisted of 87% barley grain, 8% barley silage and 5% supplement (DM basis). The DFM products (240 mg/d) were delivered equally twice daily into the fermenters just before feeding. Mean ruminal pH did not differ among treatments and ranged from 5.86 to 5.91. Total VFA concentration and its molar proportions were not affected by DFM supplementation except for caprioc acid which was higher ($P < 0.05$) for control than for the DFM addition. Number of lactate-utilizing bacteria ($P < 0.10$) and total bacteria ($P < 0.15$) tended to be greater for control than for DFM supplementation. Ruminal degradabilities of DM, OM, fiber, and CP and microbial protein synthesis were not affected by adding DFM. The present results indicate that addition of DFM such as PB, EF or EF combined with a yeast culture did not affect ruminal fermentation or nutrient degradation during CC. The mode of action of DFM in the digestive tract may depend on DFM species and the presence of ruminal protozoa. *Propionibacteria* may have an effect when there is excess lactic acid produced in the rumen while *Enterococcus faecium* may enhance nutrient absorption in the small intestine rather than affect rumen fermentation.

Key Words: Direct-fed Microbials, Ruminal Fermentation, Continuous Culture

1426 Effects of ruminal pH and fibrolytic enzymes on digestibility, bacterial protein synthesis, and ruminal fermentation during continuous culture. W. Z. Yang*, K. A. Beauchemin, and D. D. Vedres, *Agriculture and Agri-Food Canada*.

A dual effluent continuous culture system (CC) was used to investigate the effects of ruminal pH and the addition of fibrolytic enzymes to a dairy cow diet on ruminal fermentation, digestibility, and microbial protein synthesis. The experiment was a split-plot design with completely randomized main plots and four replications. Main plots were pH (5.5, 6.0, and 6.5) and sub-plots were fibrolytic enzyme supplementation (control and enzyme). The enzyme product used was a commercial blend which contained relatively high xylanase and cellulase activities (Promote®, Agribrands Inc., St. Louis, MO). Total VFA concentration and its molar proportions were increased ($P < 0.01$) with increasing ruminal pH. Ruminal degradabilities of DM, OM, fiber and CP were all affected ($P < 0.01$) by ruminal pH; considerable increase in digestion was observed when ruminal pH increased from low (5.6) to medium (6.0), but the further increase in digestion was small when pH increased from medium to high (6.6). Enzyme supplementation did not affect total ruminal VFA but increased molar proportions of acetate ($P < 0.08$) and reduced that of propionate ($P < 0.15$), as a result of increased ($P < 0.01$) ruminal degradation of NDF and ADF. However, degradation of CP and microbial protein synthesis were not affected by adding fibrolytic enzymes into the diet. Furthermore, exogenous enzymes had no effect on feed digestion when ruminal pH was on average below 5.6, suggesting that exogenous enzymes act synergistically with ruminal microbial enzymes rather than by direct hydrolysis. The present results indicate that manipulation of ruminal pH in CC was highly effective in altering ruminal fermentation pattern and fiber degradation. Fibrolytic enzymes have the potential to improve ruminal fiber degradation, but have a limited effect on ruminal OM and CP degradation.

Key Words: Fibrolytic Enzymes, Ruminal pH, Digestibility, Continous Culture

1427 Fibrolytic enzymes as feed additives for lactating dairy cows: effects on chewing behavior, salivation and ruminal pH. G. R. Bowman*[1], K. A. Beauchemin[1], and J. A. Shelford[2], [1]*Agriculture and Agri-food Canada, Lethbridge, Canada*, [2]*University of British Columbia, Vancouver, Canada*.

A study was conducted to determine the effects of supplementing a lactating dairy cow diet with a fibrolytic enzyme product (Promote®, Agribrands International, St. Louis. MO) on chewing behavior, salivation and ruminal pH. This product is characterized mainly by xylanase and cellulase activities. Four multiparous (MP) and four primiparous (PP) lactating dairy cows fitted with ruminal cannulas and housed in a stanchion barn were used in a duplicated 4 x 4 Latin square design. Diets consisted of rolled barley, 37% barley silage, and 18% alfalfa haylage (55:45 forage to concentrate, DM basis) and differed in enzyme application: 1) control, 2) enzyme applied to entire concentrate (45% of TMR), 3) enzyme applied to supplement before pelleting (4% of TMR), and enzyme applied to a premix (0.2% of TMR). Enzyme supplementation did not alter daily DM intake (MP 23.2 ± 0.7, PP 20.6 ± 1.0), time spent eating (MP 323 ± 35, PP 347 ± 29 min/d) or ruminating (MP 556 ± 47, PP 497 ± 40 min/d). However, when enzymes were added to the diet daily saliva production increased by 16% ($P < 0.05$) (control 260 ± 35 l/d, enzymes 293 ± 44 l/d), with no difference among enzyme application treatments. Enzyme supplementation did not alter mean ruminal pH (5.62 ± 0.19) or the amount of time pH dropped below 5.5 (10.5 ± 5.6 h/d) or 5.8 (17.0 ± 5.0 h/d). These results indicate that supplementation of dairy cow diets with this fibrolytic enzyme product did not alter the physical effectiveness of the feed as measured by chewing variables. Enzyme supplementation had no effect on rumen pH likely due to the increase in saliva production. Increased total saliva production due to enzyme supplementation may have been a physiological response to increased fermentation products within the rumen.

Key Words: fibrolytic enzymes, salivation, ruminal pH

1428 Effects of *Saccharomyces cerevisiae* culture and *Saccharomyces cerevisiae* live cells on in vitro mixed ruminal microorganism fermentation. H. A. Lynch and S. A. Martin*, *University of Georgia, Athens*.

The objective of this study was to compare the effects of a *Saccharomyces cerevisiae* live cell product to a *Saccharomyces cerevisiae* culture product on the in vitro mixed ruminal microorganism fermentation of ground corn, soluble starch, alfalfa hay, and Coastal bermudagrass hay. In the presence of ground corn, neither concentration (0.35 or 0.73 g/L) of *Sacc. cerevisiae* culture or *Sacc. cerevisiae* live cells had any effect on final pH, H_2, CH_4, propionate, or butyrate. *Sacc. cerevisiae* culture had no effect on acetate, but both concentrations of *Sacc. cerevisiae* live cells decreased ($P < 0.05$) acetate and the acetate:propionate ratio. When soluble starch was the substrate, both concentrations of *Sacc. cerevisiae* live cells and 0.73 g/L of *Sacc. cerevisiae* culture decreased ($P < 0.05$) the acetate:propionate ratio. Even though the treatment effects were not statistically significant, both concentrations of *Sacc. cerevisiae* live cells and 0.73 g/L of *Sacc. cerevisiae* culture numerically decreased lactate concentrations compared to the control incubations. When alfalfa hay was the substrate, *Sacc. cerevisiae* culture and *Sacc. cerevisiae* live cells had no effect on propionate, butyrate, or the acetate:propionate ratio. Both concentrations of *Sacc. cerevisiae* culture decreased ($P < 0.05$) final pH and in vitro dry matter disappearance and the 0.73 g/L treatment decreased ($P < 0.05$) acetate, whereas both treatments of *Sacc. cerevisiae* live cells increased ($P < 0.05$) final pH and decreased ($P < 0.05$) acetate and in vitro dry matter disappearance. Neither yeast treatment had much effect on the Coastal bermudagrass hay fermentations. In general, both *Sacc. cerevisiae* supplements seemed to have similar effects on the mixed ruminal microorganism fermentation.

Key Words: *Saccharomyces cerevisiae*, Rumen, Fermentation

1429 Response of lactating Holstein dairy cows to betaine supplementation. R.O. Kellems*, *Plant and Animal Sciences Department, Brigham Young University, Provo, Utah 84602*.

A 42-day lactation trial was conducted to determine the effect betaine supplementation would have on the lactation performance of Holstein cows. One hundred and seventy-four early lactation (103.8 average days in milk) Holstein cows and 1st lactation heifers receiving a common

ration were paired (lactation number, milk production, days in milk) and assigned to either the Control or Betaine Group (87 animals per group). The same Total Mixed Ration (TMR) was prepared for both groups and after the Control Group was fed, then 0.225 kg/cow/d of a betaine supplement (48.15 % betaine) was added and mixed into the remaining TMR and fed to the Betaine Group. The betaine used in this trial had been isolated from sugar beet molasses using an ionic exchange extraction procedure. No differences (P>0.05) were observed in average daily milk production (kg/cow/d)(43.85, 42.52), feed consumption (kg/cow/d)(27.6, 27.4), or yield of milk components (protein (kg/cow/d)(1.35, 1.33) and butterfat (kg/cow/d)(1.40, 1.32), respectively, for the Control and Betaine Groups.

Key Words: Betaine, Lactation, Milk Components

1430 Rumen microbial ecology and *Saccharomyces cerevisiae* CNCM I 1077: ten years of collaborative research. F. Chaucheyras-Durand*[1,2] and G. Fonty[2], [1]*Lallemand Animal Nutrition, Toulouse (France),* [2]*INRA Microbiology Laboratory, Theix (France).*

Rumen stability is a key factor for health, welfare and performance of ruminants. With high yielding animals, which have strong nutritional requirements, this is of particular importance to prevent any imbalance of the rumen microbial ecosystem and to optimize its fermentative efficiency. Since 10 years, INRA and Lallemand Animal Nutrition have been developing research programs with the aims to select a ruminant specific strain of yeast (*Saccharomyces cerevisiae*) as a rumen flora enhancer, and to better understand the effects and the modes of action of this particular strain (CNCM I-1077) in the rumen. Using *in vitro* models associating SC I-1077 and either lactate producing bacteria (*Streptococcus bovis*) or lactate fermenting bacteria (*Megasphaera elsdenii, Selenomonas ruminantium*), SC has shown its efficiency both to limit lactate production and to stimulate lactate utilization. In fistulated sheep fed a diet rich in rapidly fermentable carbohydrates, lactate accumulation in the rumen was prevented by daily distribution of SC. In consequence, rumen pH and fibrolytic activities of the ecosystem were stabilized and the acidosis risk was diminished. Moreover it has been shown that fibre degradation was stimulated in the rumen of fistulated lambs receiving the yeast daily, and that cellulolytic bacterial populations were higher and more stable than in control lambs. In parallel ruminal ammonia concentration was lower in the presence of SC, suggesting an improvement in nitrogen retention by the animal. In the rumen of young lambs receiving SC daily, the establishment of some microbial communities (cellulolytic bacteria, ciliate protozoa) was accelerated, enabling the lambs to be prepared earlier to solid feed intake and weaning. Nutritional effects as well as metabolic interactions between live SC and rumen microbes have been identified as modes of action. These scientifically sound data demonstrate that SC I-1077 can optimize the ruminal microbial balance, that is of primary importance to maintain rumen function, health and performance of producing ruminants. Practical experience on production performances will be presented. Precise recommendations on targeted situations when the use of SC I-1077 is of particular interest will be given.

Key Words: Rumen stability, *Saccharomyces cerevisiae*, Rumen microbial ecosystem

1431 Supplementation of a fibrolytic enzyme complex in the concentrate of dairy ewes during lactation. C. Flores[1], G. Caja*[1], R. Casals[1], E. Albanell[1], X. Such[1], G. Vera[1], E. Gonzalez[1], A. Bach[2], and C. Torre[2], [1]*Universitat Autonoma de Barcelona, Spain,* [2]*Agribrands Europe-Spain S.A., Spain.*

A total of seventy-two multiparous ewes from two dairy breeds (Manchega; n=36) and (Lacaune; n=36) were used in a 2x2 factorial design to evaluate the effects of diet supplementation with an exogenous fibrolytic enzyme complex (*Promote*^{TM}) on lactation performance and feed intake during suckling and milking periods. A suckling-milking mixed period was used during wk 5. Ewes were fed ad libitum a diet based on 70% forage (dehydrated mixture of 50% alfalfa and 50% maize-whole plant) and 30% concentrate to which the enzyme was added. Experimental concentrates were: Control (**C**; without enzyme) and Enzyme (**E**; *Promote*^{TM} included at 0.47 g/kg). At the same time, twenty-four dry and open ewes (Manchega, n=12; Lacaune, n=12) were used to measure the fill value of the whole diet in sheep, according to the French system (INRA, 1989). During the suckling period (wk 1 to 4) milk yield (2.41 L/d), ECM-4% fat (2.10 L/d), milk composition (fat, 6.41%; CP, 5.25%; true protein, 4.68%; CN, 3.99%; and TS, 17.24%), feed intake (2.95 kg of DM/d), lamb growth (275 g/d), as well as body weight change (-4.98 kg) and body condition score change (-0.58 units), were not affected by the enzyme supplementation. During the milking period (wk 6 to 12) milk yield (1.80 L/d), ECM-4% fat (1.67 L/d), milk composition (CP, 5.79%; true protein, 5.43%; CN, 4.43%; and TS, 17.10%) and feed intake (2.92 kgDM/d) were not affected by the enzyme supplementation, although body weight change increased (C, +0.52; and E, +1.60 kg; P<0.01), and milk fat tended to decrease (C, 6.82; and E, 6.52%; P<0.06). Breed effect was significant (P<0.01) in both suckling and milking periods, with the Manchega ewes yielding less milk with greater milk composition than the Lacaune ewes, but the interaction of treatment x breed was not significant. Enzyme supplementation reduced feed intake in the dry ewes (C, 2.01; and E, 1.76 kg of DM/d; P<0.001) giving sheep fill values for the whole diet of 80 and 75 gDM/kgPV$^{0.75}$ for C and E, respectively. In conclusion, no improvements were detected when *Promote*^{TM} was added to the concentrate of diets fed to dairy ewes.

Key Words: Fibrolytic Enzymes, Dairy Ewes, Intake

1432 Effects of glycosylation on the stability of fungal xylanase exposed to proteases or rumen fluid *in vitro*. W. F. J. van de Vyver[1], K. A. Dawson[2], and J. M. Tricarico*[2], [1]*University of Pretoria, Pretoria, South Africa,* [2]*Alltech Biotechnology Inc., Nicholasville, KY.*

A series of studies was conducted to examine the effects of glycosylation on the enzymatic activity of a commercial xylanase when exposed to proteases or rumen fluid *in vitro*. The xylanase was partially purified from a crude fermentation extract from *Trichoderma longibrachiatum* by gel filtration followed by ammonium sulfate precipitation and dialysis. The partially purified xylanase was enzymatically deglycosylated with PNGase F or Endo H. Native or deglycosylated xylanases were incubated with strained rumen fluid (RF), *Prevotella ruminicola* culture supernatant (Pr), or a commercial protease from *Bacillus subtilis* (Bs). Xylanase and protease activities were determined on samples collected after *in vitro* incubation at 37°C for 0, 3, 6, 9, and 24 h. The protease activities of RF, Pr and Bs were 0.018, 0.046 and 1.009 mg azocasein degraded per ml per h, respectively. Xylanase activity was lower (P<0.05) in the PNGase F-deglycosylated enzyme than in the native enzyme after incubation in RF for 3 and 6 h, but did not differ after incubation for 9 and 24 h. Conversely, xylanase activity was not different in the PNGase F-deglycosylated and native enzymes after incubation in Pr for 3 and 6 h, but was lower (P<0.05) in the deglycosylated enzyme after incubation for 9 and 24 h. Deglycosylation with Endo H had no effect on xylanase stability in RF or Pr. Xylanase activity for native and PNGase F- or Endo H-deglycosylated enzymes did not differ during incubation with Bs. However, 60% of the original xylanase activity was lost within the first 3 h of incubation in Bs while losses were less than 20% for the same period of time in the presence of Pr and RF. These results indicate that glycosylation enhances xylanase stability when enzymes are exposed to protease activities similar to those encountered in the rumen and therefore is an important characteristic for exogenous enzyme supplements for ruminants.

Key Words: Ruminants, Xylanase, Glycosylation

1433 The effects of enzyme treatment on ruminal digestibility of feather meal with and without supplemental blood. C.A. Moran*, J. Skaggs, and J.M. Tricarico, *Alltech Inc. Nicholasville, KY.*

This study investigated the effects of an enzymatic feather treatment, prior to conventional hydrolysis, on rumen digestibility of feather meal (FM). The treatments were allocated to a 2 x 2 factorial structure with Factor 1) presence or absence of 1lb/tonne protease and 5lbs/tonne sodium metabisulfite and Factor 2) presence or absence of 3% blood during feather hydrolysis. Two ruminally fistulated steers, receiving a 50% concentrate diet, were used to examine in situ digestibility of the FM. The remaining dry matter and crude protein (CP) of FM were determined after incubation in the rumen for 0, 8, 24 and 48h. Rumen degradable and undegradable protein (RDP and RUP) were estimated over a range of ruminal passage rates from CP analysis.
The addition of blood increased (P<0.001) the soluble CP fraction (A) and decreased (P<0.001) the undegradable CP fraction (C) regardless

of enzyme treatment. Enzyme treatment decreased ($P<0.001$) fraction A in the presence and absence of blood but only increased ($P<0.001$) fraction C when blood was present. Neither blood nor enzyme addition had an effect on the potentially degradable crude protein fraction (B) or its fractional degradation rate (k_d). The main effects of blood addition were to increase ($P<0.001$) the RDP and decrease ($P<0.001$) the RUP content of FM. Conversely, the main effect of enzyme addition was to decrease ($P<0.001$) the RDP content of FM at $k_p = 0.02$ h^{-1} (39.6 vs 43.6), 0.05 h^{-1} (37.1 vs 40.9), and 0.08 h^{-1} (36.3 vs 40.0). Moreover, the RUP content of FM was greater ($P<0.001$) when enzyme was added for the following passage rates; $k_p = 0.02$ h^{-1} (60.4 vs 56.4), 0.05 h^{-1} (62.9 vs 59.1), and 0.08 h^{-1} (63.7 vs 60.0).
These results suggest the enzyme reduced the particle size of FM thereby exposing the surface area to more heat and the concomitant denaturation of the final product. Further work is necessary to determine the optimum cooking and drying temperatures and times for use with the protease.

Key Words: Feather meal, protease, rumen digestibility

1434 The effect of direct-fed microbials on calf health and performance.

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The effect of direct-fed microbials (DFM) on young calf health and performance was evaluated in three trials. Calves were assigned to either control (current management practices) or DFM (1 billion colony-forming units (Enterococcus faecium and Lactobacillus acidophilus) and 200 million live yeast cells (Saccharomyces cerevisae) daily plus current management practices). The DFM was supplemented as an oral gel for the first 7 d and thereafter supplemented with the starter feed. In Trial 1, 18 female Holstein calves were assigned at birth to either the control or DFM treatments for 47 d and fed milk replacer. The control and DFM groups were similar for birthweight (39.50 and 41.62 kg per calf) and scour treatments (0.33 and 0.67 per calf), respectively. However, DFM supplementation increased (P<0.05) weaning weight (69.80 vs 63.28 kg per calf) and average daily gain (0.60 vs 0.51 kg) compared to the control treatment. In Trial 2, 28 female Holstein calves were randomly assigned at birth to either the control or DFM treatments for 45 d and fed whole milk and starter feed. Birth weights (44.22 and 42.17 kg per calf), weaning weights (68.31 and 70.68 kg per calf), and scour treatments (0.43 and 0.43 per calf) were similar for the control and DFM groups, respectively. However, DFM supplementation increased (P<0.05) average daily gain (0.63 vs 0.55 kg) over the control group. In Trial 3, 36 Holstein bull calves (1 to 3 d of age) were randomly assigned at arrival to either the control or DFM treatments for 42 d and fed milk replacer and starter feed. The test groups were similar for starting weight (43.98 and 45.22 kg), total starter feed intake (29.81 and 33.77 kg per calf), and health treatments (2.72 and 2.33 per calf). However, DFM supplementation increased (P<0.0001) daily gain (0.55 vs 0.44 kg) and enhanced (P<0.05) final weight (67.89 vs 62.21 kg) over the control calves. In summary, DFM supplementation increased the weight gain of young Holstein calves in three trials.

Key Words: Direct-fed microbials, Calves, Probiotics

1435 Performance of lactating dairy cows fed glyphosate-tolerant corn (event NK603).

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Sixteen multiparous Holstein cows averaging 74 days in milk were used in a replicated 4 x 4 Latin square to compare the effects on animal performance of feeding whole plant silage and grain from a glyphosate-tolerant corn hybrid (event NK603), the non-transgenic control line, and two commercial non-transgenic hybrids (DK647 and RX740). The grain and silage from the four corn hybrids were produced using the same procedures and under similar agronomic conditions at the University of Illinois. Diets contained 30% corn silage and 27.34% corn grain (DM basis) produced either from the glyphosate-tolerant, non-transgenic control, or commercial hybrids. Apart from the DM content of silages, the chemical composition of both grain and silage produced from the four corn hybrids were substantially equivalent. Feeding diets that contained event NK603 (24.6 kg/d) and DK647 (24.5 kg/d) hybrids tended (P< .06) to decrease DMI compared with the control line (25.5 kg/d) and the RX740 (26.1 kg/d). Intakes of CP, ADF, NDF, and NFC were similar (P> .05) for cows fed event NK603 and control diets. The RX740 diet resulted in the highest (P< .03) intakes of fiber and CP whereas the DK647 diet resulted in the lowest intake of CP (P< .01). These differences in nutrient intake arose from small variations in both the DMI and the chemical composition of feed ingredients and experimental diets. Production of milk, 3.5% fat-corrected milk, fat, CP, true protein, and total solids (mean = 32.1, 33.0, 1.2, 1.1, 1.0, 4.0 kg/d, respectively), and the percentages of milk fat, CP, true protein, and total solids (mean = 3.68, 3.27, 3.08, 12.39, respectively), as well as milk urea N (mean = 15.2 mg/dl) and somatic cell count (mean = 167 (10^3ml)) were not affected by treatments (P> .05). These data indicate that the stable insertion of the gene that confers tolerance to glyphosate in the corn line (event NK603) used in this experiment does not affect its chemical composition and nutritional value for lactating dairy cows when compared with conventional corn.

Key Words: genetically enhanced crops, glyphosate-tolerant corn, dairy cattle production

1436 Effects of *Propionibacterium acidipropionici*, strain DH42, as a direct-fed microbial on the performance and carcass characteristics of feedlot steers.

S.-W. Kim*, S. R. Rust, and M. T. Yokoyama, *Michigan State University, East Lansing, MI*.

A study was conducted to evaluate the effects of feeding propionic acid-producing bacteria, *P. acidipropionici*, strain DH42, to cattle fed a high concentrate diet. One hundred and twelve steers were randomly allotted to 14 pens of 8 animals each. Seven pens were randomly assigned to one of two treatments: control (C) or *P. acidipropionici*, strain DH42 (DH42). The diet included 17% corn silage, 78% high moisture corn, and 5% protein-mineral supplement. Ten mL of DH42 culture in Na-lactate broth (NLB) medium was diluted to 1 L with tap water and top-dressed on the feed of each pen assigned to the DH42 treatment. The dosage was 3.1 x 10^9 cfu/head/d. For C, 10 mL of pure NLB medium was diluted to 1 L with tap water and poured on the top of feed. After harvest, quality grade and yield grade were assigned by USDA personnel resident in the plant. Cattle receiving DH42 tended to gain slower than C from d 28-55 (P=0.075) and d 56-84 (P < 0.05). However, DH42 treated cattle tended to grow faster (P=0.098) during d 112-123. Over the entire study, cattle receiving DH42 (1.40 kg/d) tended to gain slower than C (1.50 kg/d; P=0.075). Dry matter intakes were similar among treatments for the first 55 d, but DH42 treated cattle consumed less feed from d 56 to111 (P < 0.05). Over the 123 d, DMI and feed conversion efficiency was similar for cattle on the DH42 and C. Dressing percentage and quality grade were similar among treatments, but yield grade was lower in DH42 (2.39) versus C (2.60; P < 0.05). DH42 treatment at 3 x 10^9 cfu/head/d level tended to decrease ADG and DMI of growing-finishing cattle.

	Control	DH42	SEM	Prob.
No. of pens	7	7		
No. of cattle	56	56		
Initial wt., kg	414	413	4.3	0.96
Final wt., kg	577	568	5.8	0.30
ADG, kg	1.50	1.41	0.03	0.08
DMI, kg/d	10.59	10.25	0.16	0.17
Feed/gain, kg feed/ kg gain	7.08	7.31	0.15	0.32

Key Words: Propionibacteria, DFM, Beef cattle

1437 Impact of ethoxyquin on productivity of dairy cattle.

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Ethoxyquin is a synthetic antioxidant used in animal rations to improve storage qualities. Ethoxyquin has also been implicated in improved animal performance, but this has not been evaluated in dairy cattle. For these studies, 24 fistulated, multiparious, mid-lactation Holstein cattle were randomly assigned to one of 4 diets (n=6 per group). These groups were fed ethoxyquin at 0, 50, 100 or 150 ppm in a standard total mixed ration (as fed-basis) for 2 weeks. 50 ppm ethoxyquin decreased dry matter intake from 24.4 kg/day in controls to 21.8 kg/day with 50 ppm ethoxyquin, pooled SEM = 1.4, P<0.05. Higher levels of ethoxyquin appeared similar to 50 ppm (22.2 and 22.4 kg/day with 100 or 150 ppm). Dry matter digestibility was measured by an in situ nylon bag technique. Digestibility was enhanced by 50 ppm ethoxyquin (-.037 h^{-1} in controls vs -.042 h^{-1} with 50 ppm ethoxyquin, SEM = .002),

but not by higher levels (-.038 and - .036 h^{-1} for 100 and 150 ppm ethoxyquin, respectively). Similarly, 50 ppm ethoxyquin increased milk yield (32.3 kg/day in controls vs 38.5 kg/day with 50 ppm ethoxyquin, pooled SEM = 1.4; P<0.05), whereas higher levels of ethoxyquin had no significant effect on milk yield (34.8 and 35.0 kg/day with 100 or 150 ppm ethoxyquin, respectively). Milk fat was numerically lower with 50 ppm ethoxyquin (3.6 % in control vs 3.2, 3.5 and 3.4 % with 50, 100 or 150 ppm ethoxyquin), but this difference did not approach significance (SEM = 0.29, P>0.10). Similarly, ethoxyquin had no significant effect on milk protein content (2.92, 2.71, 2.89 and 2.70% with 0, 50 100 or 150 ppm ethoxyquin, SEM = 0.11). Interestingly, milk lactose was elevated in ethoxyquin-fed cows (4.52% in controls vs 4.67, 4.74 and 4.68 % with 50, 100 and 150 ppm ethoxyquin, respectively, SEM = 0.05; P<0.05 for each treatment vs control comparison by Dunnett's test). These results indicate that ethoxyquin may increase the efficiency of lactating dairy cattle. The observed alterations in diet digestibility suggest that ethoxyquin may improve efficiency by altering rumen fermentation.

Key Words: Ethoxyquin, Antioxidant, Milk Yield

1438 Effect of live yeast culture supplementation on nitrogen digestion and ruminal liquid kinetics in cattle. M. Murillo*[1], M.S. Vazquez[1], A. Quiñones[1], J.F. Sanchez[1], F.G. Rios[2], and R. Barajas[2], [1]*FMVZ-Universidad Juarez del Estado de Durango (Mexico),* [2]*FMVZ-Universidad Autonoma de Sinaloa.*

To determinate the effect of live yeast culture supplementation on nitrogen digestion and ruminal liquid kinetics in cattle, four Holstein bulls (350 kg) fitted with T-type cannulas in rumen and duodenum were used in a Crossover design experiment. The treatments were: 1) Diet 50:50 roughage:concentrate, containing 12% CP and 2.8 Mcal ME/kg (control); and 2) Diet similar to control but supplemented with a live yeast culture (Yea-Sacc 1026 TM) in amount enough to provide 10 g per animal per day (YS). Animals were fed twice a day (800 and 1600). After a 10 day adaptation period, ruminal, duodenal and fecal samples were collected for 4 days. Rumen pH and N-NH3 concentration was measured at 0, 4, 8, 12, 16, 20, and 24 after feeding. Chromium oxide was used as solid phase marker and EDTA as liquid phase marker. Treatments had no effect (P > 0.05) on rumen N digestion (62.7 vs. 62.4%), flow of microbial N to the duodenum (86.5 vs. 93.8 g/d), N in feces (51.0 vs. 54 g/d), and apparent digestibility of N (70.3 vs. 68.7%). Live yeast culture supplementation increased (P < 0.05) rumen microbial efficiency by 11% (20.9 vs. 23.3 gMN/kg OMFR), and improved (P < 0.05) the amount of N from diet arriving in to the duodenum by 8% (86.5 vs. 93.8 g/d). Rumen N-NH3 (mean = 11.6 mg/dL) was not affected by treatment (P > 0.05). The lowest (P < 0.05) ruminal pH was observed 4 h after feeding (6.8 vs. 6.3) and was similar between treatments. Rumen liquid volume was diminished (P < 0.05) in 11% with the YS treatment (71.4 vs. 63.4 L), without effect (P > 0.05) on dilution rate (4.07 vs. 4.05 %/h), ruminal liquid flow rate (2.9 vs. 2.5 L/h) and mean retention time in rumen (16.9 vs. 17.6 h). These results suggest that live yeast culture supplementation may improve by pass of dietary N, but this effect is not enough to produce changes in digestive metabolism of nitrogen in cattle.

Key Words: Yeast, Ruminal nitrogen digestion, Cattle

1439 Dietary inclusion of silymarin in peripartum dairy cows: Effects on milk quality and detection of silymarin residue. D. Tedesco[1], A. Tava*[2], and G. Varisco[3], [1]*Dipart. di Scienze e Tecnologie Veterinarie per la Sicurezza Alimentare, University of Milano, Italy,* [2]*Ist. Sper. Colt. Foragg., Lodi, Italy,* [3]*Ist. Zoopr. Sper. Lomb. Em. Rom., Brescia, Italy.*

Silymarin, a natural hepatoprotector constituted of a mixture of flavonolignans, has shown to increase milk production if administered to dairy cows in the peripartum period. The aim of this study was to evaluate its effect on milk quality parameters and the possible presence of silymarin residues in milk. A total of 30 dairy cows has divided into two groups. Fifteen were administered 10 g/day of silymarin as an oral drench from 7 d before expected calving to 15 d after calving. Colostrum and milk samples were withdrawn on calving day and on d 7, 21, and 30 after parturition. Milk quality was evaluated according to fat, protein, lactose content, urea, inhibent activity, and cell somatic count. Fatty acid composition was evaluated in colostrum and milk at d 7 and 14 of lactation. Silymarin in milk was evaluated at 7 d of lactation. The milk quality parameters are not significantly different for treated and untreated dairy cows, even if treated animals showed a lower fat content (3.58% - 3.22% and 3.81% - 3.43% at 21 and 30 d, respectively). Fatty acids were identified and quantified as their methyl esters by capillary GC, and no differences were observed in milk and colostrum from treated and untreated animals. No inhibent activity was detected in all milk samples. To evaluate the presence of silymarin residue in the milk, HPLC analyses were performed. The starting silymarin extract was composed of: silybin 49.8%, isosilybin 14.7%, silydianin 20.1%, silycristin 6.1%, and taxifolin 4.5%. The major bioactive compound, silybin, was purified, identified by NMR, and used as a standard reference. HPLC analyses of milk from treated animals gave no evidence of the presence of free silybin residues. Since silybin is metabolized into its glucuronic and(or) sulfonic derivatives, a further analysis was conducted after enzymatic hydrolysis with glucuronidase-arilsulfatase from Helix pomatia, but no silybin residues were recorded (detection limit 10 ppb). These results showed no differences in milk from animals receiveing silymarin extract and the control animals; the milk safety parameters were mantained. Silymarin was kindly granted by I.D.B. Holding Indena S.p.a.

Key Words: Silymarin, Natural hepatoprotector, Milk quality

1440 The effects of prepartum diet composition and supplemental yeast culture on rumen fermentation. D. Chatman, J. Spain*, R. Belyea, M. Ellerseick, and M. Kerley, *University of Missouri-Columbia/USA.*

A continuous culture system was utilized to evaluate the effects of prepartum diet composition and supplemental yeast culture *(Saccharomyces cerevisiae)* on rumen fermentation. The treatments were arranged as a 2 by 4 factorial and consisted of two levels of yeast (without; Y- or with; Y+) and four diets varying in level and source of carbohydrate. Dietary carbohydrate balance was altered by utilizing different proportions of orchardgrass hay, soybean hulls and cracked corn. The standard diet contained 24% NSC; STD. The remaining diets were formulated by altering carbohydrate sources compared to the standard diet as described: cracked corn replaced with soy hulls (15% NSC; LNSC), orchardgrass hay replaced with soy hulls (24% NSC; SH) and soy hulls replaced with cracked corn (32% NSC; HNSC). Fermentors fed the SOY HULL diet had higher NAN flow/d compared to the STANDARD and HIGH NSC diets. Fermentors fed the HIGH NSC diet possessed significantly lower ammonia N flow/d compared to all other dietary treatments. Fermentors fed the LOW NSC diet had higher acetate production and a higher acetate to propionate ratio. Fermentors fed the HIGH NSC diet had higher isobutyrate production versus the LOW NSC and the STANDARD diets. Fermentors fed the SOY HULL diet supported a lower pH compared to fermentors fed the LOW NSC and STANDARD diets. Fermentor pH was similar for the SOY HULL and the HIGH NSC diets. Supplemental yeast culture decreased fermentor effluent ammonia N flow/d but had no effect on fermentor pH or VFA production. Fermentors fed the SOY HULL Y+ diet supported higher DM, OM and NDF digested/d versus the SOY HULL Y- diet. Percent NDF and ADF digested/d was increased for fermentors fed the HIGH NSC Y+ diet versus the HIGH NSC Y- diet. Percent ADF digested/d was significantly increased for the STANDARD Y+ diet compared to the STANDARD Y- diet. These results suggest that supplemental yeast culture is most effective in diets greater than 15% NSC. Diets containing 24% NSC with soybean hull NDF benefited from yeast culture supplementation compared to diets containing 24% NSC with orchardgrass hay NDF.

Key Words: Continuous Culture, Supplemental Yeast

1441 The effects of prepartum diet composition and supplemental yeast culture on rumen fermentation during the transition to a typical lactation diet. . D Chatman, J Spain*, R Belyea, M Ellerseick, and M Kerley, *University of Missouri-Columbia/USA.*

A continuous culture system was utilized to evaluate the effects of prepartum diet composition and supplemental yeast culture *(Saccharomyces cerevisiae)* on rumen fermentation during the transition to a typical lactation diet. The treatments were arranged as a 2 x 4 factorial and consisted of two levels of yeast (without; Y- or with; Y+) and four diets varying in level and source of carbohydrate. Dietary carbohydrate balance was altered by utilizing different proportions of orchardgrass hay, soybean hulls and cracked corn. The standard diet contained 24% NSC (STD). The remaining diets were formulated by altering carbohydrate sources compared to the standard diet as described: cracked corn

replaced with soy hulls (15% NSC; LNSC), orchardgrass hay replaced with soy hulls (24% NSC; SH) and soy hulls replaced with cracked corn (32% NSC; HNSC). The experiment consisted of three 10 d replicates. Each replicate consisted of an adaptation period (d 1 through 4), a prepartum phase (d 5 through 7) followed by a transition phase (d 8 through 10). Fermentors were fed prepartum diets (30 g DM/d) with or without supplemental yeast culture during the adaptation period and prepartum phase and a typical lactation diet (50 g DM/d) with or without yeast culture during the transition phase. Day of transition significantly affected fermentor VFA production, ammonia production and pH measurements. Fermentor VFA and ammonia production increased and fermentor pH decreased during the transition phase. Prepartum diet composition and supplemental yeast culture had no effect on DM, OM and fiber digestion, or effluent N flow on the last day of transition. These results suggest that adapting the rumen microflora with prepartum diets varying in level and source of carbohydrate and supplemental yeast culture does not moderate pH changes, or alter fermentation during the transition to a typical lactation diet.

Key Words: Continuous Culture, Supplemental Yeast

1442 The effect of monensin controlled release capsule at dry-off on calving-related disorders and milk yield in Holstein cows. P. Melendez*, C. Risco, and A. Donovan, *University of Florida, Gainesville, FL, USA*.

The objective was to evaluate the effect of a monesin slow-release capsule given at dry-off on the incidence of calving-related disorders and milk yield on Holstein dairy cows. The study was conducted in a 3000-cow commercial Holstein dairy farm (milk RHA of 10,500 kg). Cows were housed in a dry-lot system, fed a total mixed ration and milked 3 times a day. Between July and August 2001, 580 cows dried-off 50 to 70 d before expected parturition were randomly assigned either a treatment or a control group. Treated group (n=290) received orally a capsule of monensin (releasing 300 mg of monesin daily for 95 days). Control cows (no capsule, n=290) were randomly matched by parity. The outcome variables were incidence of dystocia, retained fetal membranes, metritis, digestive disorders, displacement of abomasum, clinical ketosis and daily milk yield up to 20 d pp. Milk yield was analyzed by repeated measure ANOVA developing a mixed model. Each calving-related disorder was analyzed by logistic regression. Cows treated with monensin were 2.1 times more likely to develop dystocia than control cows ($p \leq 0.01$). Treated cows correcting by dystocia were 0.2 times less likely to develop metritis ($p \leq 0.01$). There was no treatment effect for retained fetal membranes, displacement of abomasum, digestive disorders and clinical ketosis. For milk yield, within parity 1, treated cows without dystocia produced more milk than control cows without dystocia at d 5, 6, 10, 13, 14 and 19 ($p \leq 0.05$). However treated cows with dystocia produced less milk than control cows with dystocia at d 13 and 15 pp ($p \leq 0.05$). Within parity 2, treated cows produced more milk than control cows at d 3, 12 and 15 ($p \leq 0.05$). Within parity 3 or greater there was no interaction treatment by day effect ($p > 0.05$). It is concluded that although monensin increased milk production in certain days within parity 1 and 2, monensin also increased the incidence of dystocia and indirectly negatively might have affected milk yield within the first 20 d pp.

Key Words: Monensin, Milk yield, Calving-related disorders

1443 Effect of urea and/or fibrozyme supplementation on intake, degradability, digestibility and kinetics of oat hulls included in a basal ration for dairy steers. J.I. Aguilera*[1], J. Jimenez-Castro[1], M.A. Castillo-Pecina[2], C.F. Arechiga[2], and O. Ruiz-Barrera[1], [1]*Universidad Autonoma de Chihuahua,* [2]*Universidad Autonoma de Zacatecas*.

Present study try to determine the effect of urea and enzymatic additives (Fibrozyme® Alltech, Inc) on intake, degradability, digestibility and kinetics of oat hulls included in a ration for dairy steers. Holstein steers (n=4) were cannulated and alloted in a 2x2 factorial design repeated 4 times, testing effects of urea and Fibrozyme addition and their interaction. Rations were composed of oat hulls (33%) supplemented with either 0 or 4% of urea, flaked corn (29%), alfalfa hay (20%), cottonseed meal (16%), salts and mineral premix (1%). When required, 15g/d Fibrozyme was added to the ration. Experimental treatments were: 1) C, control diet without urea and Fibrozyme). 2) CF, control diet supplemented with Fibrozyme); 3)CU, control diet enriched with 4% urea on oat hulls); 4) CUF, control diet enriched with 4% urea on oat hulls and Fibrozyme). Urea treatment increased total tract digestion of dry matter (DM) and organic matter by at least 6%. DM intakes were: C=9.53; CF=9.68; CU=10.52; and CUF=10.65 kg/d. $BW^{0.75}$ intakes were: C=110.66; CF=112.34; CU=121.97; CUF=123.62 g/kg. ($P<0.05$). In situ DM digestibility differed from 12 to 96 h of incubation. Values at 48 h post incubation were C=33.4%; CF=33.39%; CU=44.24%; and CUF=44.08%. Potential degradability was: C=66.4%; CF=66.7%; CU=83.9%; CUF=78.2%; while Effective degradability at 5% passage rate was: C=38.7%; CF=39.8%; CU=47.5%; CUF=46.6%. Digestive kinetics were similar for all treatments ($P>0.05$). In a solid phase values were: ruminal passage rate (k1)=3.55%/h, post-ruminal passage rate (k2)=6.07%/h; transit time=11.1 h. Whereas, in liquid phase the dilution fractionation rate (kdf) was 10.31%/h and the ruminal volume=46.8 L. In conclusion, 4% of urea on oat hulls improved intake, digestion, and in situ degradability of the ration, this might be due to improvement of energy status and performance of steers on the feedlot. In contrast, Fibrozyme supplementation did not show a positive effect on the variables evaluated, probably, due to the low nutritional level of the diet formulated to obtain only a 0.5 kg of daily weight gain in dairy steers.

Key Words: Oat hulls, Urea, Additives

1444 Effects of administration of Rumensin either as a controlled-release capsule or a premix on attenuation of sub-acute ruminal acidosis in lactating Holstein dairy cows. T. Mutsvangwa*[1], J. P. Walton[1], J. C. Plaizier[2], T. Duffield[1], G. Vessie[3], R. Bagg[3], and B. W. McBride[1], [1]*University of Guelph, Guelph, ON, Canada,* [2]*University of Manitoba, Winnipeg, MB, Canada,* [3]*Provel Division, Eli Lilly Inc., Guelph, ON, Canada*.

The efficacy of Rumensin® (monensin) administered either as a controlled-release capsule (CRC) or a premix in attenuating grain-induced sub-acute ruminal acidosis (SARA) in dairy cows was investigated in two experiments. In both experiments, six multiparous, ruminally-cannulated Holstein cows were used in a crossover design with 6-wk periods. Treatments were a monensin CRC or a placebo (Expt 1) and a monensin premix or a placebo (Expt 2). At the beginning of wk 3, SARA was induced in cows for a 10-d period using a previously developed nutritional model and ruminal pH was measured continuously. The administration of monensin CRC or premix had no effect on ruminal pH characteristics (see Table below). Under the conditions of this study, monensin had no impact on attenuating SARA.

Item	Control	Monensin	SE	*P*
CRC				
Mean pH	6.17	6.20	0.03	0.68
Time pH<6, min/d	406.0	450.0	24.1	0.27
Area pH<6, min x pH/d	129.4	152.7	9.9	0.17
Time pH<5.6, min/d	128.0	161.6	13.3	0.15
Area pH<5.6, min x pH/d	30.4	34.8	3.2	0.39
Premix				
Mean pH	6.15	6.12	0.02	0.45
Time pH<6, min/d	415.0	461.0	31.1	0.36
Area pH<6, min x pH/d	126.8	144.2	15.9	0.48
Time pH<5.6, min/d	123.7	154.2	22.4	0.39
Area pH<5.6, min x pH/d	25.1	29.1	4.7	0.58

Key Words: dairy cows, monensin, acidosis

1445 Influence of fibrous feed supplements on rumen morphology and production parameters in veal calves. V. Dell'Orto[1], R. Paratte, A. Di Giancamillo, C.A. Sgoifo Rossi, V. Bontempo, A. Agazzi, C.M. Domeneghini, and G. Savoini*, [1]*University of Milan, Italy*.

The aim of this study was to determine whether the nutritional regimen of two different fibrous diets, would influence the morphometric and histological development of rumen mucosa in veal calves. One hundred twenty-six Holstein calves were housed in three sheds of 42 animals each and tethered in individual crates with either exclusively liquid diet [milk replacer, control (C)], or dried corn silage supplementation (DCS), or pelleted feed supplementation (PF). Individual live weight and morphometric measurements were recorded at d 0, 52, 102, and 158. At slaughter, meat color and drip loss were measured. The effects of the

fiber-containing diet were also studied on histological characteristics of ruminal mucosa. Average daily gain was significantly higher for calves on DCS between day 52 and day 102 (C= 1.19 Kg; DCS= 1.45 Kg; PF= 1.29 Kg; P≤0.01). Over the 158-d experimental period, the DCS group had greater ADG (C= 0.92 Kg; DCS= 1.03 Kg; PF= 0.99 Kg), although no significant difference was observed. Meat samples from the control animals had significantly greater lightness values than samples from the other groups (C= 53.89; DCS= 50.48; PF= 49.60; P≤0.05). There were histological abnormalities in the rumen of all animals examined, but particularly in those given pelleted feed. Papillae length (C= 1,765 μm; DCS= 1,386 μm; PF= 1,411 μm) and epithelial thickness (C= 77.58 μm; DCS= 76.2 μm; PF= 72.2 μm) of ruminal papillae were greater in controls than fiber-supplemented animals. The dried corn silage supplement resulted in a good compromise between rumen characteristics, health, growth performance and meat quality. This fact is in accordance to a recent European Union regulations, which stipulate that the traditional liquid diet of veal calves must be supplemented with a certain daily quantity of dietary fiber to improve rumination.

Key Words: calves, rumen, fiber diets

1446 Comparison of three sieving methods to measure particle size distribution of forages.

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Methods of measuring particle size of forages differ in the number and aperture of sieves, shaking motion (horizontal or vertical), and status of the sample (undried or dried). These differences alter the particle size distribution of feeds depending on the method used. We evaluated relationships among particle size distributions of hays, corn silages, grass silages and TMR's using three methods: method S424 of American Society of Agricultural Engineers (ASAE), Penn State particle separator (PSPS), and the vertical shaking method (VERT) used to estimate peNDF. Both ASAE and PSPS use wet samples and shake horizontally. In contrast, VERT requires dry samples and shakes vertically. For all of the three methods, the largest sieve aperture was 19 mm. The smallest sieve aperture was 1.17, 8.00, and 1.18 mm, respectively for ASAE, PSPS and VERT. Materials were separated in duplicate according to each procedure. For a subset of corn silage samples, methods ASAE and PSPS were repeated using dried samples. Dry matter also was measured on all fractions obtained with the ASAE and PSPS methods when the initial sample was undried. Across all feeds, PSPS had the largest proportion of DM retained in the top screen and pan. Largest differences among methods were observed for the pan fraction that averaged 10, 54, and 15% of DM for ASAE, PSPS, and VERT, respectively, due in part to the difference in aperture. When dried corn silages were sieved, top and pan fractions obtained with ASAE were similar to VERT, but fractions separated with PSPS remained significantly different from VERT. Using undried material, the distribution of particles for ASAE and PSPS was not different when expressed on a wet or DM basis. In conclusion, sieving methods did not provide the same description of particle size distribution. Due to differences in aperture and technique, PSPS did not provide estimates of peNDF similar to VERT. Drying corn silage prior to sieving decreased retention on sieves with larger apertures, indicating improved separation efficiency.

Key Words: particle size, peNDF, silage

1447 Gas production kinetics and fermentation end product formation from neutral detergent fiber and sucrose by mixed ruminal microorganisms in vitro.

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The effect of sucrose on neutral detergent fiber (NDF) digestion by mixed ruminal microorganisms was determined using an in vitro 40-channel gas pressure measurement system with computerized data acquisition. Isolated bermudagrass (*Cynodon dactylon*) NDF (4 mg/mL) was incubated in 8.5 mL of Goering/Van Soest (pH 6.8) buffer amended with 1.5 mL of blended and squeezed ruminal fluid and varying amounts of sucrose (0, 2, 4, or 6 mg/mL, six replicates per treatment). Additional sets of vials contained no added substrate (blanks), or 6 mg sucrose/mL without NDF. Gas production data from 153 to 178 data points collected over a 48-h period were blank-corrected and fitted to single-pool (NDF or sucrose alone) or dual-pool (NDF + sucrose) exponential models that incorporated one or two discrete lag terms, respectively. Sucrose concentration had no effect on the rate constant of gas release from either sucrose (0.29-0.30/h) or NDF (0.053/h). However, lag times for gas release from NDF digestion increased markedly with sucrose concentration (4.3, 8.0, 10.4, and 13.0 h at 0, 2, 4 and 6 mg sucrose/mL, respectively; $P < 0.05$). Acetate represented a smaller proportion of total VFA as sucrose increased (0.66 and 0.59 at 0 and 6 mg sucrose/mL, respectively; $P < 0.05$), whereas the proportion of butyrate increased (0.07 and 0.12 at 0 and 6 mg sucrose/mL, respectively; $P < 0.05$). Fermentation product ratios from 6 mg sucrose/mL alone were similar to those from 6 mg sucrose + 4 mg NDF/mL, but differed from those samples in which lower concentrations of sucrose were incubated with NDF. Values for pH at 48 h decreased ($P < 0.01$) with increasing sucrose (6.65, 6.46, 6.25 and 6.04 at 0, 2, 4 and 6 mg sucrose/mL, respectively). The data support the hypothesis that the rate constant of fiber digestion is dependent on the pH at which the fermentation is initiated.

Key Words: Ruminal Microorganisms, Digestion Kinetics, Neutral Detergent Fiber

1448 Relationship of forage fiber content and mechanical strength to particle size reduction during ingestive mastication by steers.

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Forage fiber content and mechanical toughness have been proposed as factors that limit particle size reduction and feed intake of ruminants. Three coarsely chopped forages were available ad lib to six mature rumen-fistulated Murray Grey steers (794 27 kg). The oaten and mature alfalfa hays were similar in NDF concentration (42.4 and 41.5 % DM, respectively), while the immature alfalfa hay contained less NDF (34.2 % DM). However, the acid detergent lignin content of the NDF fraction was much higher for both the immature and mature alfalfa hays (12.3 and 12.8 % NDF, respectively) than the oaten hay (2.1 % NDF). Compression energy was higher for the mature alfalfa hay (3.86 kJ/kg DM) than for the oaten and immature alfalfa hays (3.64 and 3.57 kJ/kg DM, respectively). Shear energies were similar among the hays (7.34 kJ/m^2). Each hay was fed to two steers during two periods in a crossover design. Periods consisted of 7 d for adaptation followed by 5 d of data collection. Ingestive boli were collected from each steer by catching the swallowed boli as they entered the rumen. Hay intake did not differ among the oaten and immature and mature alfalfa hays (9.4, 11.1, and 12.4 kg DM/d, respectively). Hay and boli samples were sieved into large (retained on 2.75 mm screen), medium (retained on 1.18 mm screen), and small (passed 1.18 mm screen) particle fractions. The percentage of particles in the large particle size fraction in the ingestive boli compared to the hays declined more for the mature alfalfa and oaten hays (-31.3 and -37.7 %, respectively) than for the immature alfalfa (-11.6 %). No differences for boli compared to hays were observed for the medium size particle fraction (+4.2 % change), but the change in percentage of small particles in the boli of mature alfalfa and oaten hays (+52.4 and +54.4 %, respectively) increased more than was observed for the immature alfalfa (+13.4 %). Lower compression energy and reduced fiber concentration of immature alfalfa, but not fiber lignification, were associated with greater particle size reduction during ingestive mastication.

Key Words: Forage, Intake, Mastication

1449 Effects of feeding corn silage that was allowed to spoil for five days with or without yeast cell walls on production parameters in early lactation Holstein cows.

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Proper silage management is important to reduce excessive spoilage due to air exposure. The objective of this study was to compare the effects on production of feeding spoiled silage and yeast cell walls (YCW) to Holstein cows. Forty-eight early lactation cows were randomly assigned to one of four treatment diets within parity. Diets included: 1) corn silage blended into a TMR (CON), 2) CON with added YCW (CON+YCW), 3) spoiled silage blended into a TMR (SP), 4) SP with added YCW (SP+YCW). Cows were started on trial at 21 DIM. Cows received the same silage type for the duration of the experiment, but switched to or from YCW treatment at the experimental midpoint (45 days). CON silage was stored in a covered trench silo. SP silage was taken from the same trench silo and piled under a covered shelter for 5 days before being

fed and then blended into the TMR based on prior DM change. There were no significant differences in %CP, %ADF, and calculated Mcal/kg NE_L for treatment diets (P > 0.10). Milk yield (35.36, 37.02, 36.74 and 37.44 kg/d), DMI (22.1, 22.3, 22.9, and 23.3 kg DM), % fat (3.24, 3.29, 3.29, and 3.32%), fat yield (1.14, 1.19, 1.16, 1.23 kg), %CP (2.87, 2.88, 2.80, and 2.80%), and protein yield (1.01, 1.05, 0.99, and 1.02 kg) were not significantly different among CON, CON+YCW, SP, and SP+YCW, respectively (P > 0.10). Acetate: propionate ratio was not significantly different among CON, CON+YCW, SP, and SP+YCW (2.4, 2.3, 2.4, and 2.3; P > 0.10), respectively. Concentrations of BUN (19.8, 20.0, 21.8, and 22.7 mg/dl), and rumen ammonia (10.7, 10.8, 10.0, and 9.7 mg/dl), as well as rumen pH (6.9, 6.8, 6.8, and 6.8) were not significantly different among treatments CON, CON+YCW, SP, and SP+YCW, respectively (P > 0.10). Milk %CP (P < .08) was significantly lower for the cows fed the SP silage. Concentrations of BUN (19.9 vs 21.5 mg/dl; P < 0.01) were significantly different for cows fed CON and SP silage, respectively.

Key Words: silage, yeast cell walls, spoilage

1450 Peak strains and strain energy transferred through the jaws and skull of sheep eating roughage and concentrate diets.

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Five sheep were used to study the strain energy developed during chewing and how this was transmitted through the jaws and skull to fragment food. With the sheep under sodium pentobarbital anesthesia, 3 simple strain-gauges were glued to the underside of each jaw bone and 4 rosette gauges to the maxilla and the frontal bones on each side of the skull. Upon recovery, each sheep was fed randomly alfalfa hay (Medicago sativa; 53% NDF), bromegrass hay (Bromus molis; 64% NDF) or finisher pellets (31% NDF) twice while recording strains ($\mu\epsilon$) for 22.5 sec periods. The sheep chewed on either its left or right side but never on both sides together (side changed frequently). The underside of the jaw used for chewing bent down in the middle creating gauge tension under the bolus. It was bent upward at the front on this side by forces transferred from the opposite jaw whose underside was always bent upwards in the middle by unopposed masseter muscle action (no bolus here). The mean peak strains recorded in the mandibular gauges during chewing were not different for the 2 hays (+476 and +485 for tensions in the middle gauges on chewing side and -524 and -607 for compressions in these gauges on the balancing side; P>0.05) but they were greater than the maximum values for the pelleted diet (+80 on the front chewing side; -145 on the front balancing side, P<0.05). Not unexpectedly then, the mean chewing effort (mean area under chewing strain curves)was similar for the hays being 61 vs 68 (P>0.05) and exceeded that for pellets (29; P<0.004). With right or left sided chews, both frontal bones were compressed since the maxillae were rotated caudally and dorsally. The compressions were once again similar for the 2 hays (-264 and -290; P>0.05) and exceeded that for pellets (-103; P<0.01). The maxillae in the nose rotated slightly toward the non chewing side due to the compression of the bolus during chewing and the unopposed downward pull by the masseter on the opposite side. Again, hay effects were similar (P>0.05) on the chewing (-124 vs -115) and non chewing sides (341 vs 399) and exceeded values for pellets (-56 vs 131; P<0.04). Since chewing frequency was similar for all diets (118-128/min; P>0.05), a tougher roughage must be chewed longer with more chews/kg dry matter eaten.

Key Words: Chewing, Strains, sheep

1451 Effects of buffer selection and level of digestible dry datter on *in vitro* NDF digestion.

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The objective of these studies were to evaluate the effect of in vitro buffer systems on fiber digestion. Three common buffers were evaluated based on the level of digestible DM associated with a depression in fiber digestion. Fermentations using the recommended buffer for the ANKOM Daisy fermenter system (Kansas State Buffer, KS), the Goering and Van Soest buffer (GVS), and the Marten and Barnes buffer (MB) were performed in duplicate using 150 ml serum bottles. A corn silage of known DM digestibility was added to deliver 3.6, 6, 10, and 14 mg/ml of digestible DM to assess the ability of each buffering system to support increasing fermentable substrate. In vitro frementations were performed as a balanced incomplete block design with two buffer treatments per block. Increasing the level of digestible DM above 6mg/ml progressively decreased final pH and 48 h NDF digestion for each buffer. The depression in NDF digestion was more pronounced in the Kansas State buffer than with the other buffer systems (P<. 05). To evaluate whether the depression in NDF digestion with the Kansas State buffer was of practical importance, 8 feed samples, including 4 corn silages, 2 alfalfa samples, soyhulls and wheat straw, were fermented in triplicate on 3 separate days using the Daisy Fermentation System with each buffer represented. Average NDF digestion for these samples was significantly lower using the KS buffer, differences between the GVS and MB buffers were not significant. Based on these results the GVS and MB buffer systems appear more robust when evaluating highly digestible substrates.

Treatment	1	2	3	SEM	SE DIFF.[2]	P =	
Item	KS	MB	GVS			1 vs. 3	2 vs. 3
DMD	56.8	59.8	61.2	5.7	1.2	.002	.26
NDFd	42.0	46.2	48.2	6.0	1.4	.0005	.18
IVTD	71.2	73.7	74.4	5.8	0.8	.0009	.35

[2]Standard error of the differences among treatments.

Key Words: Buffer, Fiber digestion, In vitro

1452 Fiber hydrolysis in the rumen: effects of pH and forage type.

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The objectives of this study were to determine the effects of rumen pH and forage type on fiber hydrolysis in the rumens of Holstein heifers. Rumen and duodenal cannulated pregnant heifers (n=8) were sequentially fed eight unbuffered diets containing 100, 80, 60 and 40% oat or alfalfa hay. The remaining portion of each diet was a concentrate mix. All oat hay diets contained 10% crude protein (CP) and all alfalfa hay diets contained 20% CP. All animals were housed individually and fed twice a day at 8am and 6pm. After a 14d adjustment period to each diet, filter bags (ANKOM F57) containing samples of ground hay to match the forage in that diet were incubated in the rumen for 2, 4, 6, 8, 10 or 12h beginning at the morning feeding. After removal, bags were washed with tap water 6 times for 1 min in an ANKOM 200 Fiber Analyzer at room temperature. Bags were then frozen until further analysis of NDF using the ANKOM system. Rumen pH was recorded every 15 min during the incubation period by an indwelling pH probe (Model 450CD, Sensorex, Garden Grove, CA) inserted through the rumen cannula. A 96h incubation was also carried out to ascertain the potentially digestible NDF (pdNDF) fraction of each hay. Rate of degradation was expressed as the proportion of pdNDF disappearance in each 2h interval. pH data were grouped into classes from pH 5.25-7.25 in increments of 0.5 pH units. Forage type had no effect on rate of pdNDF digestion. Above pH 6.5 the rate of degradation of pdNDF was constant (2.993%/h). Below pH 6.5 there was a linear decline in the rate of digestion, decreasing by 0.12% for each 0.1 unit of pH. These data improve our understanding of the depression in fiber digestibility on high concentrate diets.

Key Words: pH, rumen, fiber digestion

1453 Vitamin A administration as a means of udder protection in lactating cows.

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A study was conducted to determine the effect of vitamin A administration on teat canal keratin (TCK) composition as an indication of udder protection. Eight Holstein cows of different parity in early and mid lactation were randomly allocated into two groups. Cows of the first group (A) were injected with 700,000 IU of vitamin A/wk.The control group (C) received no supplemental vitamin A. Feed provided to both groups supplied about 400,000 IU of vitamin A/h/d during the 9 wk trial period. Data collection included daily milk yield, weekly measurements of electric conductivity(EC) of milk as an indicator of sub clinical mastitis and TCK content of every teat. Results showed that milk yield and TCK weight were not significantly different (p>0.05), 24.5 Vs 24.3 kg/d and 5.87 Vs 5.78 mg/teat, between treatments A and C, respectively. The TCK fatty acid profile of group A had a significantly (p<0.05) higher level of Palmitic acid only during week 5 of the study (56.83 Vs 48.46%).

The incidence of sub clinical mastitis in teats of the A group was significantly ($p< 0.01$) lower than that of the control (8.5 Vs 20.7%). The latter results lead to the conclusion that although cows had adequate daily intake of vitamin A, additional supplementation had favorable response on mammary gland protection.

Key Words: Vitamin A, Teat Canal Keratin, Mammary Gland

1454 Effects of dietary supplements of vitamin B_{12} and biotin (B_8) on the net flux of nutrients across the splanchnic tissues of lactating dairy cows. C.L. Girard*[1], J.J. Matte[1], and A. Desrochers[2], [1]*Agriculture and Agri-Food Canada, Lennoxville, QC, Canada,* [2]*Universite de Montreal, S-Hyacinthe, QC, Canada.*

The objective of these trials was to define the effects of dietary supplements of vitamins B_8 and B_{12} on the flux of nutrients across portal-drained viscera (PDV) and liver. Four lactating cows equipped with catheters in the portal and a hepatic veins and a mesenteric artery and an ultrasonic flow probe around the portal vein were fed twelve times per day a TMR at 95% of ad libitum DMI. Daily supplements of 0 or 500 mg B_{12} + 20 mg B_8 (Trial 1) or 500 mg B_{12} + 20 mg B_8 or 500 mg vitamin B_{12} only (Trial 2) were fed according to a double 2x2 Latin Square with two 4-wk periods for each study. On the last day of each period, blood samples were collected every 30 min for 4 h. In Trial 1, B_8+B_{12} increased milk (30.5 to 31.6 kg/d;P=0.08) and protein (1.04 to 1.07 kg/d;P=0.02) yields as compared to the control diet in cows at 1185.6 DIM and 23.10.4 kg DMI. It decreased blood arterial urea (9.4 to 8.8 mM;P=0.03) and portal flux (mmol/h) of B-OH-butyrate (180 to 150;P=0.03), acetate (2970 to 2544;P=0.06), propionate (1092 to 1020;P=0.12), n-CH_3-butyrate (36 to 30;P=0.07), butyrate (228 to 198;P=0.13) and ammonia (696 to 612;P=0.05). It decreased liver removal of butyrate (-223 to -206,P=0.11), i-valerate (-64 to -56,P=0.15) and lactate (-102 to -66,P=0.14). In Trial 2, B_8+B_{12}, compared to B_{12} alone, had no effect on milk yield (27.7 1.2 kg/d) of cows at 1815.6 DIM and 22.5.3 kg DMI. It decreased arterial blood glucose (3.7 to 3.6 mM;P=0.02) and urea (10.4 to 9.3 mM;P=0.03) and portal flux (mmol/h) of ammonia (648 to 576;P=0.04). It increased liver removal of butyrate (-149 vs -178,P=0.04) and i-valerate (-35 to -44,P=0.15), release of B-OH-butyrate (213 to 313,P=0.13) and decreased removal of ammonia (-897 to -665,P=0.005). In Trial 1, B_8+B_{12} reduced portal flux of VFA and ammonia. Comparisons with Trial 2 give an indication that most of the effects are due to B_{12} alone, except for the effects on nitrogen metabolism, butyrate and i-valerate.

Key Words: Cow, Biotin, Vitamin B12

1455 The effect of feeding complexed trace minerals to pregravid Holstein heifers on the incidence of prepartum and postpartum claw diseases. T.R. Drendel*[1], P.C. Hoffman[1], and M.T. Socha[2], [1]*University of Wisconsin, Madison,* [2]*Zinpro Corp., Eden Prairie, MN.*

In a field study pregravid (12 mo) Holstein heifers (n = 421) were alternately assigned by age to either diets without (Control) or with 7 g/d of complexed trace minerals (CTM) (Availa-4, Zinpro Corp.) Diets were formulated bi-weekly and fed for approximately 335d. Heifers were housed at a commercial heifer rearing facility in open mounded lots. Claws were evaluated for incidence and severity of 12 claw diseases prior to treatment assignment, at end of treatment period, and 60d postpartum. Evaluations were conducted using a clean, light grind evaluation system. Claw diseases were scored on a severity scale of 1=milk, 2=moderate, or 3=severe. Severity of disease per heifer was expressed as [Sum (maximum claw severity codes)]/12. Data were statistically analyzed by CATMOD and GLM procedures of SAS. Incidence of dorsal wall ridges, abaxial wall lesions, double soling, sole abscess, sole ulceration, interdigital dermatitis, and foot rot was low (< 1%) and not statistically analyzed. Incidence of digital dermatitis, sole hemorrhage, white line separation, and abaxial wall fissure was higher ($P < 0.03$) postpartum (20.0, 59.7, 55.0, 31.9%) as compared to prepartum (14.3, 40.1, 22.4, 3.8%), respectively. The number of claws with heel erosions (3.4 vs 3.8) and digital dermatitis (1.2 vs 1.3) was lower ($P < 0.04$) postpartum, but claws/heifer with white line separation (1.8 vs 1.5) and abaxial wall fissures (2.1 vs 1.2) were higher ($P < 0.04$) postpartum as compared to prepartum. Feeding CTM decreased ($P < 0.04$) the incidence, claws affected/heifer, and severity of sole hemorrhages postpartum but not prepartum. Also, feeding CTM decreased ($P < 0.05$) the incidence of heel erosions postpartum but not prepartum. Feeding CTM tended to ($P < 0.10$) decrease claws affected with white line separation and the severity of abaxial wall fissures postpartum but not prepartum. Mechanisms by which CTM decreased selected claw disease indicators postpartum but not prepartum are unclear.

Key Words: Dairy Heifers, Complexed Trace Minerals, Claw Diseases

1456 Characterization of prepartum and postpartum serum mineral concentrations in periparturient Holstein dairy cows. A. B. Todd* and G. A. Varga, *The Pennsylvania State University, University Park, PA.*

The relationships between mineral intakes, serum mineral levels, absorbable mineral intakes (NRC 2001), and postpartum health in the periparturient cow were investigated. This study also evaluated the effects of feeding a traditional dry cow diet (A) vs one formulated to contain 25% of the ration DM as non-forage fiber sources (B) on serum mineral levels prepartum and postpartum. The blood serum from thirty cows randomly chosen from each trial was analyzed from the period 4 wk prepartum to 4 wk postpartum. Some of the data is presented in the table below. Cows fed diet B had significantly greater prepartum DMI than cows fed diet A (16.8 vs 13.3 $\pm$ 0.30 kg/d). DMI did not differ postpartum and the average milk yields for diets A and B were 45.3 kg/d and 47.3 kg/d, respectively. A significant finding in this study was an increase in serum Ca ($P \leq 0.001$) and Mg levels ($P \leq 0.001$) and a decrease in serum Cl levels ($P \leq 0.001$) in healthy cows during the postpartum period.

		Prepartum			Postpartum		
Diet	Mineral	Mean Absorbable Intake (g)	Mean Serum	Std Error	Mean Absorbable Intake (g)	Mean Serum	r Std Error
A	Ca (mg%)	38.15	8.12	0.09	93.25	8.53	0.12
	Mg (mg%)	7.70	2.24	0.03	12.51	2.52	0.03
	K (mEq/L)	239.05	4.79	0.04	276.45	4.80	0.04
	Na (mEq/L)	12.10	140.68	1.19	62.72	142.24	1.76
	Pi (mg%)	35.88	5.83	0.08	54.99	5.57	0.09
	Cl (mEq/L)	27.52	102.6	0.30	70.43	99.12	0.36
	Zn (ppm)	0.107	1.02	0.02	0.192	0.99	0.02
	Fe (ppm)	0.664	1.85	0.06	0.639	1.54	0.05
	Cu (ppm)	0.005	0.60	0.02	0.012	0.61	0.01
B	Ca (mg%)	49.82	8.38	0.09	95.71	8.34	0.08
	Mg (mg%)	12.72	2.28	0.03	11.09	2.22	0.03
	K (mEq/L)	231.09	4.70	0.04	279.00	5.03	0.04
	Na (mEq/L)	36.57	134.19	0.96	71.04	130.44	0.78
	Pi (mg%)	45.91	6.18	0.08	54.61	5.51	0.10
	Cl (mEq/L)	39.25	102.13	0.24	96.56	99.00	0.25
	Zn (ppm)	0.263	1.16	0.02	0.218	1.01	0.02
	Fe (ppm)	0.826	2.02	0.06	0.395	1.51	0.05
	Cu (ppm)	0.020	0.53	0.01	0.015	0.62	0.01

Key Words: Minerals, Dairy Cow, Metabolic Profile

1457 Effect of chromium methionine and zinc methionine supplementation on blood concentrations of immunoglobulin G and M and inflamatory response to a phytohemaglutinin in stressed fedlot calves. L. Almeida*[1] and R. Barajas[1], [1]*FMVZ-Universidad Autonoma de Sinaloa (Mexico).*

To determine the effect of chromium methionine and zinc methionine supplementation on immunoglobulin levels in stressed feedlot calves, one experiment was conducted. Twenty bull calves (Brahman crossbreed; BW = 198 2.2 kg), just arrived at the feedlot, were allotted in groups of five and used in a randomized design experiment with a 2 x 2 factorial arrangement, with Zn supplementation of 0 or 60 ppm from zinc-methionine (Zn-met) and Cr levels of 0 or 1 ppm from chromium-methionine (Cr-met). The basal diet was 35:65 roughage:concentrate, with 14.3% CP, 1.37 Mcal of NEm/kg of DM, and 55 ppm of Zn (from Zn sulfate). Blood samples were taken from the jugular vein on d 0, 7, 14, and 28. Globulins G (IgG) and M (IgM) were determined in serum samples. On d 28, an intradermal injection of phytohemaglutinin (PHA) was applied in the base of tail, and the inflamatory response was measured at 0, 12, 24, and 36 h after injection. IgG values were increased ($P < 0.01$) by Zn-met on d 7 (1,973 vs 2,230 mg/dL), 14 (2,072

vs 2,935 mg/dL) and 28 (2,327 vs 2,939 mg/dL). IgG concentration was increased (P < 0.01) by Cr-met in d 7 (1,957 vs 2,198 mg/dL), 14 (2,167 vs 2,840 mg/dL) and 28 (2,312 vs 2,955 mg/dL). IgM concentration was enhanced (P < 0.01) by Zn-met supplementation on d 7 (255 vs 326 mg/dL), 14 (316 vs 410 mg/dL), and 28 (334 vs 468 mg/dL). Cr-met increased IgM values on d 7 (250 vs 330 mg/dL), 14 (229 vs 428 mg/dL), and 28 (320 vs 482 mg/dL). Inflamatory response to PHA was increased (P < 0.01) by Zn-met at 24 h (1.28 vs 1.44 cm), whereas Cr-met increased the response (P < 0.01) both at 24 h (1.23 vs 1.49 cm) and 36 h (1.11 vs 1.23 cm) after PHA injection. It is concluded that both zinc-methionine and chromium-methionine supplementation can reduce the impact of stress in calves recently arrived to feedlot.

Key Words: Immunoglobulins, Zinc, Chromium

1458 Effect of chromium methionine and zinc methionine supplementation on cortisol, glucose, aspartate amino transferase, and cratinin in blood of stressed feedlot calves. L. Almeida*[1] and R. Barajas[1], [1]*FMVZ- Universidad Autonoma de Sinaloa (Mexico).*

With the objective of determinate the effect of chromium methionine and zinc methionine supplementation on cortisol, glucose, aspartate amino transferase, and creatinin levels in blood of stressed feedlot calves, one experiment was conducted. Twenty just arrived to feedlot bull calves, males, Brahman crossbreed (BW = 198 2.2 kg), alloted in groups of five, were used in an randomized design experiment with a factorial arrangement 2 x 2 where levels of zinc supplementation 0 or 60 ppm from zinc-methionine (Zn-met), and two chromium levels 0 or 1 ppm from chromium-methionine (Cr-met) were tested. Basal diet was 35:65 roughage:concentrate, with 14.3 % CP, 1.37 Mcal of NEm/kg of DM, and 55 ppm of zinc (from Zn sulfate). Blood samples were taken from jugular vein at days 0, 7, 14 and 28. Blood cortisol, glucose, asparte amino transferase enzyme (ATT), and creatinin were assayed in blood samples. Zn-met decreased (P < 0.01) cortisol level in days 7 (2.77 vs. 0.34 μ/dL) and 14 (2.13 vs. 0.29 μ/dL). Cr-met diminished (P < 0.01) cortisol serum values in days 7 (2.73 vs. 0.38 μ/dL), 14 (2.04 vs 0.38 μ/dL), and 28 (2.82 vs. 1.98 μ/dL). Glucose levels in blood was diminished (P < 0.01) in day 14 both by Zn-met (70.72 vs 61.26 mg/dL) as by Cr-met (70.27 vs 61.71 mg/dL) diminished blood glucose (P < 0.01). An aditive effect (P< 0.01) Zn + Cr supplementation was detected. ATT blood concentration was diminished (P< 0.05) by Zn-met in days 7 (72.20 vs. 61.36 IU/L), 14 (44.81 vs. 40.05 IU/L). Cr-met decreased (P< 0.05) ATT values in days 7 (73.62 vs. 59.99 IU/L), 14 (46.03 vs. 39.50 IU/L) and 28 (34.04 vs. 31.86 IU/L). Creatinin in blood was reduced (P < 0.01) by Zn-met in days 14 (1.62 vs. 0.94 mg/dL) and 28 (1.25 vs. 0.74 mg/dL), and by Cr-met in days 14 (1.65 vs 0.90 mg/dL) and 28 (1.29 vs. 0.70 mg/dL). It is concluded, tan both zinc-methionine and chromium-methionine supplementation are able to reduce the impact of stress in calves recently arrived to feedlot.

Key Words: Cortisol, Glucose, Zinc, Chromium, Calves

1459 Release of phosphorus from feedstuffs for cattle. J. Sehested* and M.R. Weisbjerg, *Danish Institute of Agricultural Sciences, Denmark.*

Besides the nutritious effects of phosphorus (P), there is an increasing concern regarding the environmental and economical impact of surplus P from animal production. The utilisation of dietary P in cattle is estimated to be less than 30%, and there seems to be a significant potential for improvement. In this study, release of P from 21 feedstuffs including minerals, roughages and concentrates was measured by the nylon bag techniques. For each feedstuff six replicate sets of mobile nylon bags (pore size 11 μm) were incubated in three fistulated cows (Hvelplund & Weisbjerg, 2000): in the rumen for 16 hours; then in pepsin-HCl solution (pH 2.4) for 24 hours; finally through the intestine and collected from the feces. Six *in situ* nylon bags (pore size 36×36 μm) were incubated in the rumen for 0, 2, 4, 8, 16, 24 or 48 hours in three fistulated cows (Madsen & Hvelplund, 1994). P-content of the samples and bag residues were analysed by colorimetri and availability of P was calculated from the disappearance of P from the bags. Effective ruminal availability of P was calculated as described by Hvelplund & Weisbjerg (2000), using a 4% fractional outflow rate from the rumen. The effective ruminal availabilities, as measured by the *in situ* bags, varied significantly between feedstuffs (roughages: 35% to 95%; concentrates and by-products: 38% to 93%). Low digestibility of roughages and expanding of concentrates reduced ruminal availability. The total release of P (mobile bags: rumen + intestine) from concentrates and by-products was high (94% to 99%), but it can not be excluded that some of the released P was bound as phytate. The total release of P from minerals varied between 29% and 100%. The total release of P (RP) from roughages was correlated to availability of dry matter (DDM): RP(%)= 0.25×DDM(%)+77.5; R^2=0.81.

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Key Words: Phosphorus, Cattle, Availability

1460 Effect of dietary phosphorus concentration on reproductive performance of lactating dairy cows. H. Lopez*[1], F. D. Kanitz[2], V. R. Moreira[2], M. C. Wiltbank[1], and L. D. Satter[1,2], [1]*University of Wisconsin, Madison WI,* [2]*US Dairy Forage Research Center, USDA-ARS, Madison WI.*

There is a widespread notion that increasing dietary phosphorus (P) for lactating cows above NRC requirements will improve reproductive performance. The objective of this study was to determine the effect of dietary P concentrations of .37 or .54% of the TMR (DM basis) on reproductive performance. At calving (d 0) Holstein cows (n=134 for .37 and n=133 for .54%) were randomly assigned to one of the treatments. Cows received a radiotelemetric transmitter (d 50) and were bred to natural estrus from d 50 to d 100 and to synchronized estrus after d 100. The first number of paired results shown below is for the .37% and the second for the .54% treatment. Days to first estrus (701.6 and 681.2; P=0.24), days to first service (742.2 and 721.8; P=0.58), and conception rate at first service (44.4% and 55.8%; P=0.19) did not differ between groups. Similarly, there were no differences in overall conception rate (33.3% and 36.3%; P=0.45) and days open (1103.5 and 1163.8; P=0.29). The total number of natural ovulations was 495 (n=226 for .37 and n=269 for .54%) and the total number of natural estruses was 260 (n=116 for .37 and n=144 for .54%). These two measures are sensitive to the 100 d end point for measuring natural ovulation and natural estrus, since a 2 d delay to first service (74 and 72 d for .37 and .54%) would reduce the number of cows cycling a second time before the 100 d cut off point. Double ovulation rates were 20.3% and 19.0%, respectively (P=0.69). Anovulatory condition was diagnosed in 34.3% and 29.3% of the cows (P=0.38). Pregnancies lost from 30 d to 60 d (16.4% and 17.8%; P=0.80) did not differ between groups. The mean duration of estrus was 8.80.7 and 8.80.8 h (P=0.98). The average number of mounts per estrus was 7.40.6 and 7.70.6 (P=0.71) and the total mounting time was 27.42.2 and 25.31.9 s (P=0.47). Phosphorus treatment had no detectable effect on reproductive performance.

Key Words: Dairy Cow, Reproductive Performance, Phosphorus Requirement

1461 Effects of dietary calcium (Ca), anionic salts (AS) and vitamin D_3(D_3) on Ca and acid-base status of steers. G. Aranda-Osorio* and J.J. McKinnon, *University of Saskatchewan, Saskatoon, SK. Canada.*

The objective of this study was to evaluate the effects of dietary Ca manipulation, and supplementation with AS and D_3 on blood levels of Ca, parathyroid hormone (PTH), calcitonin, D_3, 25 hydroxyvitamin D_3 (25(OH)D_3), 1-25 dihydroxyvitamin D_3 (1-25$(OH)_2D_3$) and on systemic acid-base parameters. Twenty steers (448 26 kg), penned individually, were fed a 90% barley-based concentrate, 10% barley silage diet (DM basis). For the first 14 d (d L1-L14), the Ca level of the diet was 0.16%. For the next 10 d (d S1-S10) the Ca level of the diet was 0.84%. During this period the cattle were fed AS at 1.5 Eq/d (56.8 g ammonium chloride (NH_4Cl) and 56.8 g magnesium sulfate ($MgSO_2$)/hd/d) for 3 d and then at 3 Eq/d (113.5 g NH_4Cl and 113.5 g $MgSO_2$/hd/d) for the next 7 d. During this period the steers were divided into 4 groups and randomly assigned to 0, 0.6, 1.2 and 2.4 million IU (MIU) D_3/hd/d. The cattle were then put on a 5 d withdrawal period (d W1-W5). Blood samples were obtained every second day by venipuncture. The data were analyzed by repeated measures analysis and single degree of freedom contrasts. Feeding the low Ca diet decreased (P<.05) total (TCa) and ionized (ICa) serum Ca levels on d L7 and L14; plasma D_3 on d L7 and 25(OH)D_3 on d L7 and L14. From d S1-S10, TCa and ICa levels increased (P<.05) in all groups, with the greatest response (P<.05) in the D_3 fed steers. Maximum serum Ca levels for all 3 D_3 treatments were

achieved during the withdrawal period. Plasma D_3 increased quadratically, reaching a maximum of 122.6 ng ml-1 on d S5 for the 2.4 MIU D_3 treatment. In contrast, $25(OH)D_3$ increased in a linear fashion. Supplementing AS at 3 Eq/d decreased (P<.05) blood pH. On d W1, PTH levels were decreased (P<.05) while $1,25(OH)_2D_3$ increased (P<.05), responses related to the level of D_3 fed. These results show that dietary Ca manipulation along with AS and D_3 feeding, elevates plasma Ca levels, a response related to improved beef quality.

Key Words: Calcium, Anionic Salts, Vitamin D_3, Beef Quality

1462 Offering sodium bicarbonate and sodium bentonite free-choice to lactating dairy cattle. L.E. Wester*, C.C. Stallings, M.L. McGilliard, and W.S. Swecker, Jr., *Virginia Polytechnic Institute and State University, Blacksburg, Virginia.*

The objective of this trial was to evaluate the effects of free-choice intake of sodium bentonite and sodium bicarbonate on physiological and production parameters. Twenty-five cows (8 Jerseys, 17 Holsteins) were randomly assigned to two groups to equalize stage of lactation, age and production history. Each group followed a different sequence of: 1) control diet, 2) control diet with added bicarbonate at 1.2% DM, 3) diet 1 with free-choice option, and 4) diet 2 with free-choice option. Free-choice options of bentonite and bicarbonate were offered side by side in a covered feeder to breed groups. Diets were changed every 10 days to provide 8 periods with a repetition of each diet. All diets consisted of corn silage, alfalfa silage, high moisture corn, soybean meal and corn meal and adjusted to 17% ADF and 17% CP. There were no differences between diets for blood protein, blood packed cell volume, fecal pH, visual fecal consistency scores, milk composition, or daily milk yield. Urine pH was higher in Jerseys fed free-choice (8.28) versus no free-choice (8.22). Urine specific gravity was lower in cows force-fed bicarbonate [diets 1, 3 (1.029, 1.028) versus diets 2, 4 (1.025, 1.026)]. In Jerseys, MUN was higher with free-choice diets (1,2 versus 3,4). Holsteins force-fed bicarbonate consumed 1.2 kg/d more DM than Holsteins not force-fed but daily milk yield was not different. Force-fed bicarbonate intake was approximately 300 g/d for Holsteins and 240 g/d for Jerseys. Free-choice intake of bicarbonate averaged 33.6 g/d for Holsteins and 81.3 g/d for Jerseys, and free-choice intake of bentonite averaged 80.7 g/d for Holsteins and 97.9 g/d for Jerseys. Force-fed bicarbonate decreased urine specific gravity and free-choice intake of bicarbonate and bentonite increased urine pH in Jerseys.

Key Words: sodium bicarbonate, free-choice, cows

1463 The effects of sub-acute rumen acidosis on sodium bicarbonate supplemented water intake for lactating dairy cows. G. Cottee*[1], V. R. Osborne[1], I. Kyriazakis[2], T. M. Widowski[1], and B. W. McBride[1], [1]*University of Guelph, Guelph, Ontario, Canada,* [2]*Scottish Agricultural College, Edinburgh, UK.*

Sub-acute rumen acidosis (SARA) is common in dairy cows. An experiment was conducted to evaluate if cows subjected to SARA would select for drinking water supplemented with sodium bicarbonate. Four ruminally fistulated Holstein dairy cows (142 ± 20 DIM) were used in a repeated block design. Each cow was presented with a choice from two opposite positioned lateral water bowls. Sodium bicarbonate was supplemented into one of the water bowls via an in-line water medicator delivery system at 2.5 g/L. The other bowl contained normal water. SARA was induced by replacing 25% (DM basis) of a total mixed ration with 50:50 wheat:barley pellets. The average daily water intake was 85.7 ± 3.1 L/d during the control period and 80.5 ± 3.1 L/d during the SARA period ($P = 0.24$). Individual preference ratios [PR = treatment bowl intake /(treatment bowl intake + control bowl intake)] for sodium bicarbonate supplemented drinking water during the control and SARA periods were not different ($P = 0.97$). The PR for sodium bicarbonate supplemented water was 0.41 and 0.41 ± 0.07 during the SARA and control periods respectively. There was, however, a large variation in individual preference for drinking water supplemented with sodium bicarbonate .

Key Words: sub-acute rumen acidosis, sodium bicarbonate, water intake

1464 Effect of dietary cations-anions difference on physiological and productive responses in dairy goats during early lactation. F. Meschy and D. Sauvant*, *INRA-INAPG Physiologie de la Nutrition et Alimentation Paris France.*

Numerous studies have dealt with the role of manipulating the dietary cation-anion difference (DCAD) to prevent milk fever in dairy cows but much less investigated the DCAD effects on productive and physiological parameters. This experiment was designed to determine the effect of DCAD on milk production, ruminal and blood responses in lactating goats during early lactation (wk 1 to wk 8 after kidding). Twenty-four Alpine or Saanen multiparous goats including 6 rumen canulated animals (mean BW at the beginning of the experiment 74 ± 13 kg). At 7 DIM goats were assigned to three experimental groups: D80, D200 and D320. Animals were fed TMR (pulp silage, grass hay, dehydrated alfalfa and concentrate) with a forage: concentrate ratio of 50: 50 (DM basis). Diets differed only on DCAD ([Na + K] # [Cl + S]) values, mEq/ kg : 84, 200 and 319 for D80, D200, D320 respectively (analytical basis). DMI and milk production were recorded daily, milk, rumen and blood parameters analysis were performed once a week.DMI increased (p< 0.001)with D320: 119 g/kg BW 0.75 ws 103 and 110 for D80 and D200 respectively. Milk production (g/BW 0.75) was higher for D200 (166.7)compared with D80 (155.6), D320 (163.5) did not show any difference with two other groups. No difference among the treatments were observed for milk composition.pH decreased linearly when DCAD increased: 7.05, 6.94 and 6.80 for D80, D200 and D320 respectively but remains in a range which is favorable for microbial activity. This could be explained by a linear increasing of total VFA production: 100.3, 127.4 and 137 mmol/L. Acetate percentage was significantly higher for D300: 66.1 % vs 64.3 and 64.7 for D80 and D200 respectively while other VFA percentages were not significantly differents. NEFA (Eq/L) were higher for D200 (428) than for D80 (369) and D320 (310), a significant difference was observed between these two latter groups. Blood urea (mg/L) was lower in D200 (0.34) and D320 (0.33) compared with D80 (0.42). β-hydroxybutyrate (mg/L)was higher in D200 (46.0) and D320 (45.2) than in D80 (42.5).These results indicate that manipulating DCAD could improve performance and metabolic responses in lactating goats during early lactation. At this physiological stage a DCAD of 300 mEq/kg DM might be recommended.

Key Words: DCAD, Goat, Performances

1465 Use of organically complexed trace minerals in lactating dairy cow diets. H. Chester-Jones*[1], J. G. Linn[3], G. D. Marx[2], W. G. Olsen[3], M. C. Jacobson[2], D. M. Ziegler[1], K. Brokken[4], W. Brommelsiek[4], and D. A. Vermeire[5], [1]*University of Minnesota, Waseca, MN,* [2]*University of Minnesota, Crookston, MN,* [3]*University of Minnesota, St. Paul, MN,* [4]*Quali-Tech Inc., Chaska, MN,* [5]*Nouriche Nutrition, St. Louis, MO.*

A 2-yr study was designed to evaluate performance, health and reproductive responses to sulfate, polysaccharide complexed or specific amino acid chelated, Cu, Mn, Zn and Fe. Thirty-nine primiparous (pp) and 62 multiparous (mp) lactating Holstein cows at the Northwest Research and Outreach Center were assigned to one of 4 trace mineral supplements. Trace mineral (Cu, Mn, Zn, and Fe) supplement sources were: 100% inorganic sulfate (SULF), 100% polysaccharide complex (SQM), 67% SULF:33% SQM (SULFSQM) and 67% SULF:33% amino acid chelates (SULFAA). Supplements were formulated to supply 40 ppm Zn, 40 ppm Mn, 20 ppm Fe and 10 ppm Cu in the total diet (DM basis). Cows were housed in a tie-stall barn, milked twice daily and fed a TMR containing their respective supplement once daily from freshening to dry off. Mean lactation length for all cows was 297 days. Cows were switched from a 'high' (18% CP, 1.73 Mcal/kg NEL, 42% NFC, 18.3% ADF, 27.9% NDF) to 'low' (15.3% CP, 1.66 Mcal/kg NEL, 42% NFC, 29.6% ADF, 31.1% NDF) TMR when milk production was < 30 kg per day. Average DMI for the lactation was 21.4 kg per day. Somatic cell counts were not affected by supplement (P >.05). Days to first heat and days to first service were 65 and 84 days, respectively. Days open were lower (P < .02) for cows fed SQM (112.9) than those fed SULF (173.2) but similar (P >.10) to those fed SULFSQM (135.9) and SULFAA (128.5). First service conception rate and total services per conception were lowest (P < .03) for cows fed SQM (71, 1.5) versus SULFAA (29, 3.4), SULFSQM (32, 3.7) and SULF (28, 4.8). Number of cows culled during the study (main criteria > 200 days open) was 11, 8, 7, and 4 for those fed SULF,

SULFAA, SULFSQM, and SQM supplements, respectively. Under conditions of this study, 100% inclusion of polysaccharide complexed Cu, Mn, Zn, and Fe improved reproductive efficiency.

Key Words: Lactating cows, Reproduction, Polysaccharide complexed minerals

1466 The effect of steam flaked or ground corn and supplemental phytic acid on ruminal phytase activity and P balance in lactating cows. A.D. Guyton*, J.M. McKinney, and K.F. Knowlton, *Virginia Polytechnic Institute and State University.*

The effect of starch source and supplemental phytic acid on P partitioning and ruminal phytase activity was evaluated in 8 lactating cows (4 ruminally cannulated; 113 DIM). Cows were assigned to one of four treatments in 2, 4x4 Latin squares with 18 d periods. Diets were 61% forage, 37% starch, 16.6% CP, and 31% NDF, and included dry ground corn (DG) or steam flaked corn (SF), with a no supplemental P (L; 0.34% P) or supplemental purified phytic acid (PA; 0.45% P) to provide additional P from an organic source. Total collection of milk, urine, feces, and feed was conducted on d 16-18 of each period. Rumen fluid (RF) was sampled and rumen pH measured every 4 h on d 16-18. Excretion of feces, urine, and P was lower in cows fed SF than in cows fed DG (7.2 kg/d, 22.9 kg/d and 50.4 g/d vs. 8.5 kg/d, 26.0 kg/d and 61.6 g/d for SF and DG). In cows fed SF, apparent P digestibility tended to be higher, and milk P as a percent of P intake increased (14.8 vs. 13.0%) when compared to cows fed DG. Milk yield was unaffected by diet (mean = 33.6 kg/d), despite lower DMI by cows fed SF (24.0 vs. 25.8 kg/d). Cows fed SF had increased DM digestibility compared to those fed DG, and tended to have higher feed efficiency (1.40 vs. 1.35 kg milk/kg DMI). Rumen pH was unaffected by diet (mean = 6.1), but milkfat content was lower for cows fed SF. Milk yield, DMI, and feed efficiency were not affected by PA. Cows fed PA had increased P intake (108.8 vs. 79.8 g/d) and excretion (67.0 g/d vs. 45.0 g/d) compared to cows fed L, but apparent P digestibility was unaffected (mean = 41.3%). P balance tended to be higher in cows fed PA (29.4 vs. 22.4 g/d), but milk P as a percent of intake was reduced (11.8 vs.16.0%). The interaction of starch source and PA affected ruminal phytase activity (2.51, 5.41, 4.14, and 3.15 umol/min/ml RF for DG-L, DG-PA, SF-L, and SF-PA). Altering dietary sources of starch and P offers opportunity to improve P availability and reduce manure nutrient excretion.

Key Words: phosphorus excretion, phytase activity, starch digestibility

1467 Comparative metabolism of calcium from calcium carbonate and calcium propionate in growing steers. J. W. Spears*[1], V. Fellner[1], and F. R. Valdez[2], [1]*North Carolina State University,* [2]*Kemin Americas, Inc., Dex Moines, Iowa.*

Twenty-four Angus and Angus crossbred steers (255 kg initial BW) were used to determine the effect of calcium (Ca) source on calcium metabolism in steers fed dietary Ca below or in excess of requirements. The experiment was conducted over three trials with eight steers randomly assigned in each trial to treatments in a 2 x 2 factorial design. Treatments consisted of two dietary levels (0.25 or 0.75%) and two sources ($CaCO_3$ or Ca propionate, NutroCAL® of Ca. Steers were individually fed a corn-cottonseed hull based diet for 21 d. Following the 21-d period, steers were placed in metabolism crates. Steers were acclimated to the crates for 7 d followed by a 5-d total collection of urine and feces. Ruminal soluble Ca concentrations were much higher ($P<0.01$) in steers supplemented with Ca propionate. A Ca level x Ca source interaction ($P<0.01$) was observed with ruminal soluble Ca increasing greatly when dietary Ca was increased from Ca propionate, but increasing dietary Ca from $CaCO_3$ had little affect on soluble Ca concentrations. Plasma Ca was slightly higher ($P<0.10$) in steers fed high dietary Ca, but was not consistently affected by Ca source. Apparent absorption (%) of Ca was higher ($P<0.05$) for steers fed low dietary Ca. Percent Ca absorption was affected by a Ca level x Ca source and a trial x treatment interaction. Apparent absorption of Ca was higher from CaProp at the low Ca level, but not at the high level. Urinary excretion of Ca was higher ($P<0.05$) in steers supplemented with Ca propionate. Molar proportion of acetate was lower in steers supplemented with Ca propionate compared to those given $CaCO_3$ especially at the high Ca level (interaction, $P<0.05$). At the low Ca level, propionate was not affected by Ca source, but at the high Ca level molar proportion of propionate was higher in steers fed Ca propionate (interaction $P<0.10$). Calcium propionate may affect ruminal fermentation differently from $CaCO_3$. Calcium from Ca propionate was absorbed more efficiently when supplied at low dietary concentrations.

Key Words: Cattle, Calcium

1468 Production and economic responses of high producing lactating dairy cows to increasing Dietary Cation Anion Difference during non-heat stress seasons. W.K. Sanchez*[1], M.A. DeGroot[2], E. Block[2], D.E. Weber[1], and K.R. Cummings[1], [1]*Arm & Hammer Animal Nutrition Group, Church & Dwight Co., Inc., Princeton, NJ,* [2]*Fresno State University, Fresno, CA.*

Five controlled field studies were conducted in commercial Holstein herds to test the effects of increasing Dietary Cation Anion Difference (DCAD) on milk production. In each herd the high group was split into two pens (min. 85, max. 145 cows per pen) with one pen receiving a higher calculated DCAD (meq (Na + K) - (Cl + S)/100g DM) (treatment) than the other. DCAD was altered by either reducing dietary Cl or by increasing K or Na and K (see table). One trial had individual milk yields monitored daily; the others were individually recorded every other week by DHI. All but one trial had milk components assayed bi-monthly. Three of five trials showed significant ($P<.05$) production responses to increasing DCAD. The other two trials tended ($P<.1$) to produce a production response to elevated DCAD. The Fall trial revealed no milk response ($P>.1$) but an increased FCM yield ($P<.05$) to elevated DCAD. Combining trials showed that increasing DCAD improved milk and FCM yields with a positive return on investment. Because DMI was not recorded, the assumption was made that extra DM was required to achieve the milk response and was included in the economic analysis. Break-even analysis showed that a response of 0.9 lb. of milk is required to repay the cost of treatment with a 93% chance of exceeding that response (Type I and Type II error analysis). In conclusion, increasing DCAD during non-heat stress seasons improves production performance of cows in early to mid lactation in a positive economic fashion.

Early Lactation Studies

		Trial Description					
		Winter	Winter	Winter	Fall	Spring	
Item	Units	-CL	+K	+K	+Ka +Na	+K	Avg.
DCAD Control	Meq/100g DM	18.9	18	38	25	33	28.78
DCAD Treatment	Meq/100g DM	25.1	26	43	35	39	35.02
% K for Control	%DM	1.38	1.20	1.52	1.63	1.50	1.45
% K Treatment	%DM	1.33	1.50	1.80	1.84	1.70	1.63
Product Cost	$cow	0.05	0.10	0.08	0.08	0.09	0.08
Cost of extra DM(est)[a]	$/cow/d	0.09	0.16	0.07	(0.06)	0.05	0.09
Milk Response	Lb./cow/d	3.0*	5.4*	2.4†	-2.0	1.5	2.1
Fat Response	Lb./cow/d	NA	0.14	0.04	0.40*	0.01	0.15
FCM Response	Lb./cow/d	3.0*	3.3*	2.0†	5.6*	1.9†	3.2
Revenue (est)[b]	$/cow/d	0.36	0.39	0.25	0.67	0.23	0.38
Net Profit	$/cow/d	0.22	0.13	0.09	0.65	0.09	0.24
Return on Investment	%	157	49	62	3260	69	719

[a]Estimated intake needed for milk response; [b]Revenue estimated with milk at $12/cwt of FCM; *P<.05; †P<.10

Key Words: DCAD, Potassium, Early Lactation

1469 Selenium status of beef calves from dams receiving different forms of selenium supplementation. G. Valle[1], L. R. McDowell[1], P. A. Davis*[1], D. L. Prichard[2], P. J. Chenoweth[3], D. L. Wright[2], F. G. Martin[4], W. E. Kunkle[1], and N. S. Wilkinson[1], [1]*University of Florida, Department of Animal Sciences, Gainesville,* [2]*UF-IFAS North Florida Research and Education Center,* [3]*College of Veterinary Medicine, University of Florida, Gainesville,* [4]*University of Florida, Department of Statistics, Gainesville.*

Seventy-five Angus cows (150-240 d gestation) were randomly assigned to five groups and received either no selenium (Se) supplementation (control), 5 ml sodium selenite via subcutaneous injection (Mu-Se, Burns Biotech Labs, Inc. Oakland, CA) every six mo, 9 ml barium selenate via subcutaneous injection (Deposel, Grampian Pharmaceuticals Ltd, Lancashire, UK), and two groups received selenized yeast (Se-Plex, Alltech Biotech, Nicholasville, KY) via ad libitum salt-based mineral mixtures (30 ppm Se) for two yr. Calf plasma Se levels were determined at birth, 60, 120 and 180 d postpartum each yr. During yr 1, calf plasma Se concentrations at birth were at critical concentrations (0.03 mg/L) for the control, Mu-Se, and Deposel treatments. The two free-choice mineral treatments had an average Se concentration of 0.06 mg/L, which is borderline to adequate (0.07 mg/L). At 60, 120 and 180 d, the control, Mu-Se and Deposel treatments were below critical Se concentrations, whereas the averages for the free-choice mineral mixtures were at or above adequacy. During yr 2, control calves were below critical concentrations at all times, while Mu-Se and Deposel treatments were at a critical level at birth and 60 d postpartum and below the critical level thereafter. Calves from the two free-choice mineral treatments were higher in plasma Se ($P<0.05$) than calves from all other treatments with average concentrations being borderline (0.055 mg/L) at birth and near adequate (0.065 mg/L) for the remainder of the experiment. In general, the control and the two injectable inorganic treatments resulted in calf plasma Se concentrations declining with time and at no time being adequate. Calves on the two free-choice mineral mixture treatments with organic Se had adequate plasma Se during the majority of the study. Neither injectable inorganic Se source was effective for increasing and maintaining calf plasma Se concentrations during this experiment. Calves nursing dams on inorganic Se treatments had plasma Se concentrations that tended to decrease with time. Organic Se treatments were effective in attaining and maintaining near adequate plasma Se concentrations throughout the experiment.

Key Words: Beef calves, Selenium, Supplementation methods

1470 Estimating bone mineral content in dairy cows. B.E. Keene*, A.M. Rutledge, S.M. Nickols-Richardson, C. Holtaway, J.M. McKinney, and K.F. Knowlton, *Virginia Polytechnic Institute and State University, Blacksburg.*

The objectives were to evaluate non-invasive measures of bone mineral content (BMC) and bone mineral density (BMD) in dairy cows, and to evaluate effects of parity and stage of lactation on BMC and BMD using dual energy X-ray absorptiometry (DXA). DXA is an imaging technique used to assess bone strength and to predict osteoporosis fractures in humans. The tail (caudal vertebrae) and right front leg (metacarpal) were excised from 107 Holstein cull cows following slaughter. Parity and days in milk (DIM) of donor animals were obtained for 43 sets of samples. Samples were grouped by parity (1, 2, 3, 4+) and stage of lactation (0-89 DIM; 90-150; 151-250; 251+). BMC and BMD of the fused 3rd and 4th bones of the metacarpal, and of caudal vertebrae 14 and 15 were measured by DXA. In the metacarpal, increasing parity increased BMC linearly, but stage of lactation had no effect. Stage of lactation affected BMC of caudal vertebra 15, with the highest values observed in samples from cows in late lactation (151-250 DIM). Imaging techniques offer opportunity to evaluate factors affecting bone mineral metabolism of dairy cows.

	Parity						P<	
	1	2	3	4	SEM	Parity	Lin	Quad
Metacarpal								
BMC_{UPPER}[1]	9.47	13.06	10.70	14.58	1.77	0.07	0.07	0.92
BMC_{MID}[2]	33.41	44.04	37.83	45.49	4.07	0.06	0.07	0.67
BMC_{TOTAL}[3]	43.65	60.05	49.59	61.24	5.75	0.04	0.04	0.63
BMD_{UPPER}[4]	1.52	1.90	1.65	1.98	0.17	0.10	0.11	0.85
	Stage of lactation[5]						P <	
	1	2	3	4	SEM	Stage	Lin	Quad
Caudal vertebrae								
BMC_{V14}[6]	1.44	1.42	2.18	1.37	0.27	0.09	0.58	0.15
BMC_{V15}[7]	0.91	0.87	1.65	0.92	0.24	0.05	0.34	0.15
BMC_{VTOTAL}[8]	4.96	4.78	7.47	4.84	0.94	0.10	0.49	0.20
BMD_{V15}[9]	0.45	0.44	0.51	0.45	0.02	0.10	0.43	0.25

[1]BMC_{UPPER}= BMC of upper metacarpal, g; [2]BMC_{MID}= BMC of mid-section of metacarpal, g; [3]BMC_{TOTAL}= Total BMC of mid- and upper metacarpal, g; [4]BMD_{UPPER}= BMD of upper metacarpal, g/cm^2; [5]Stage of lactation defined by DIM. Stage 1 = 0-89; Stage 2 = 90-150; Stage 3 = 151-250; Stage 4 >250; [6]BMC_{V14}= BMC of caudal vertebra 14, g; [7]BMC_{V15}= BMC of caudal vertebra 15,g; [8]BMC_{VTOTAL} = Total BMC of caudal vertebrae 14 and 15, g
[9]BMD_{V15} = BMD of caudal vertebra 15, g/cm^2

Key Words: Bone mineral content, Bone mineral density, DXA

1471 Organic chromium and selenium effects on immunoglobulins concentration, and carcass composition of finishing lambs. I. Dominguez-Vara[1], S. Gonzalez*[2], R. Barcena[2], M. Cobos[2], and G. Mendoza[2], [1]*Universidad Autónoma del Estado de México,* [2]*Colegio de Postgraduados.*

Fifty four lambs (27.0 kg BW) were fed 95 d and assigned to a completely randomized experiment (2x3 factorial arrangement) using organic Se (0, 0.3 ppm, as Sel-Plex-50) or Cr (0, 0.250, 0.350 ppm, as Biochromium). Sel-Plex-50 (0.0, 3.0 g/lamb/d) and (Biochromium, 0.0, 2.5, 3.5 g/lamb/d) were offered with the morning feeding. Basal diet (%DM) had shorgum 65.0, corn stover 13.0 and DPW 12.0, as main ingredients. Jugular blood samples were taken at the begining and weeks two, seven and eleven. Plasma metabolites, tryglicerides, cholesterol, glucose and urea-N were analyzed using enzimatic methods, and serum inmunoglobulins IgG by ELISA. At the beginning of the experiment four lambs were slaughtered and 30 at the end, to measure carcass composition by specific gravity. Three days before slaughter, backfat depth was measured in vivo on 6th and 10th ribs by ultrasound and in situ with a metallic rule. Means were analyzed by ortogonal contrasts (C): C-1, 0 Se vs 0.3 ppm Se; C-2, 0 Cr 0 Se vs 0.250+0.350 ppm Cr+0 Se; C-3, 0 Cr+0.3 ppm Se vs 0.250+0.350 ppm Cr+0.3 ppm Se; C-4, 0.250 ppm Cr+0 Se vs 0.350 ppm Cr+0.3 ppm Se; C-5, 0.250 ppm Cr+0.3 ppm Se vs 0.350 ppm Cr+0.3 ppm Se. Among weeks there were differences for tryglicerides and cholesterol at 0 h ($P<0.0008$ and $P<0.0001$) and 3 h ($P<0.04$ and $P<0.0002$); for glucose and urea-N concentration at 0 h ($P<0.074$ and $P<0.021$); and for IgG ($P<0.0001$). Carcass in situ measurements at the 10th rib and in vivo at the 6th rib were significant for C-2 ($P<0.01$, $P<0.07$). Body fat was reduced by Cr (C-2, $P<0.01$; C-4, $P<0.02$) and total carcass energy was higher for lambs without Cr or Se. Weight of heart, lung, liver and spleen was increased ($P<0.04$; C-3) by Cr and Se. Addition of organic Cr improved carcass composition of finishing lambs; however, tryglicerides, cholesterol, glucose and urea-N, and inmunoglobulins IgG levels were not affected by treatments.

Key Words: Organic chromium and selenium, Immunoglobulins and carcass composition, Finishing lambs

Animal Behavior and Well-Being

1472 Effect of greenhouse housing on performance of neonatal dairy calves housed in hutches. D.R. McKnight*[1], P.H. Sharpe, and R.S. Rana, [1]*Kemptville College, University of Guelph.*

Eight studies with a total of 198 calves were conducted during 2 consecutive years and 4 seasons to evaluate the effects of providing supplemental greenhouse shelter to neonatal dairy calves housed in polyethylene hutches. Purchased Holstein bull calves from 3 to 7 days of age weighing 40 to 45 kg. were randomized by weight to 12 hutches in an open control area or 12 hutches under a greenhouse shelter. The greenhouse shelter had an open ridge vent, removable side curtains and end walls, and a translucent grey cover rated to prevent 60% of sunlight penetration. Side curtains and end walls were removed during summer and fall trials. The